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JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CALIFORNIA

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(NASA CR - - - - - - ; JPL-WT 20-519) OTS: #

WIND-TUNNEL TEST OF THE SPACE-GENERAL CORPORATION ASTROBEE-1500 MODEL

Charles E. Searls, Jr. 16 Oct. 1963 reger

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PASADENA, CALIFORNIA
October 16, 1963

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PLOTS

Plot No.	Run No.	Configuration	ϕ (deg)	Mach No.	q (psi)
1	4	I	0	1.81	10.2
1	8	I_E	0		
2	5	I	22.5		
2	9	I_E	22.5		
3	6	I	45		
3	10	I_E	45		10.3
4	7	I	90		10.2
4	11	I_E	90		10.3
5	16	I	0	2.41	6.8
5	12	I_E	0		
6	17	I	22.5		
6	13	I_E	22.5		
7	18	I	45		
7	14	I_E	45		
8	19	I	90		6.7
8	15	I_E	90		6.8
9	20	I	0	3.50	4.1
9	24	I_E	0		
10	21	I	22.5		
10	25	I_E	22.5		
11	22	I	45		
11	26	I_E	45		
12	23	I	90		
12	27	I_E	90		
13	32	I	0	4.54	3.0
13	28	I_E	0		
14	33	I	22.5		
14	29	I_E	22.5		
15	34	I	45		
15	36	I	45		

PLOTS (Cont'd)

Plot No.	Run No.	Configuration	ϕ (deg)	Mach No.	q (psi)
15	30	I_E	45	4.54	3.0
16	35	I	90	↓	↓
16	31	I_E	90		

I. INTRODUCTION

Wind-tunnel Test 20-519 was a test of the Space-General Corporation (El Monte, Calif.) Astrobee-1500 model. The purpose of the test was to determine the six-component forces and moments of the Astrobee-1500 model. The approximate aerodynamic parameters for the test were Mach No. 1.81, 2.41, 3.50, and 4.54; dynamic pressures from 3.0 to 10.2 psi; and Reynolds No./in. from 0.32×10^6 to 0.57×10^6. The test variables and ranges were angles of attack from -2 to 10 deg and angles of roll from 0 to 90 deg, for each of two configurations.

Each model configuration consisted of a two-part conical nose, a cylindrical body, four equally-spaced tail fins, and two auxiliary booster rockets at the base. Forces and moments were obtained for the complete configuration on a six-component, internal, strain-gage balance.

The test* was conducted at the Jet Propulsion Laboratory (JPL) on August 31, 1962, with the Space-General Corporation represented by Mr. J. D. McNerney.

II. MODEL DESCRIPTION

The model is shown in Fig. 1. A more detailed description of the model and components is contained in Ref. 1.

III. WIND TUNNEL AND INSTRUMENTATION

Reference 2 describes the construction and operating conditions of the 20-in. supersonic wind tunnel. The wind tunnel has a nominal test-section size of 20 in. square, a Mach range from 1.3 to 5.0, a flexible-plate nozzle, and operates with continuous flow. Table 1 presents representative values of the test-section flow parameters for the Mach numbers at which this test was conducted.

A six-component, internal, strain-gage balance was used to measure force-and-moment data.

*The symbols used in this Report are defined in the Nomenclature.

IV. TEST PROCEDURE

Prior to actual test operations, measurements were made to determine the position of the model, the deflection constants, and the balance tares. During the test, data points were obtained at successive values of angle of attack. These data points were plotted vs angle of attack, and any data which appeared questionable were checked before the conclusion of the run. At least one data point was checked even if all data appeared correct.

V. DATA REDUCTION

The force-and-moment data were reduced to dimensionless coefficients in coordinates specified by the Space-General Corporation. The coefficients were obtained as follows:

$$\text{force coefficient} = \frac{\text{force}}{q\,A}$$

$$\text{moment coefficient} = \frac{\text{moment}}{q\,Ad}$$

where

q = free-stream dynamic pressure (psi)

A = reference area = 1.2096 (in.^{2})

d = reference length = 1.2384 (in.)

and the point about which the moments were measured was at the model base, on the model centerline.

The coefficients were obtained on a digital computer by a standardized series of formulae as indicated in Ref. 3. The repeatability of the coefficient data is indicated in Table 2.

The coefficients are defined in the Nomenclature, and the coefficient sign conventions are shown in Fig. 2.

VI. RESULTS

The results of this test have been reduced to dimensionless coefficients and are presented in Plot Series 1a through 16g.* The method by which C. P. (see Nomenclature) was computed rendered it insignificant at small angles of attack. No attempt was made in this Report to interpret the results.

*Also numbered from 1 through 112 in the lower left-hand corner of the ozalid plot pages.

NOMENCLATURE

General

A	model reference area (in.^{2})
C_l	rolling-moment coefficient (CR on plots)
$C'_{m_{cg}}$	pitch-axis pitching-moment coefficient (CMCGP on plots)
$C'_{n_{cg}}$	pitch-axis yawing-moment coefficient (CNCGP on plots)
C'_N	pitch-axis normal-force coefficient (CNP on plots)
C_X	axial-force coefficient (CX on plots)
C'_Y	pitch-axis side-force coefficient (CYP on plots)
C.P.	$C'_{m_{cg}} \div C'_N$
d	model reference diameter (in.)
M	Mach number
q	free-stream dynamic pressure (psi)
α'	pitch-axis angle of attack (ALPHP on plots)
ϕ	model roll angle

Model

I	basic complete configuration
I_E	basic configuration with longer nose

REFERENCES

1. Space-General Corporation. A 0.04-Scale Astrobee-1500 Wind-Tunnel Model Test, J. D. McNerney. Azusa, California, Space-General, July, 1962. (Pre-Test Report No. 5132: R0001:GVM) UNCLASSIFIED

2. Jet Propulsion Laboratory, California Institute of Technology. Wind-Tunnel Facilities at the Jet Propulsion Laboratory, Wind-Tunnel Staff. Pasadena, California, JPL, April 18, 1961. (Technical Release No. 34-257) UNCLASSIFIED

3. Jet Propulsion Laboratory, California Institute of Technology. Equations for Wind-Tunnel-Force Data Reduction, Wind-Tunnel Staff. Pasadena, California, JPL, April 19, 1957. (Internal Memorandum SWT G-T3), UNCLASSIFIED

Table 1. Average aerodynamic parameters

Parameter	Mach Number			
	1.81	2.41	3.50	4.54
Static pressure (psia)	4.460	1.660	0.480	0.209
Stagnation pressure (psia)	26.0	24.5	36.6	63.6
Dynamic pressure (psia)	10.22	6.75	4.12	3.02
Reynolds number (per in. x 10^{-6})	0.566	0.388	0.319	0.323

Table 2. Coefficient repeatability

Mach No.	Coefficient*					
	C'_N	$C'_{m_{cg}}$	C'_Y	$C'_{n_{cg}}$	C_r	C_X
1.81	0.017	0.030	0.008	0.033	0.009	0.013
2.41	0.025	0.057	0.010	0.045	0.005	0.006
3.50	0.012	0.052	0.010	0.073	0.004	0.008
4.54	0.014	0.075	0.010	0.084	0.003	0.006

*Based upon the following reference area and length: A = 1.2096 in.^{2}, and d = 1.2384 in.

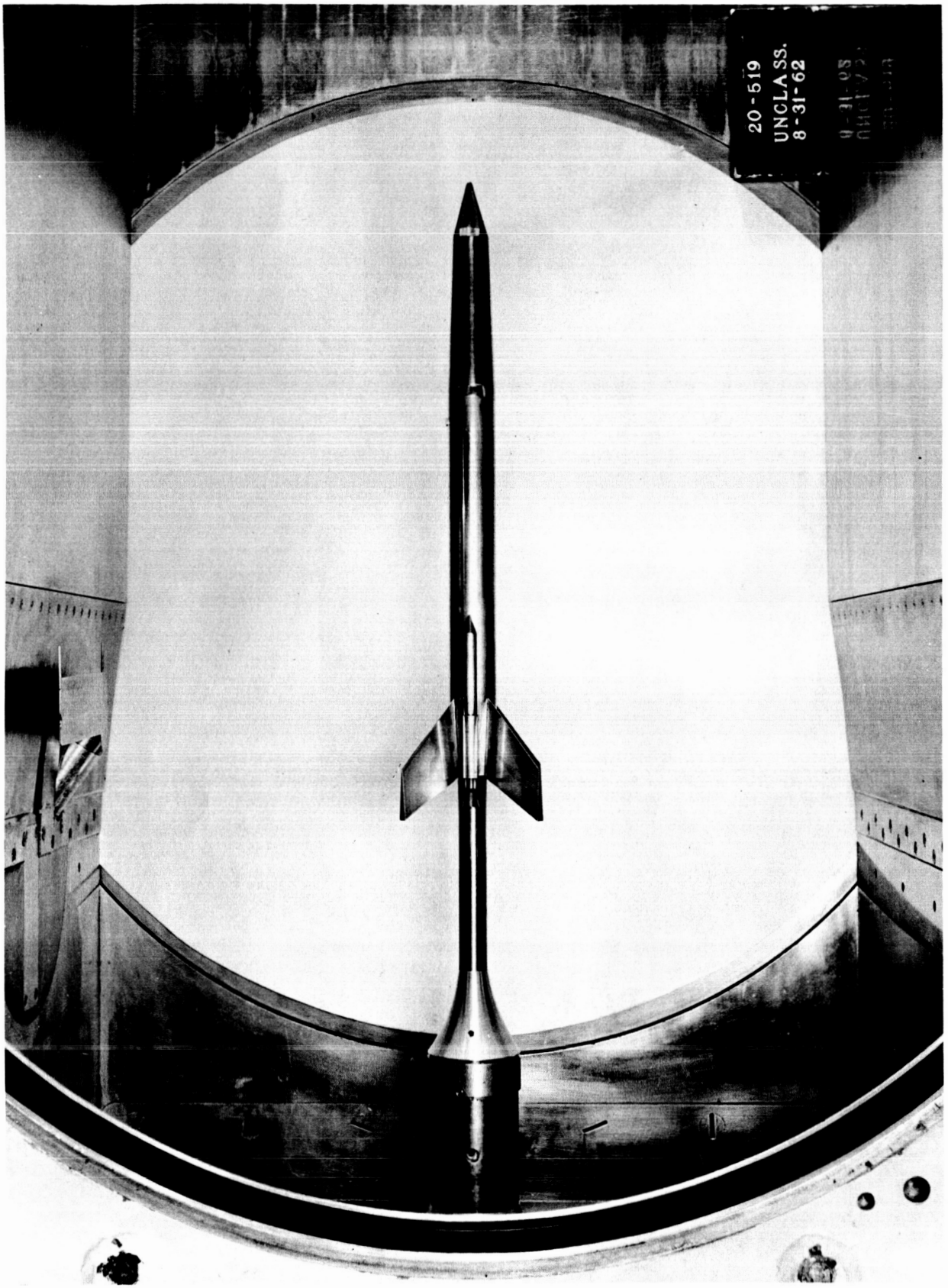


Fig. 1. Model installation

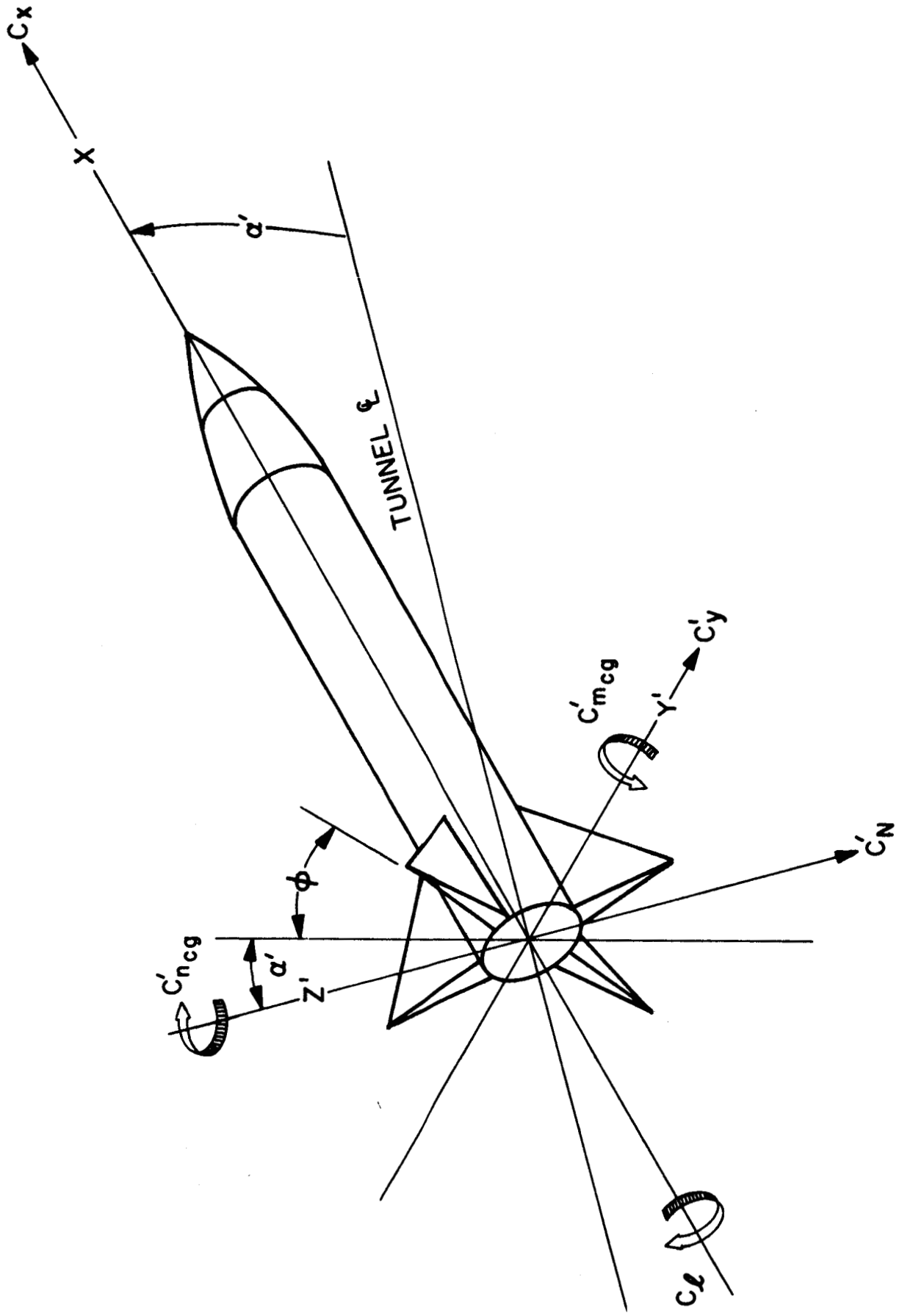
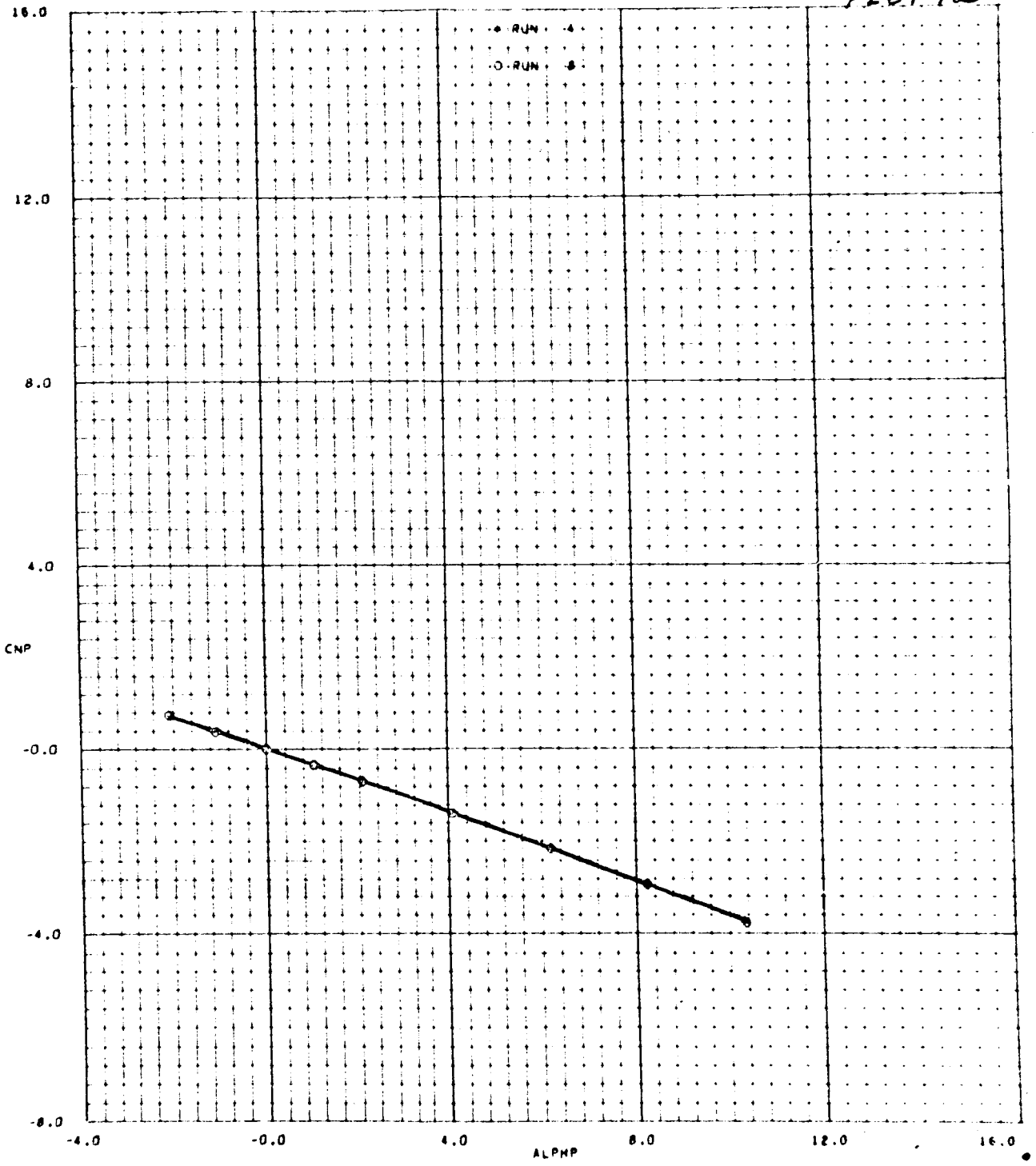
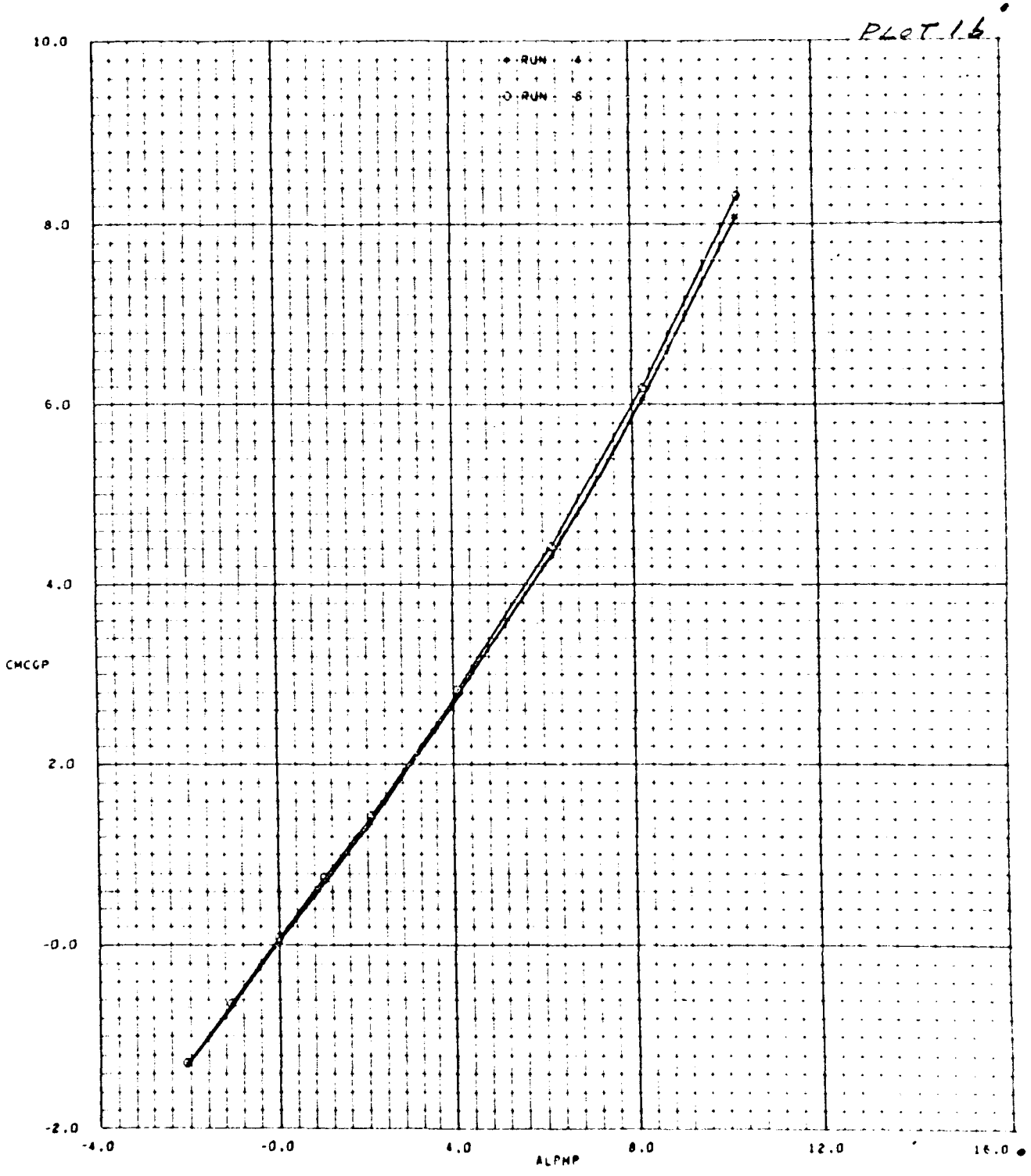


Fig. 2. Pitch axes and sign conventions

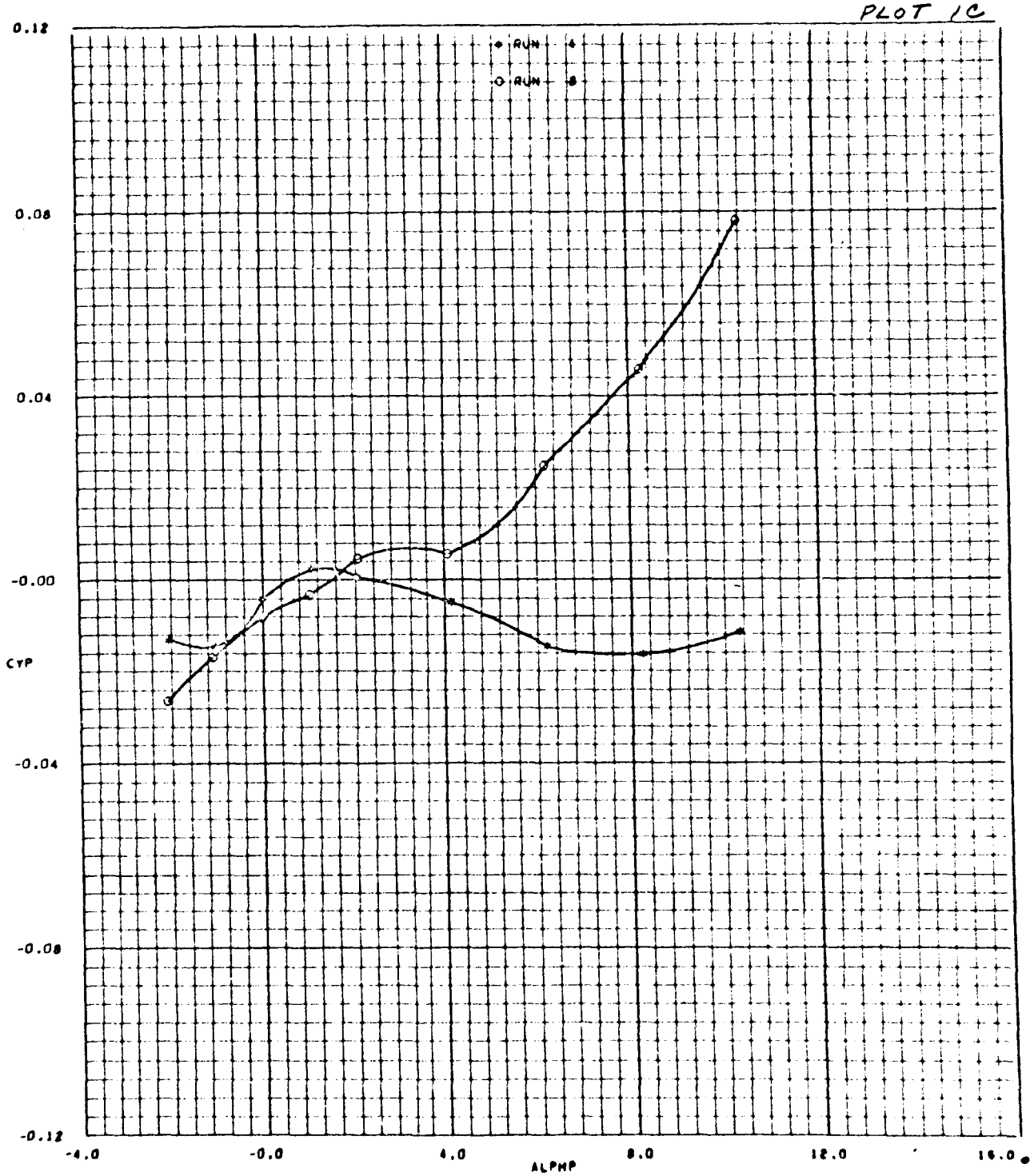
PLOT 1a




PLOT 1.6
RUN 4
RUN 6
10.0
8.0
6.0
4.0
2.0
-0.0
-2.0
CMCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

2

PLOT 1C


RUN 4
RUN 8
0.12
0.08
0.04
-0.00
CYP
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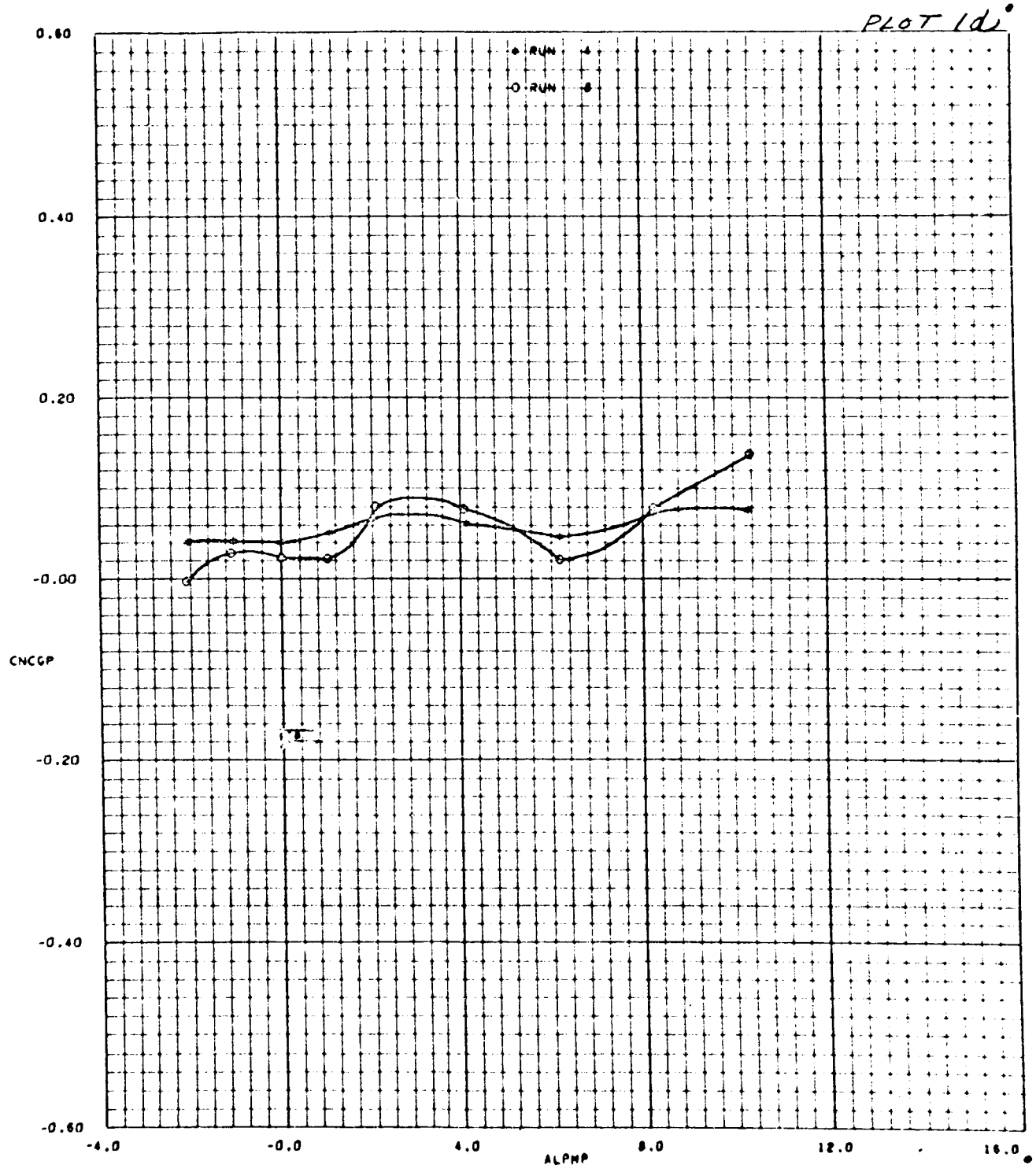
-0.08
-0.12
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

3


PLOT 1d
• RUN 4
O RUN 8
0.60
0.40
0.20
-0.00
-0.20
-0.40
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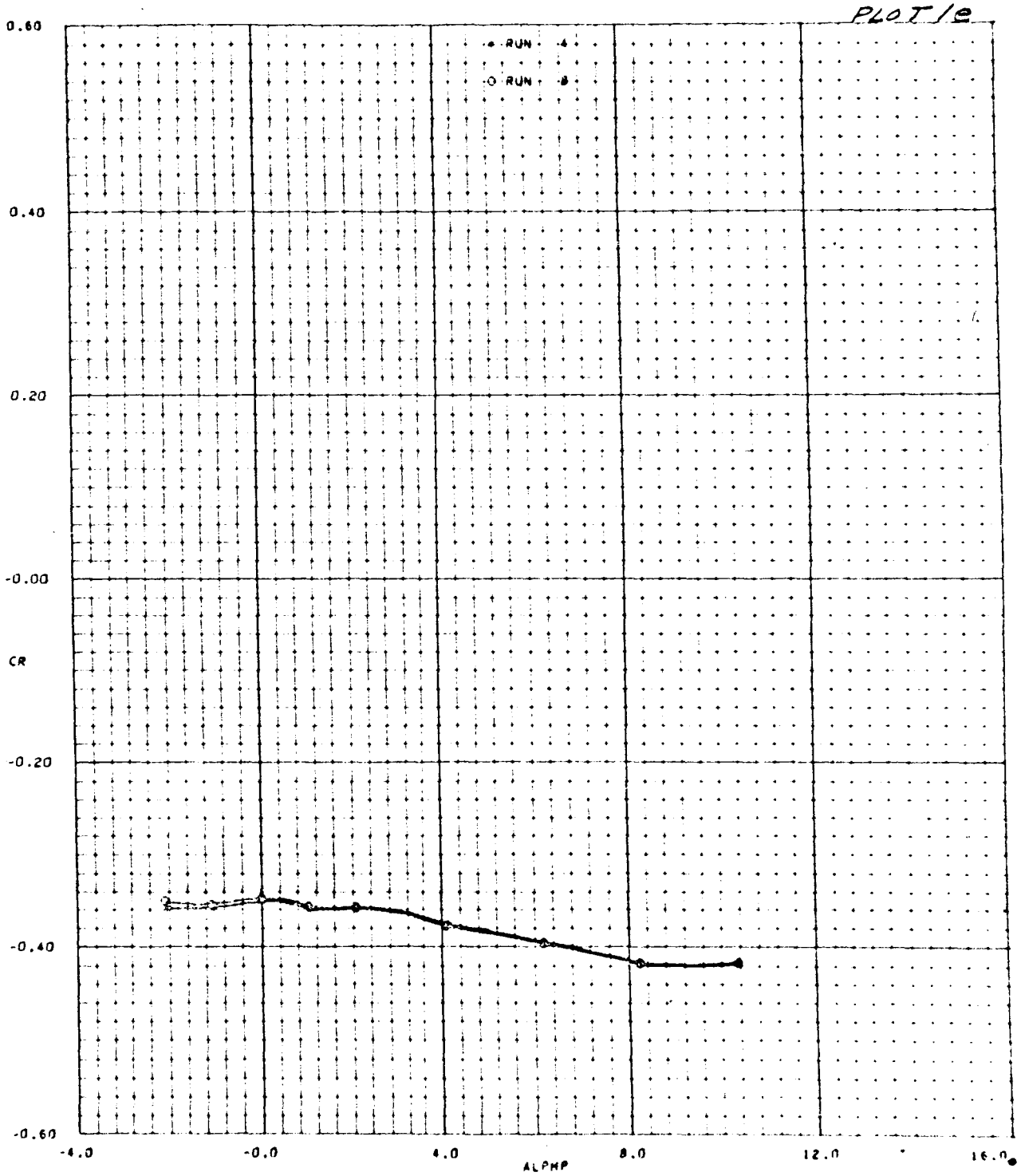
CNCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

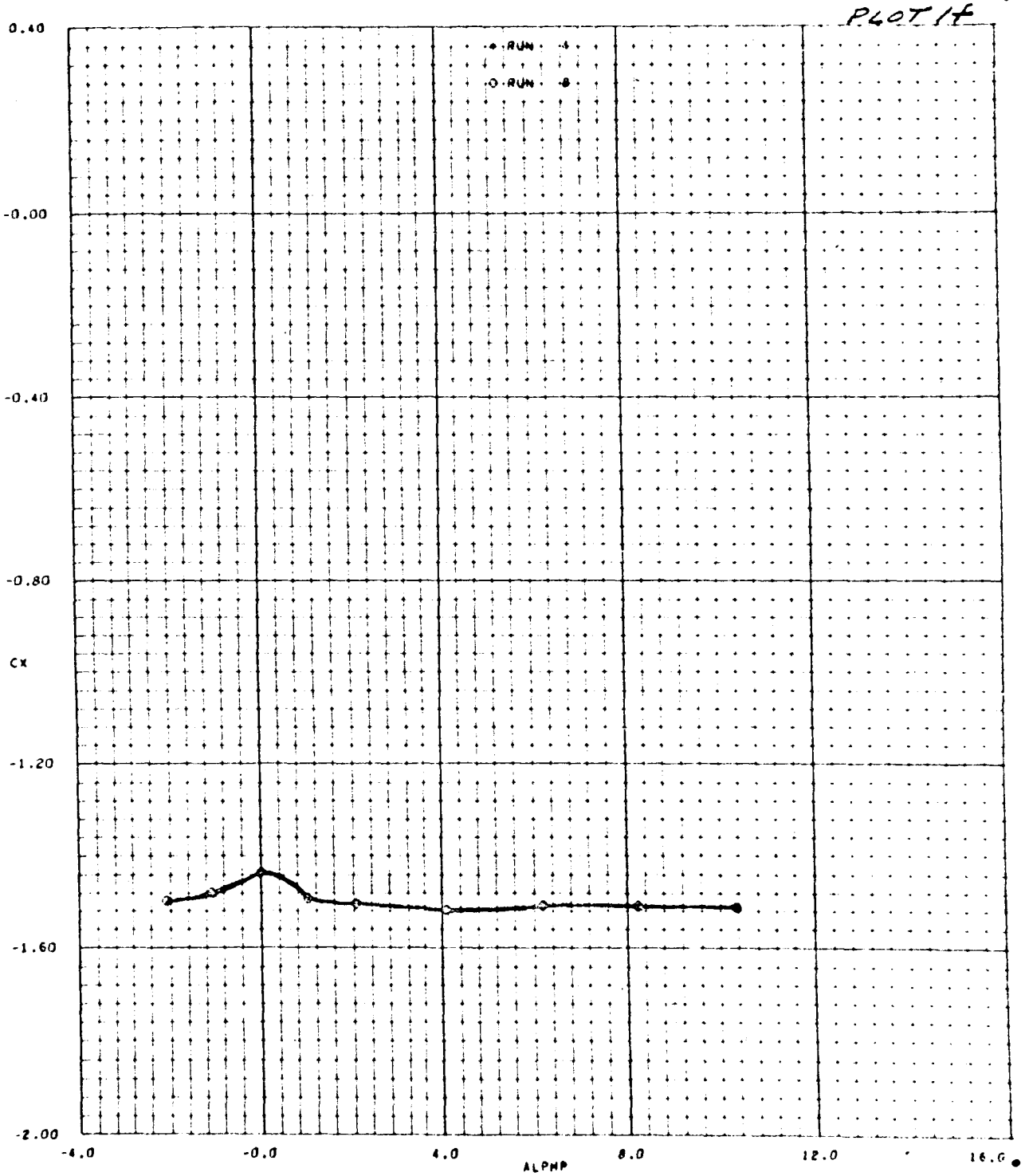
4

PLOT 1e


0.60
0.40
0.20
-0.00
CR
-0.20
-0.40
-0.60
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
RUN 4
RUN 8

5

PLOT 1f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CX
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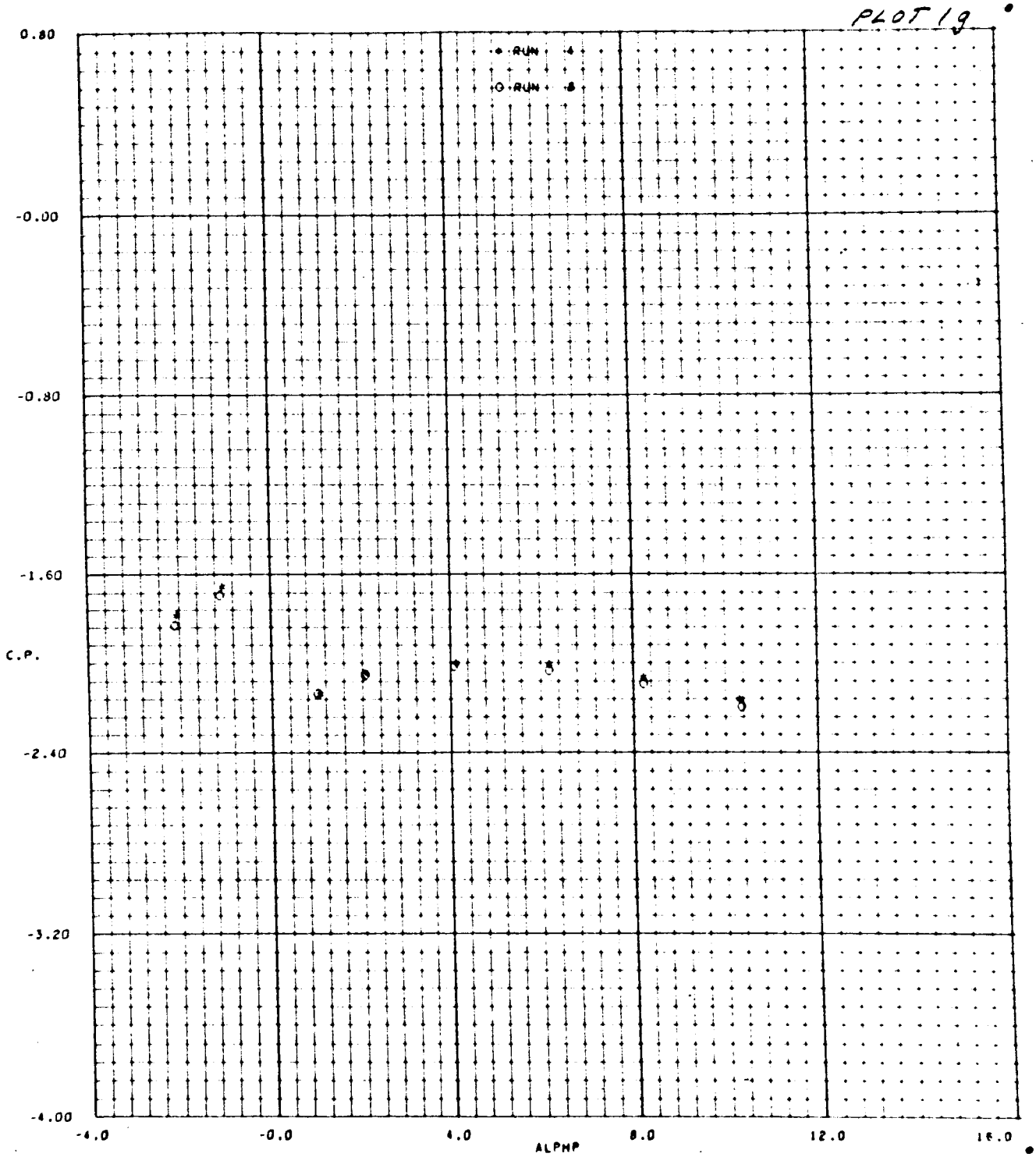
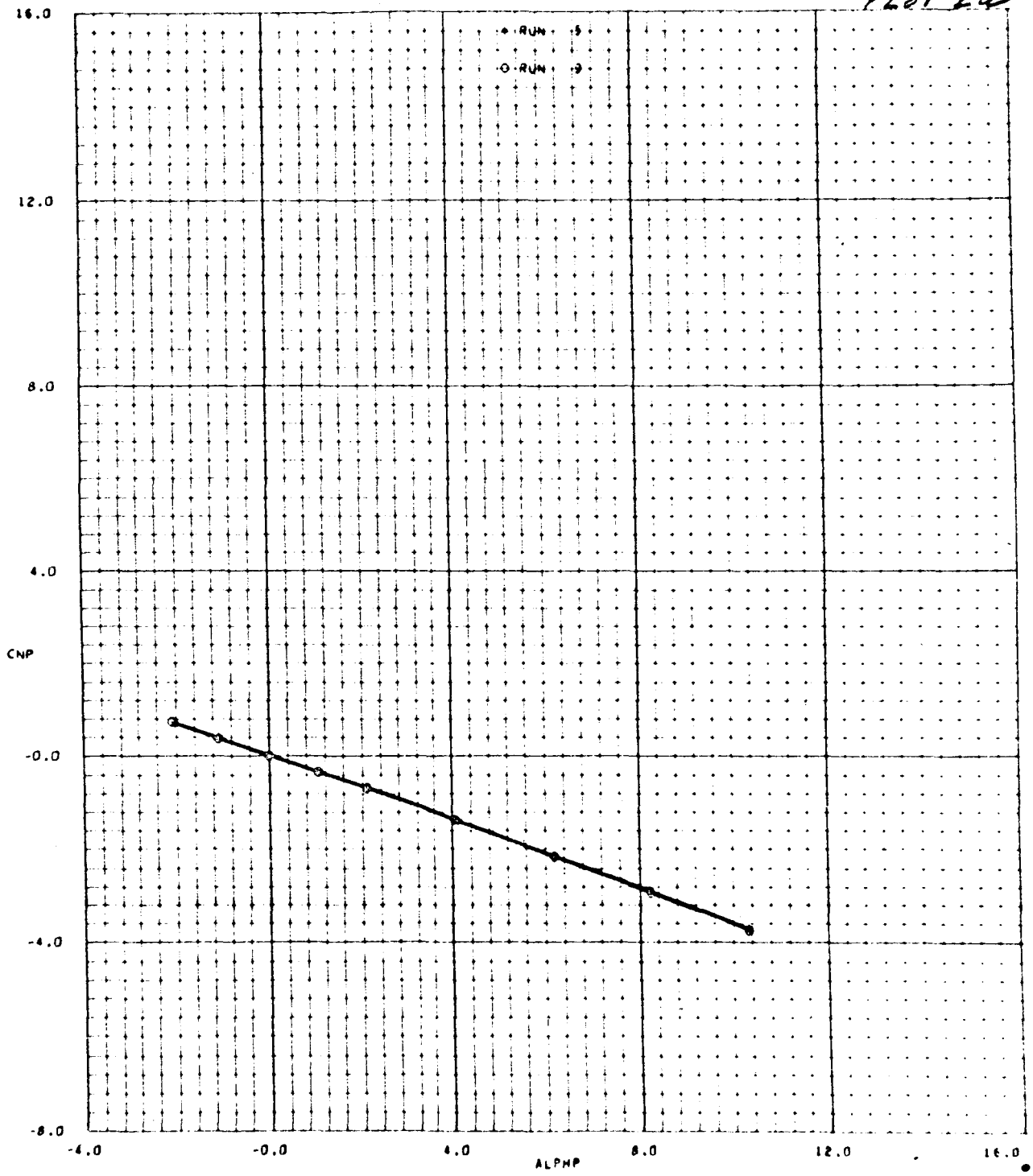
-0.0
4.0
8.0
12.0
16.0
ALPHP
RUN 4
RUN 8

PLOT 19


RUN 4
RUN 8
0.80
-0.00
-0.80
-1.60
C.P.
-2.40
-3.20
-4.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

7

PLOT 29



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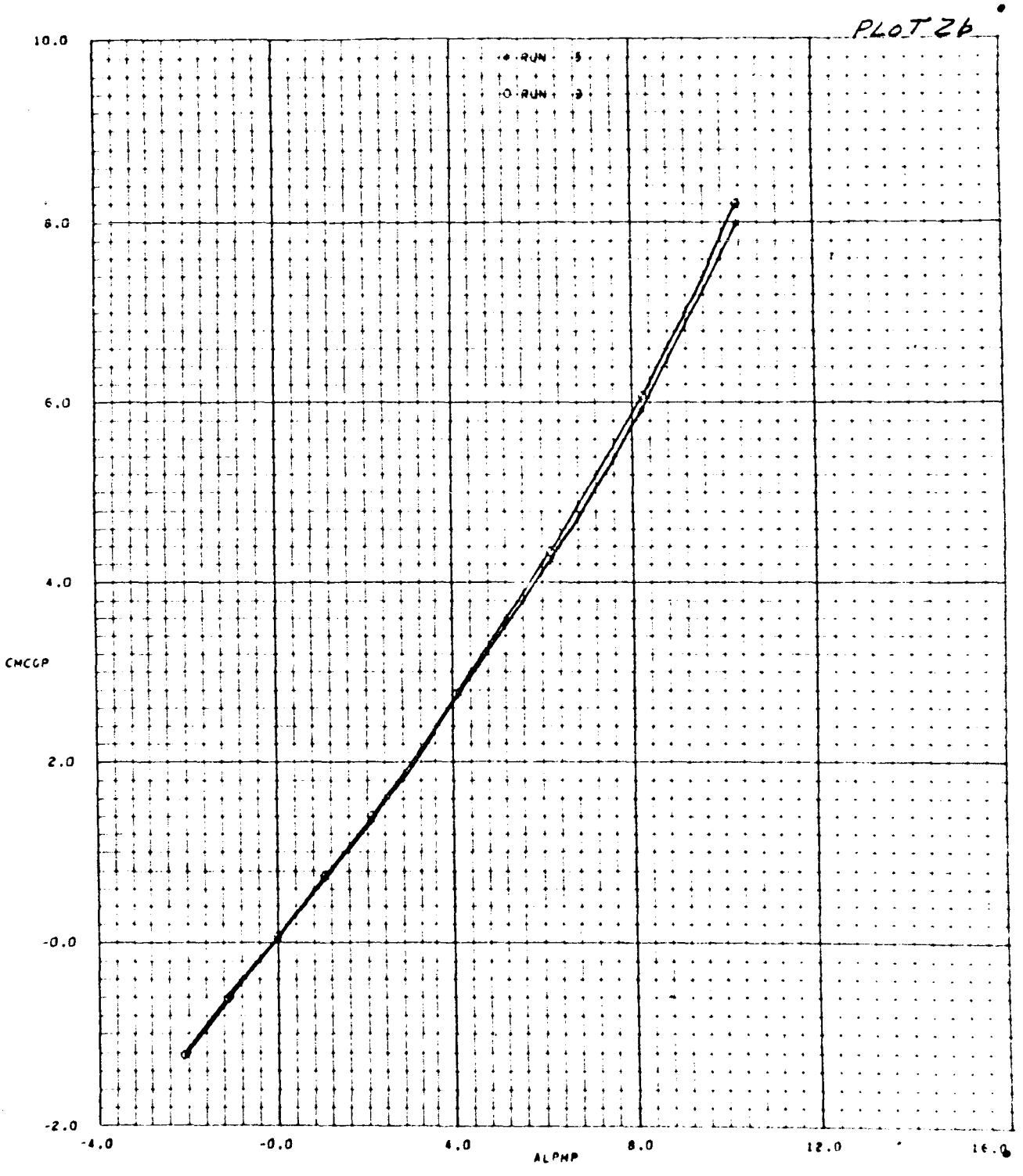
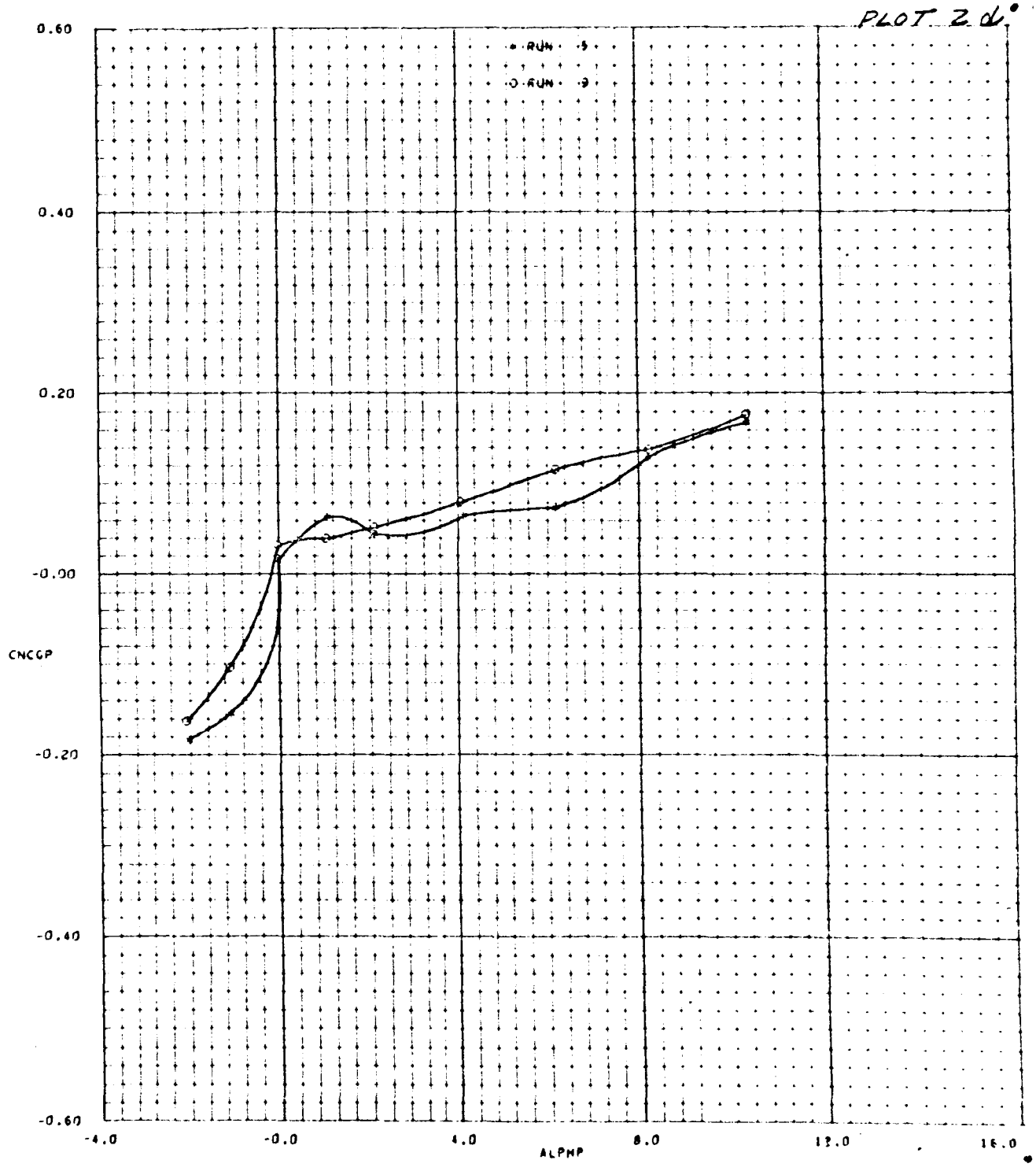

PLOT 2b
+ RUN 5
O RUN 3
10.0
8.0
6.0
4.0
2.0
-0.0
-2.0
CMCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

9

PLOT 2C

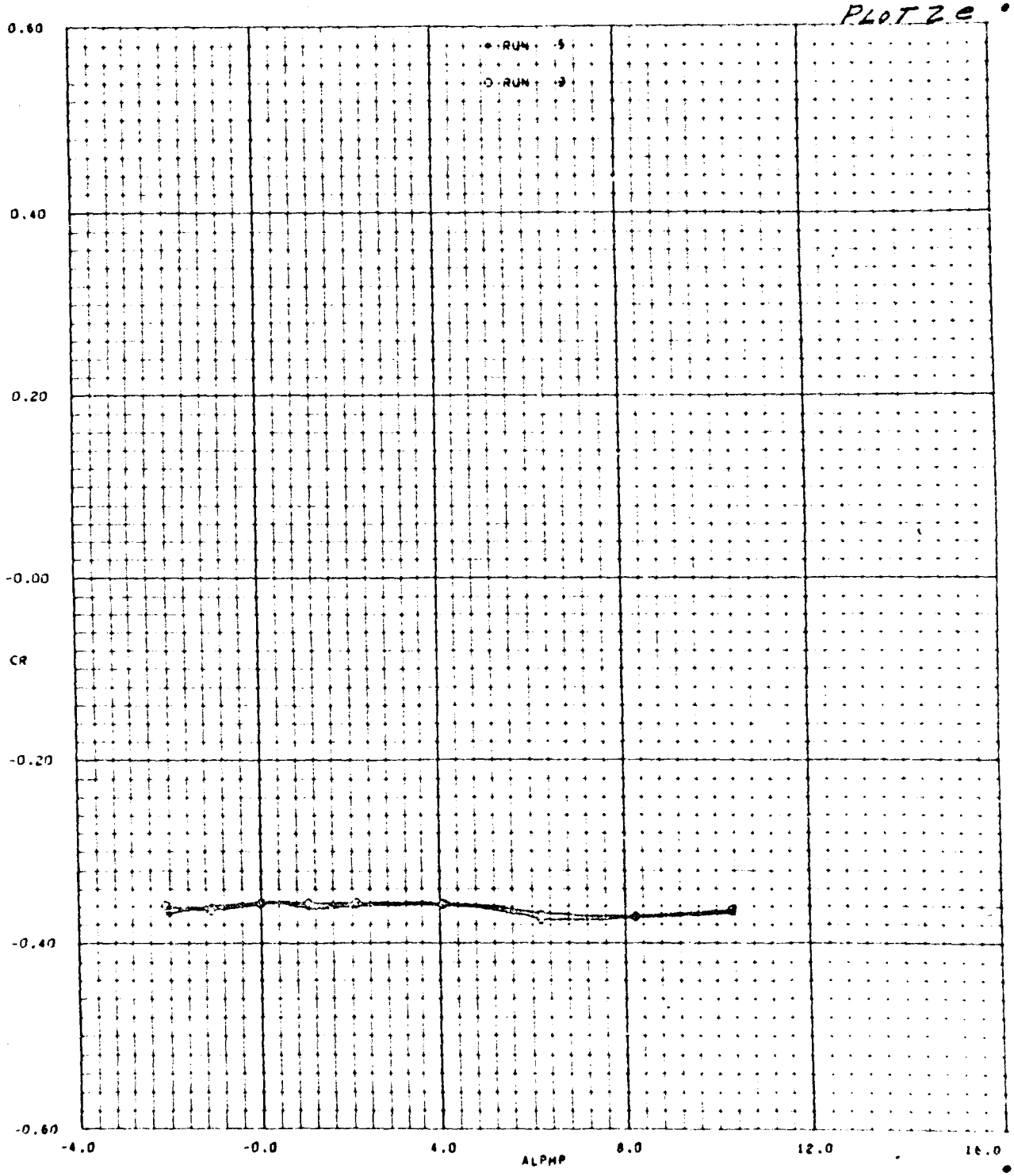
RUN 5
RUN 9
0.12
0.08
0.04
-0.00
CYP
-0.04
-0.08
-0.12
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

10


PLOT 2 d.
• RUN 5
O RUN 9
0.60
0.40
0.20
-0.00
-0.20
-0.40
-0.60
CNCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

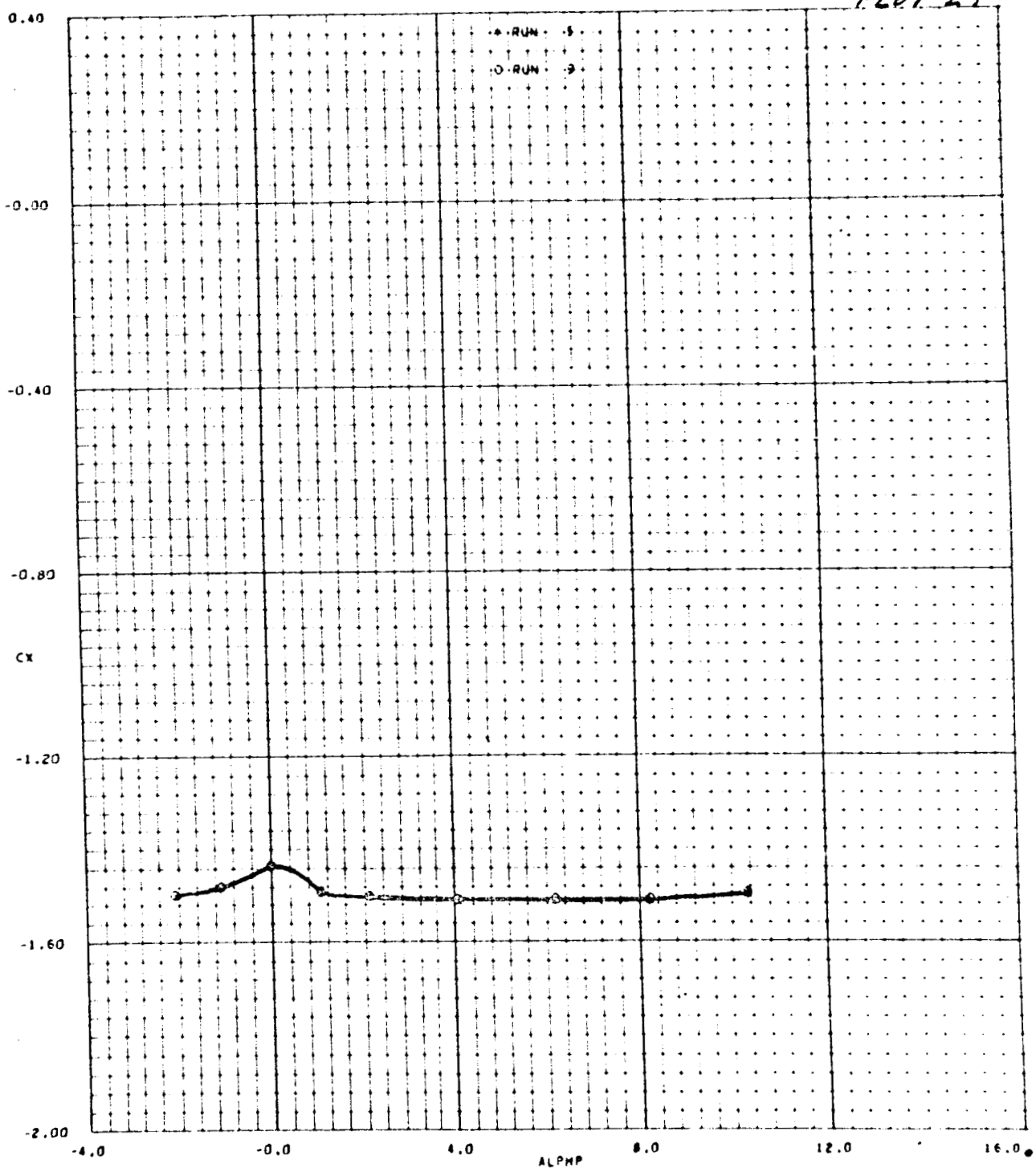
11

PLOT 2e


RUN 5
RUN 3
0.60
0.40
0.20
-0.00
CR
-0.20
-0.40
-0.60
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

12

PLOT 2f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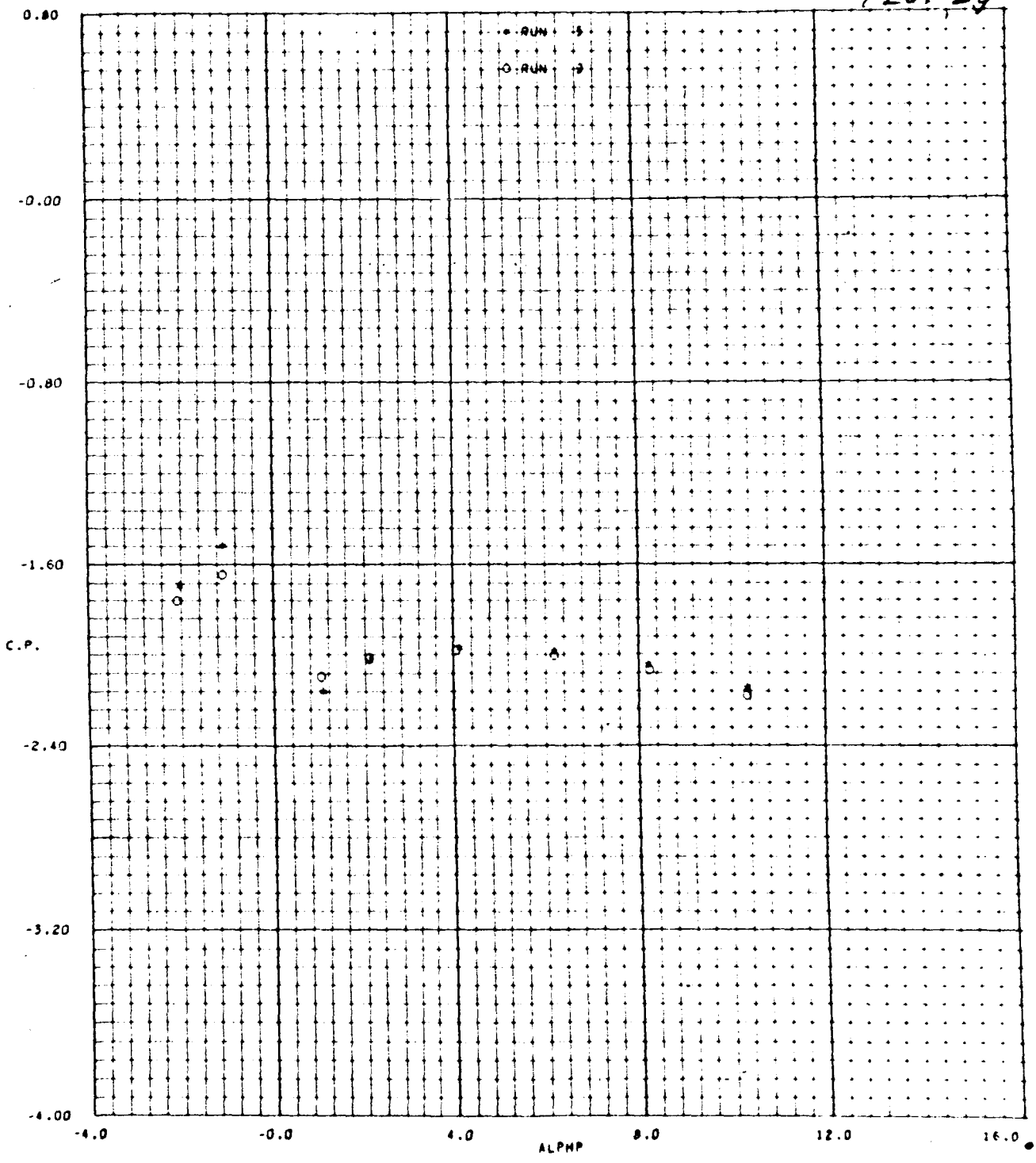
-0.00
-0.40
-0.80
CX
-1.20
-1.60
-2.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
+ RUN 5
O RUN 9

13

PLOT 29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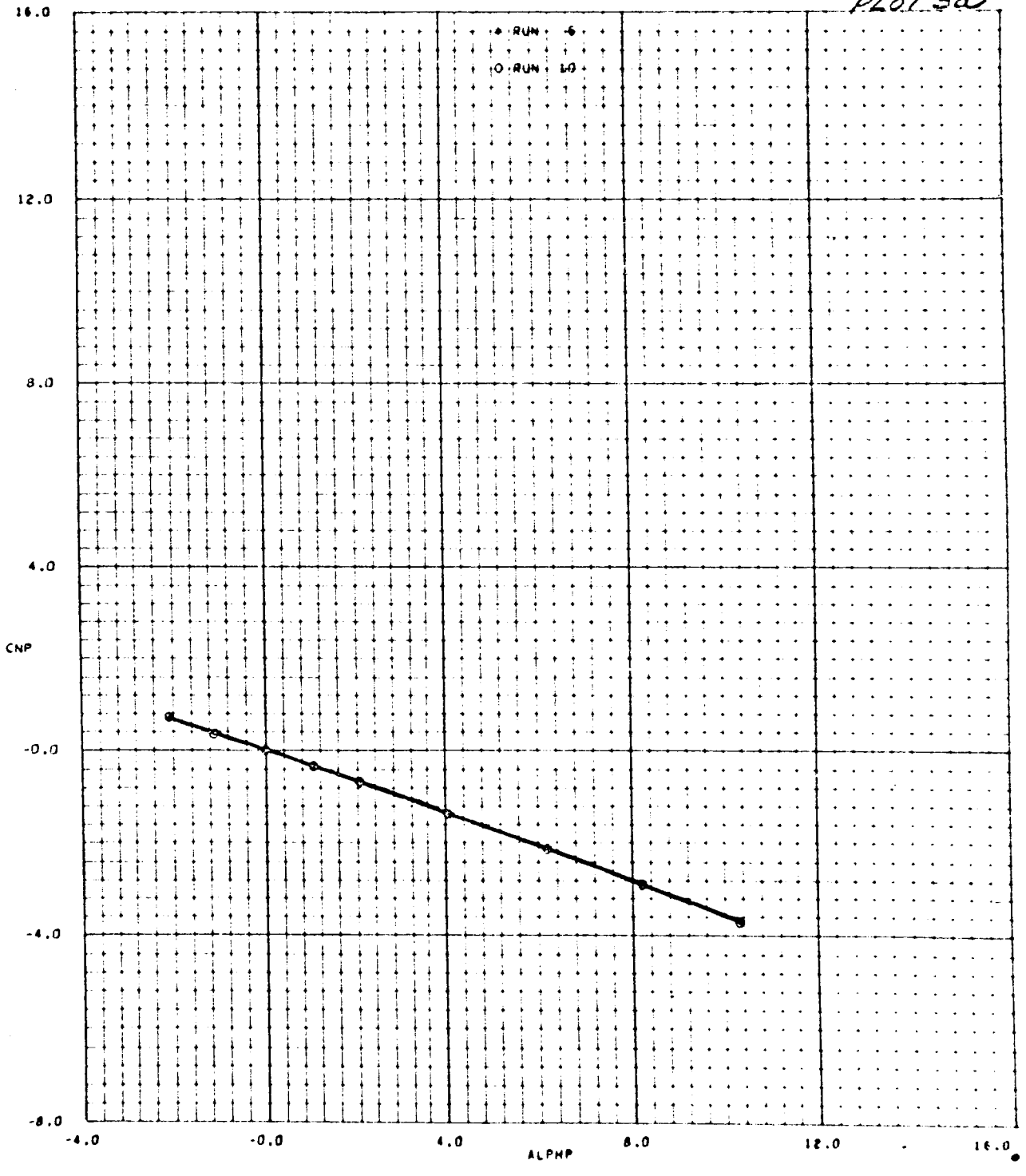
-0.80
-1.60
C.P.
-2.40
-3.20
-4.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
• RUN 5
O RUN 9

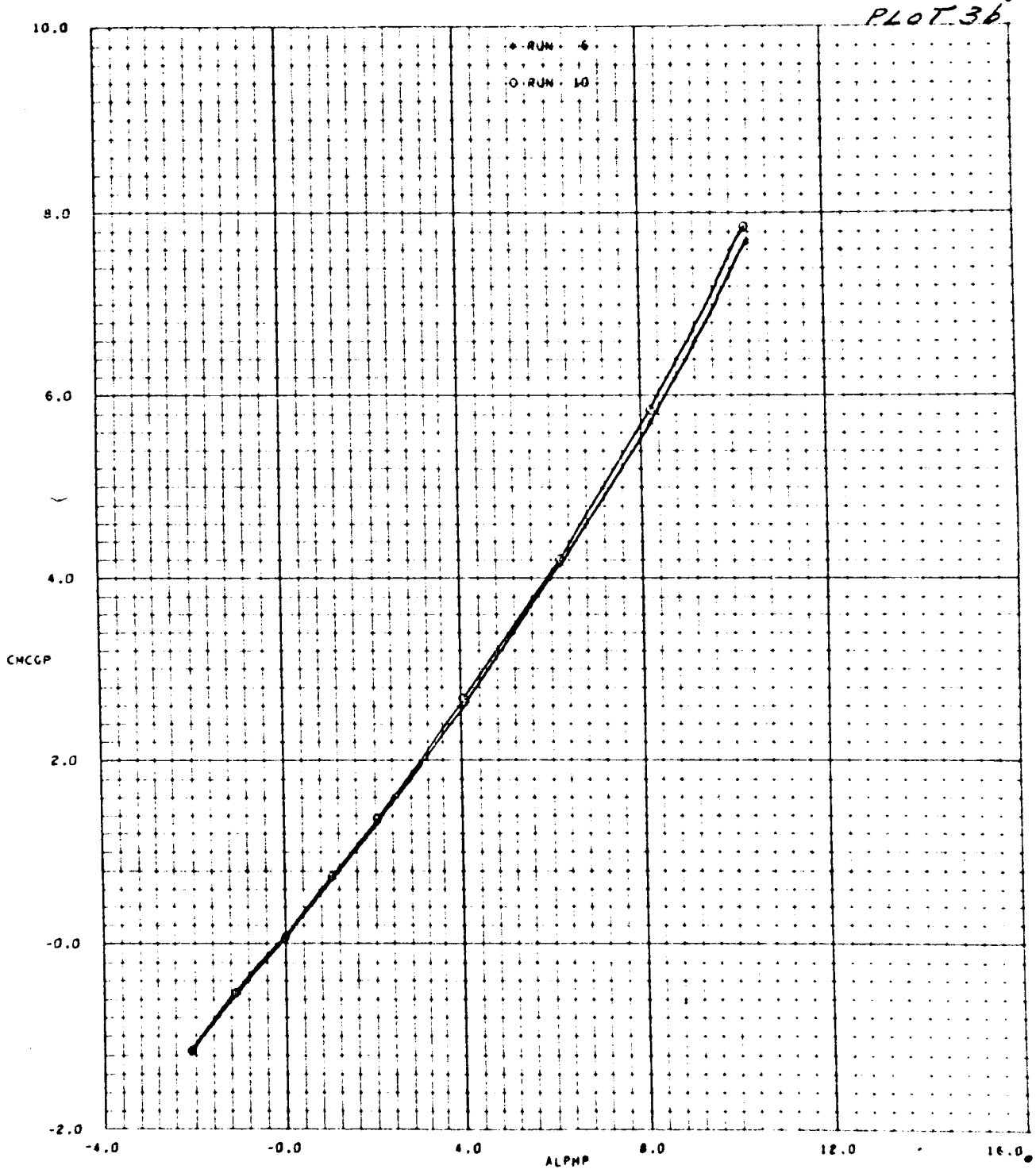
14

PLOT 3a



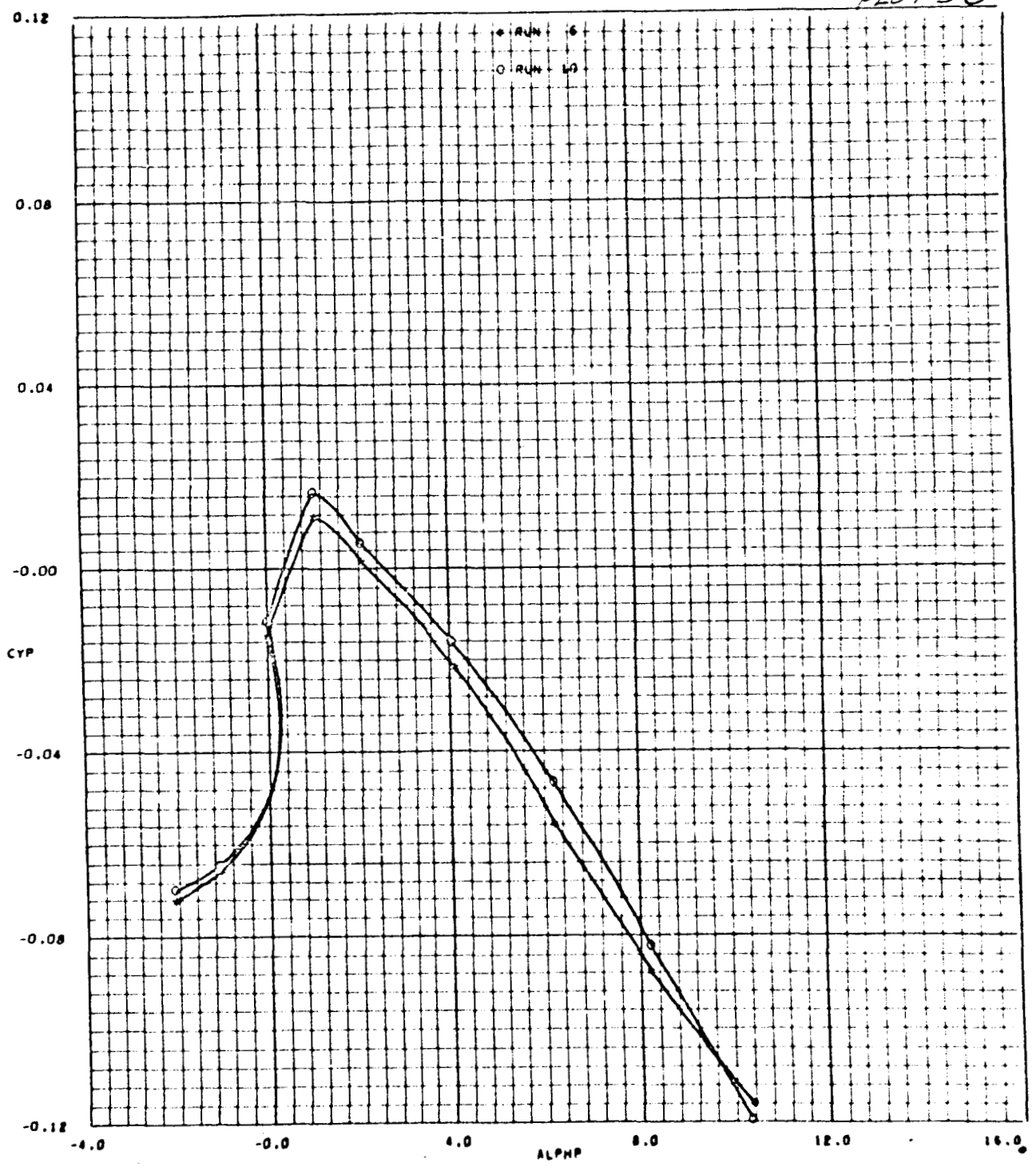
15

PLOT 3b

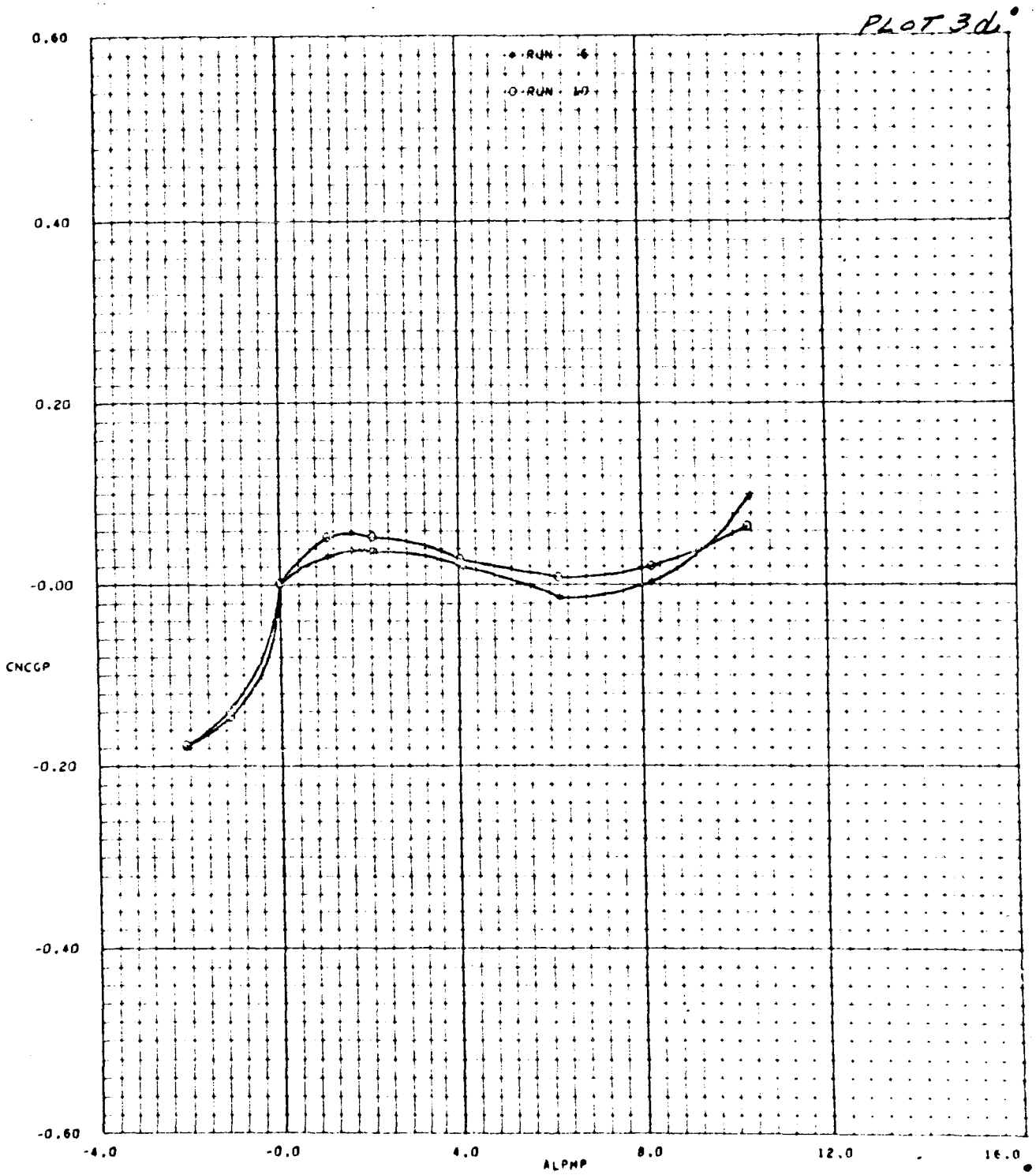


16

PLOT 3 C

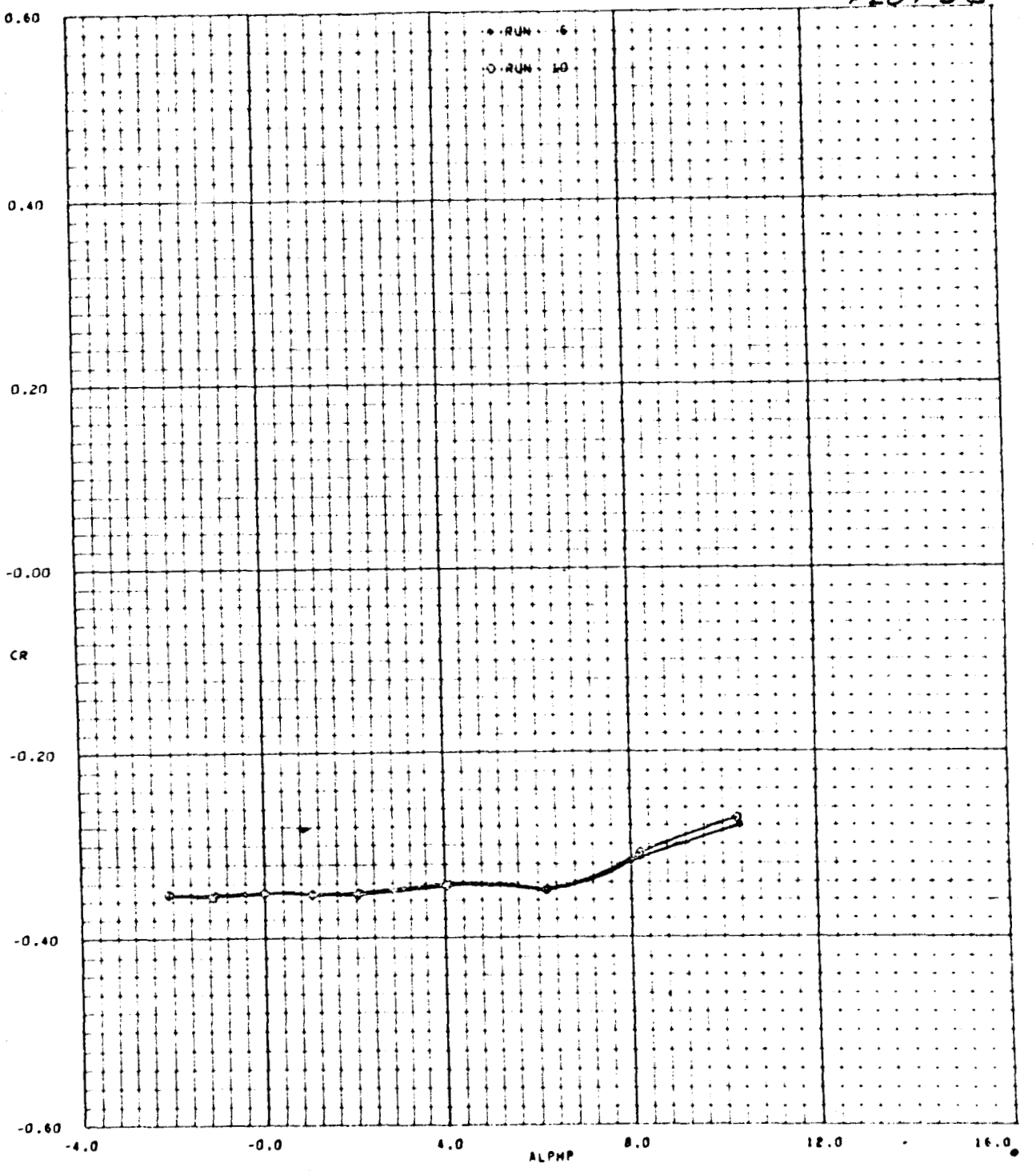

0.12
0.08
0.04
-0.00
CYP
-0.04
-0.08
-0.12
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
◆ RUN 6
○ RUN 40

17


PLOT 3d
• RUN 4
O RUN 10
0.60
0.40
0.20
-0.00
-0.20
-0.40
-0.60
CNCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPMP

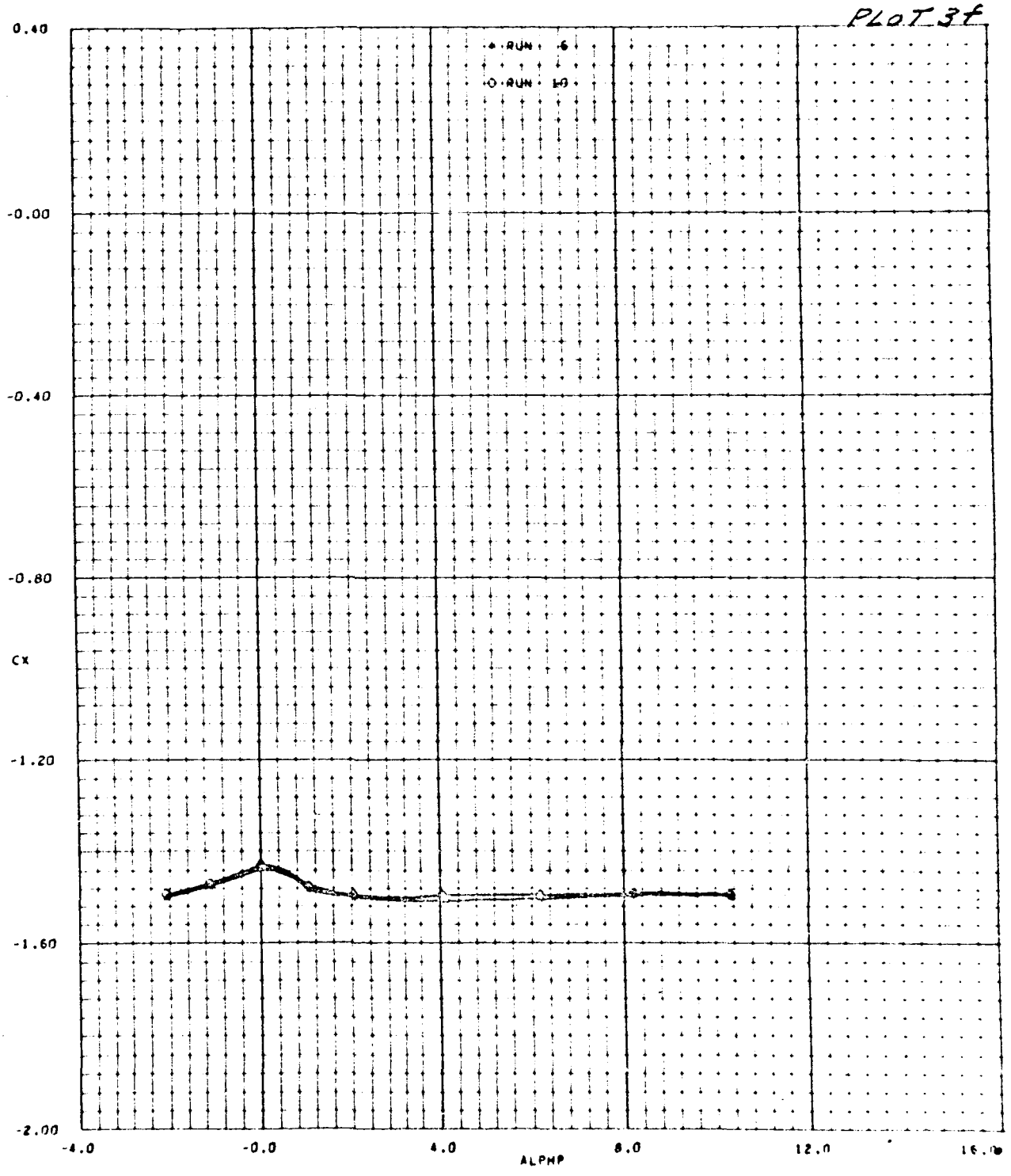
18

PLOT 3e


0.60
0.40
0.20
-0.00
CR
-0.20
-0.40
-0.60
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
• RUN 6
O RUN 10

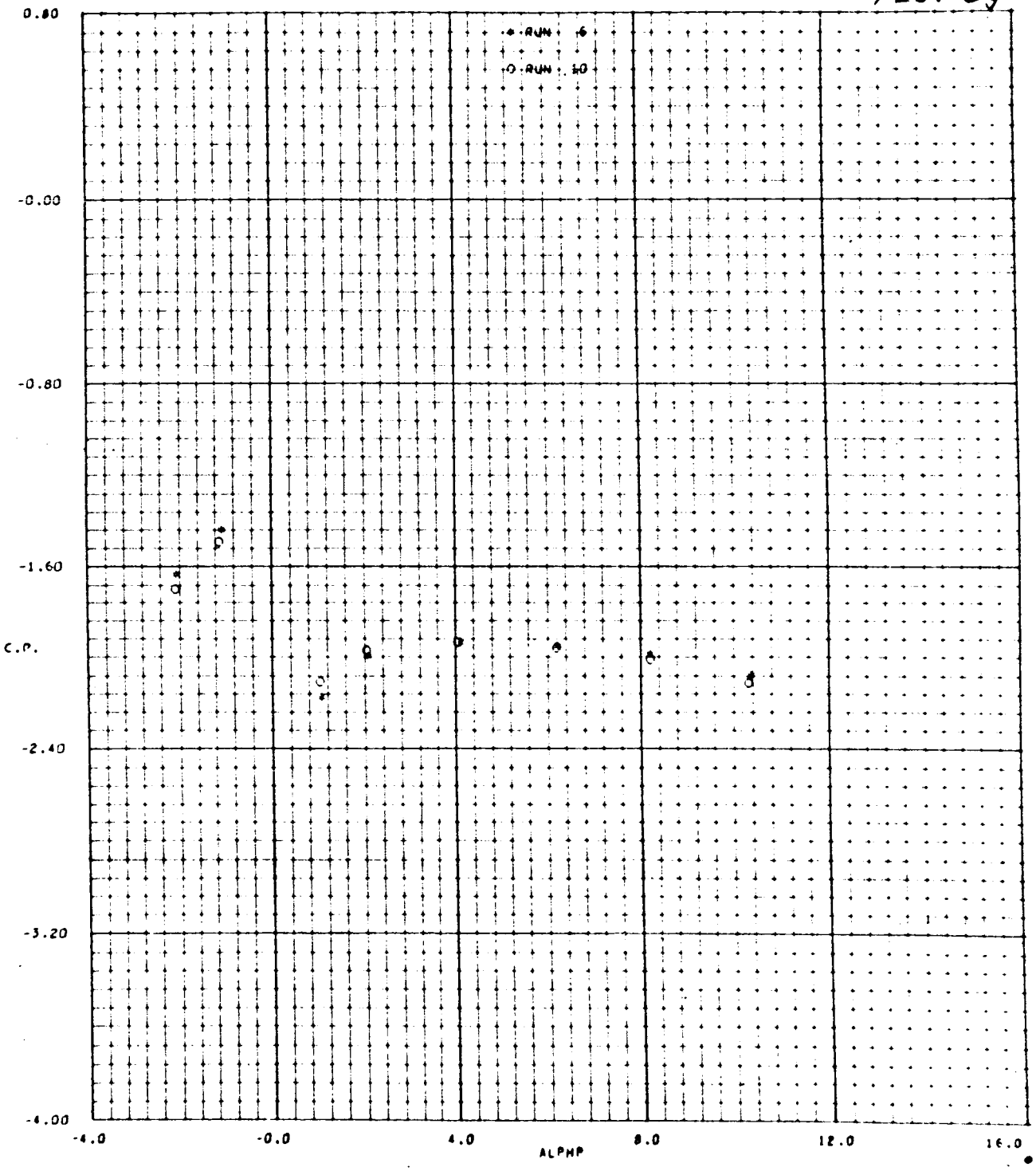
19

PLOT 3f


RUN 6
RUN 10
0.40
-0.00
-0.40
-0.80
CX
-1.20
-1.60
-2.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

20

PLOT 39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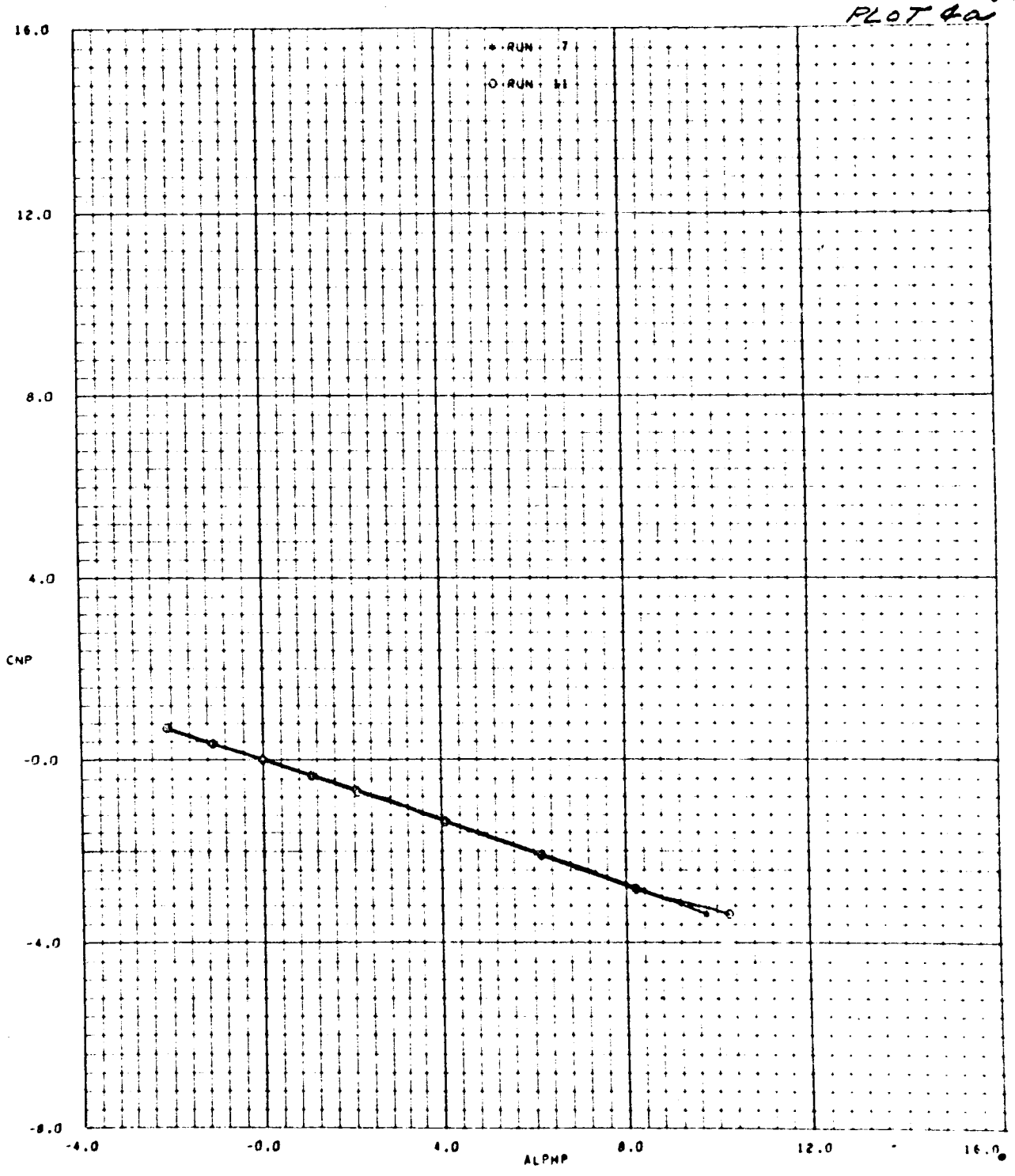
-0.80
-1.60
C.P.
-2.40
-3.20
-4.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
RUN 6
RUN 10

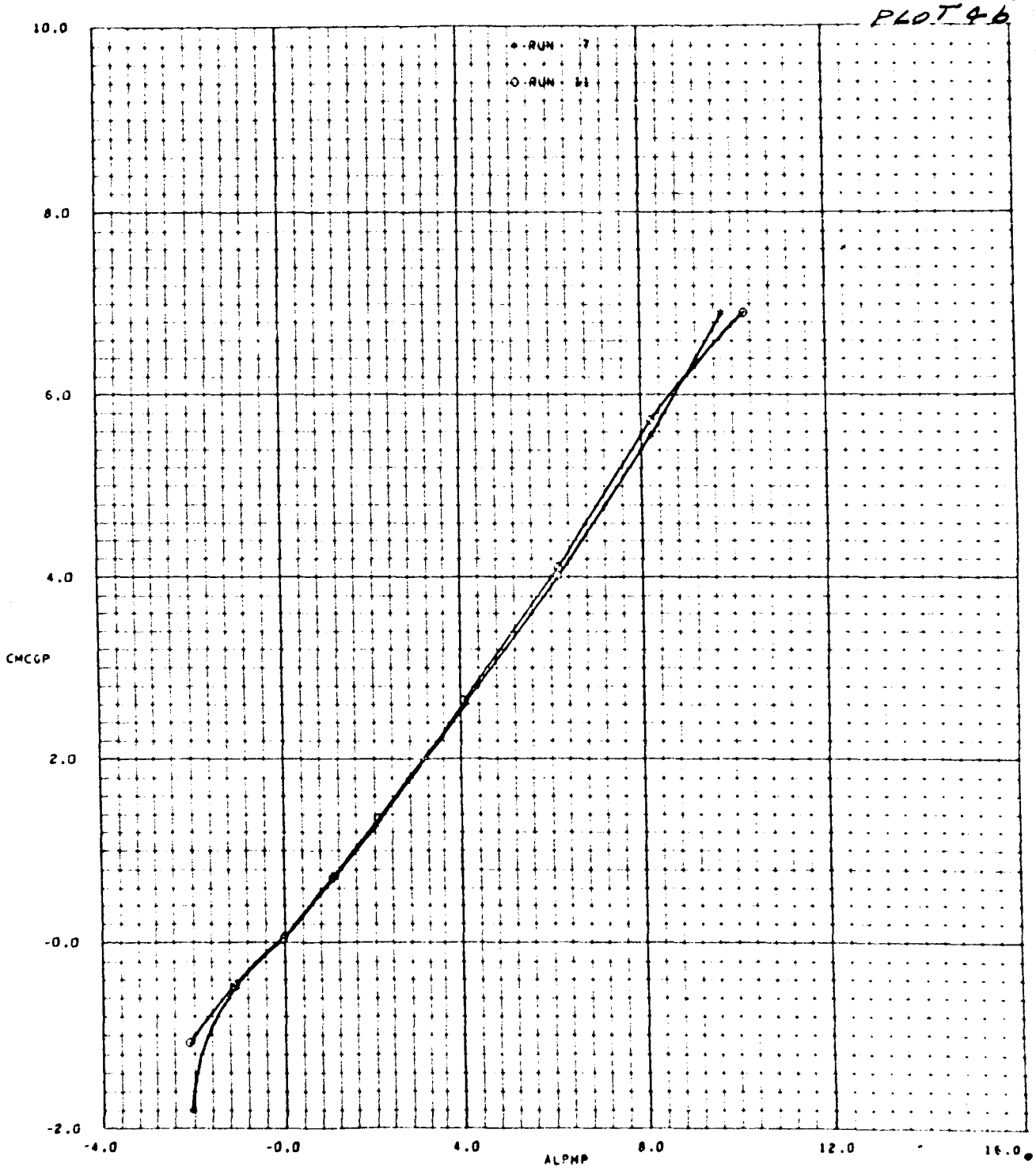
21

PLOT 4a

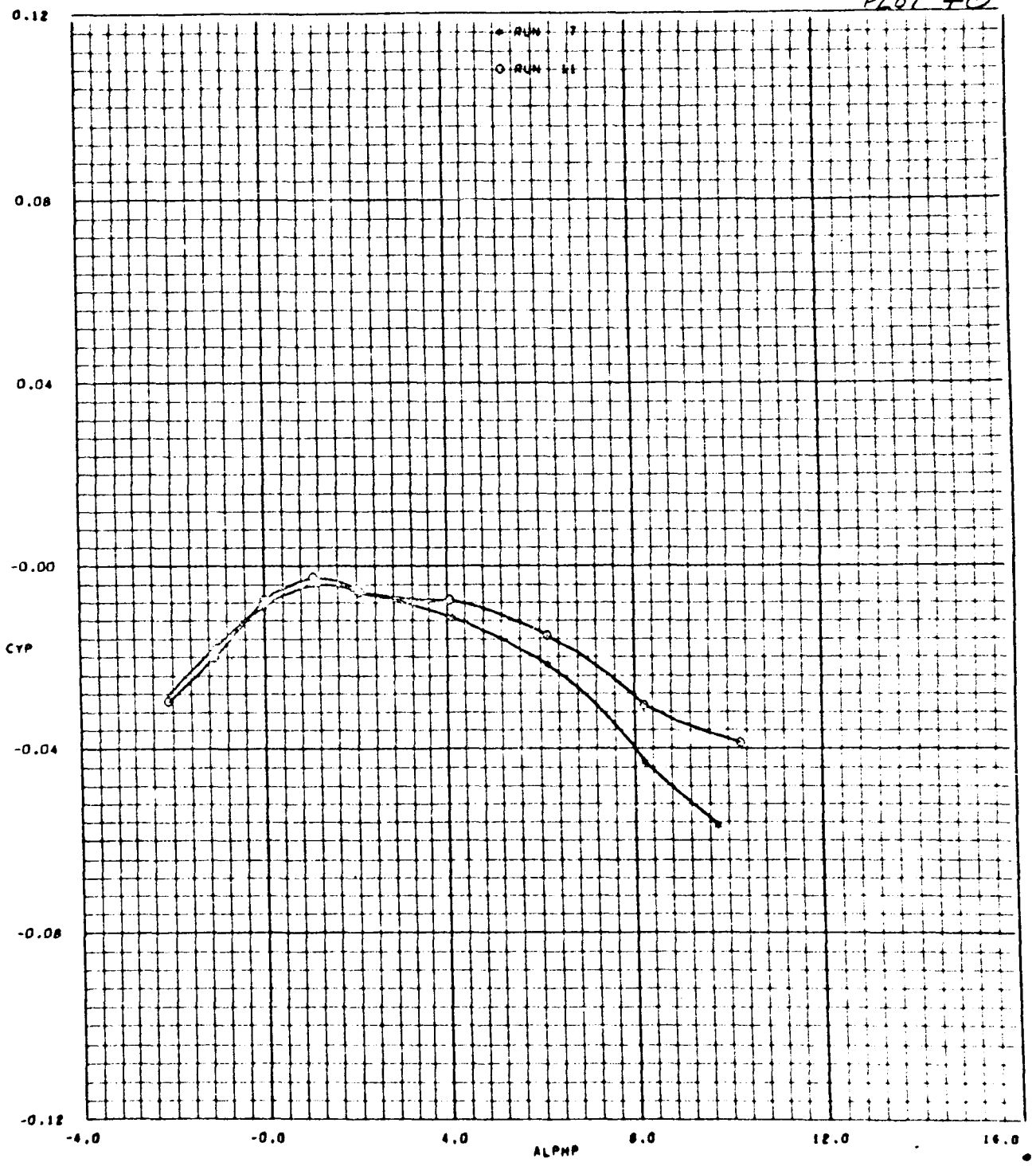


22

PLOT 4b



PLOT 4C


0.12
0.08
0.04
-0.00
CYP
-0.04
-0.08
-0.12
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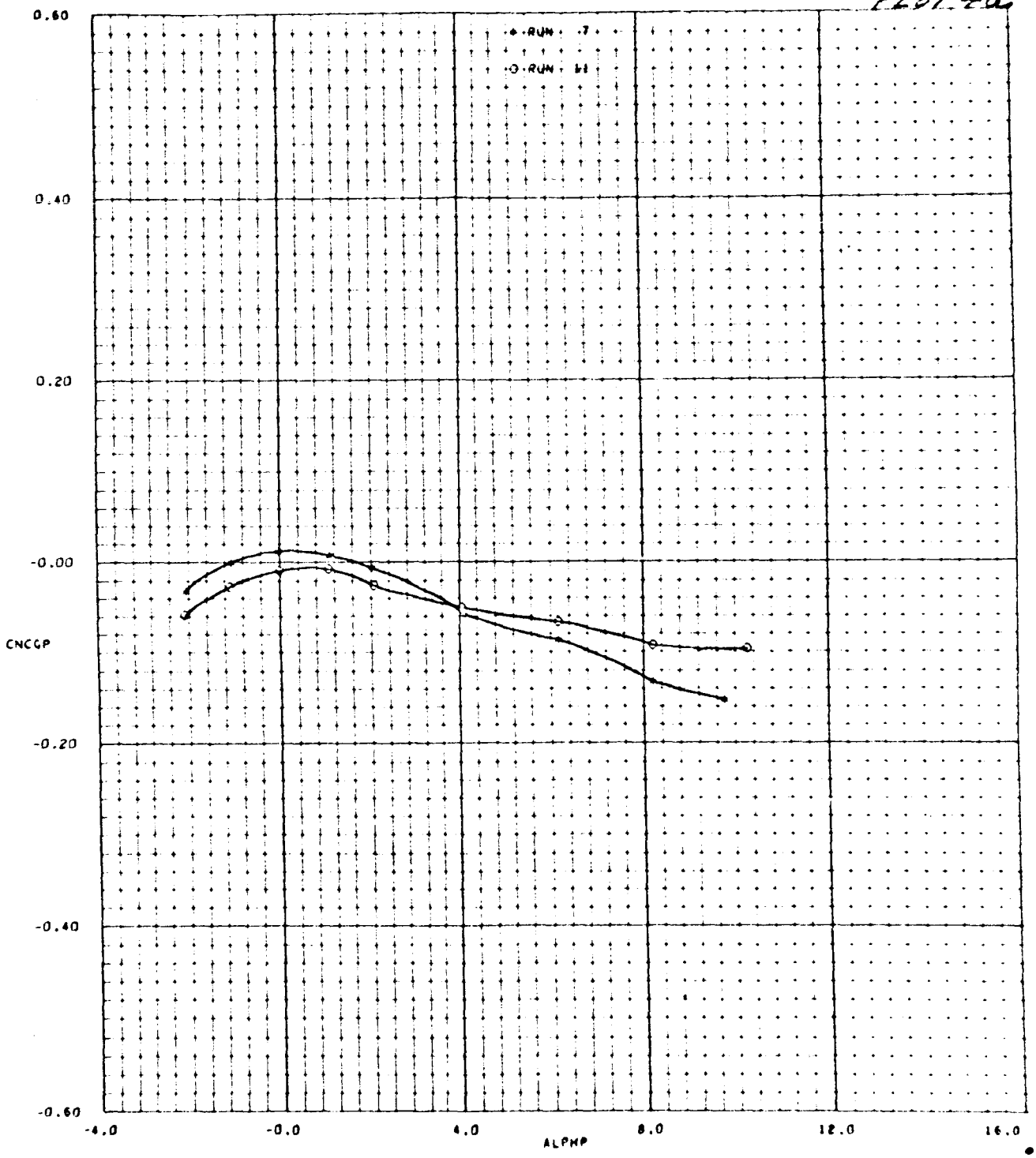
-0.0
4.0
8.0
12.0
16.0
ALPHP
RUN 7
RUN 41

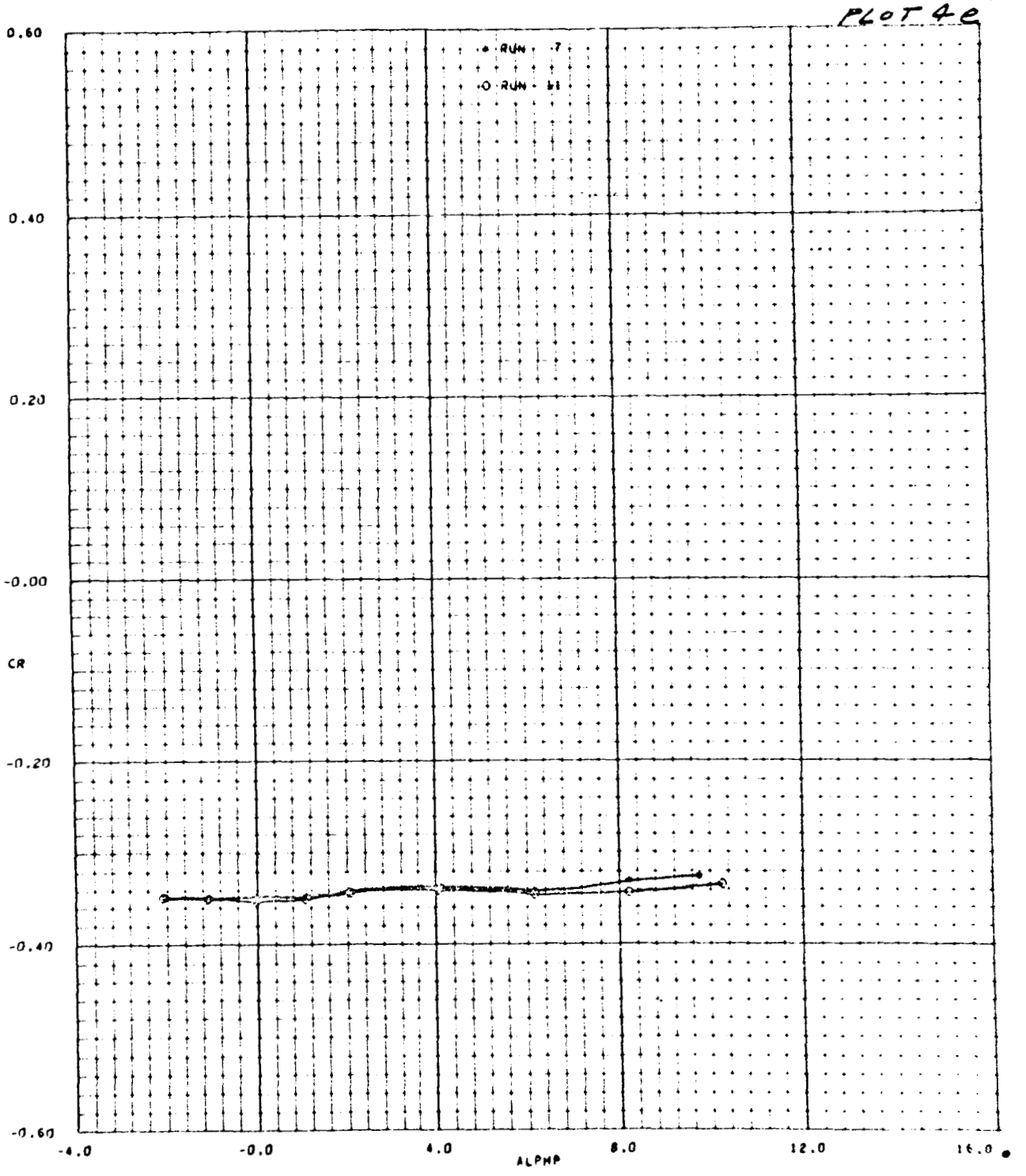
24

PLOT 4d


+ RUN 7
O RUN 11
0.60
0.40
0.20
-0.00
-0.20
-0.40
-0.60
CNCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

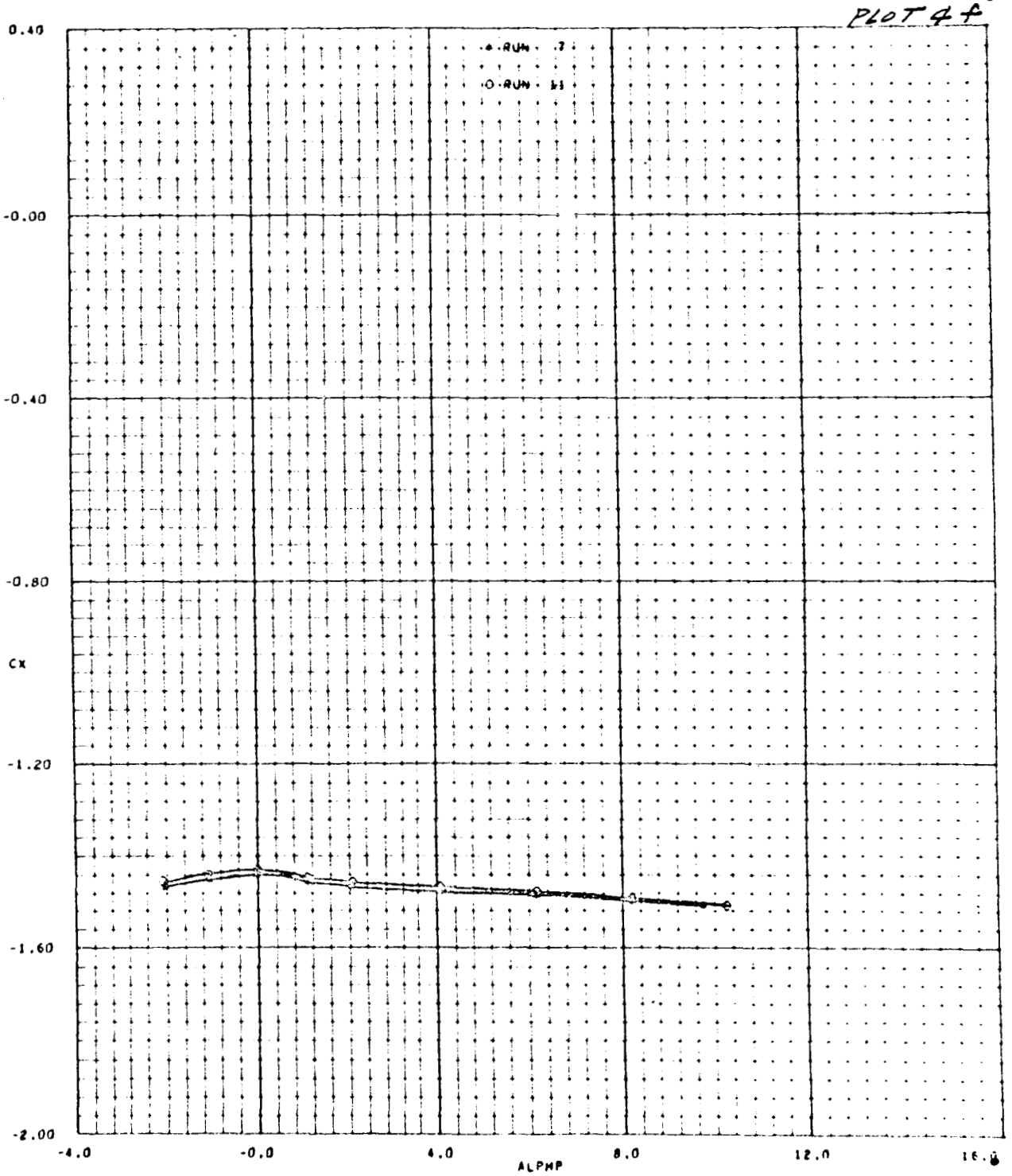
25

PLOT 4e

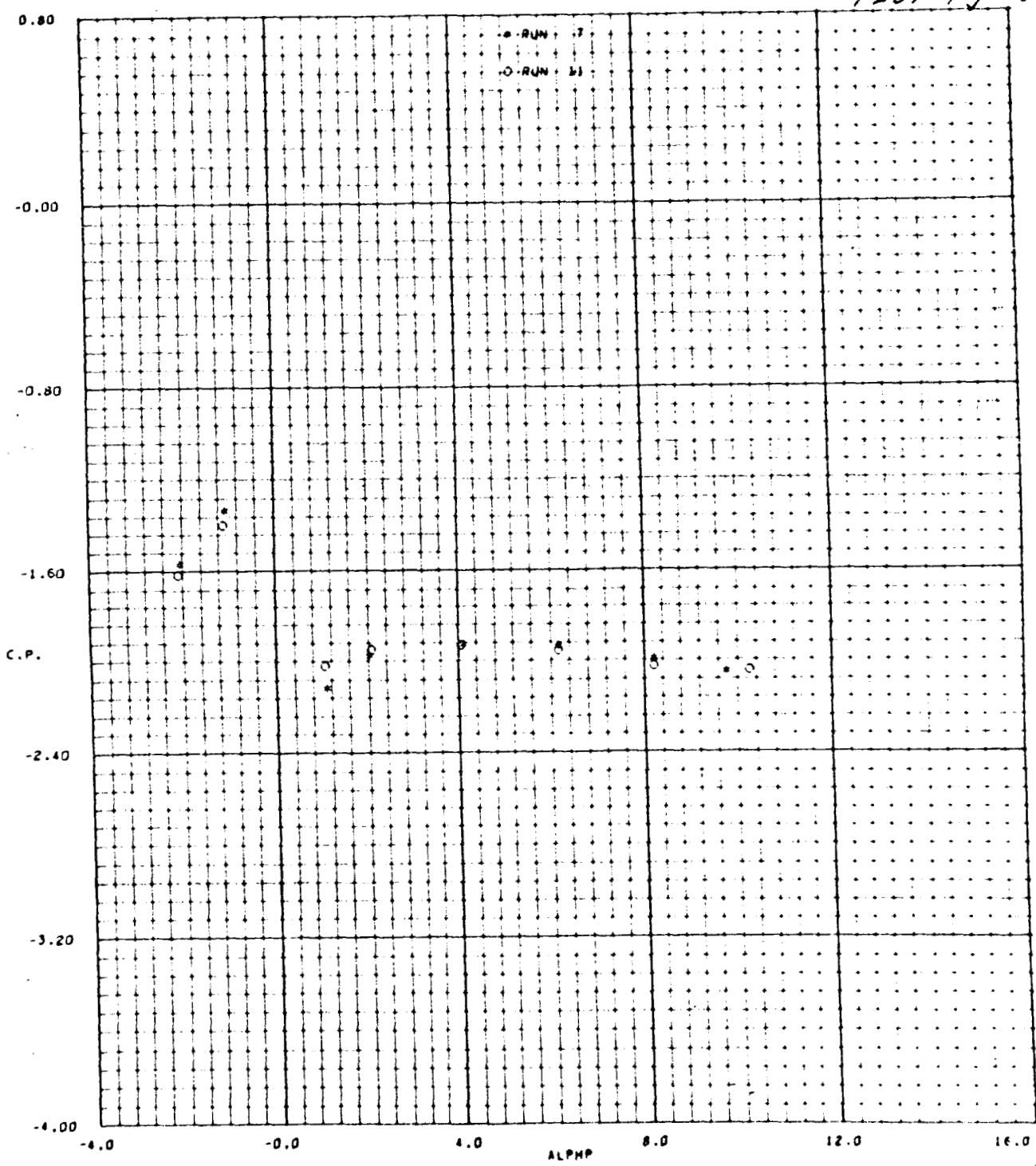

0.60
0.40
0.20
-0.00
CR
-0.20
-0.40
-0.60
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
+ RUN 7
O RUN 11

26

PLOT 4f

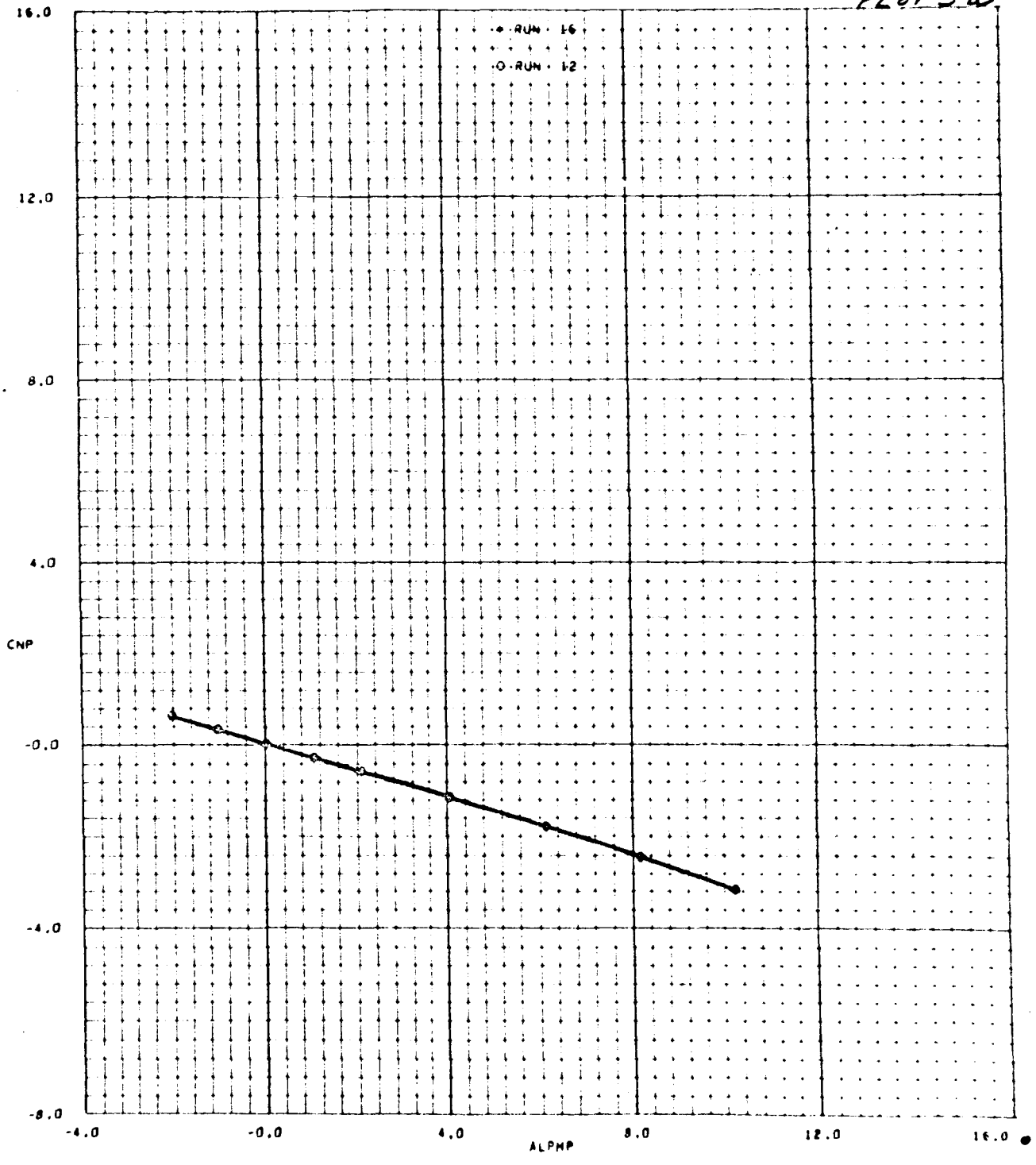

0.40
-0.00
-0.40
-0.80
Cx
-1.20
-1.60
-2.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
• RUN 7
O RUN 11

PLOT 49


0.80
-0.00
-0.80
-1.60
C.P.
-2.40
-3.20
-4.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
RUN 7
RUN 41

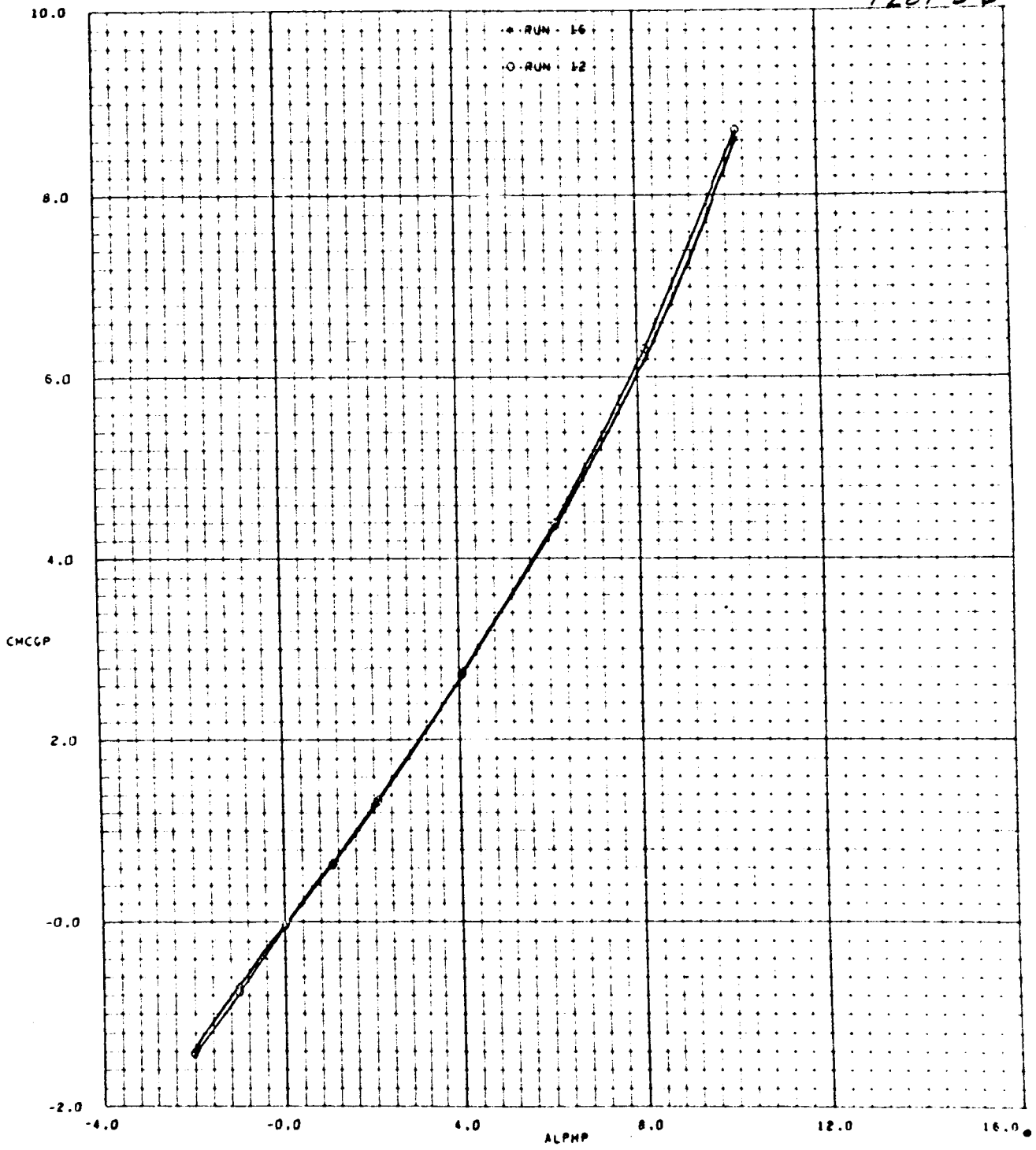
28

PLOT 5a

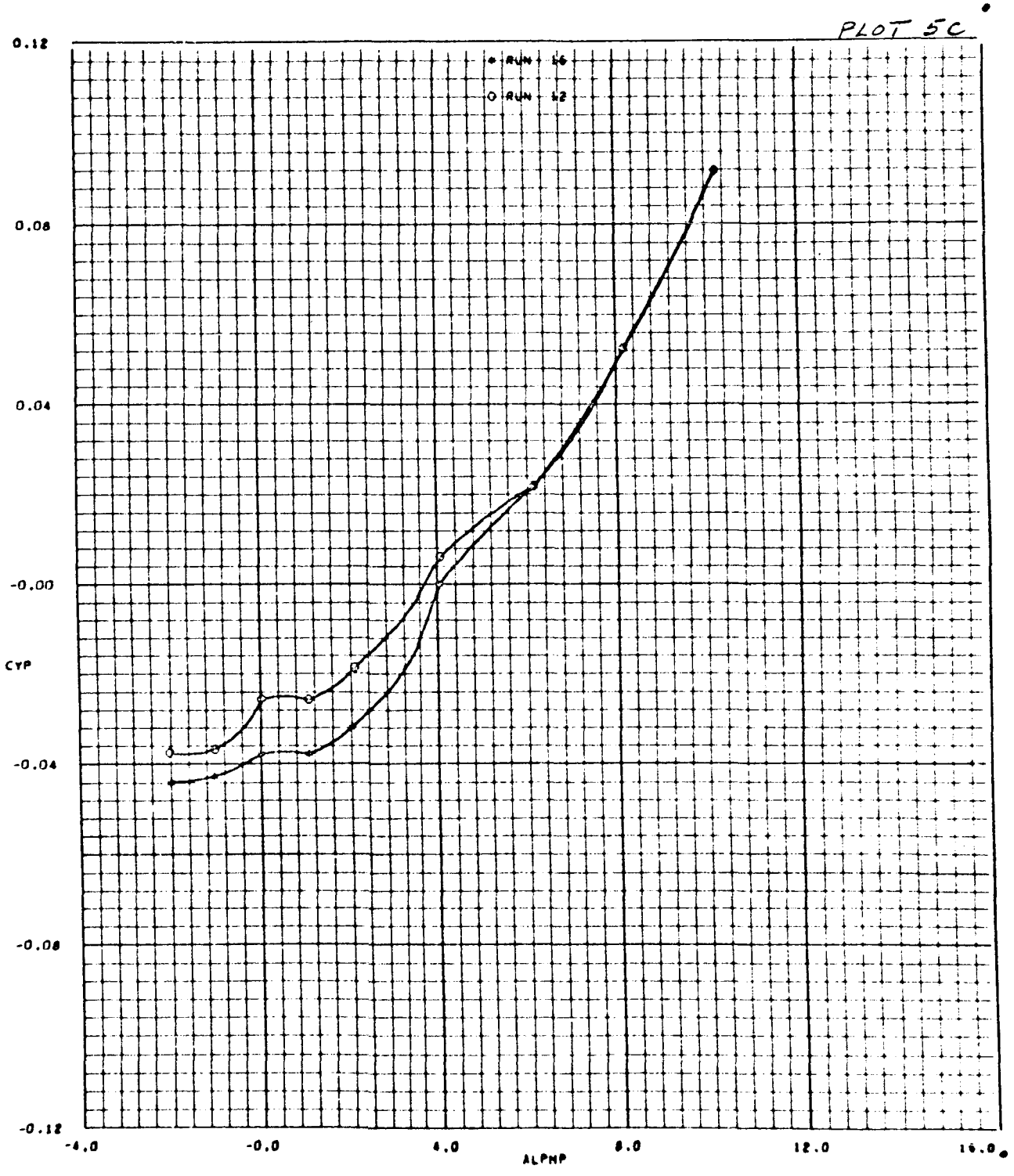


29

PLOT 56

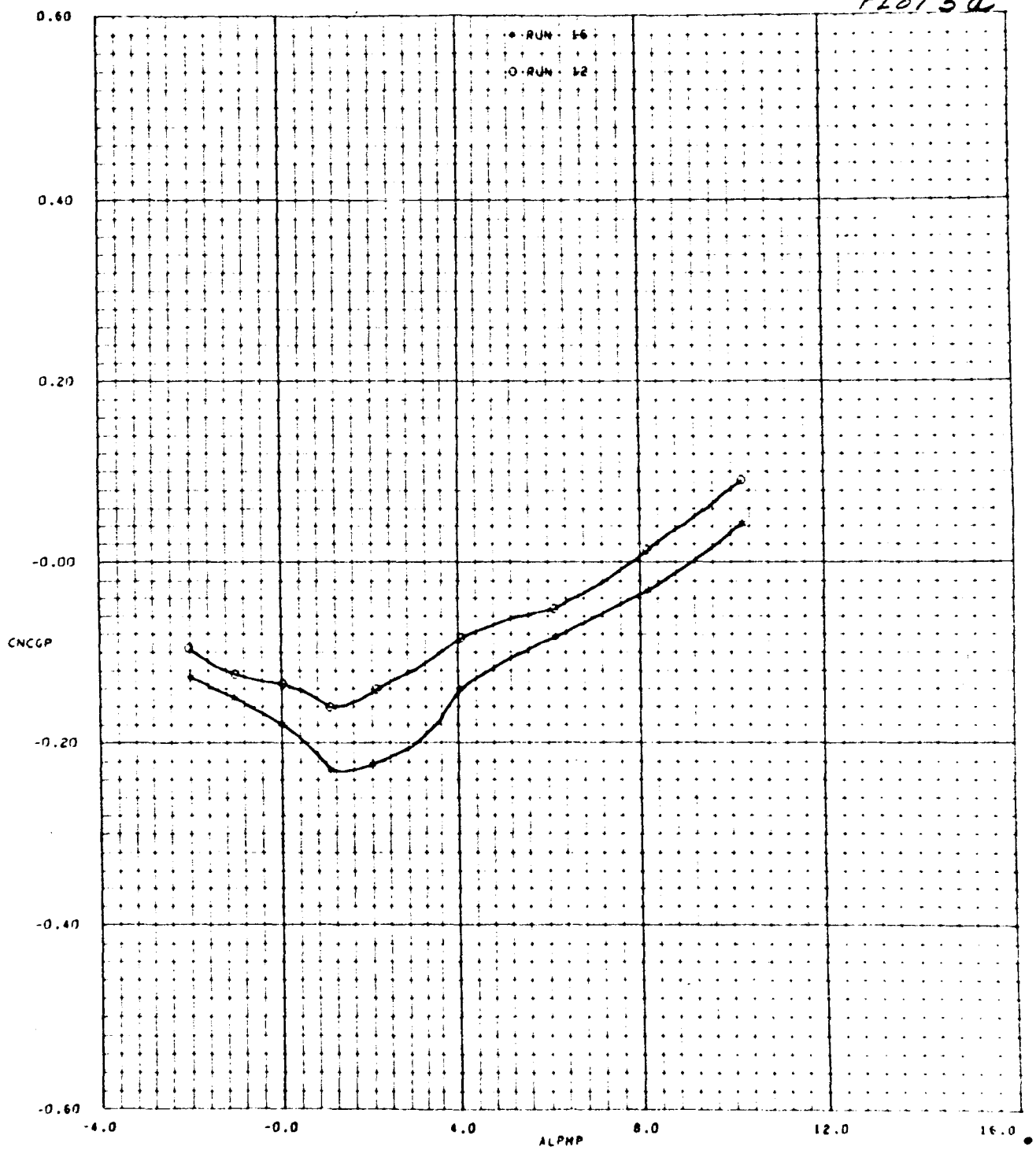


30

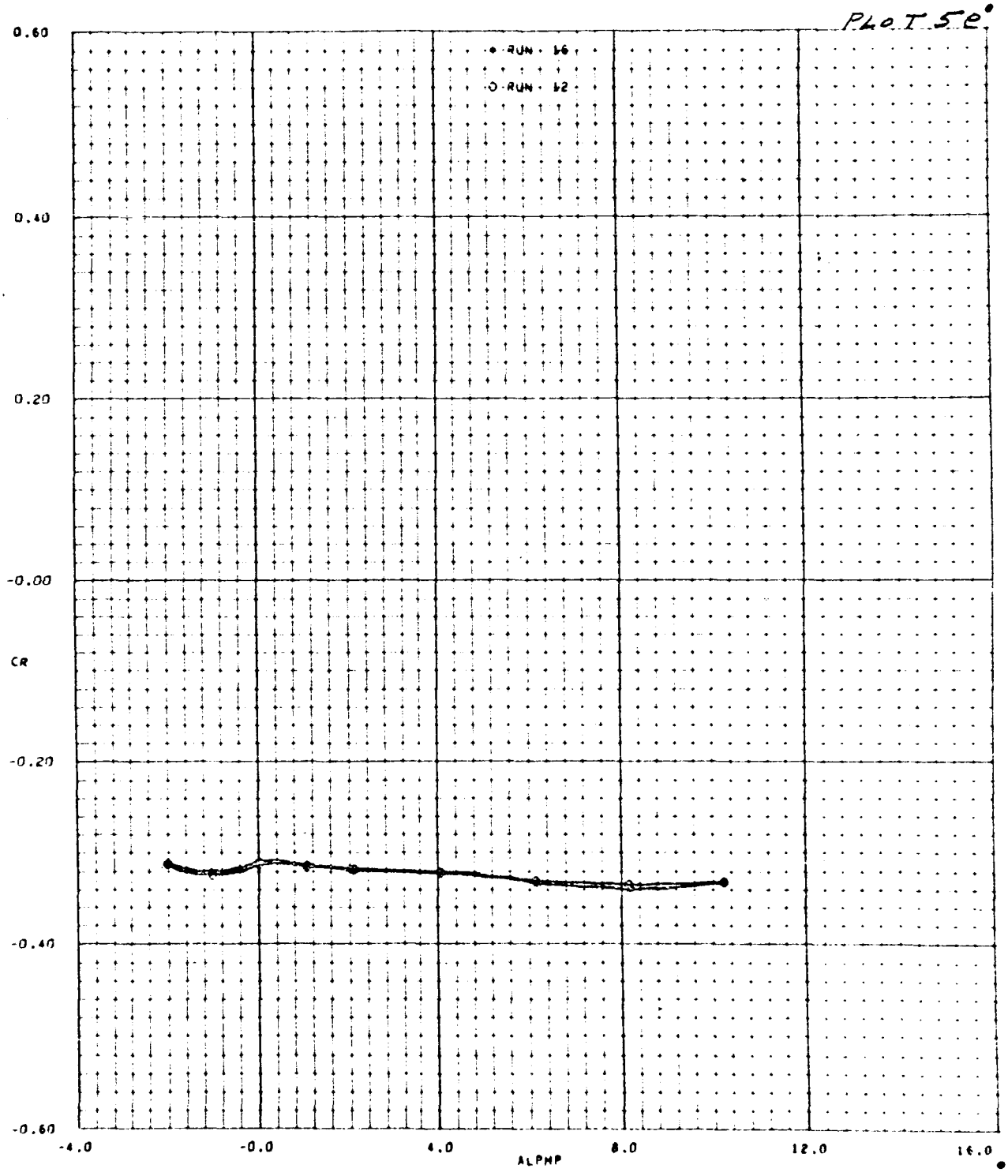

PLOT 5C
• RUN 46
O RUN 42
0.12
0.08
0.04
-0.00
CYP
-0.04
-0.08
-0.12
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

31

PLOT 5d

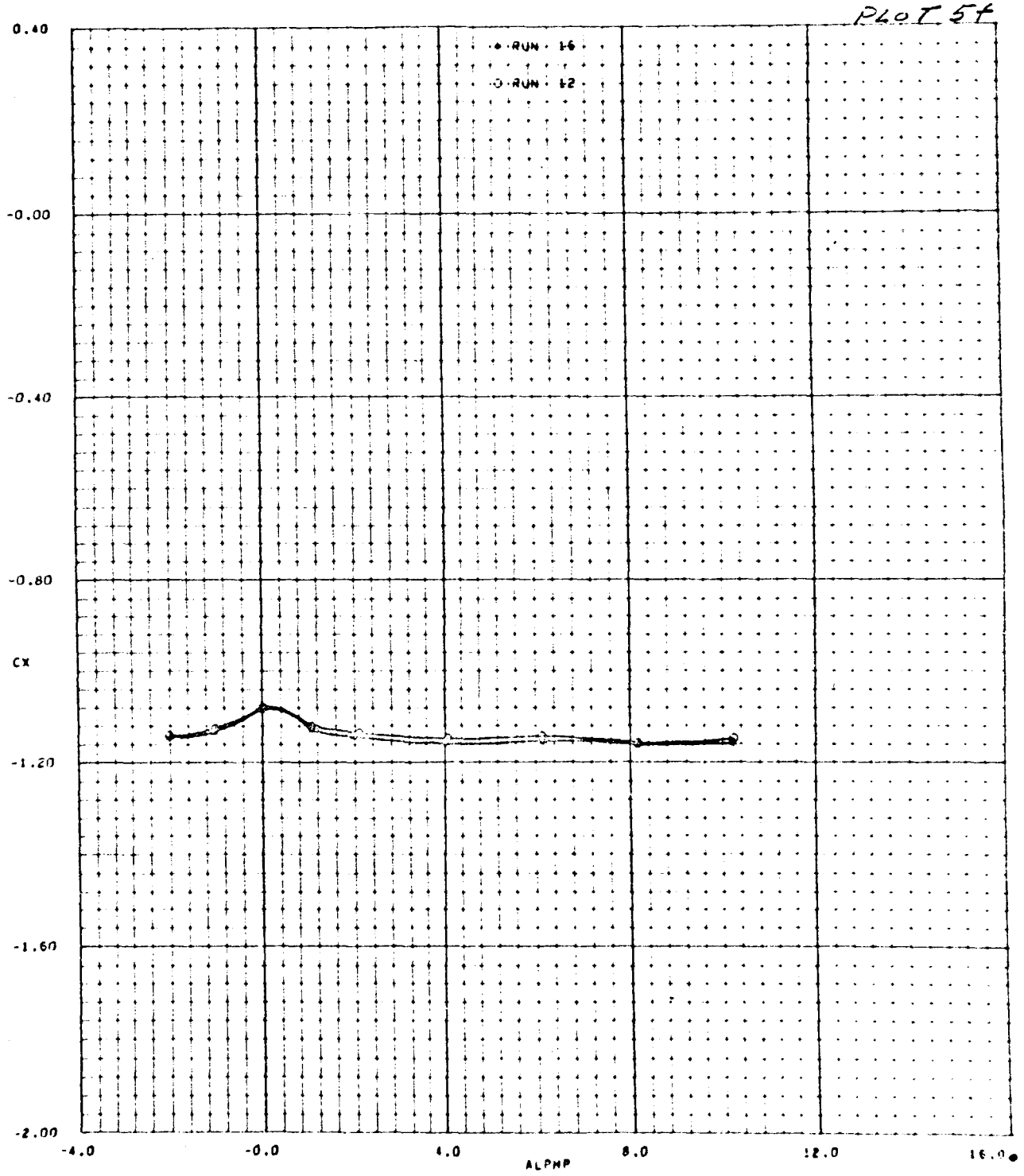

0.60
0.40
0.20
-0.00
-0.20
-0.40
-0.60
CNCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
• RUN 16
O RUN 12

32


PLOT 5e
• RUN 46
○ RUN 42
0.60
0.40
0.20
-0.00
CR
-0.20
-0.40
-0.60
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

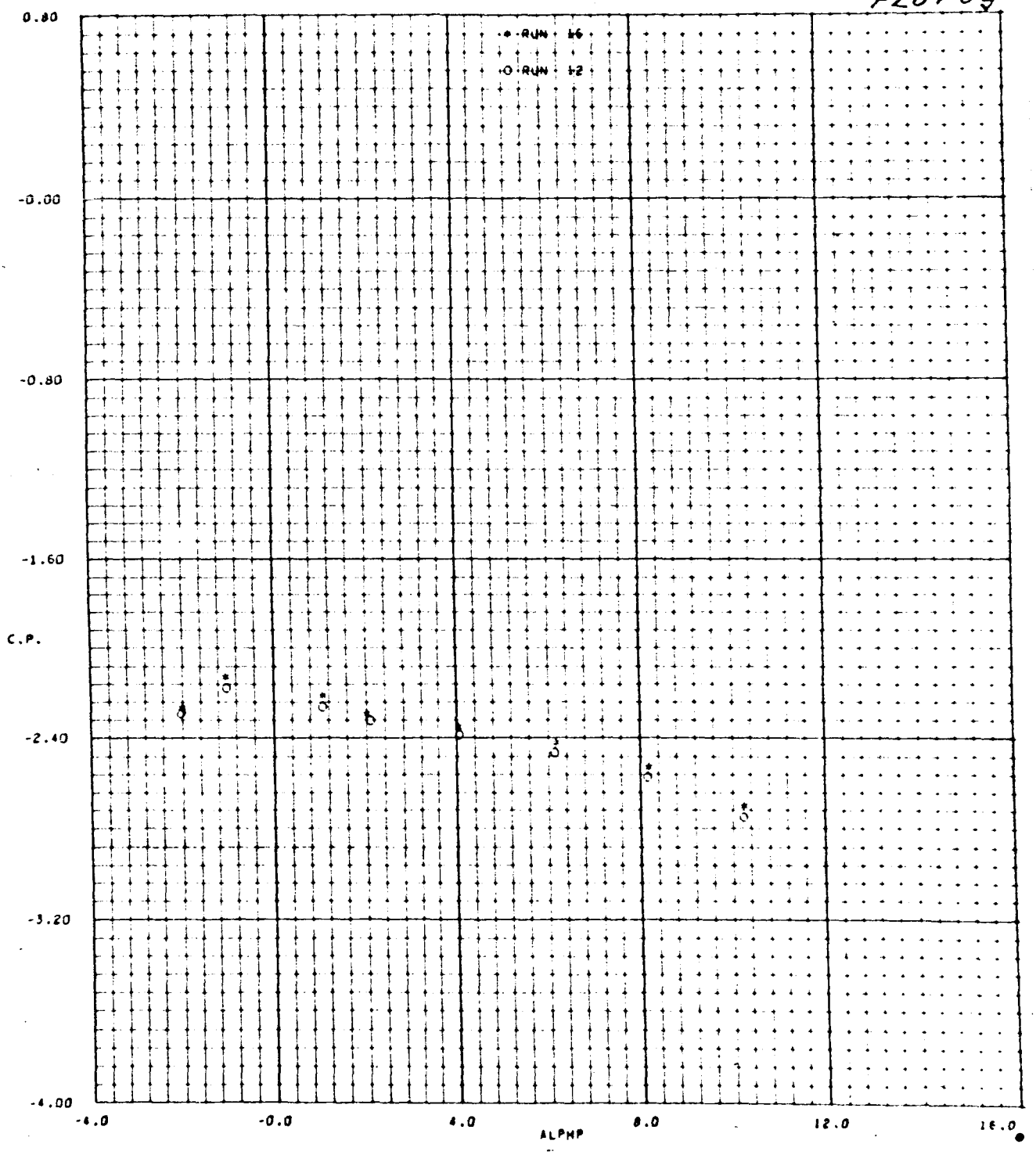
33

PLOT 54


RUN 16
RUN 12
0.40
-0.00
-0.40
-0.80
CX
-1.20
-1.60
-2.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

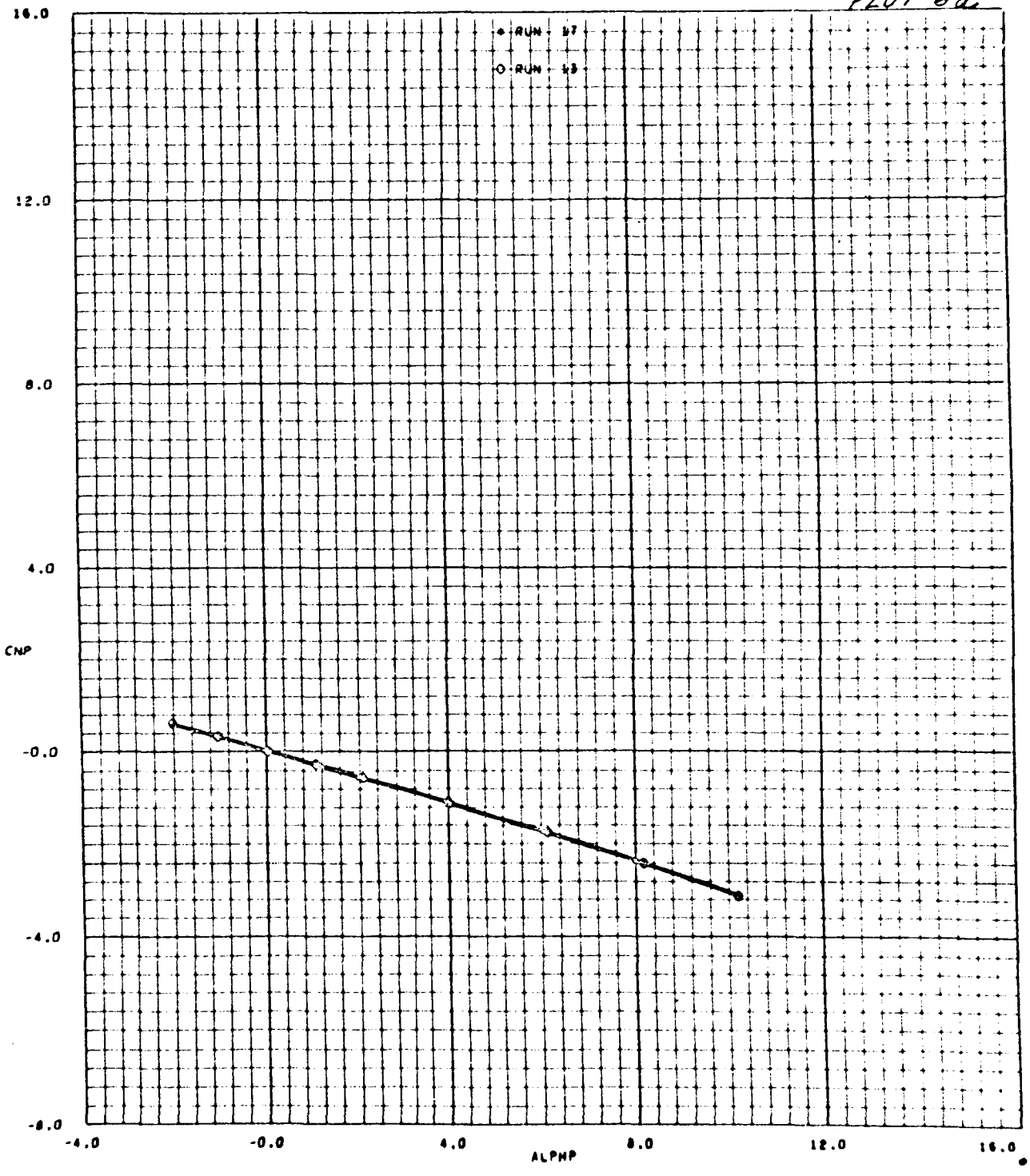
34

PLOT 59


• RUN 16
O RUN 12
0.80
-0.00
-0.80
-1.60
C.P.
-2.40
-3.20
-4.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

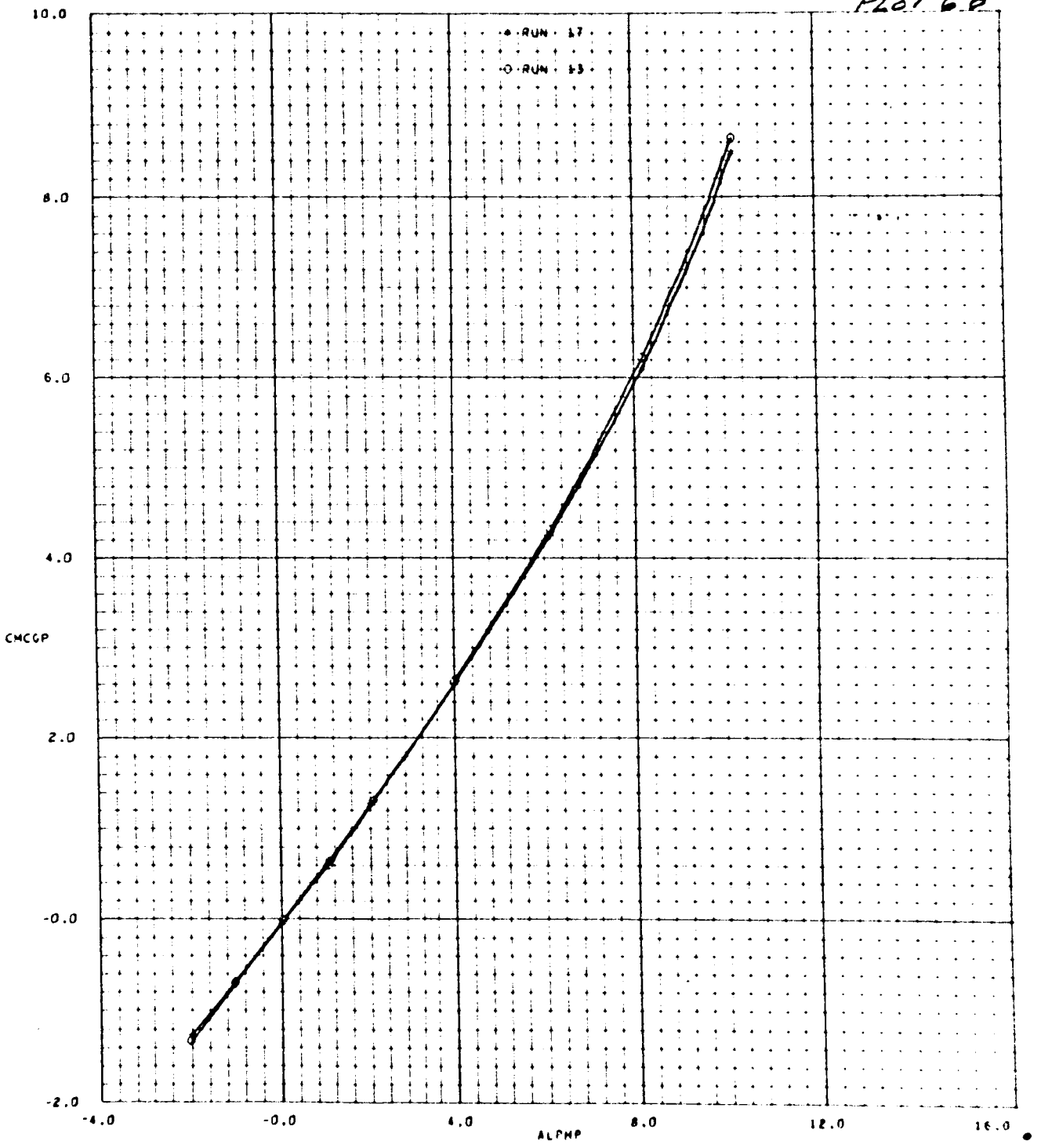
35

PLOT 6a

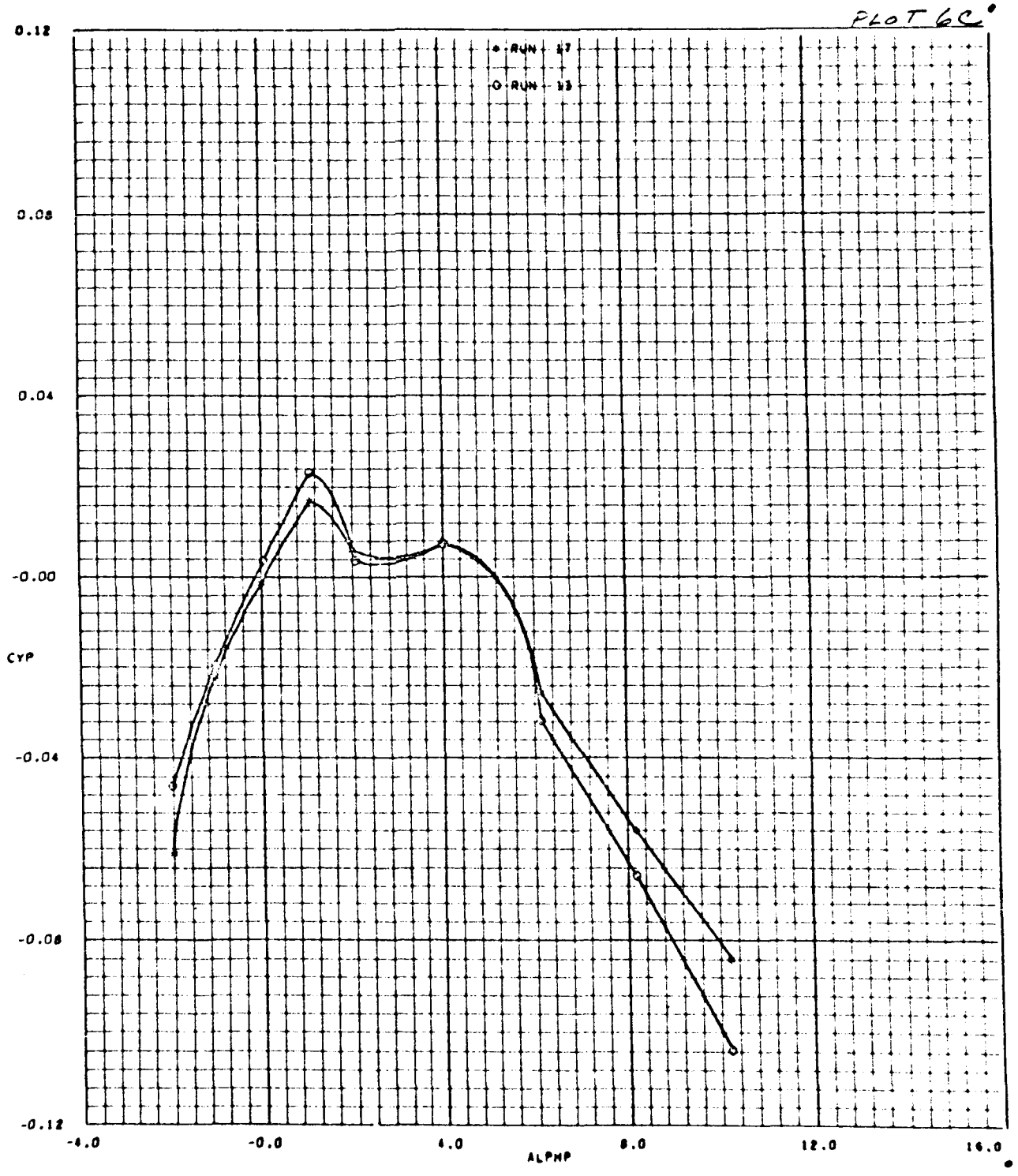


36

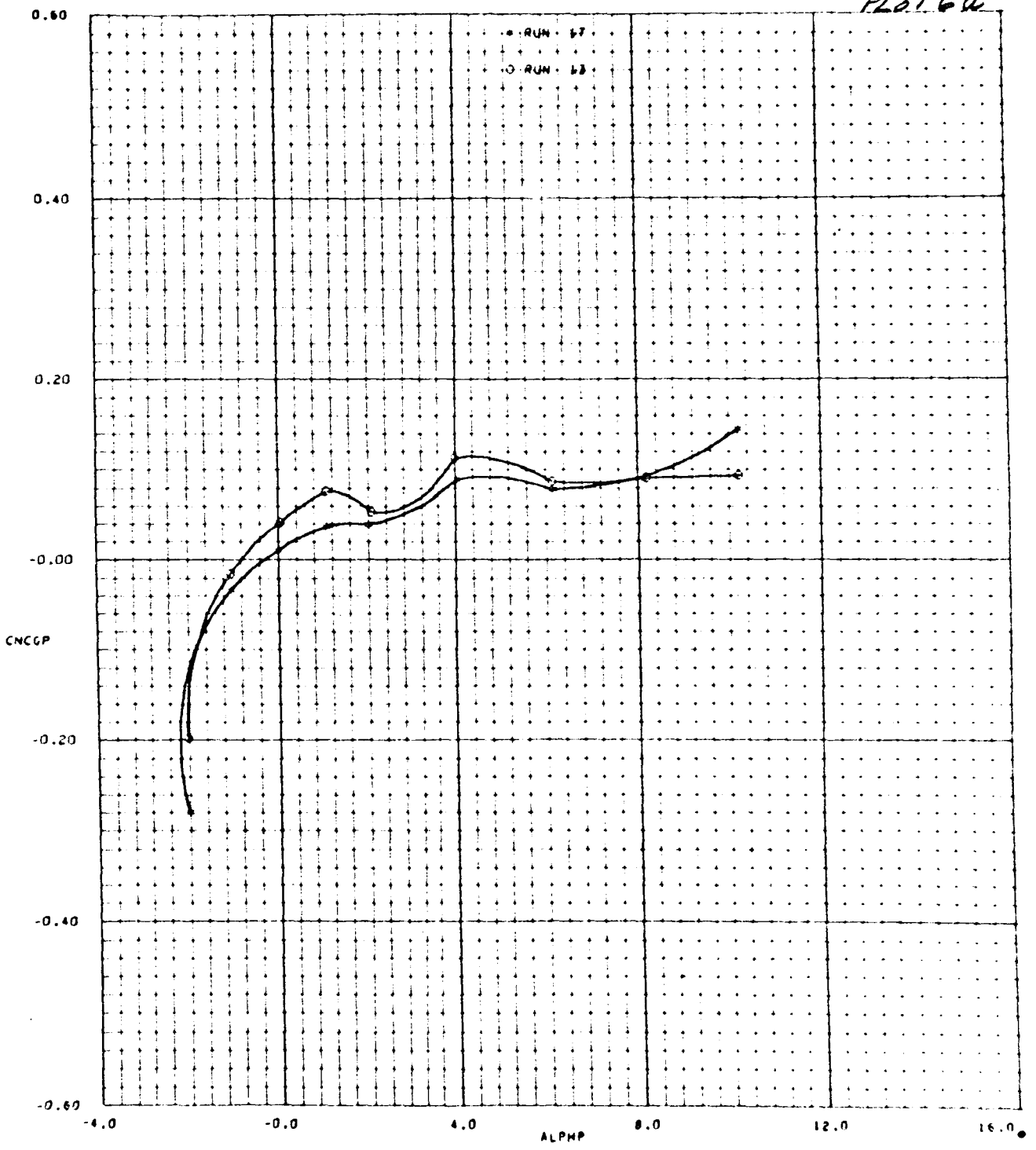
PLOT 66



37

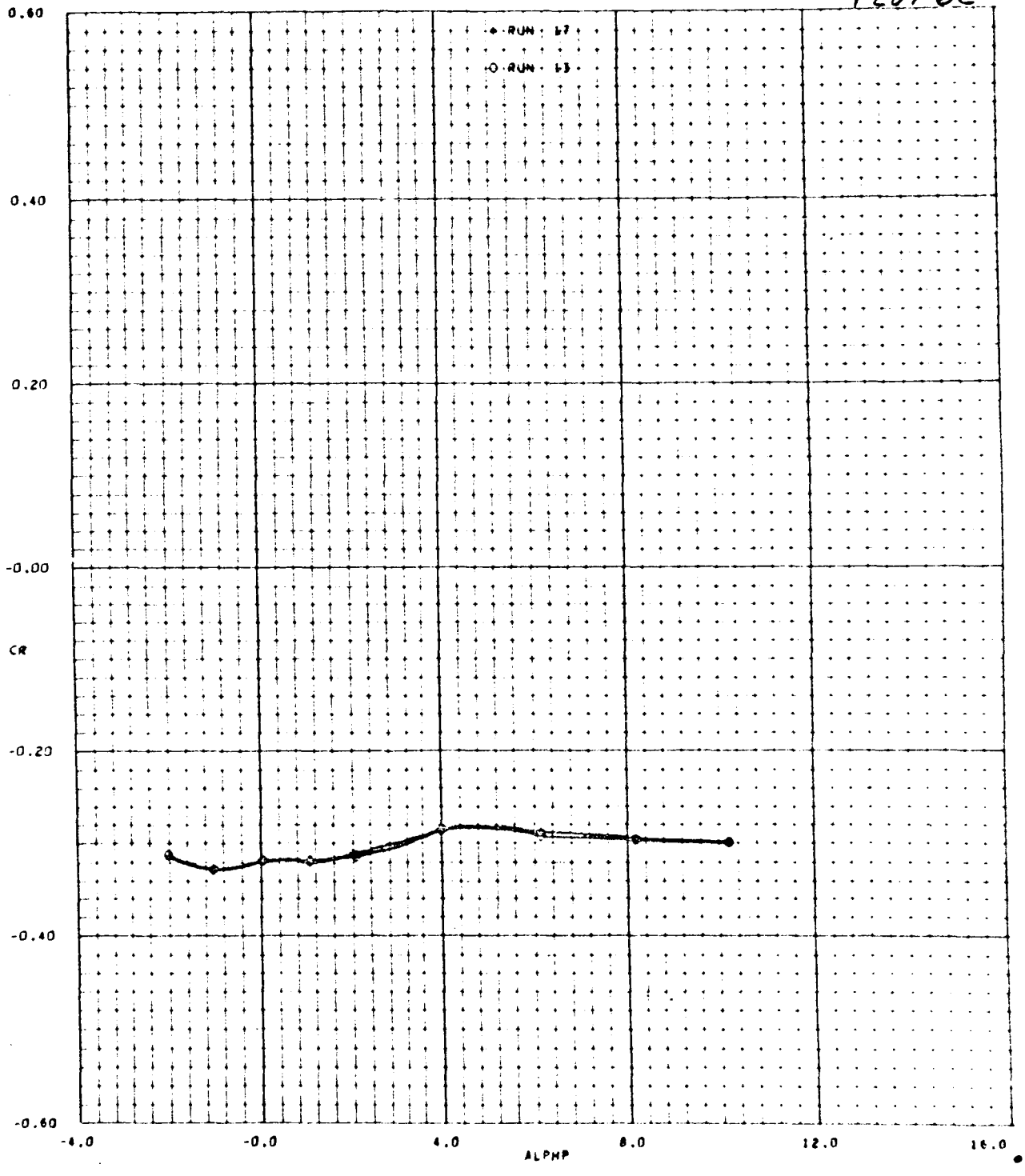

PLOT 6C
RUN 47
RUN 43
0.12
0.08
0.04
-0.00
CYP
-0.04
-0.08
-0.12
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

PLOT 6d

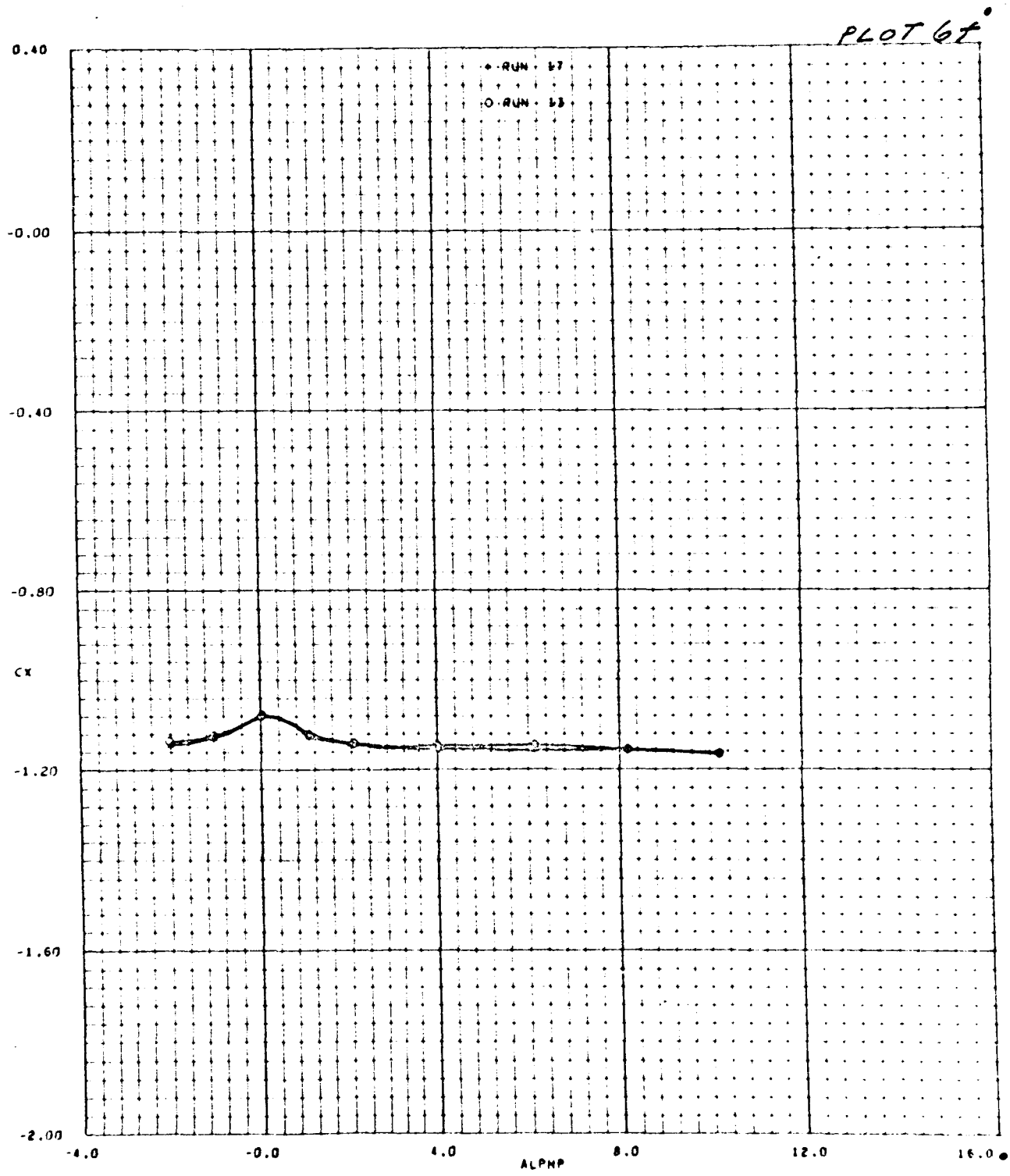

RUN 67
RUN 63
0.60
0.40
0.20
-0.00
-0.20
-0.40
-0.60
CNCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

39

Plot 6e

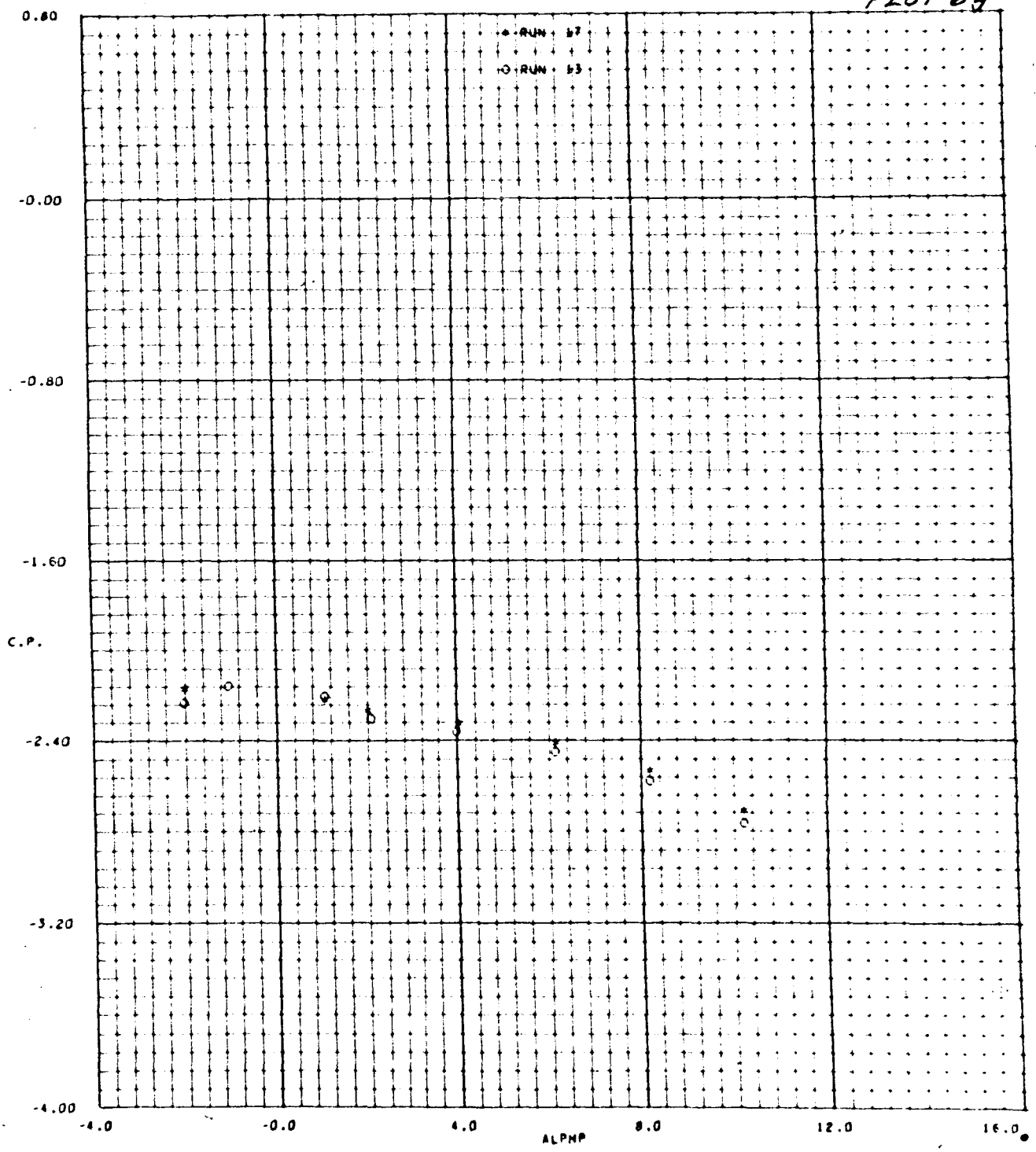

RUN 67
RUN 63
0.60
0.40
0.20
-0.00
CR
-0.20
-0.40
-0.60
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

40

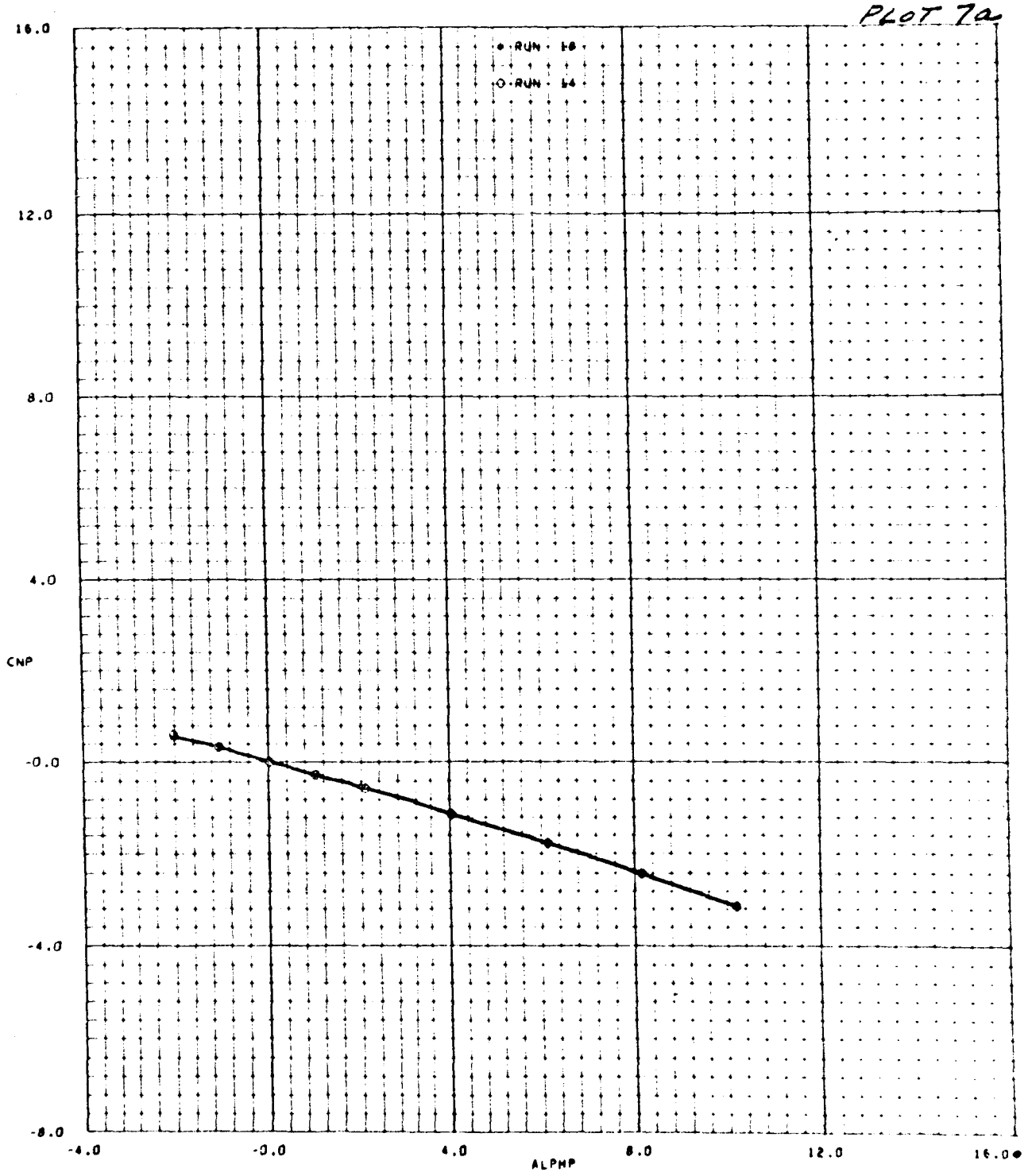

PLOT 61
+ RUN 67
O RUN 63
0.40
-0.00
-0.40
-0.80
CX
-1.20
-1.60
-2.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

41

PLOT 69

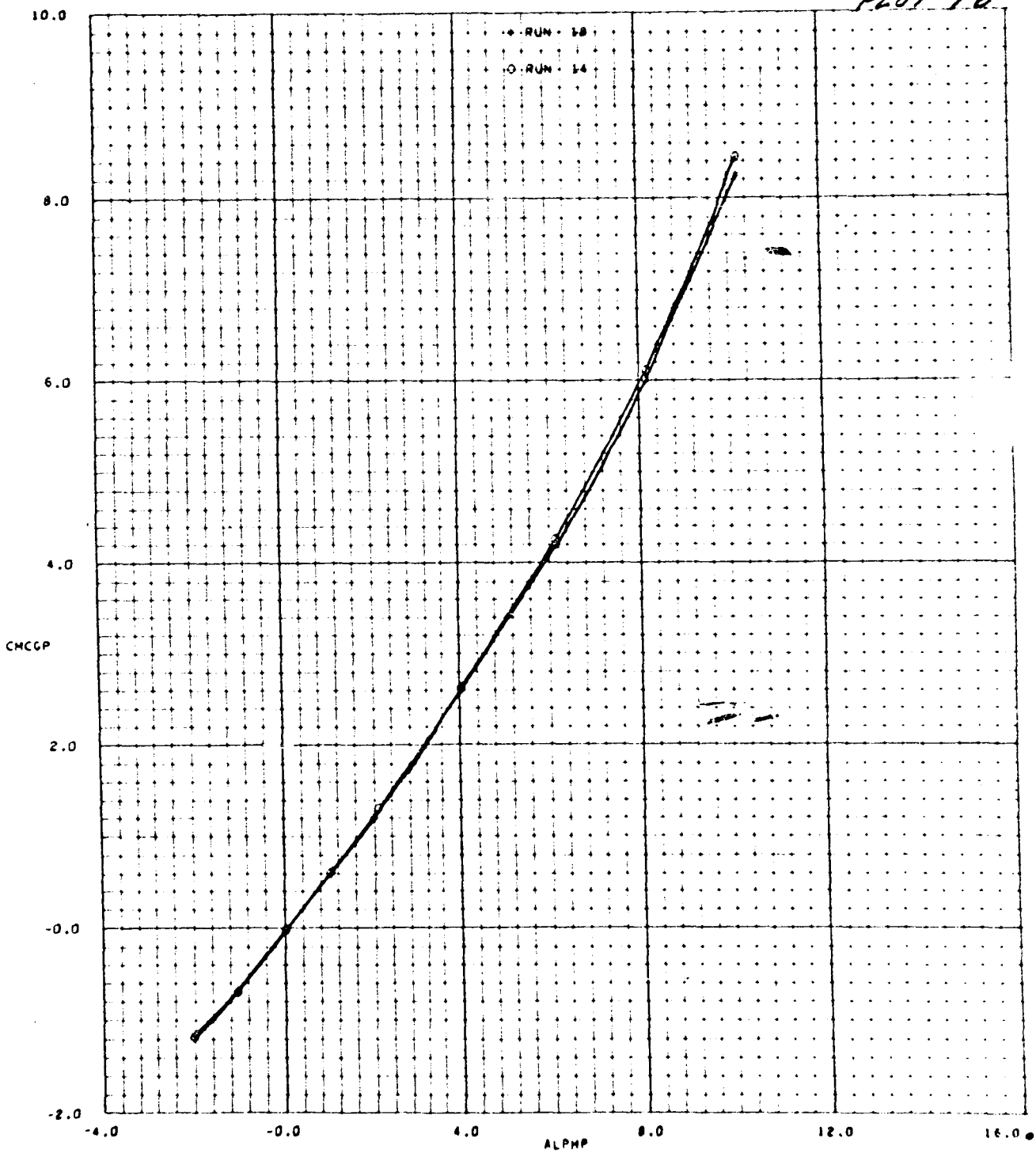

RUN 67
RUN 63
0.80
-0.00
-0.80
-1.60
C.P.
-2.40
-3.20
-4.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

PLOT 7a

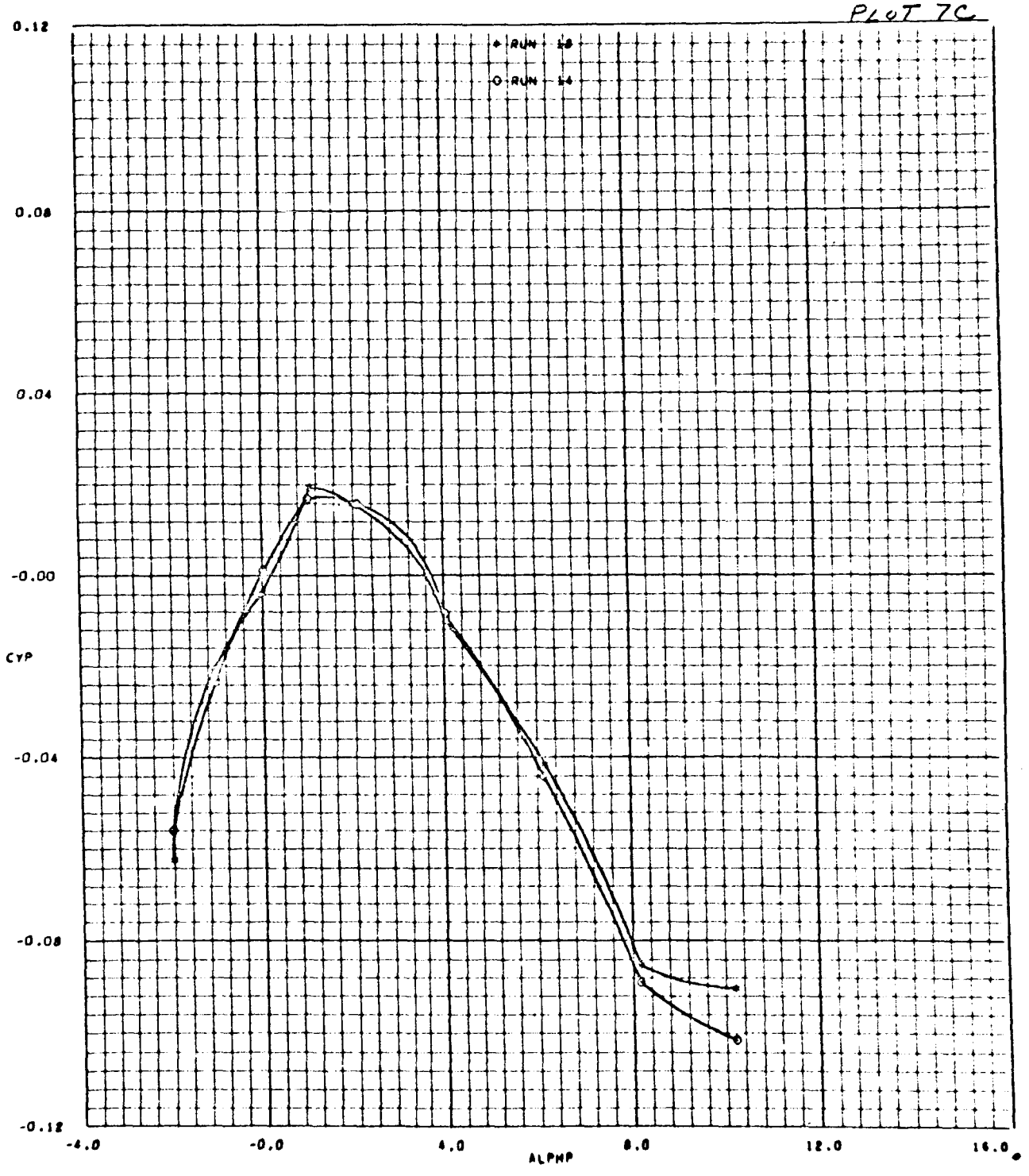


43

PLOT 76

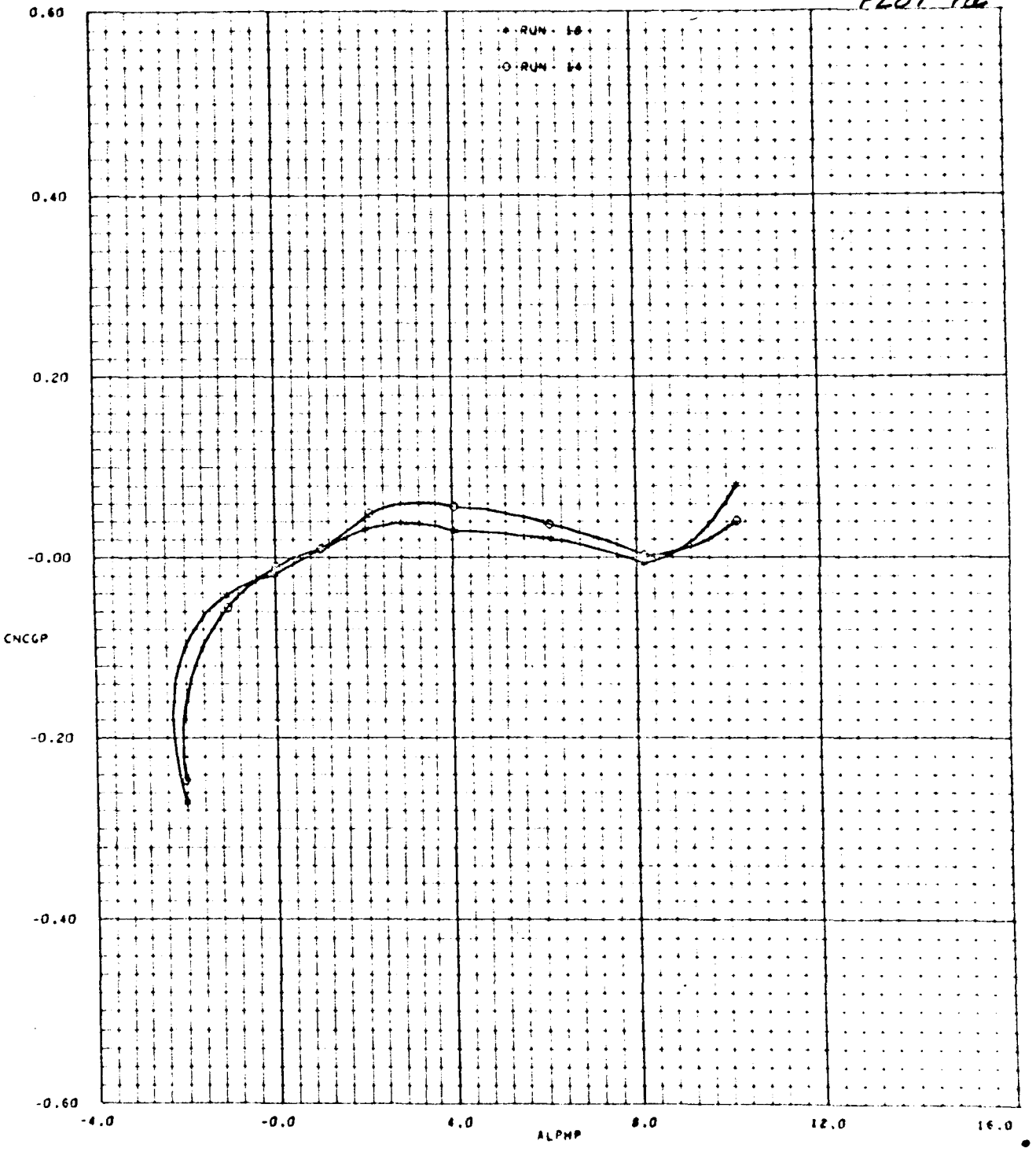

+ RUN - 18
O RUN - 14
10.0
8.0
6.0
4.0
2.0
-0.0
-2.0
CMCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

PLOT 7C


+ RUN 13
O RUN 14
0.12
0.08
0.04
-0.00
CYP
-0.04
-0.08
-0.12
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

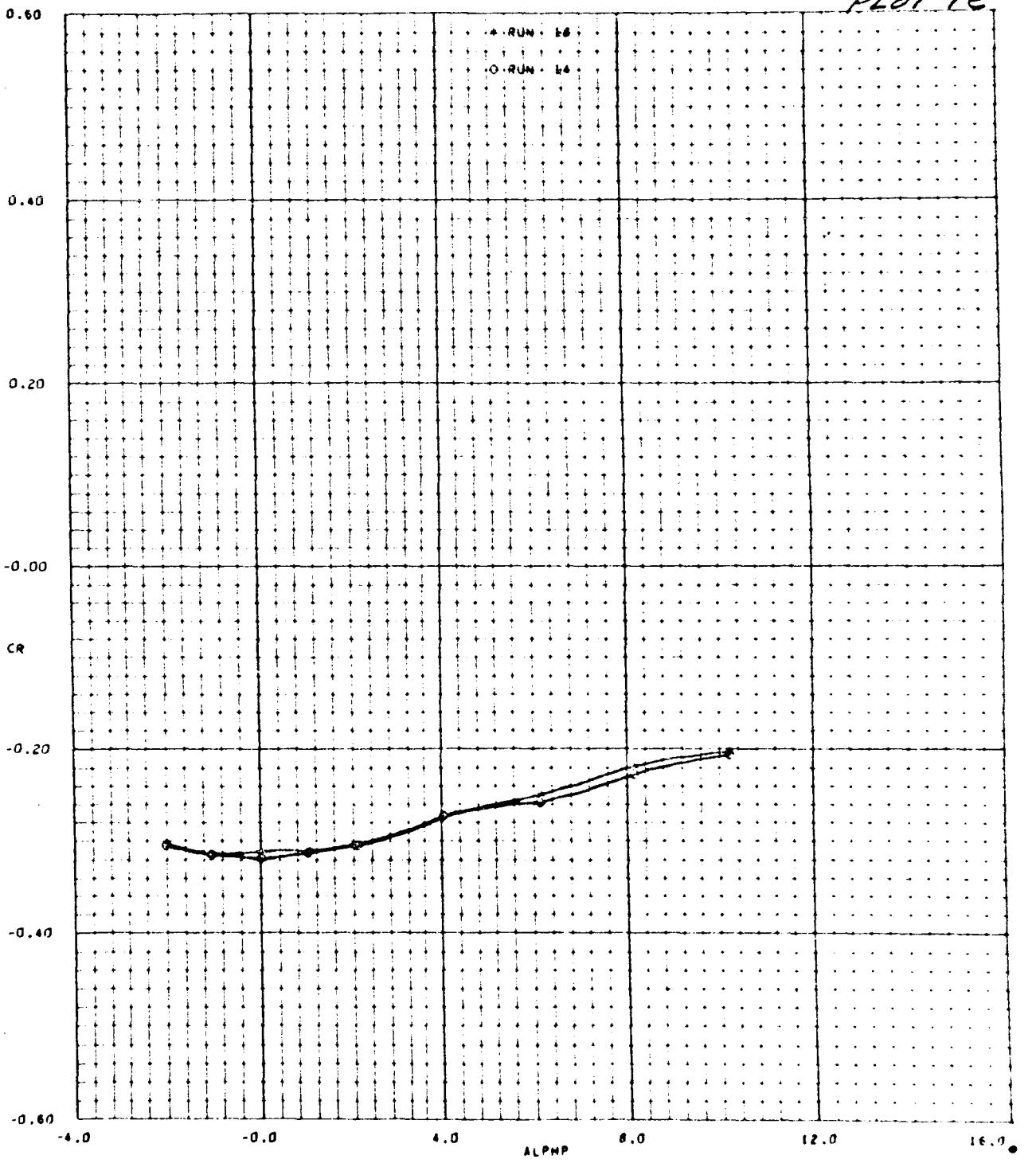
45

PLOT 7d


RUN - 16
RUN - 14
0.60
0.40
0.20
-0.00
-0.20
-0.40
-0.60
CNCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

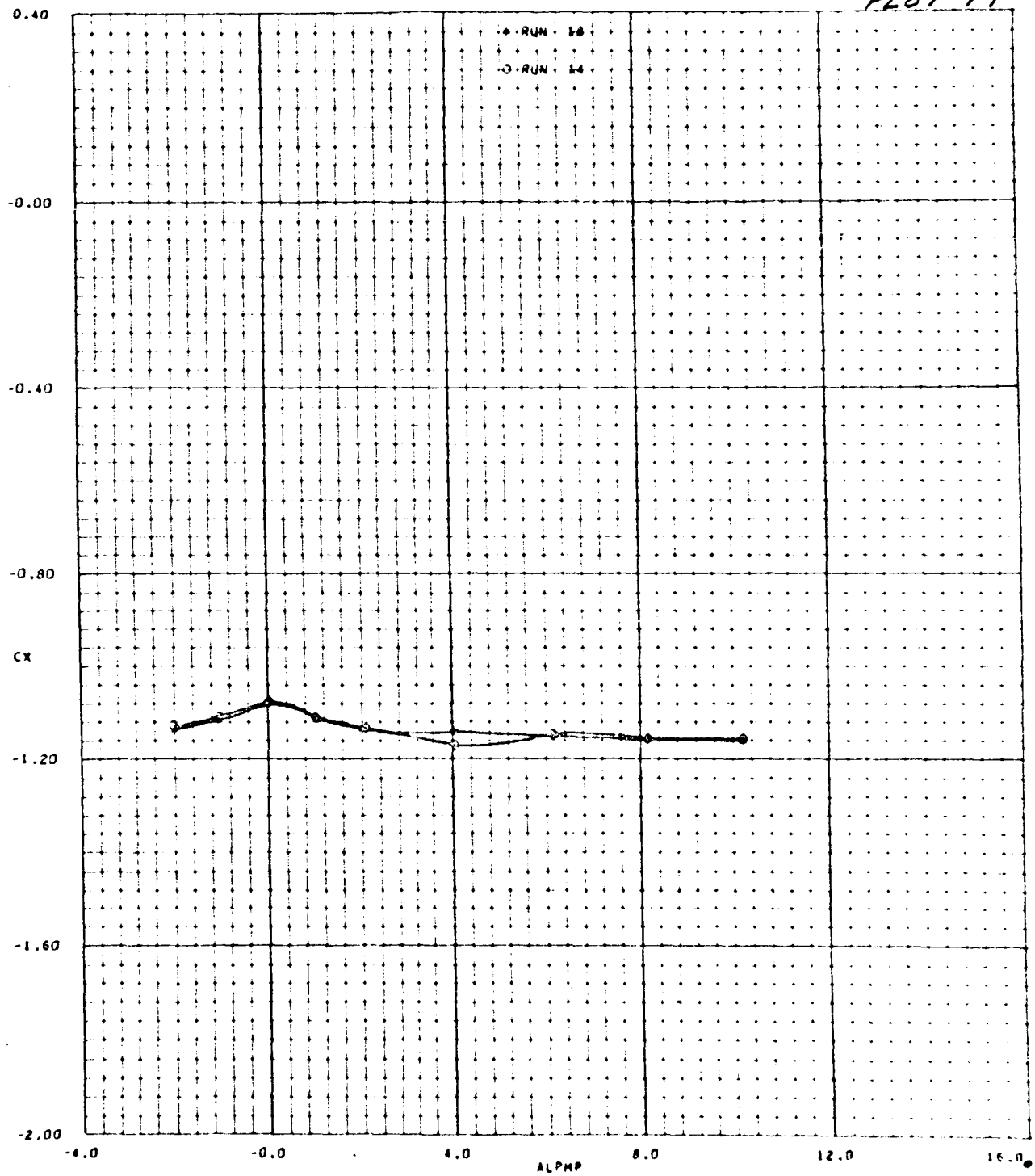
46

PLOT 7e



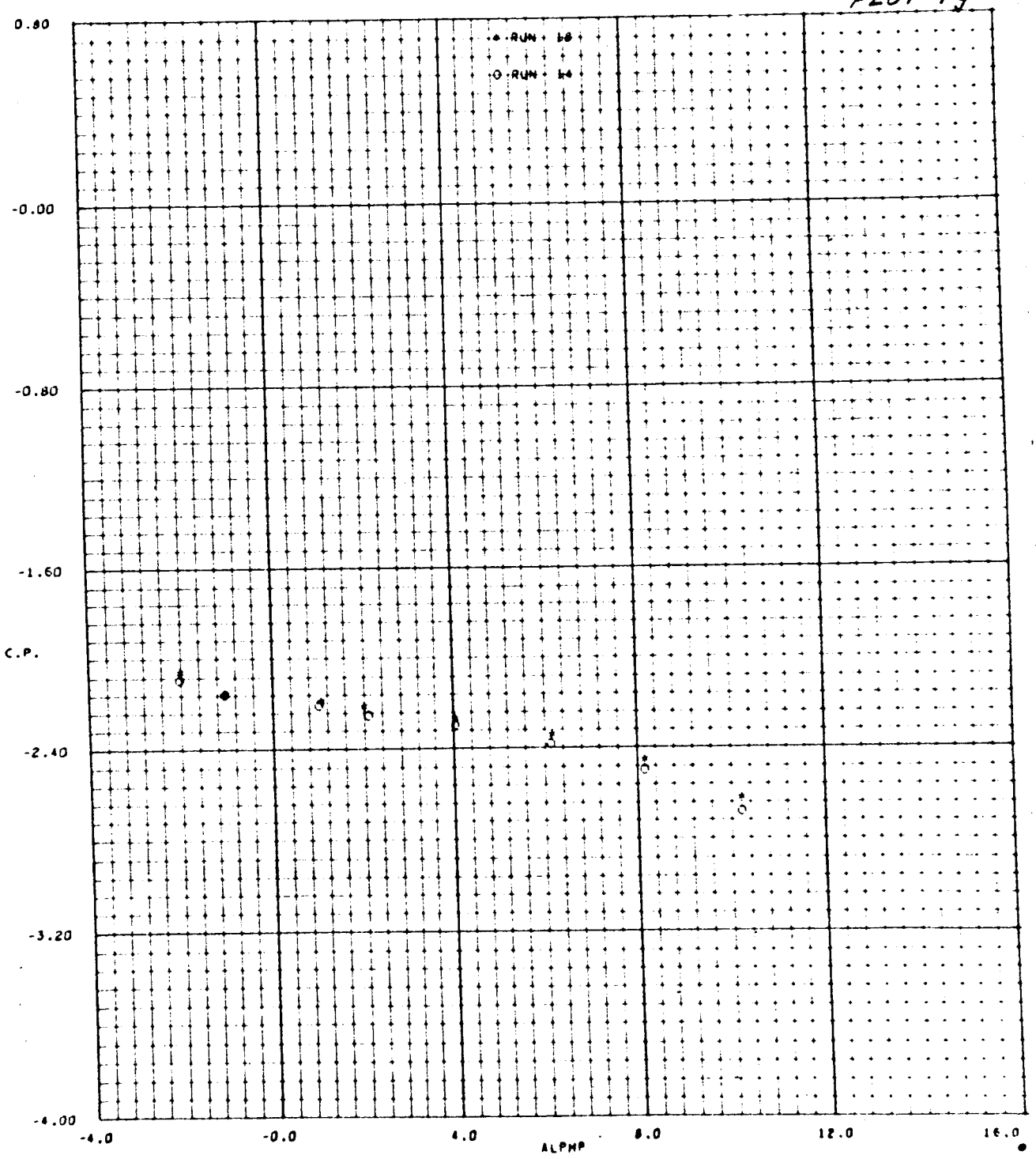
47

PLOT 7f


0.40
-0.00
-0.40
-0.80
CX
-1.20
-1.60
-2.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
• RUN 14
O RUN 14

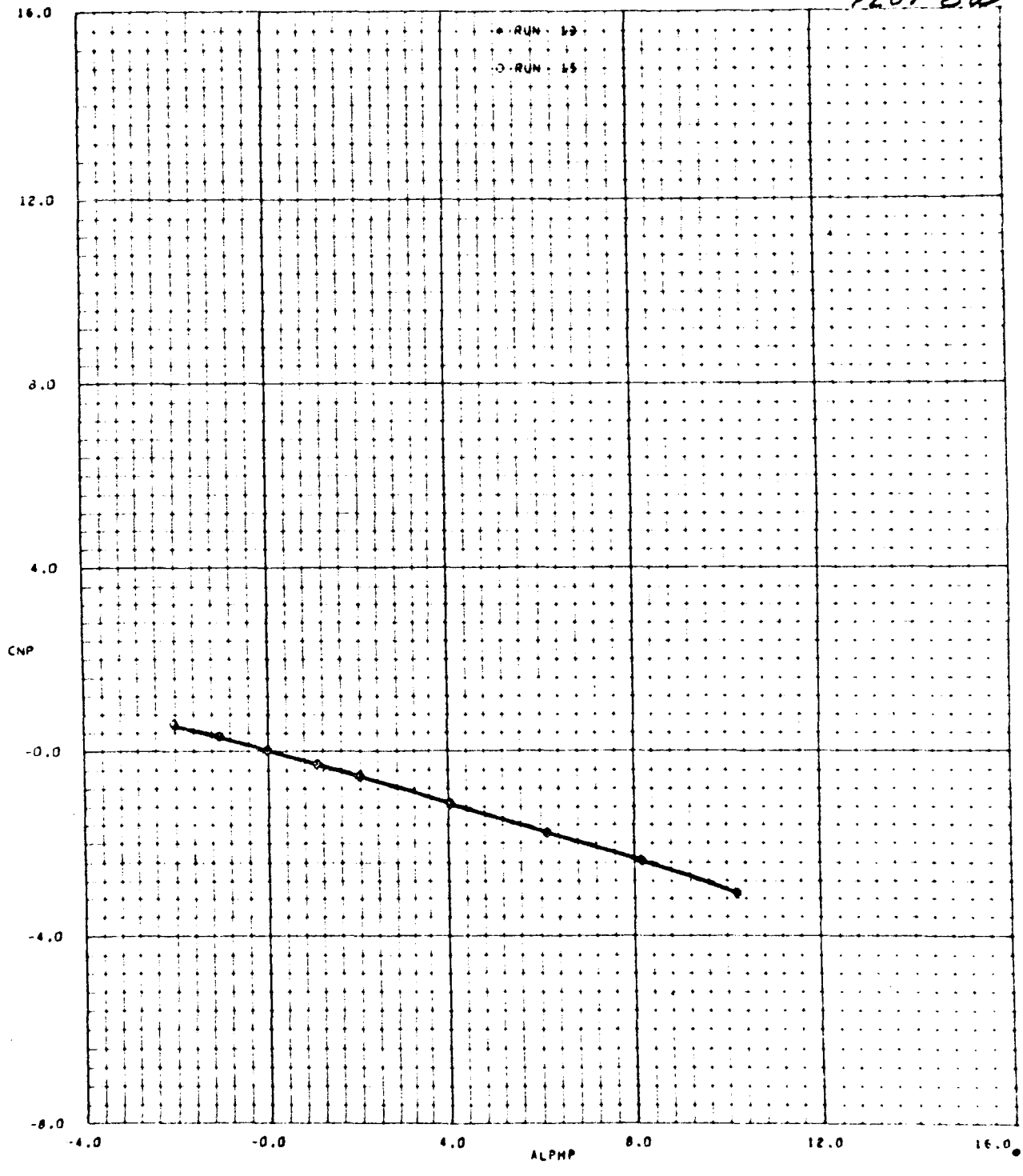
48

PLOT 79


0.80
-0.00
-0.80
-1.60
C.P.
-2.40
-3.20
-4.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
RUN 68
RUN 64

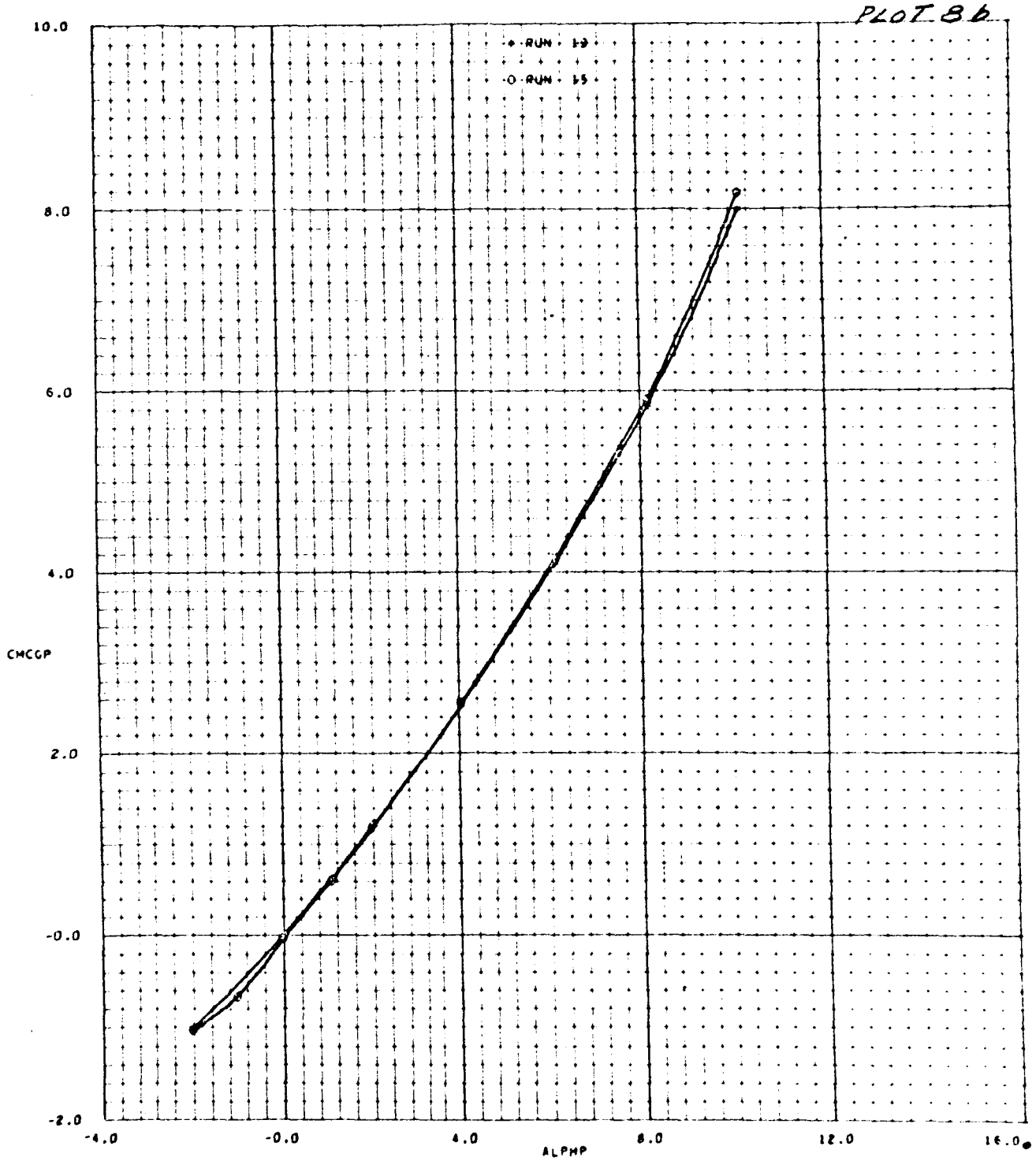
49

PLOT 8a

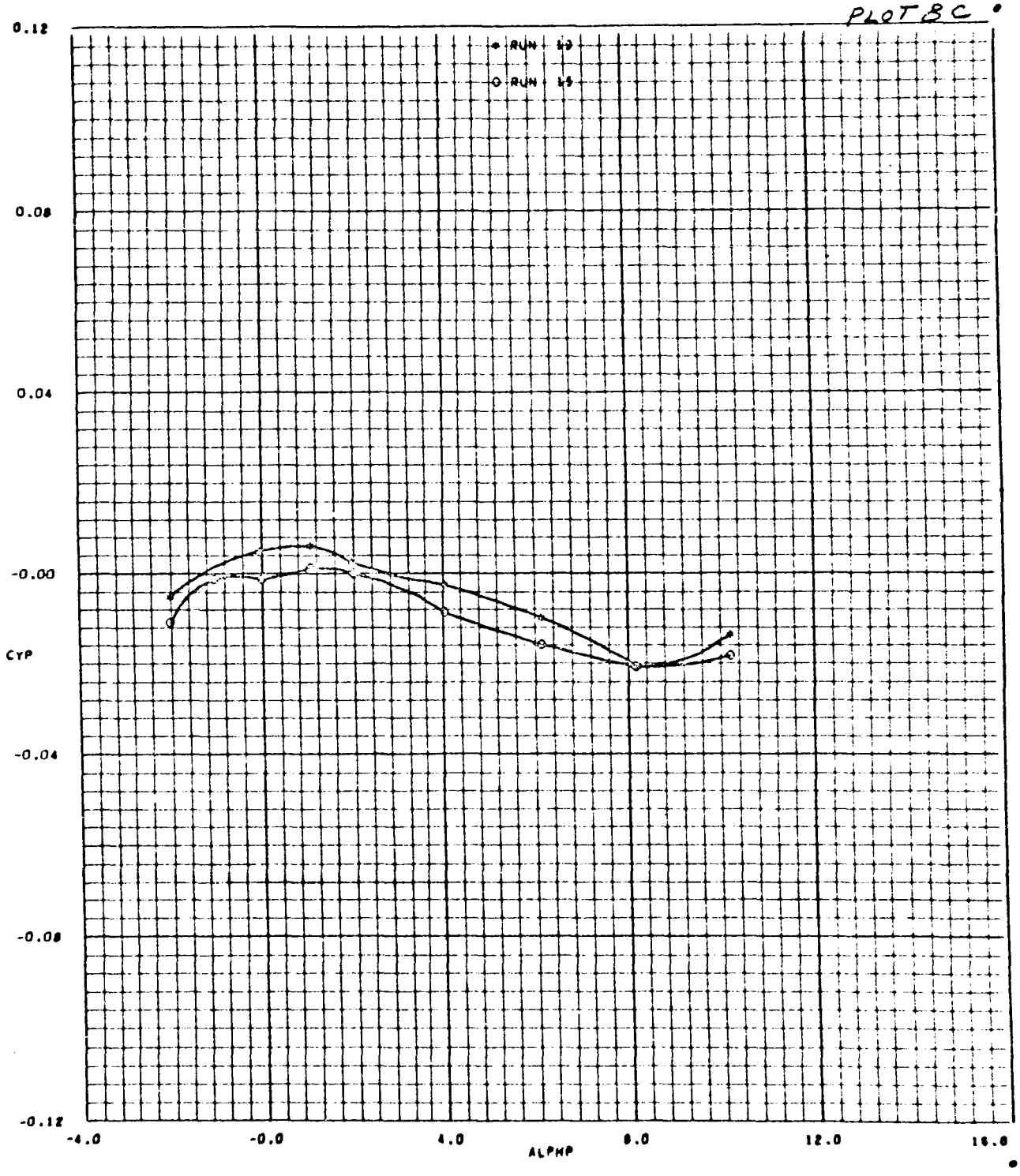


50

PLOT 8b

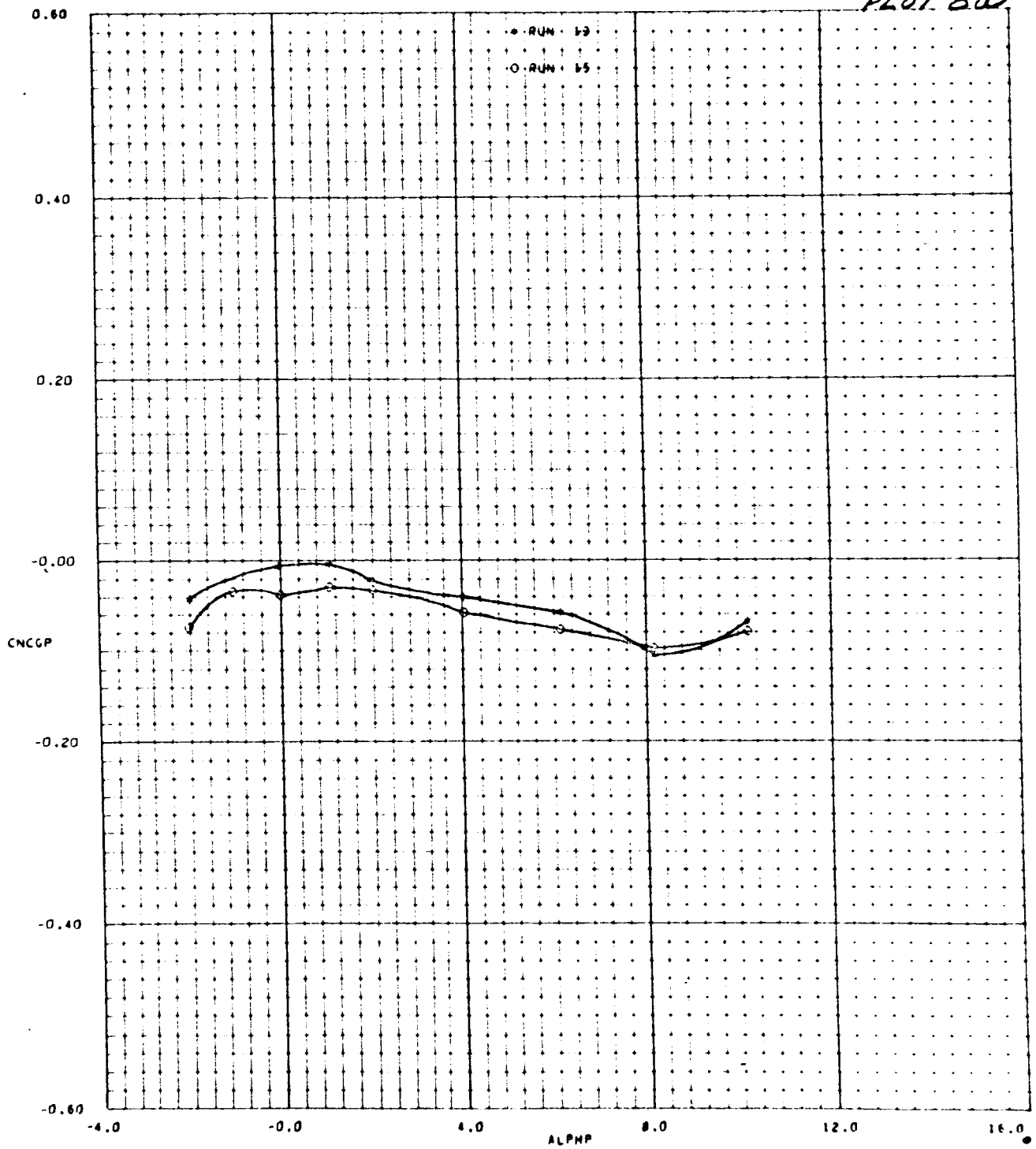

+ RUN 14
O RUN 15
10.0
8.0
6.0
4.0
2.0
-0.0
-2.0
CMCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

51


PLOT 3C
RUN 49
RUN 45
0.12
0.08
0.04
-0.00
CYP
-0.04
-0.08
-0.12
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

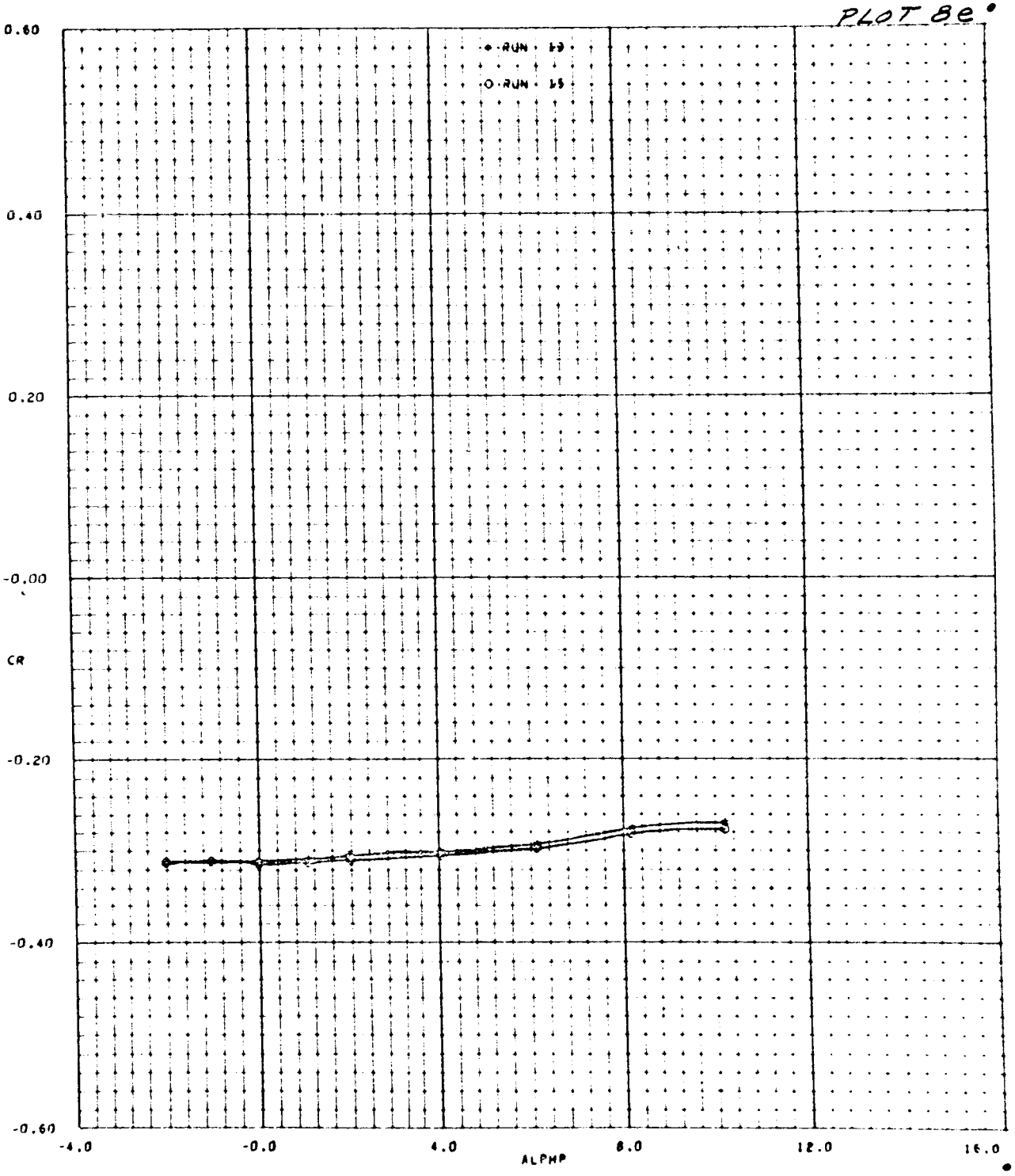
52

PLOT 8d


RUN 63
RUN 65
0.60
0.40
0.20
-0.00
-0.20
-0.40
-0.60
CNCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

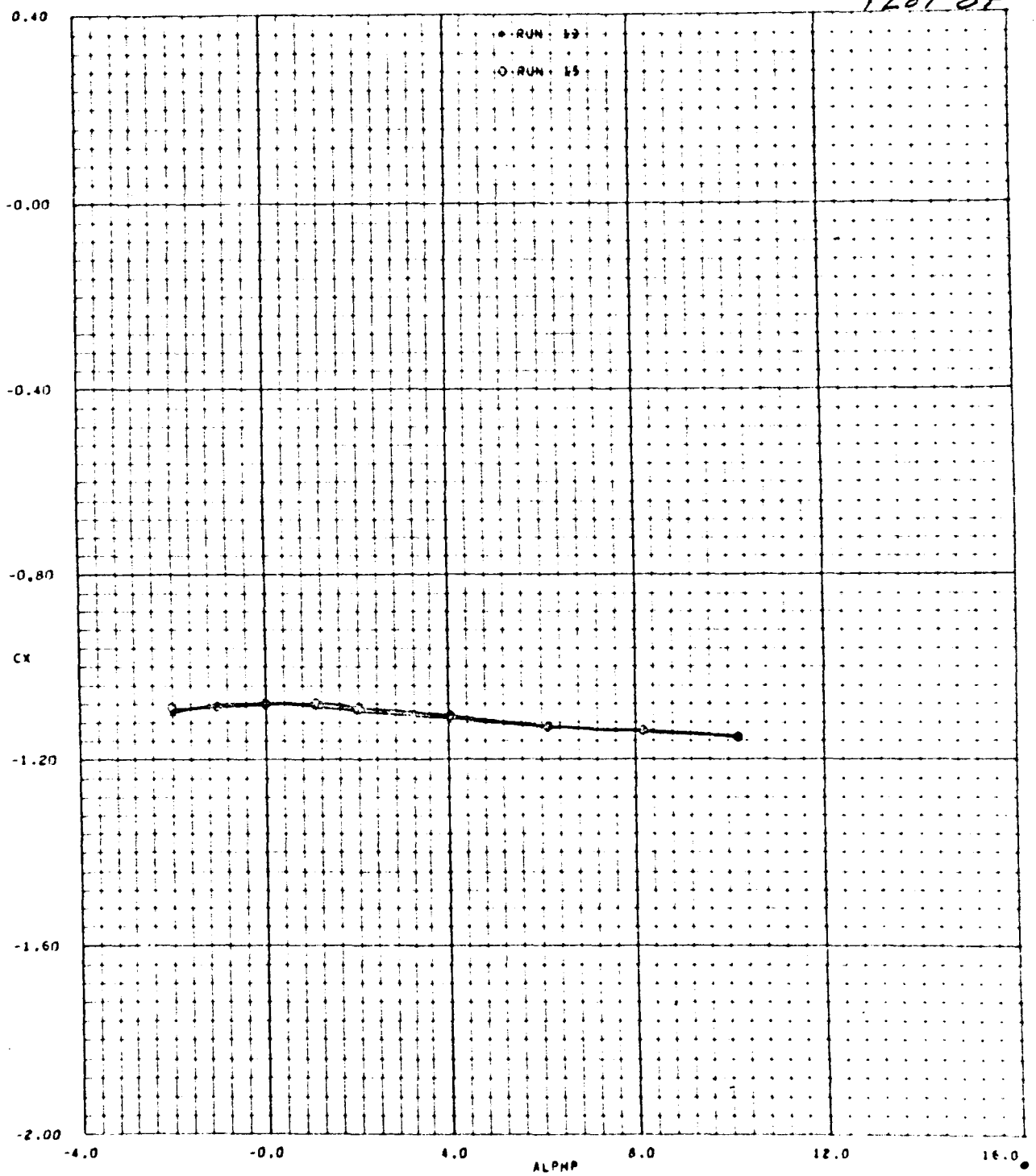
53

PLOT 8e


0.60
0.40
0.20
-0.00
CR
-0.20
-0.40
-0.60
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
• RUN 69
O RUN 65

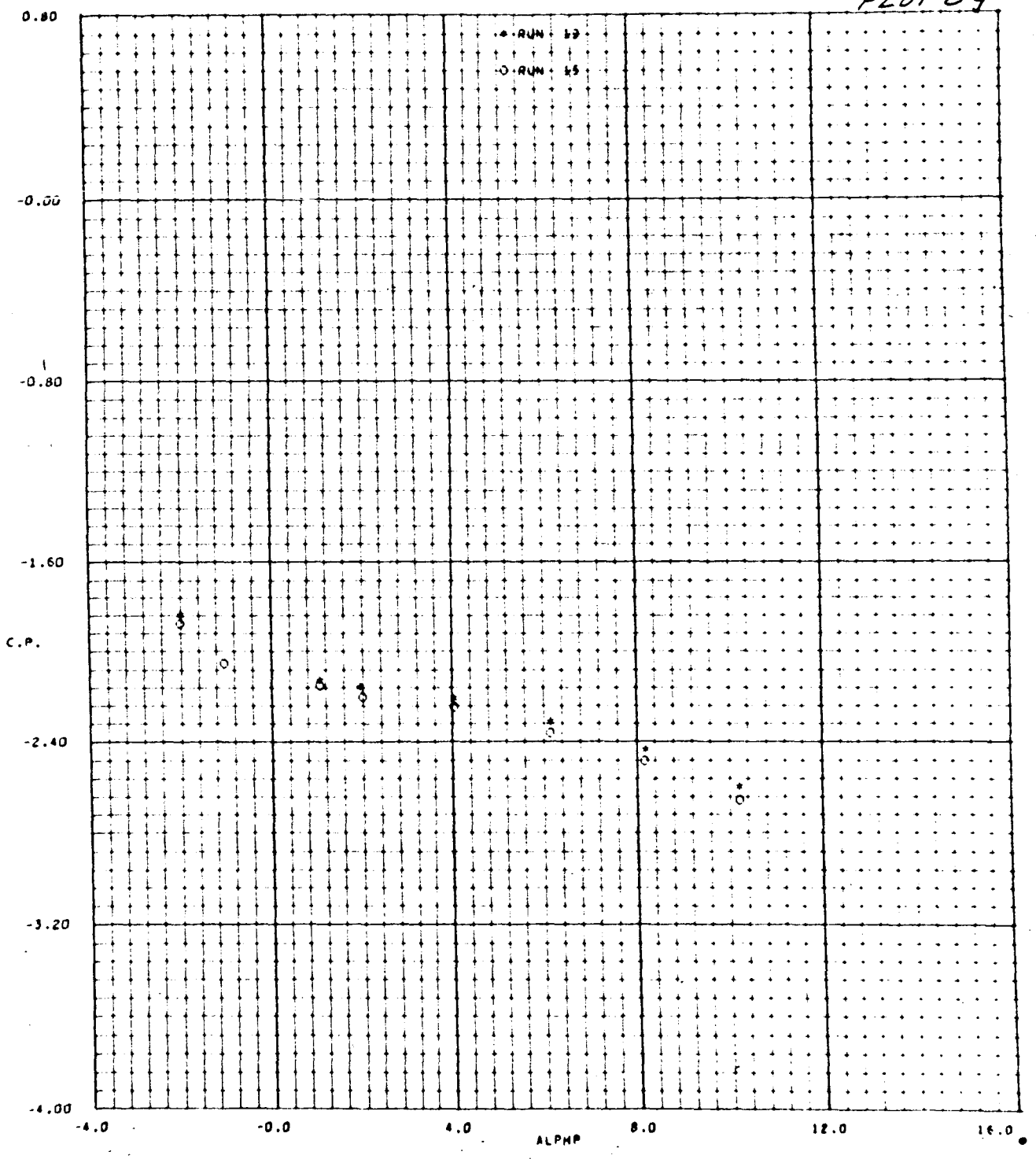
54

PLOT 8f


0.40
-0.00
-0.40
-0.80
CX
-1.20
-1.60
-2.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
• RUN 49
O RUN 45

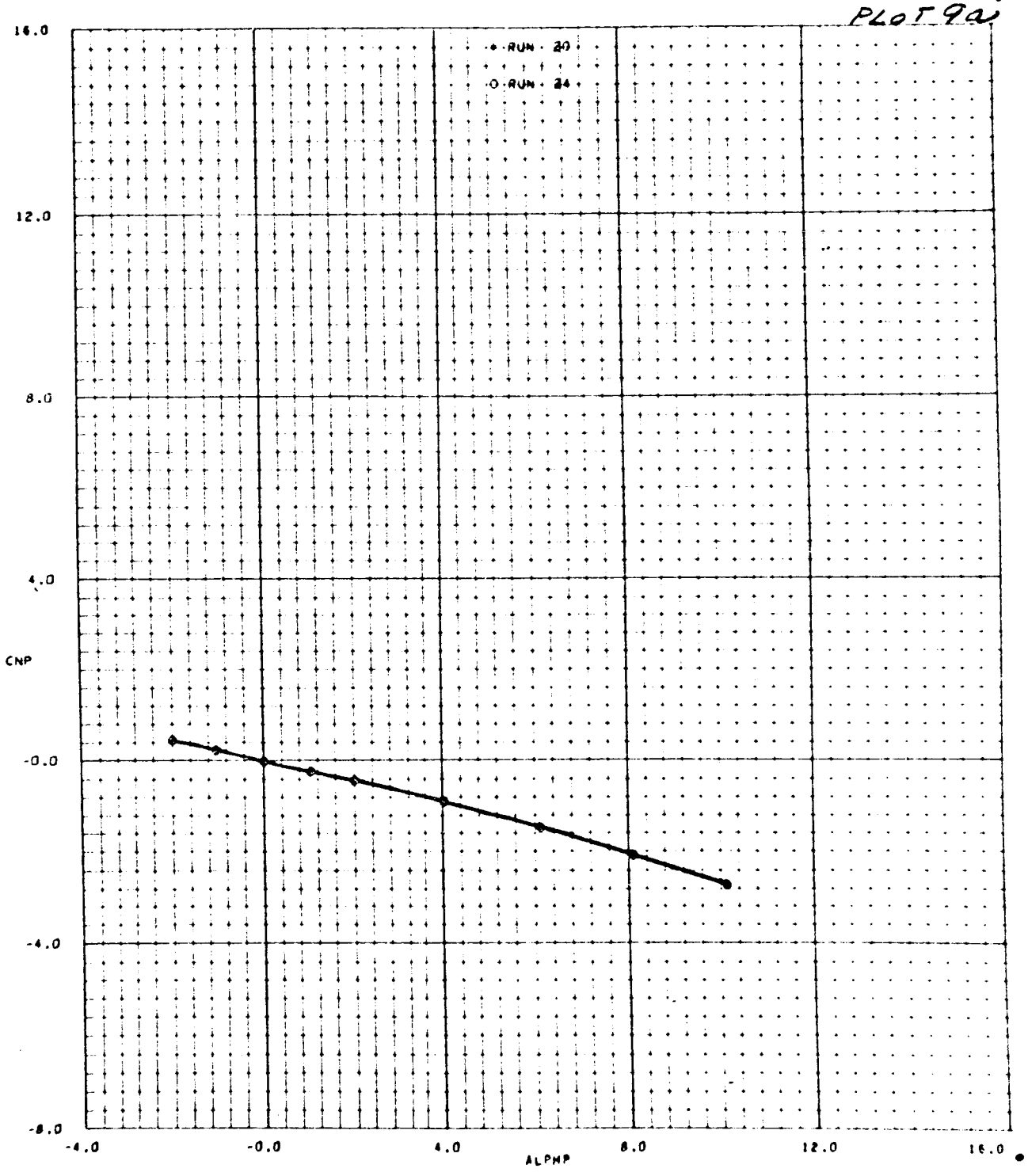
55

PLOT 89


RUN 43
RUN 45
0.80
-0.00
-0.80
-1.60
C.P.
-2.40
-3.20
-4.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

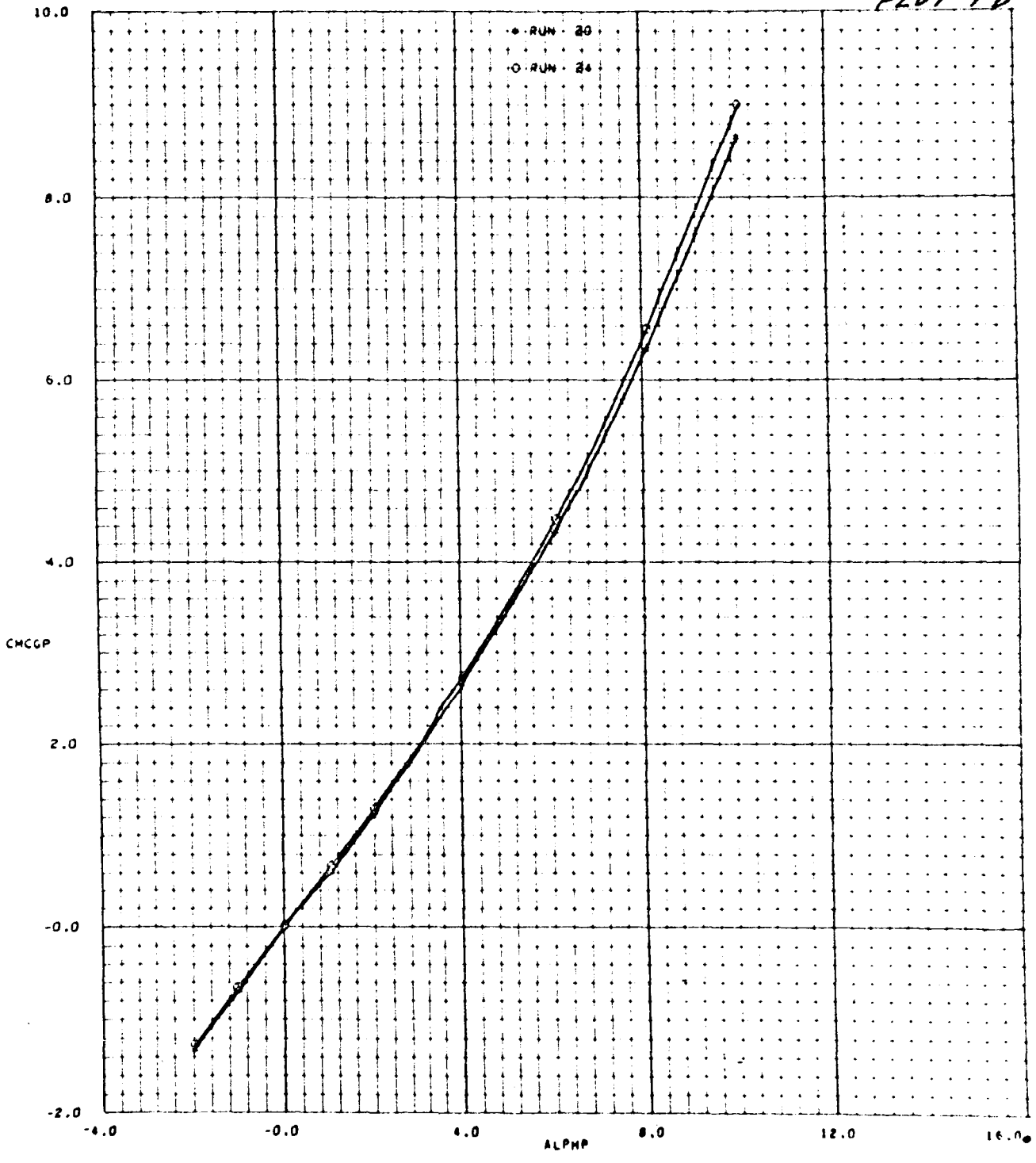
56

PLOT 9a



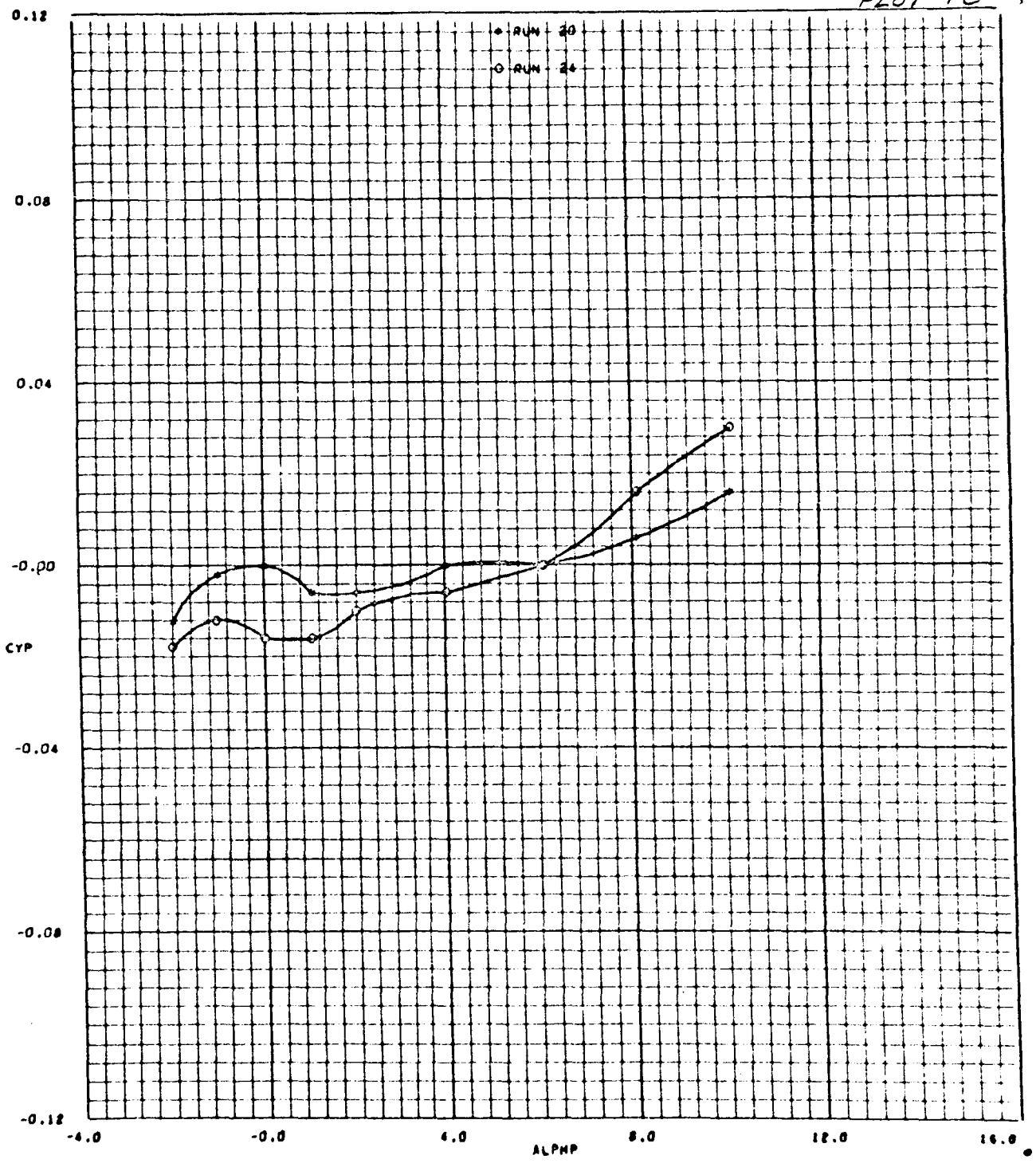
57

PLOT 9b


+ RUN 20
O RUN 24
10.0
8.0
6.0
4.0
2.0
-0.0
-2.0
CMCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

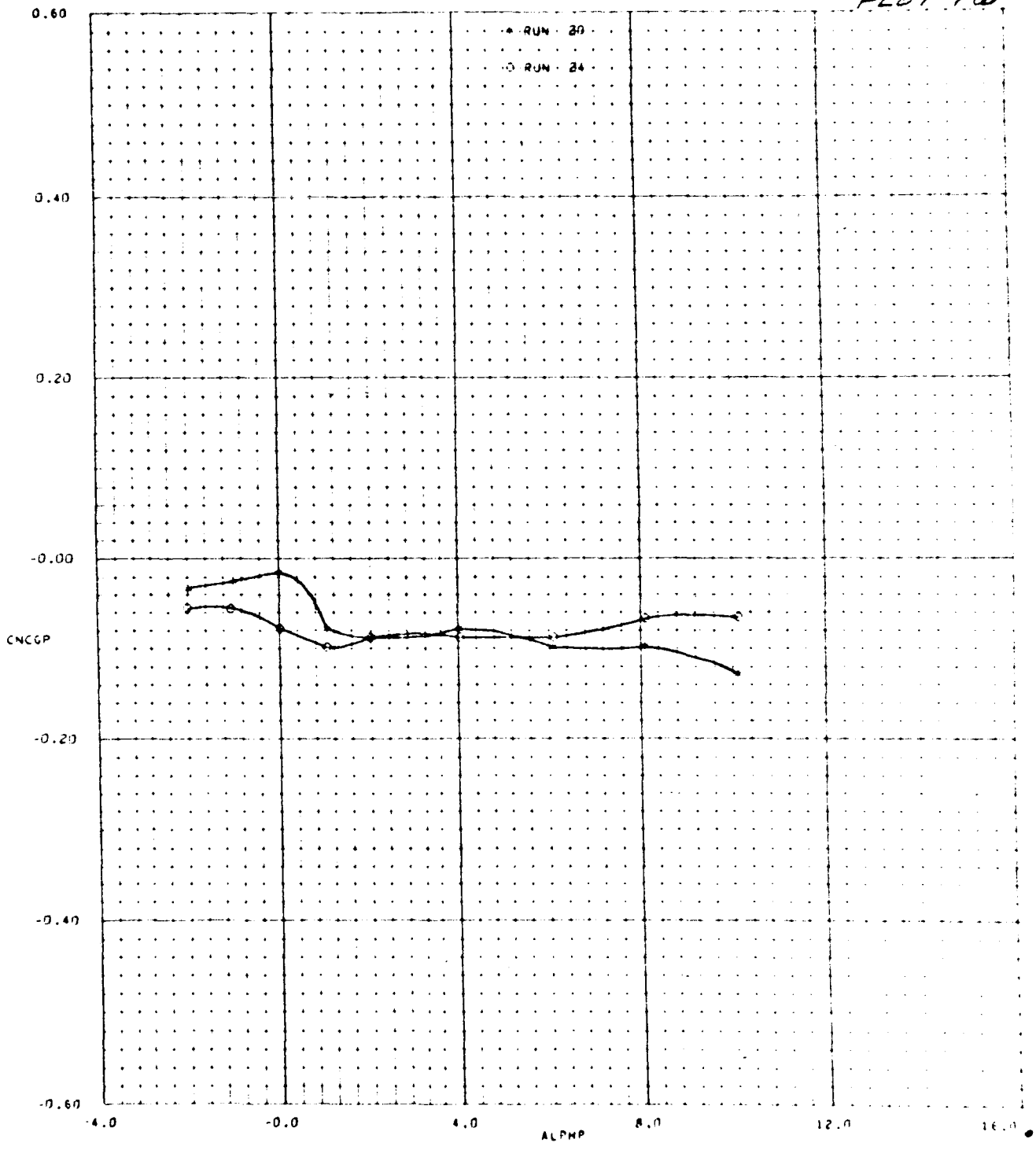
58

PLOT 9C


RUN 20
RUN 24
0.12
0.08
0.04
-0.00
CYP
-0.04
-0.08
-0.12
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

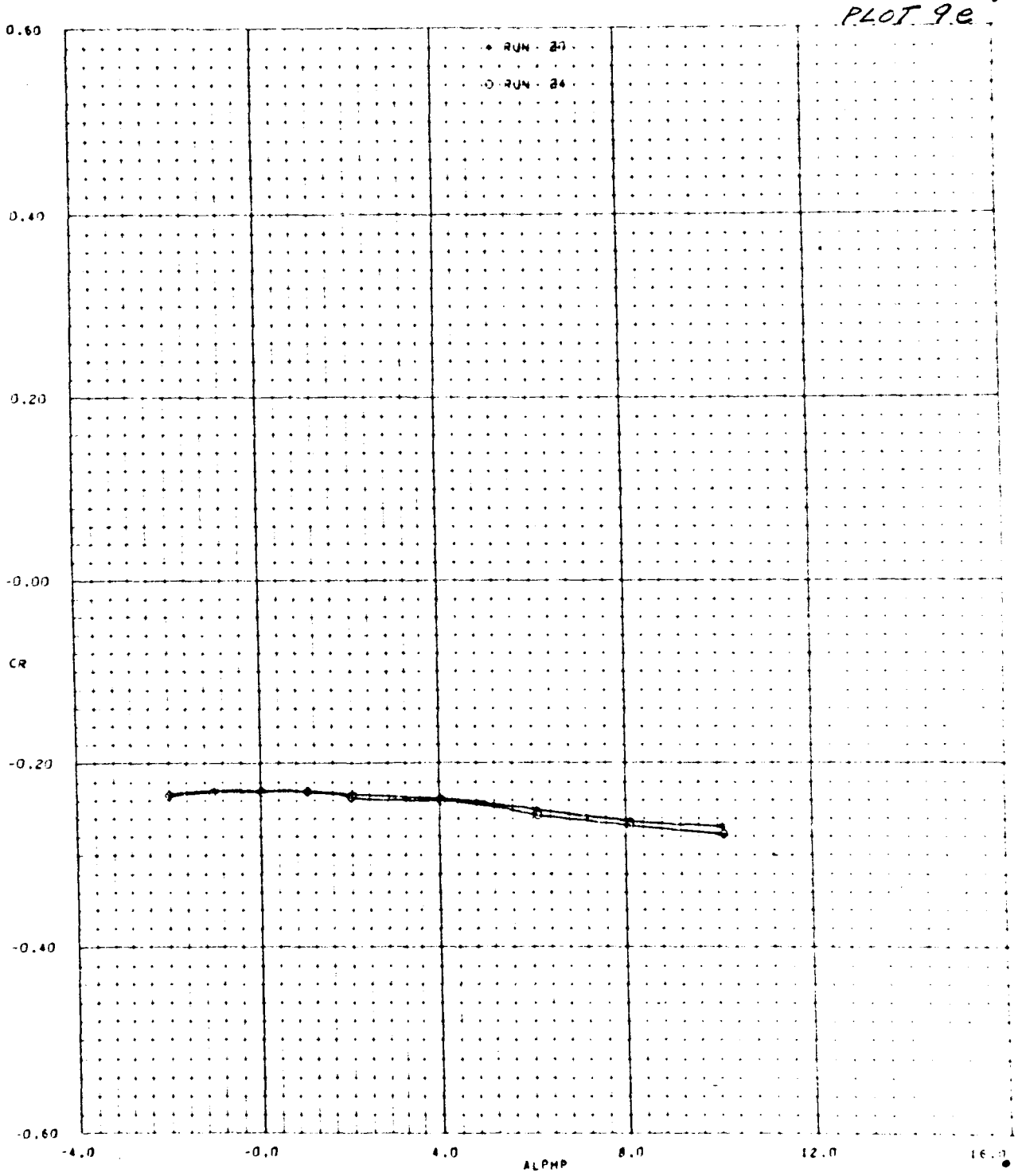
59

PLOT 9d


RUN 30
RUN 34
0.60
0.40
0.20
-0.00
-0.20
-0.40
-0.60
CNCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

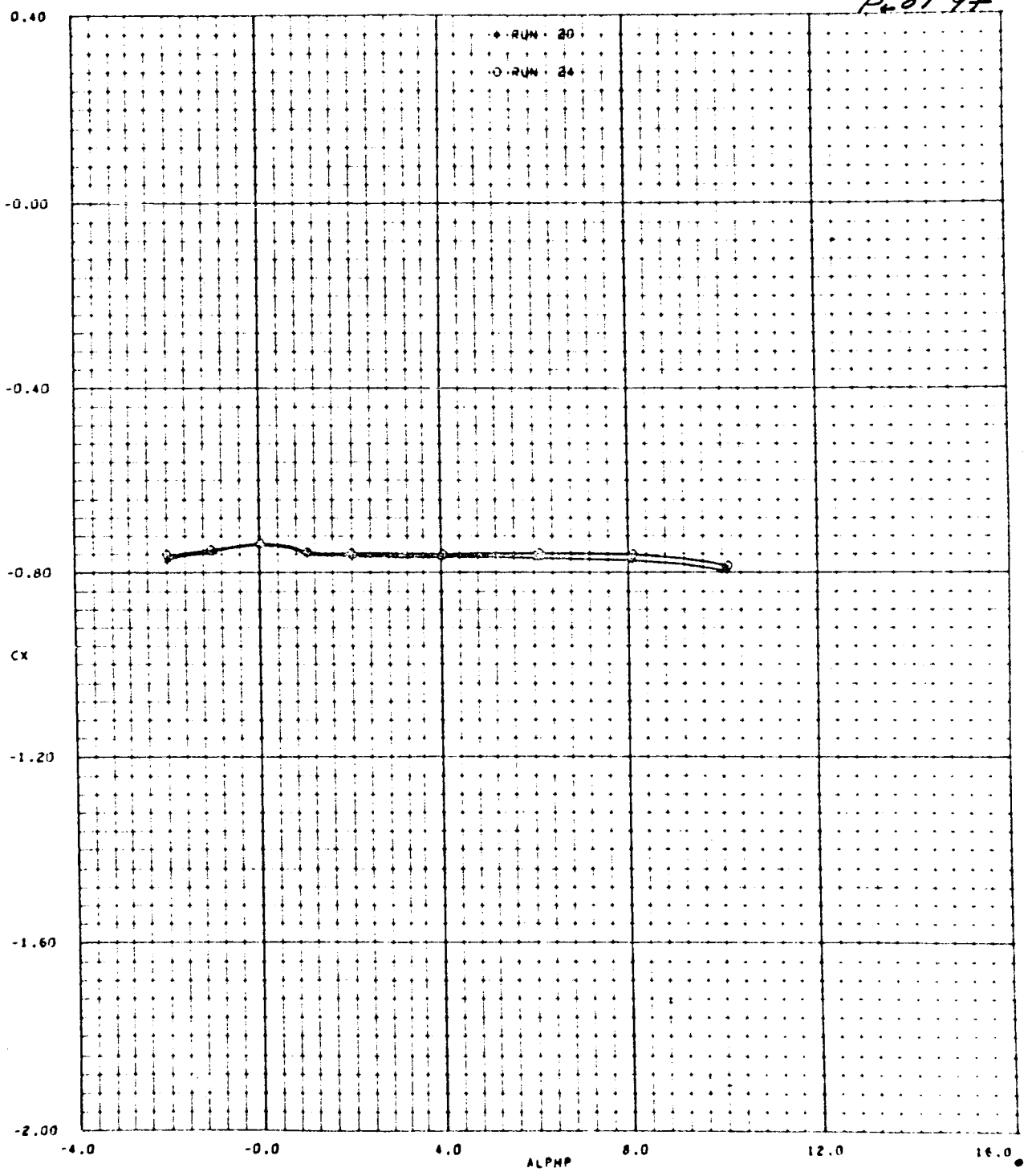
60

PLOT 9e


+ RUN 20
O RUN 24
0.60
0.40
0.20
-0.00
CR
-0.20
-0.40
-0.60
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

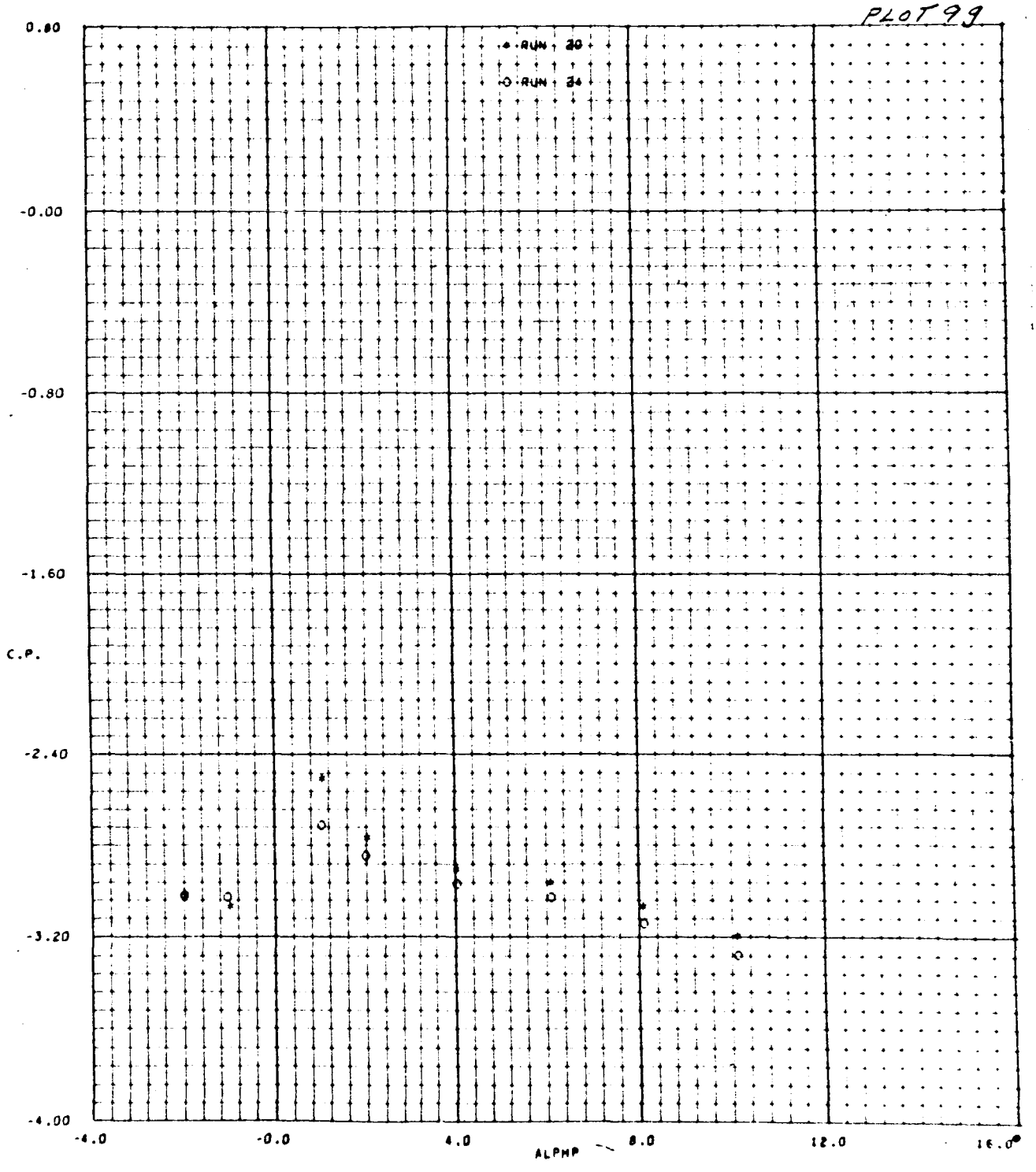
61

Plot 9f


+ RUN 20
O RUN 24
0.40
-0.00
-0.40
-0.80
CX
-1.20
-1.60
-2.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

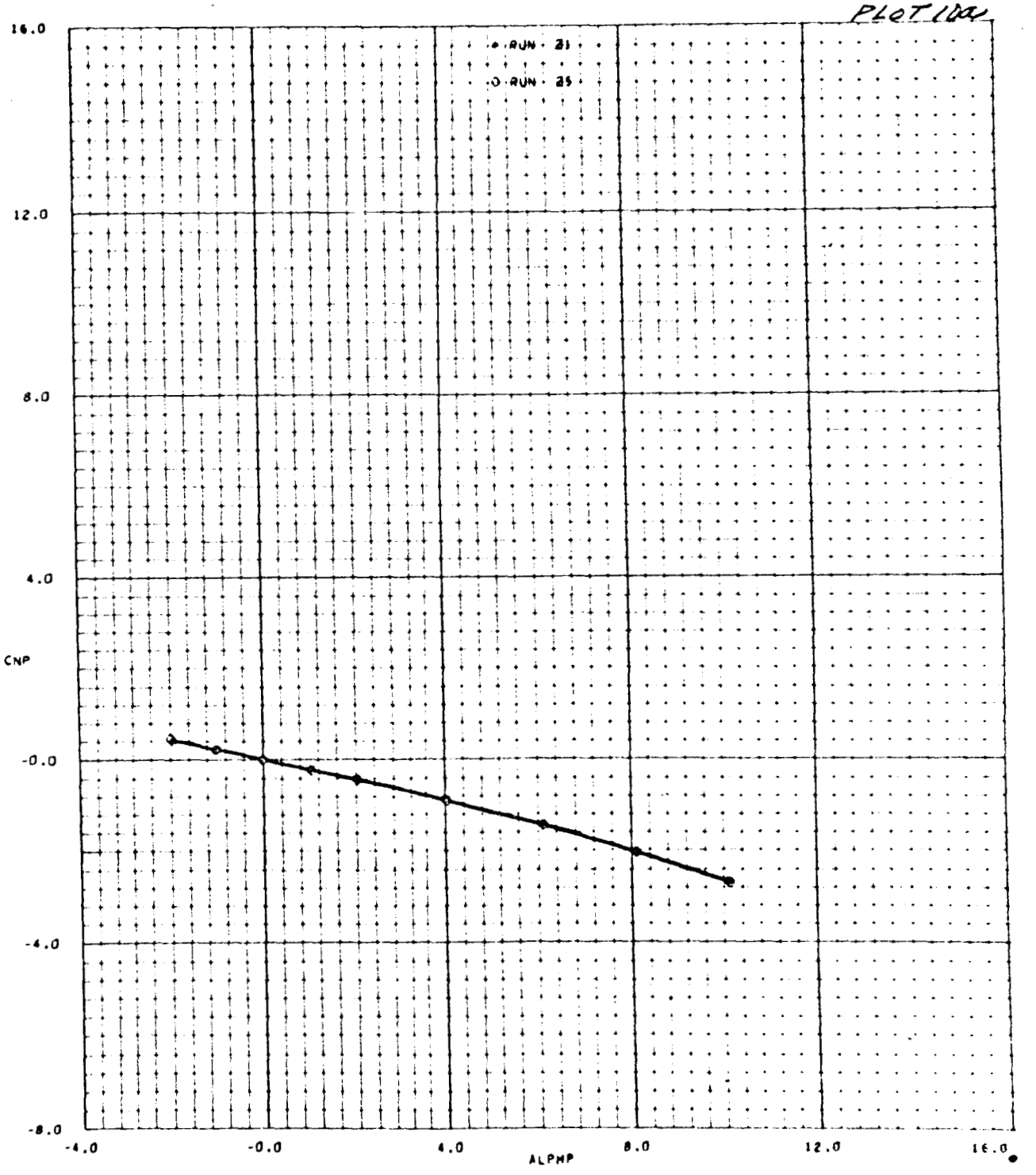
62

PLOT 99


0.80
-0.00
-0.80
-1.60
C.P.
-2.40
-3.20
-4.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
+ RUN 20
O RUN 24

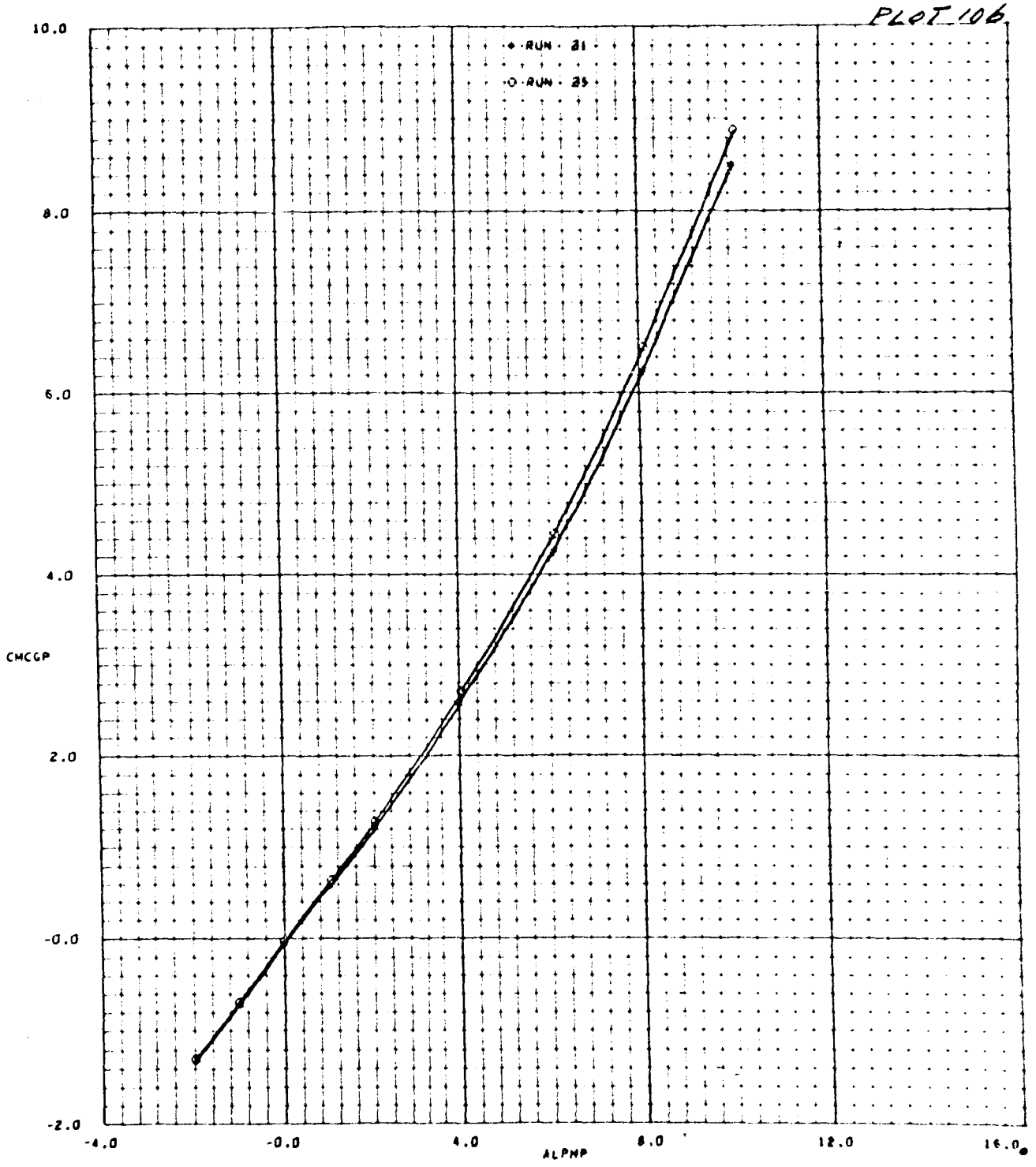
63

PLOT 100



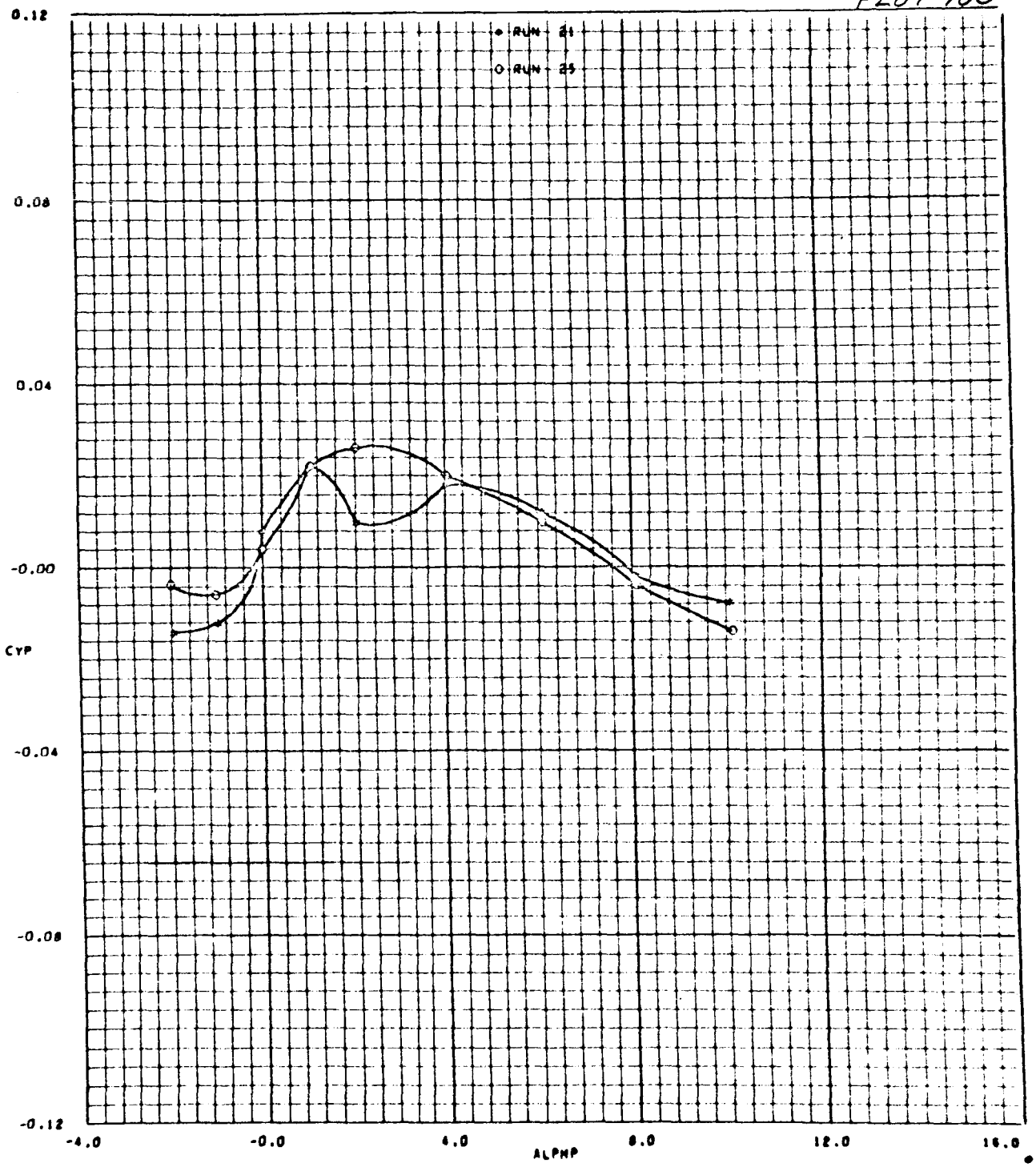
64

PLOT 106


+ RUN 21
O RUN 25
10.0
8.0
6.0
4.0
2.0
-0.0
-2.0
CMCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

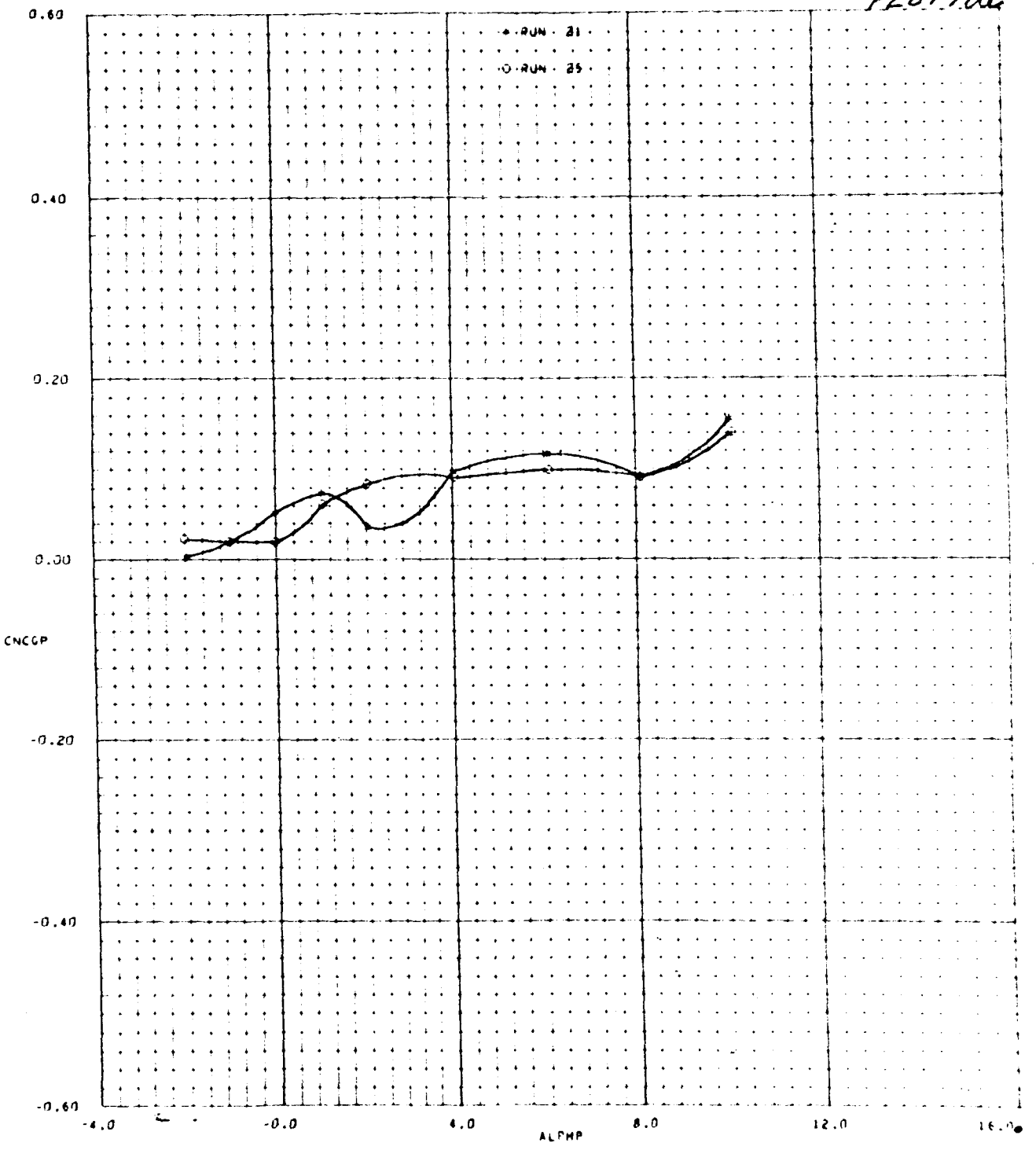
65

PLOT 10C


• RUN 21
O RUN 25
0.12
0.08
0.04
-0.00
CYP
-0.04
-0.08
-0.12
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

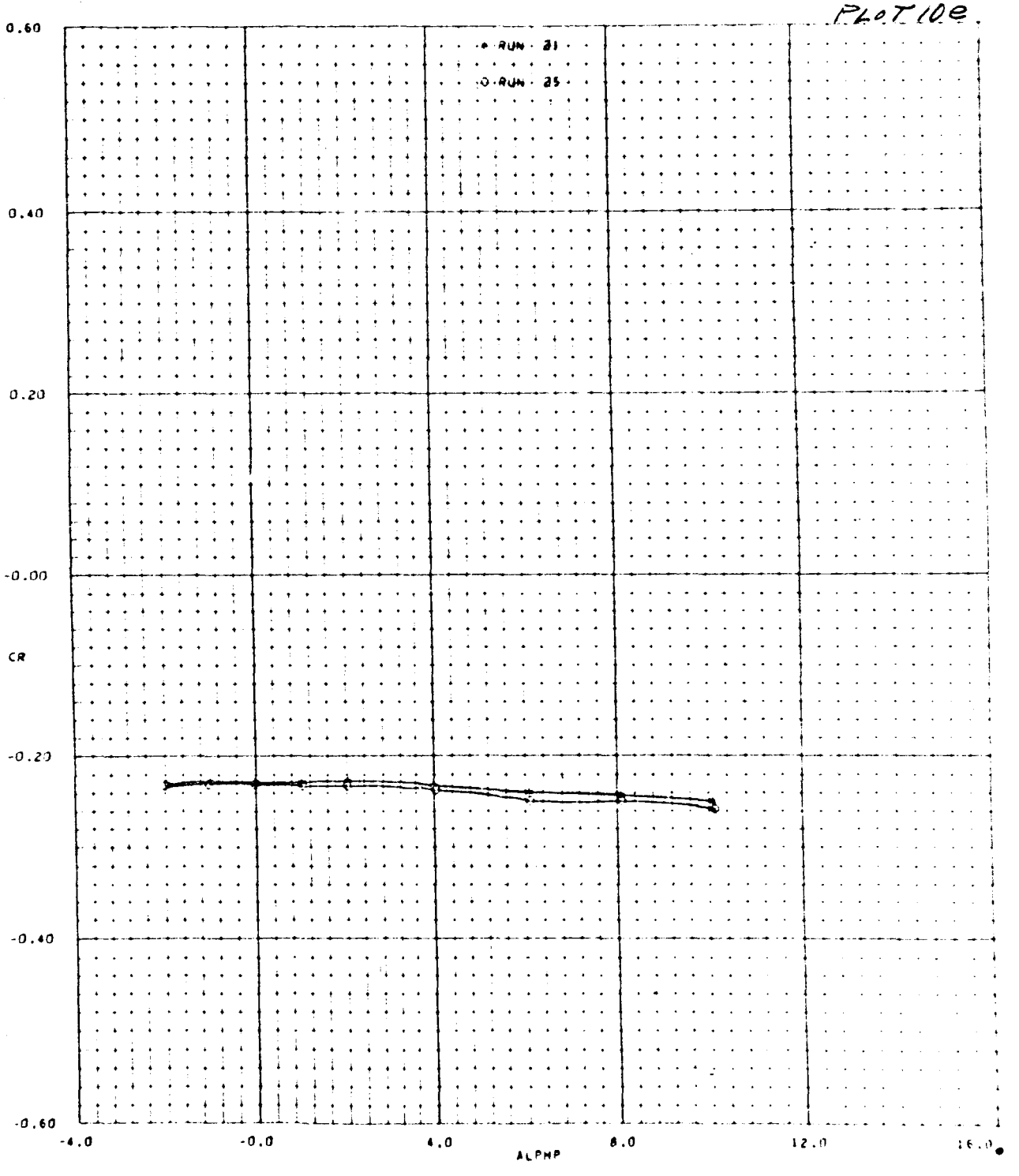
66

PLOT 10d


0.60
0.40
0.20
0.00
CNCGP
-0.20
-0.40
-0.60
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
RUN 21
RUN 25

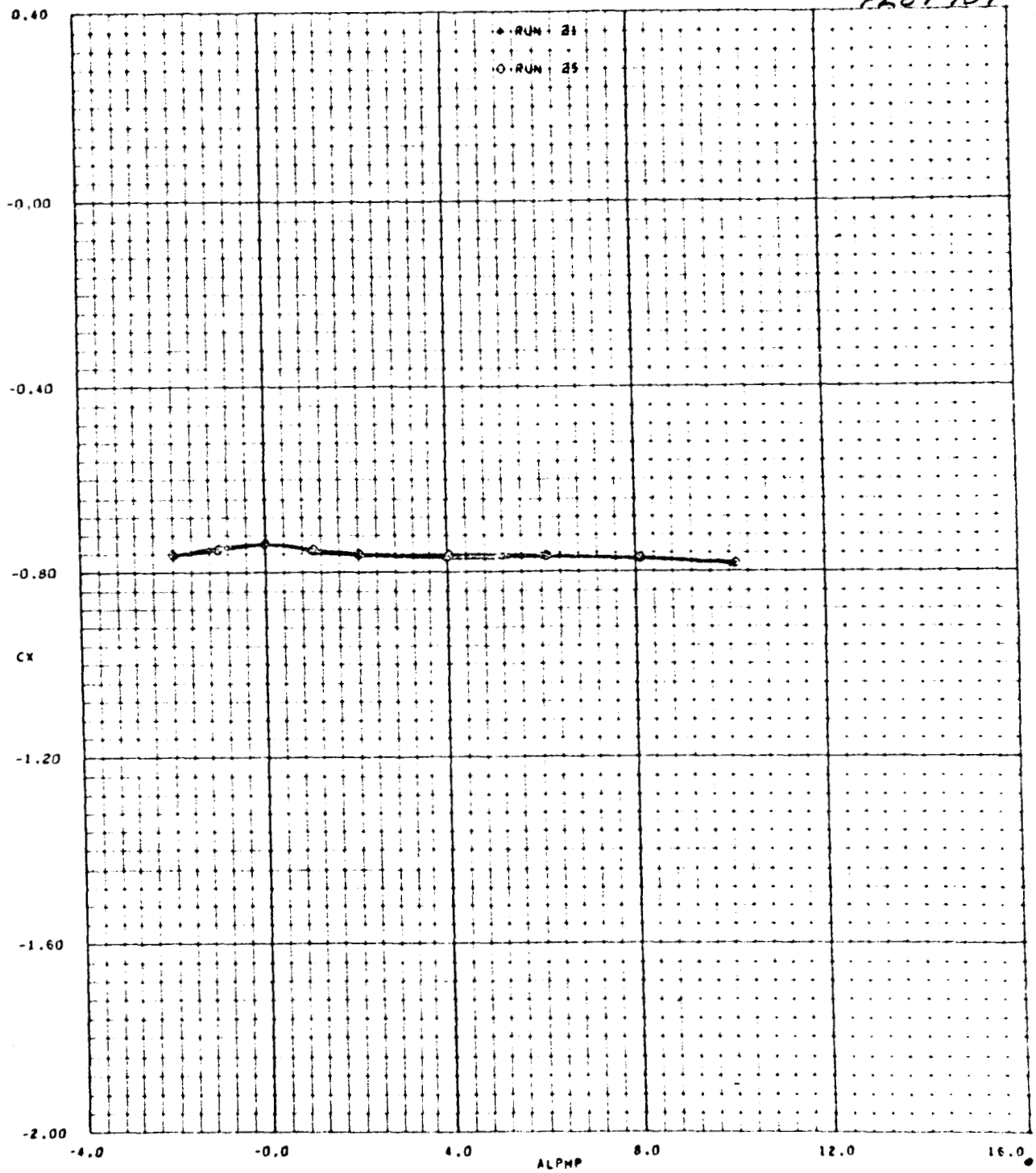
67

Plot 10e


0.60
0.40
0.20
-0.00
CR
-0.20
-0.40
-0.60
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
• RUN 21
O RUN 25

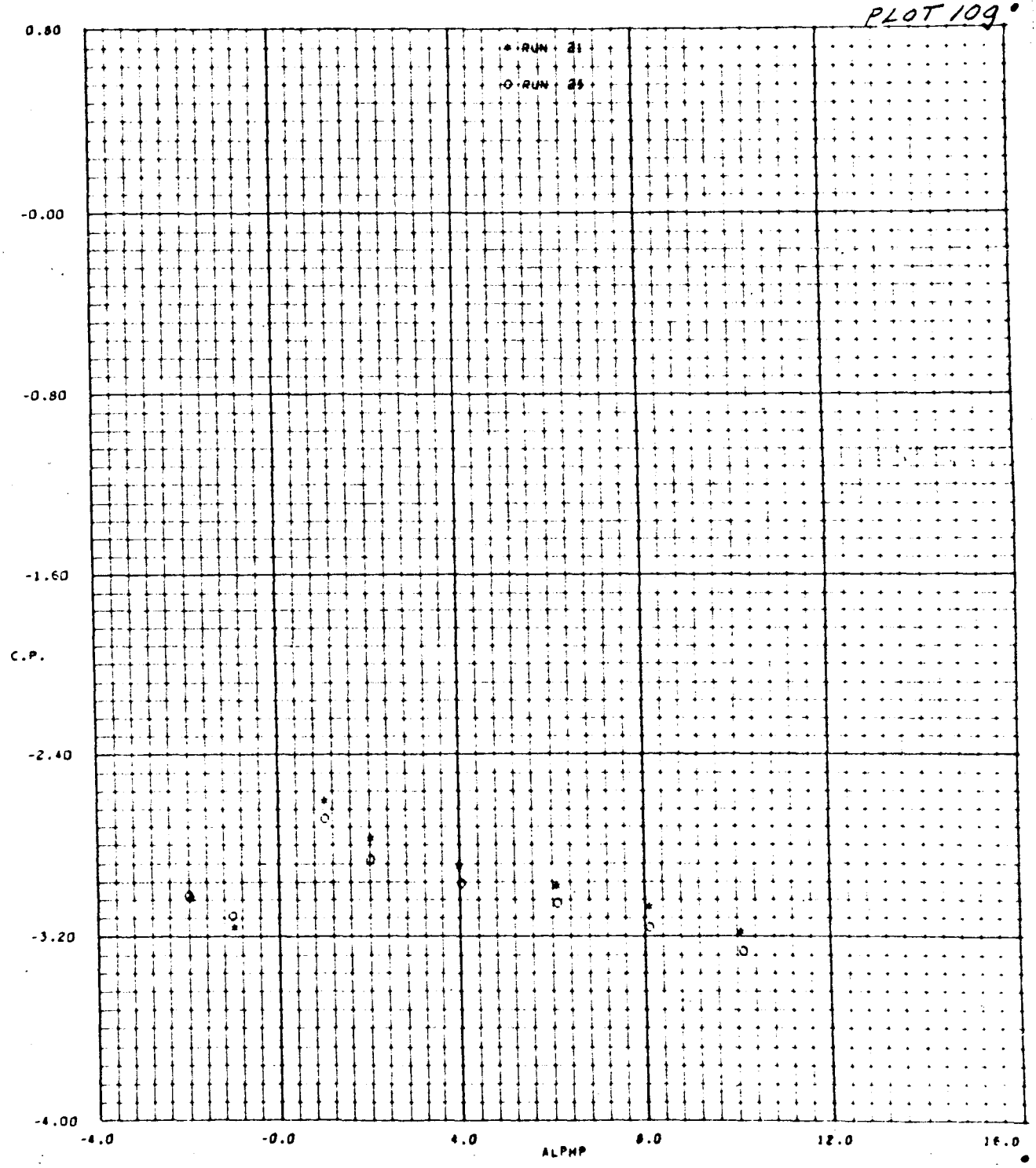
68

PLOT 10f


RUN 21
RUN 25
0.40
-0.00
-0.40
-0.80
CX
-1.20
-1.60
-2.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

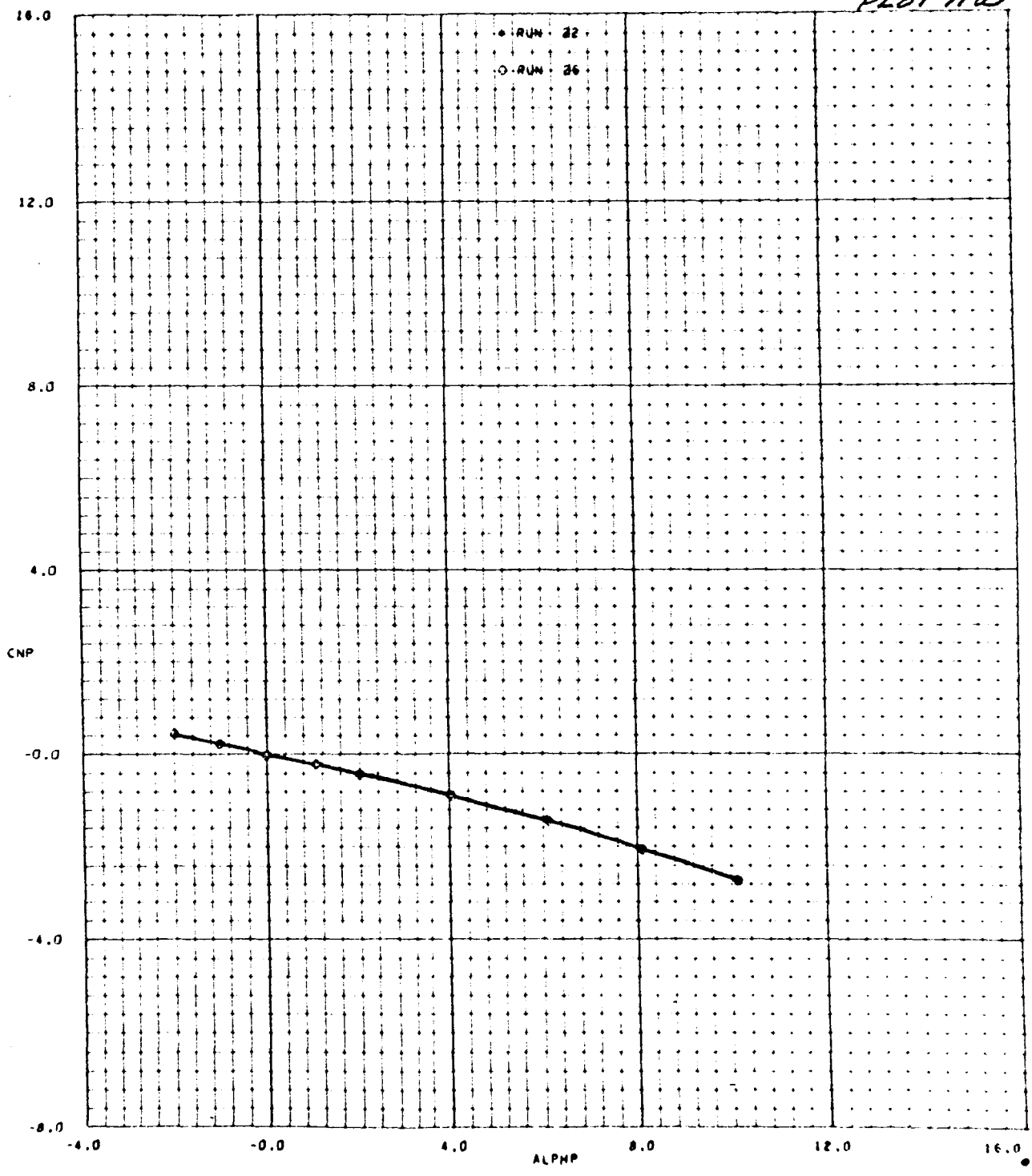
69

PLOT 109

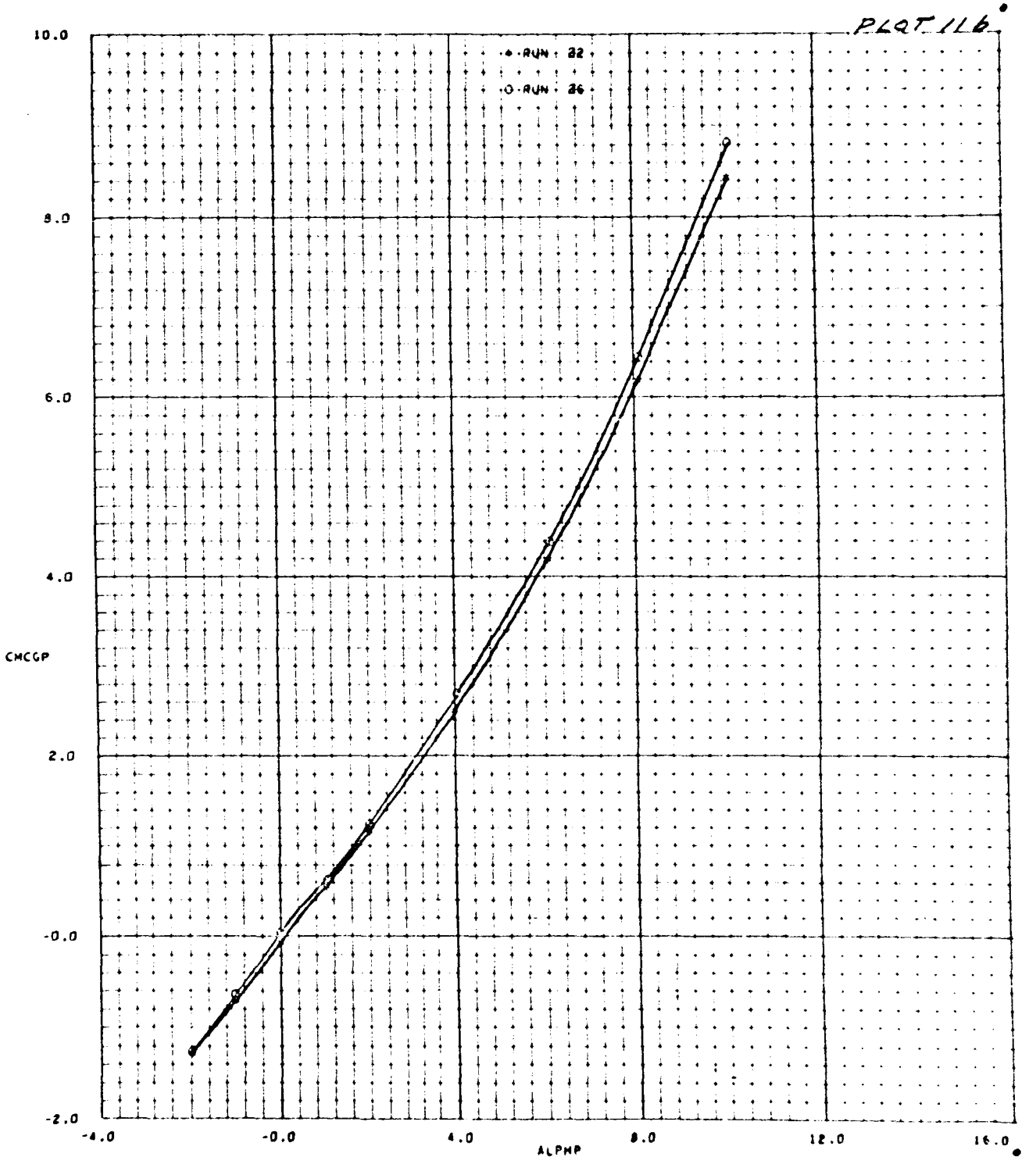

* RUN 21
O RUN 25
0.80
-0.00
-0.80
-1.60
C.P.
-2.40
-3.20
-4.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

70

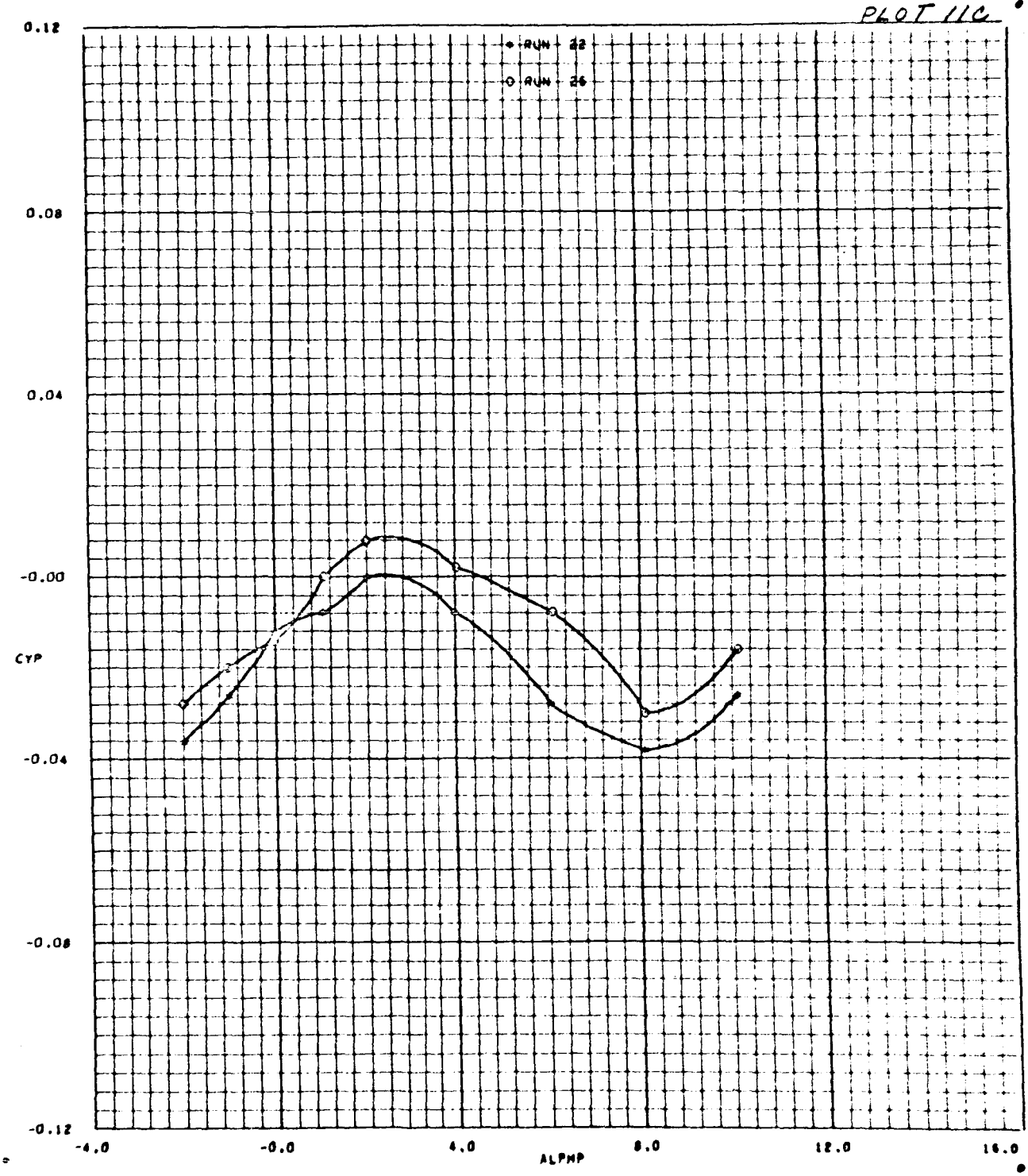
PLOT 11a



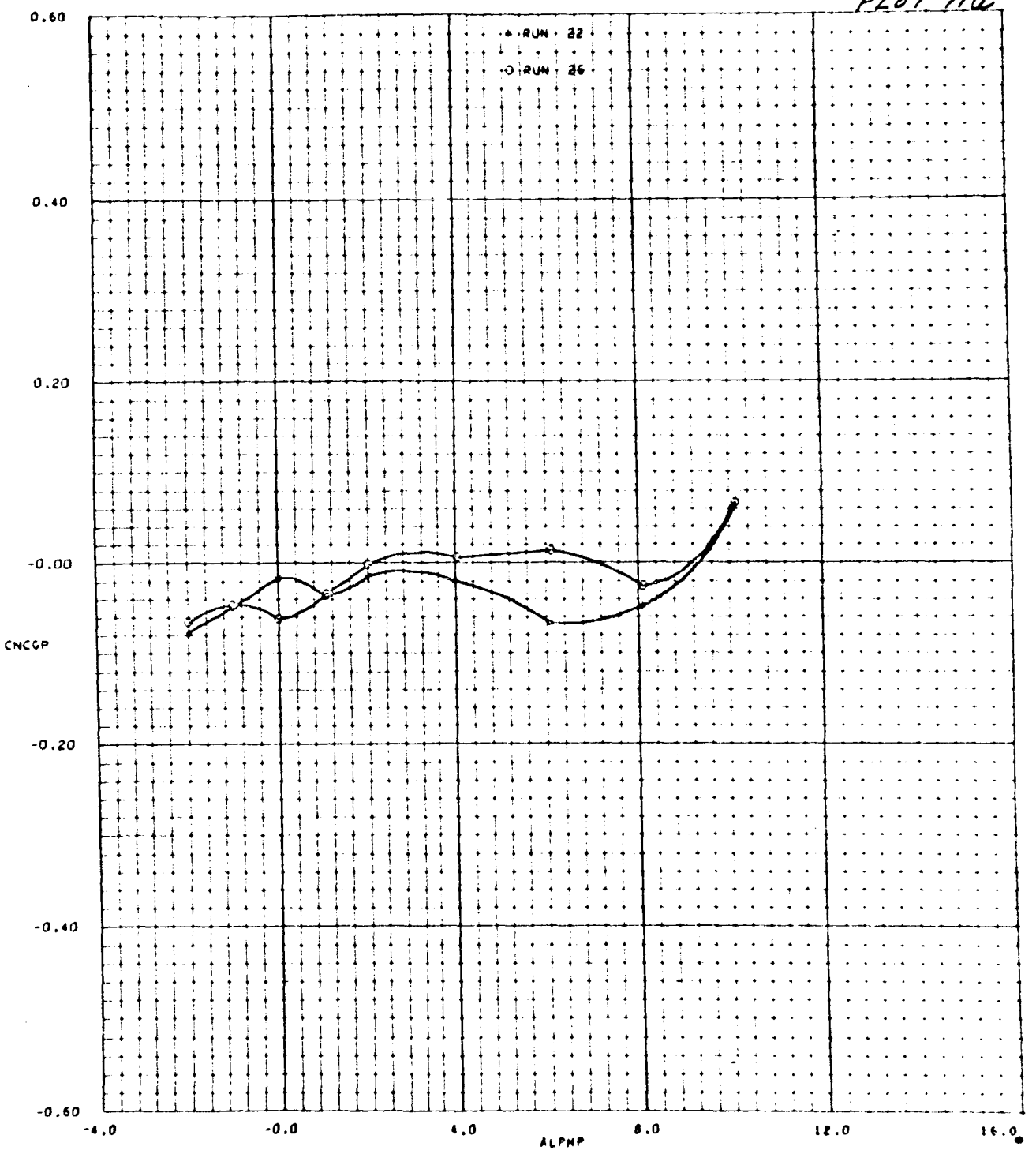
71


PLOT 116
RUN 22
RUN 26
10.0
8.0
6.0
4.0
2.0
-0.0
-2.0
CMCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

PLOT 11C

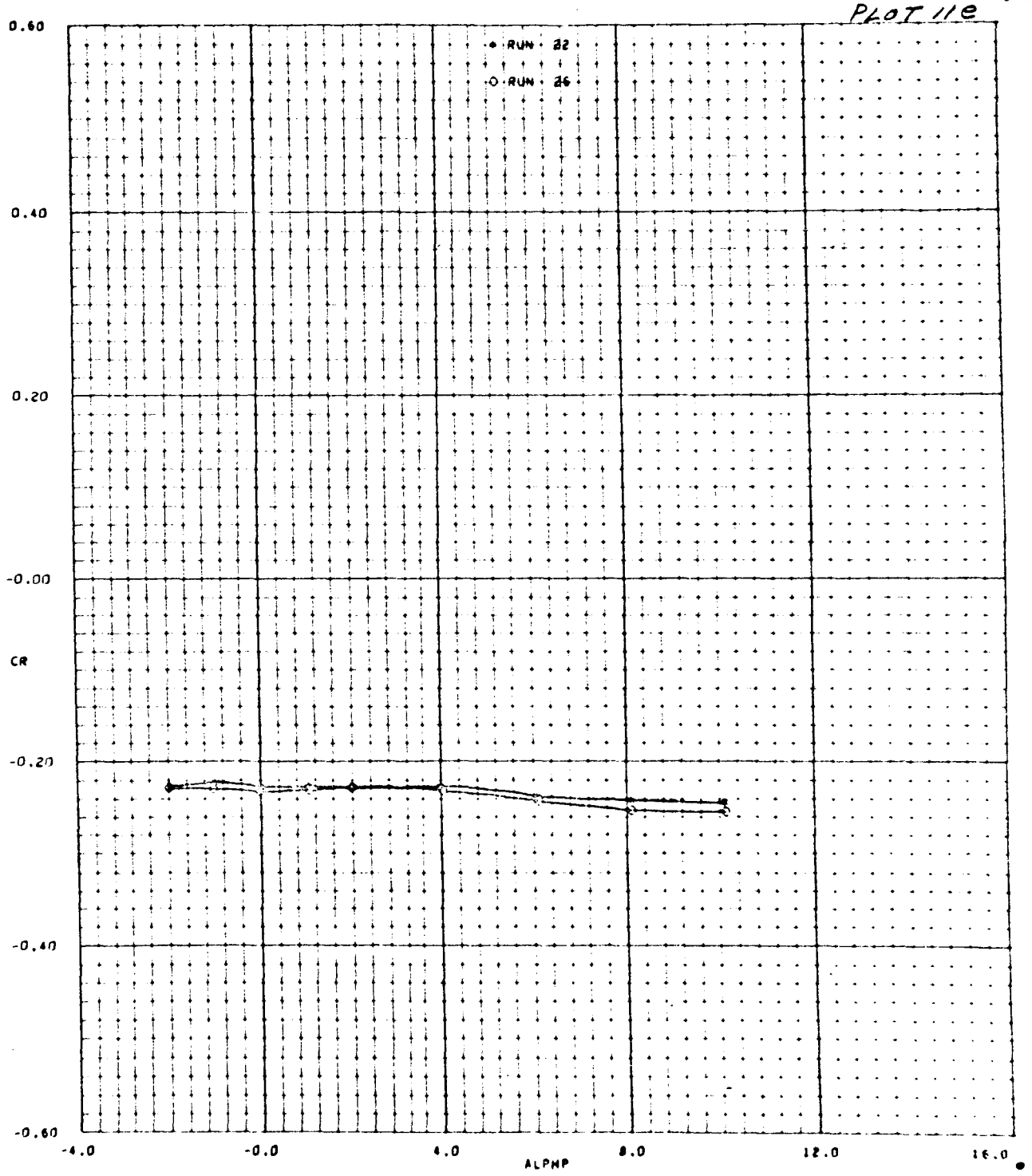

RUN 22
RUN 26
0.12
0.08
0.04
-0.00
CYP
-0.04
-0.08
-0.12
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

PLOT 11d


0.60
0.40
0.20
-0.00
-0.20
-0.40
-0.60
CNCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
RUN 22
RUN 26

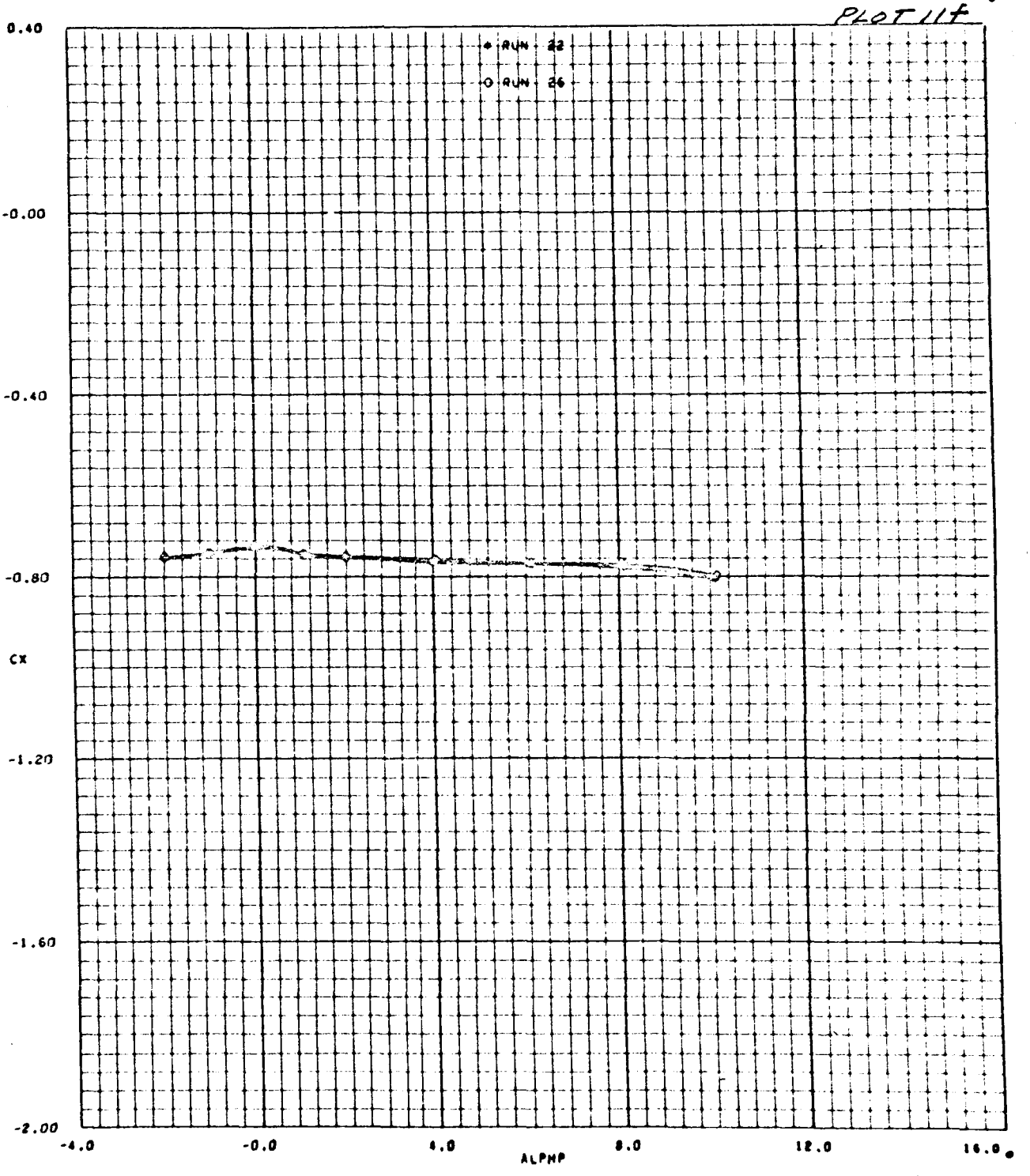
74

PLOT 11e


RUN 22
RUN 26
0.60
0.40
0.20
-0.00
CR
-0.20
-0.40
-0.60
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

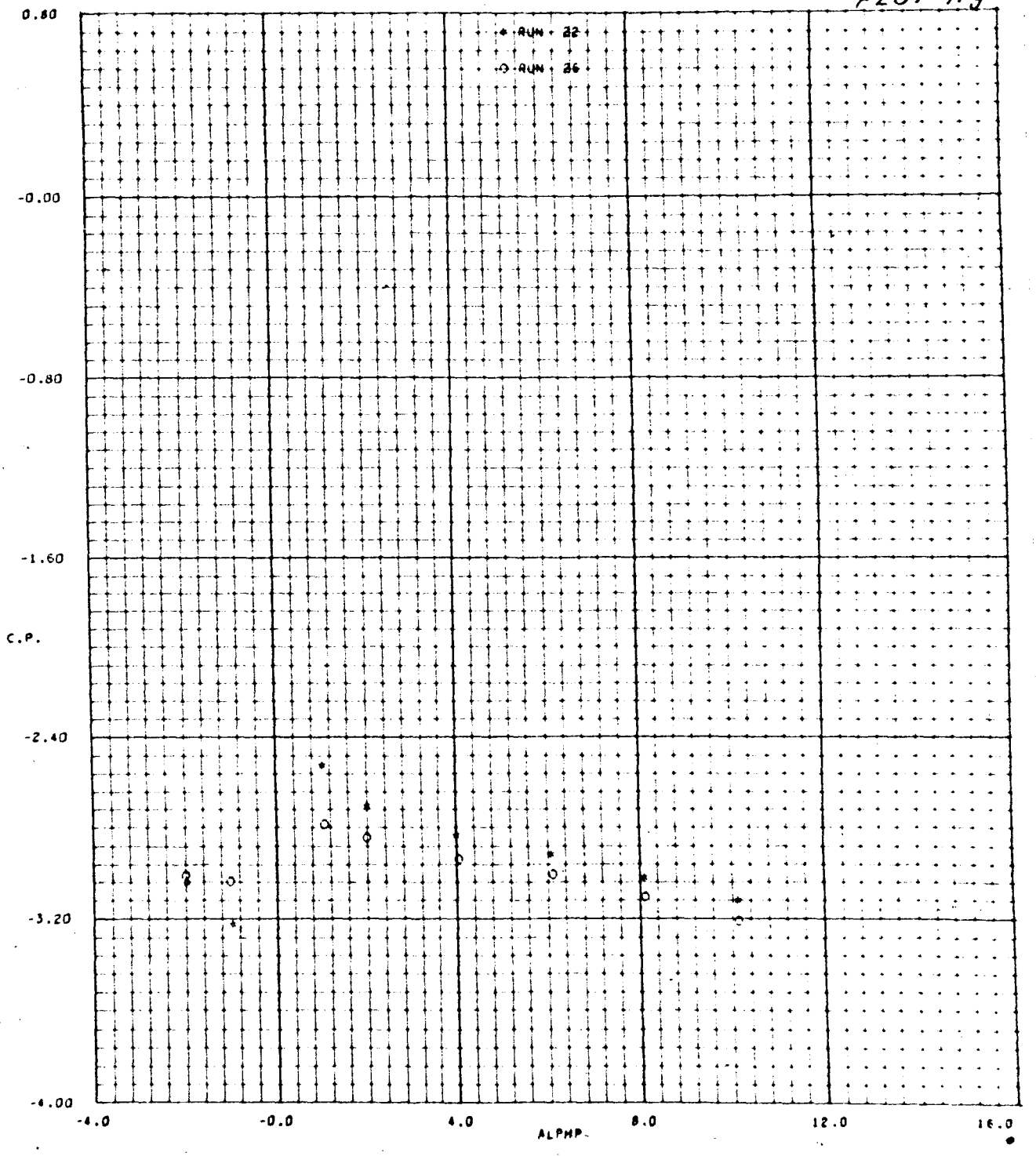
75

PLOT 11f


0.40
-0.00
-0.40
-0.80
CX
-1.20
-1.60
-2.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
RUN 22
RUN 26

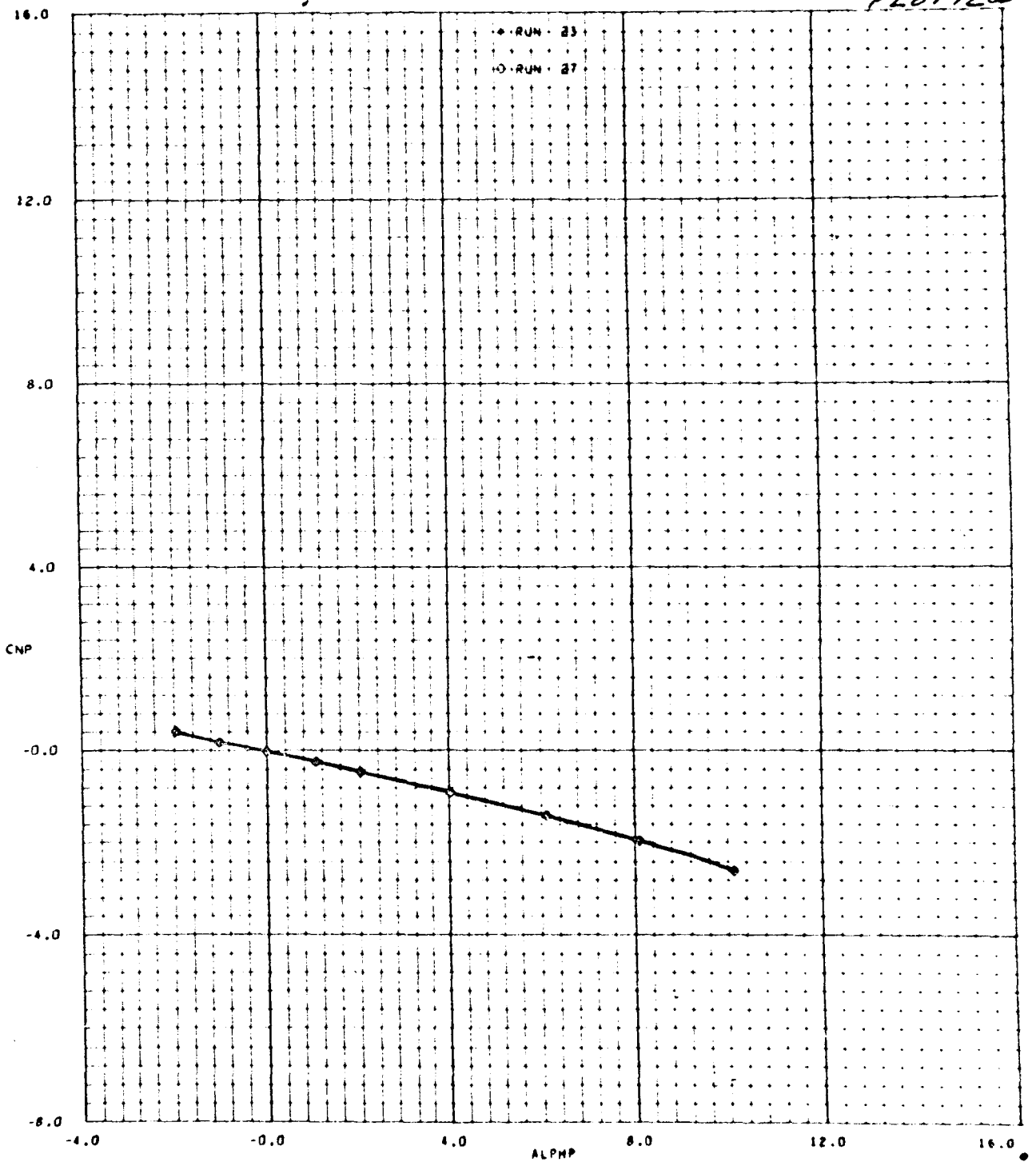
76

PLOT 119


* RUN 22
O RUN 26
0.80
-0.00
-0.80
-1.60
C.P.
-2.40
-3.20
-4.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

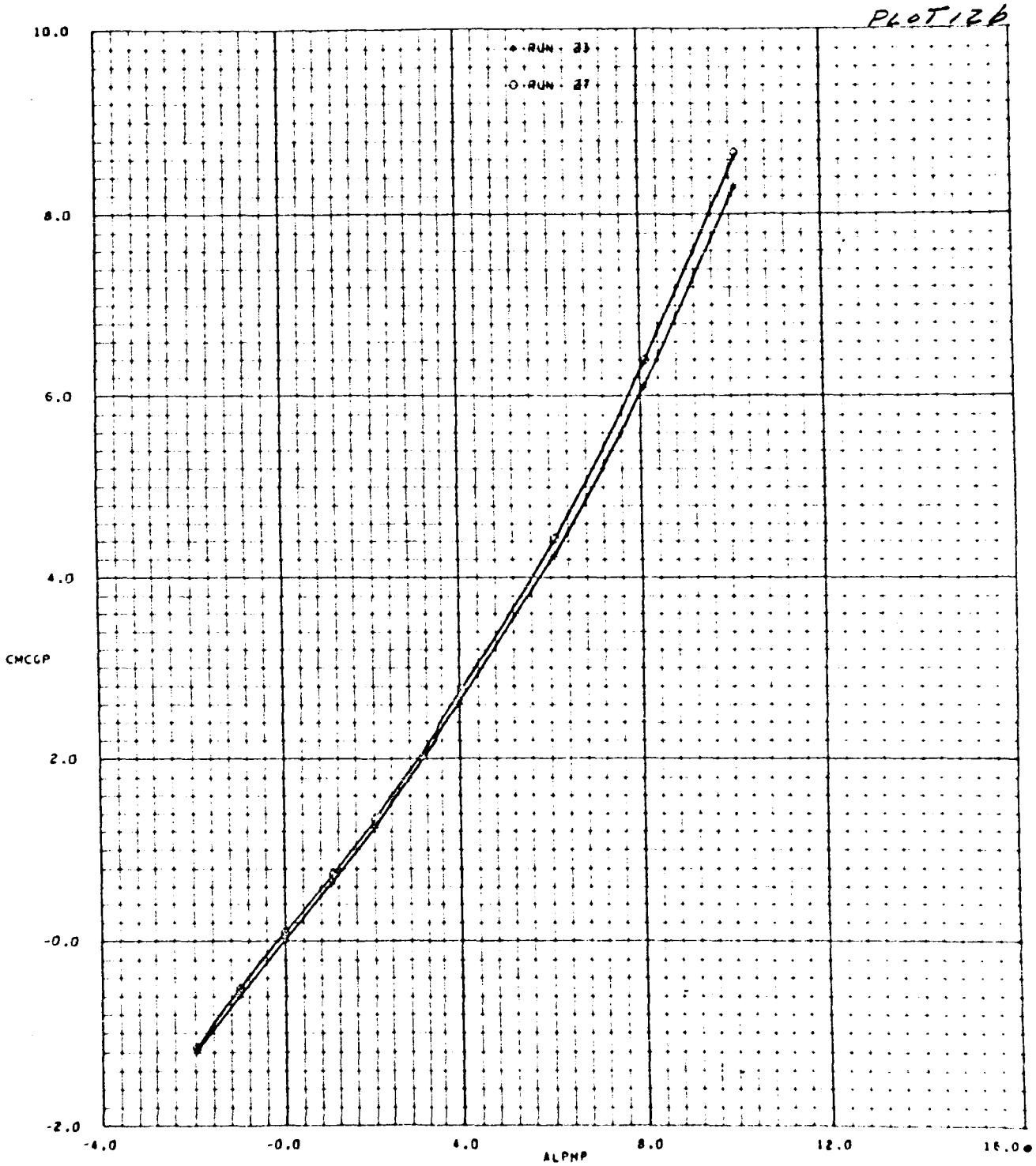
77

PLOT12a



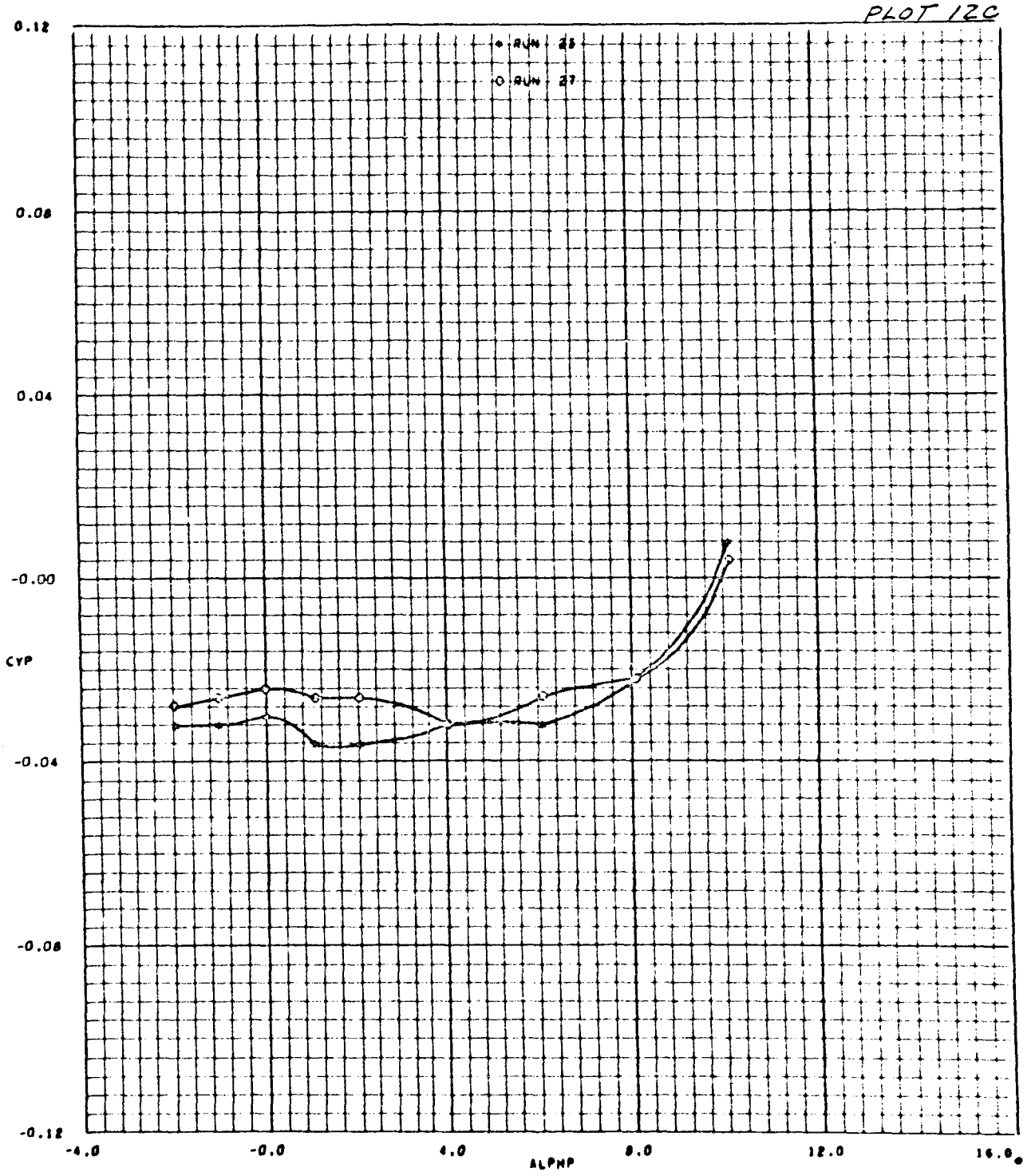
78

PLOT 12b


10.0
8.0
6.0
4.0
2.0
-0.0
-2.0
CMCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPMP
• RUN 23
O RUN 27

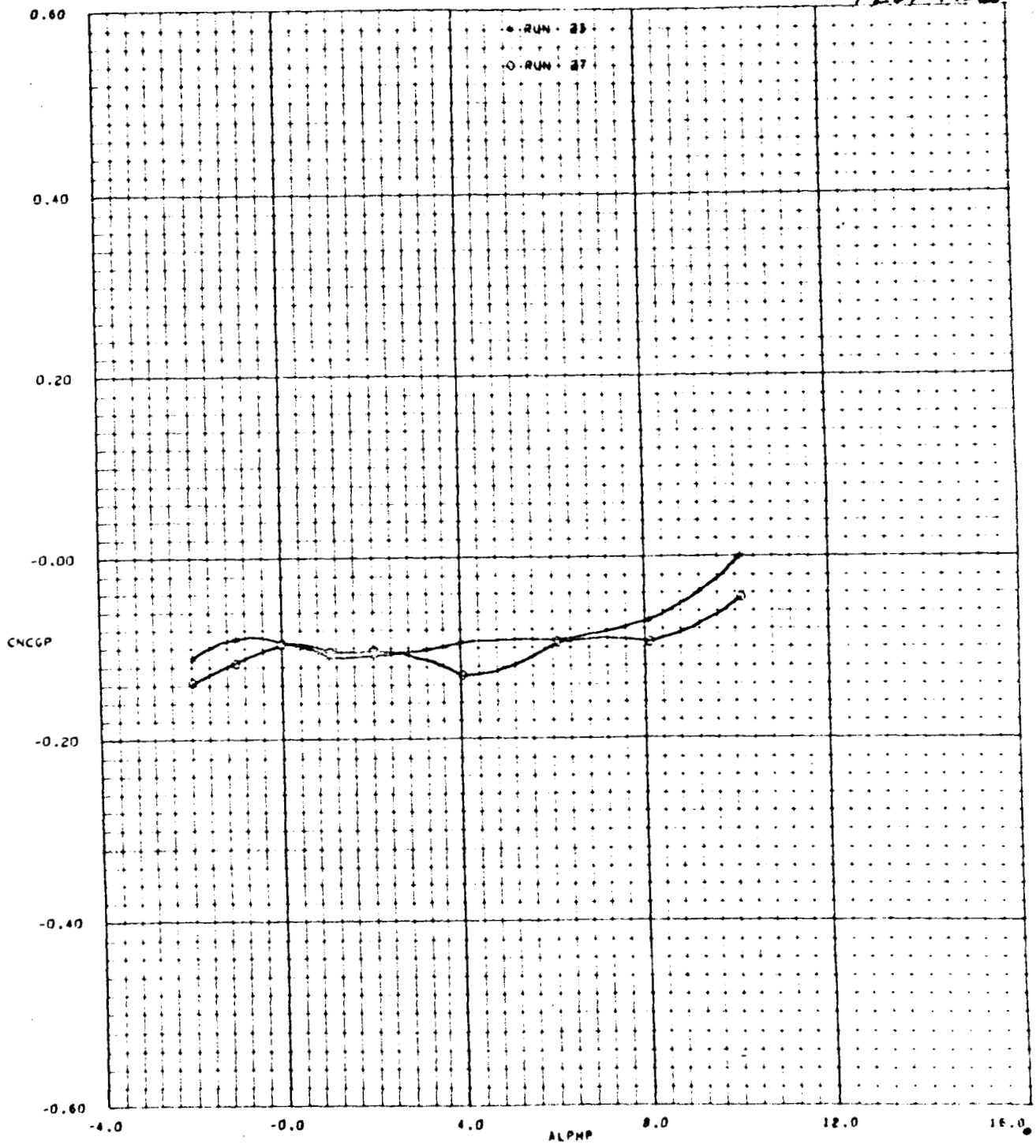
79

PLOT 12C


0.12
0.08
0.04
-0.00
CYP
-0.04
-0.08
-0.12
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
+ RUN 25
O RUN 27

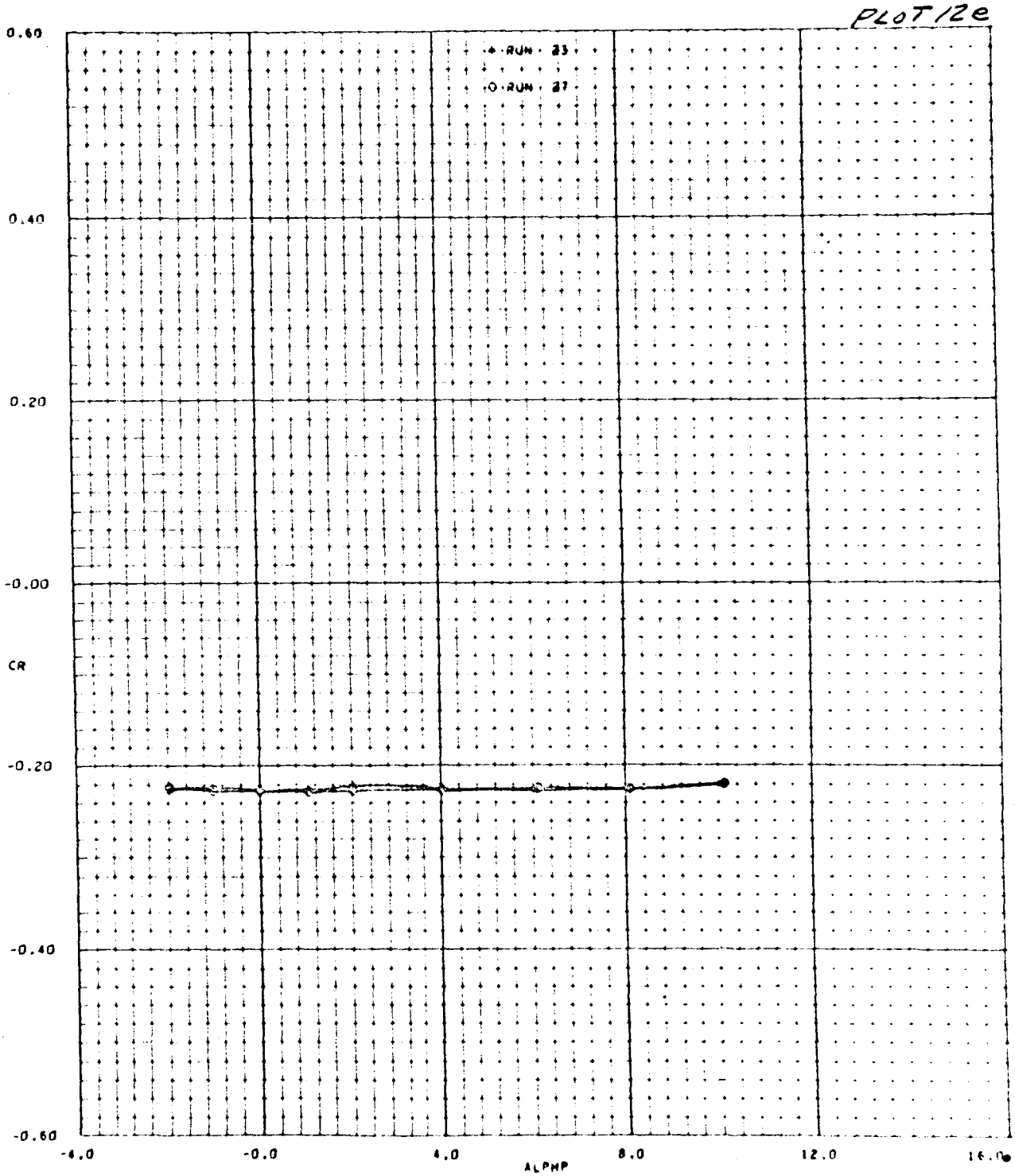
80

PLOT 12d


0.60
0.40
0.20
-0.00
-0.20
-0.40
-0.60
CNCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
+ RUN 23
O RUN 27

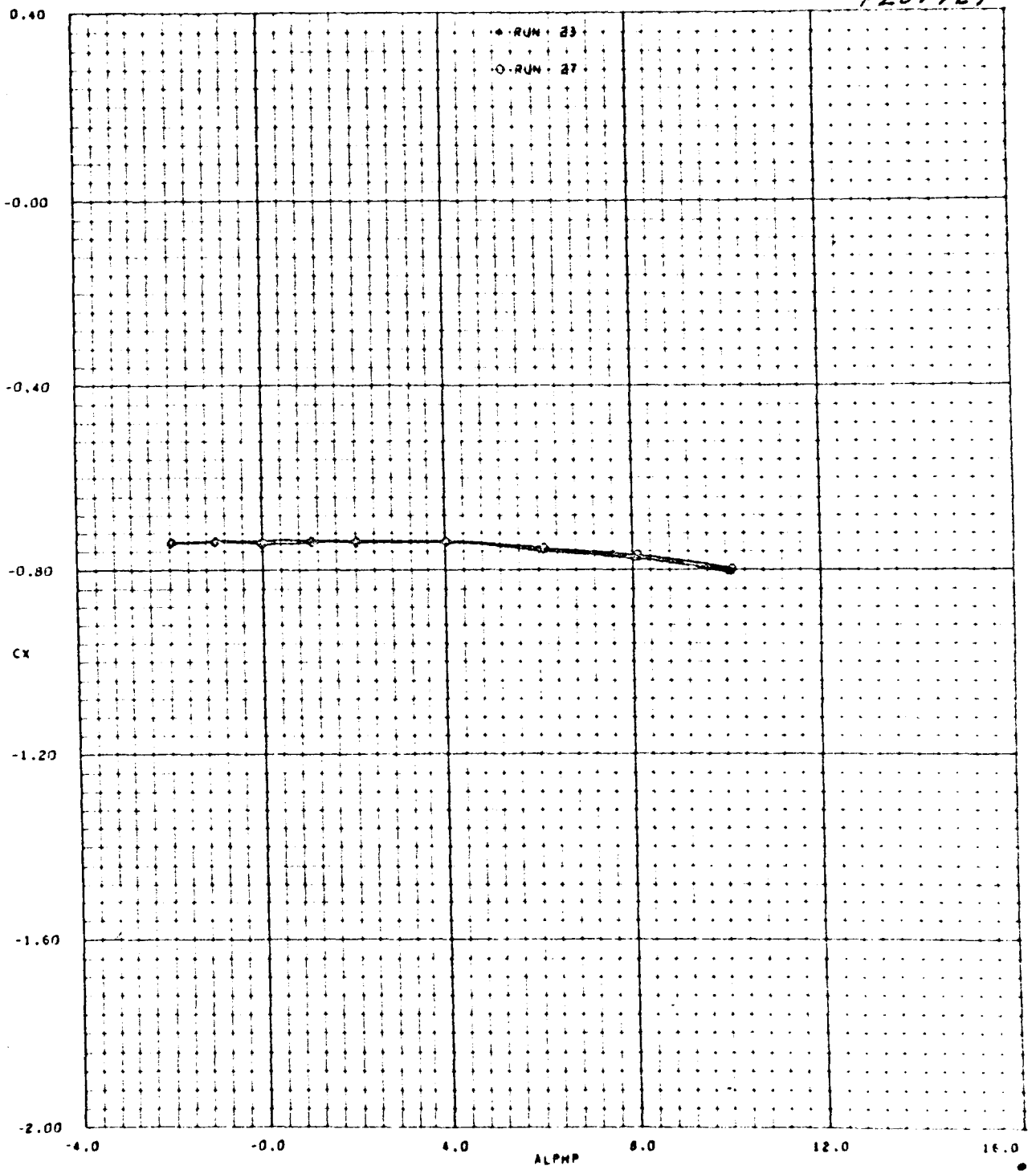
81

PLOT 12e


+ RUN 23
O RUN 27
0.60
0.40
0.20
-0.00
CR
-0.20
-0.40
-0.60
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

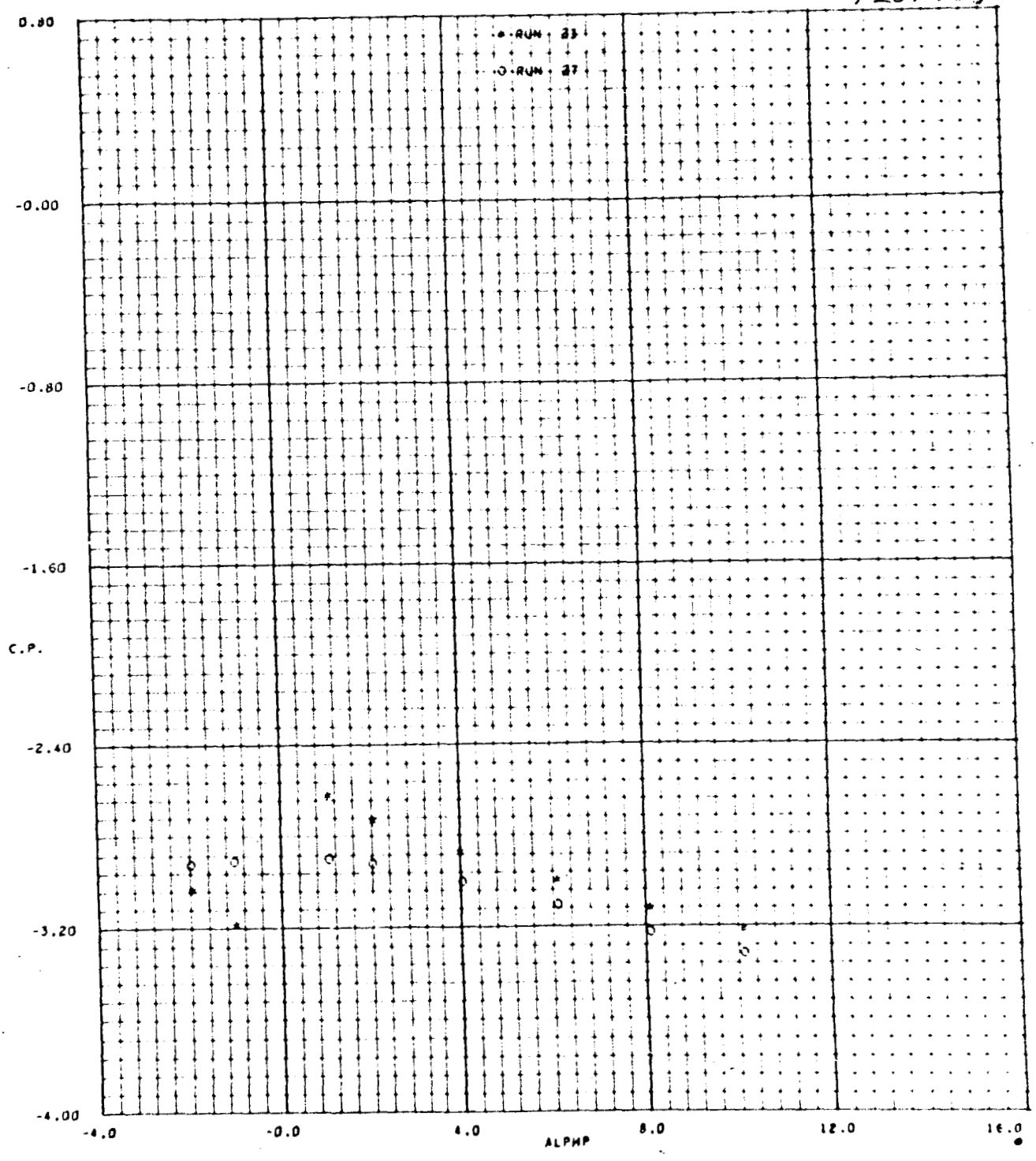
82

PLOT 12f


RUN 83
RUN 87
0.40
-0.00
-0.40
-0.80
CX
-1.20
-1.60
-2.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

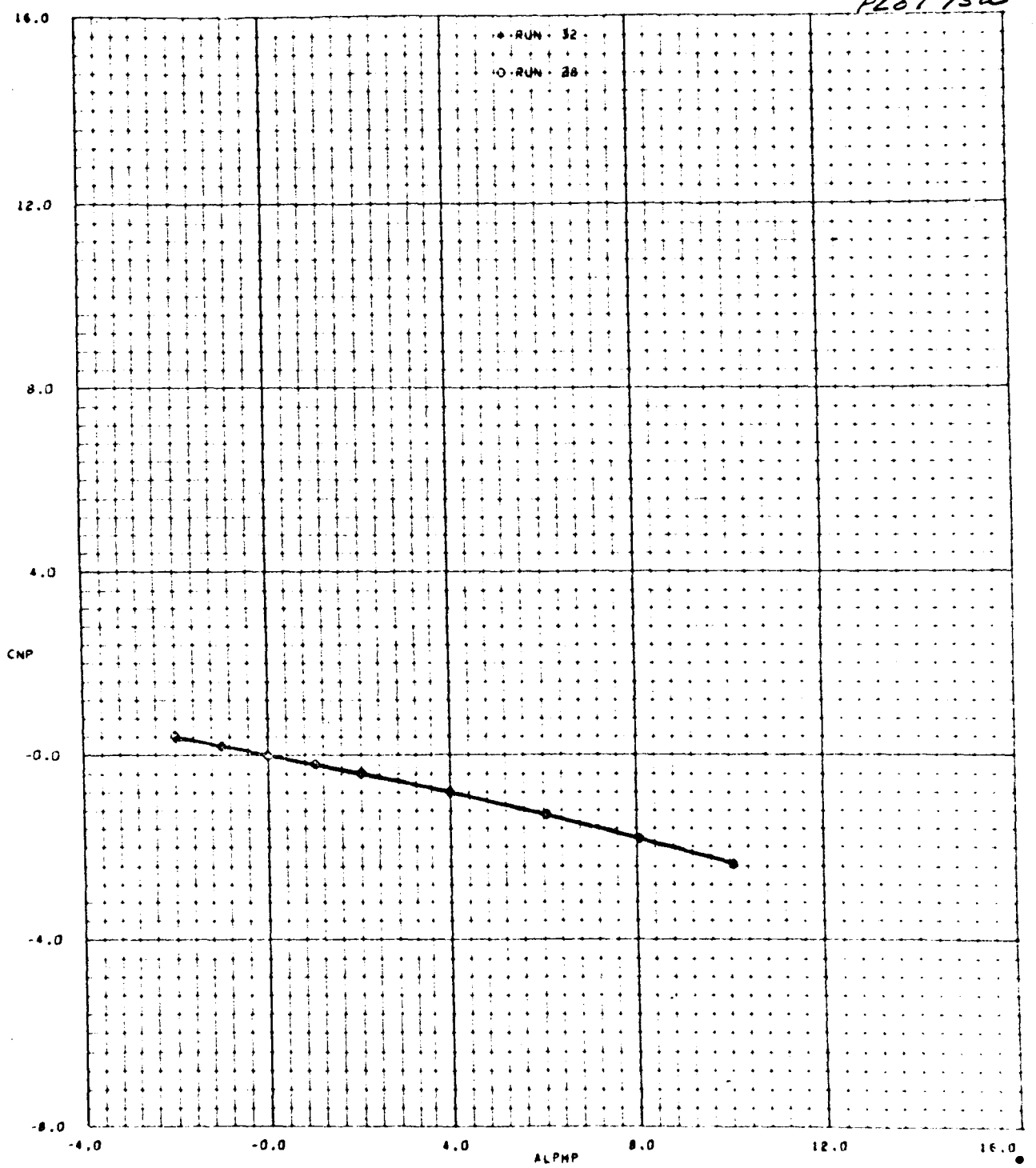
83

PLOT 129


0.80
-0.00
-0.80
-1.60
C.P.
-2.40
-3.20
-4.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
• RUN 23
O RUN 27

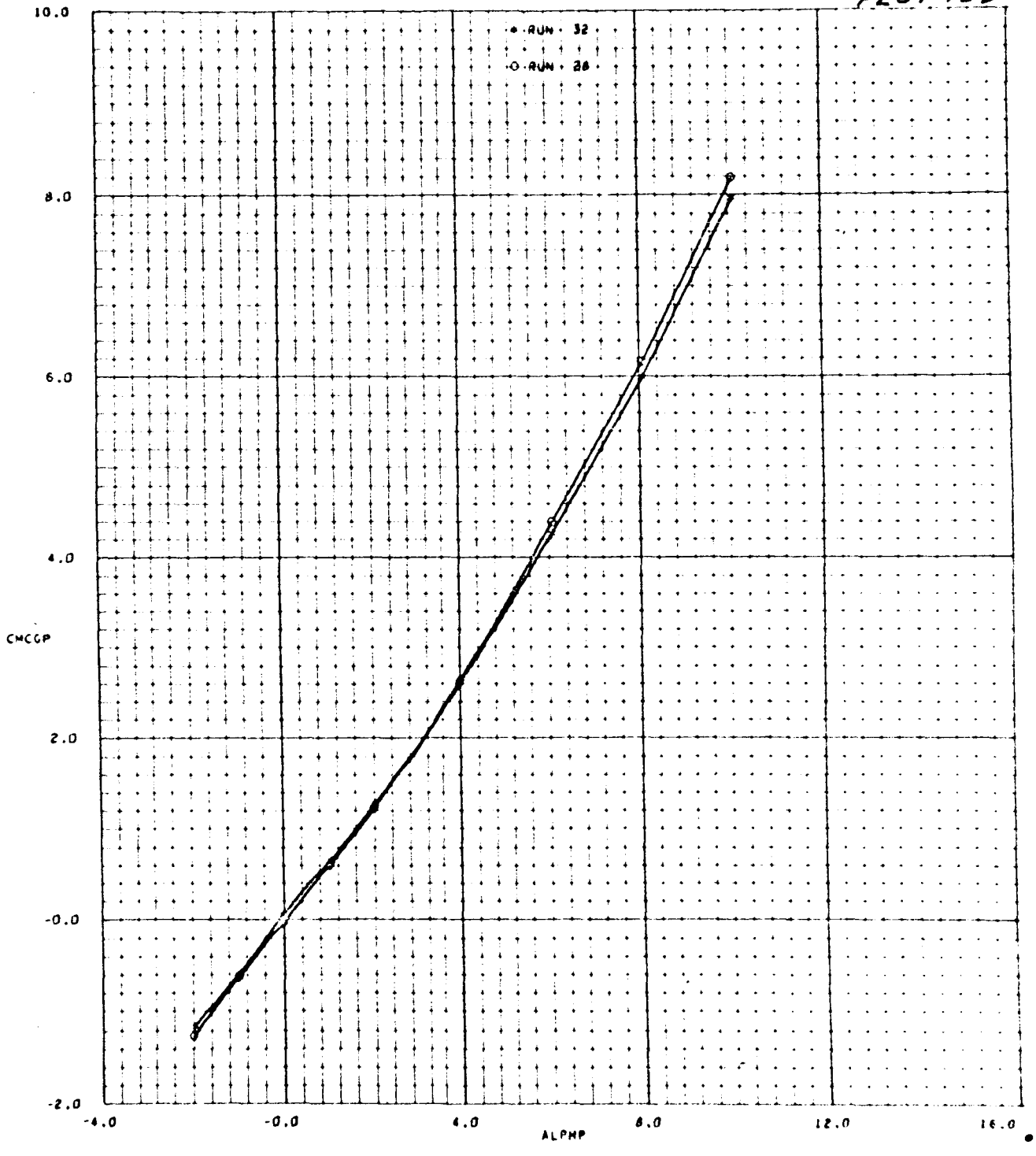
84

PLOT 13a



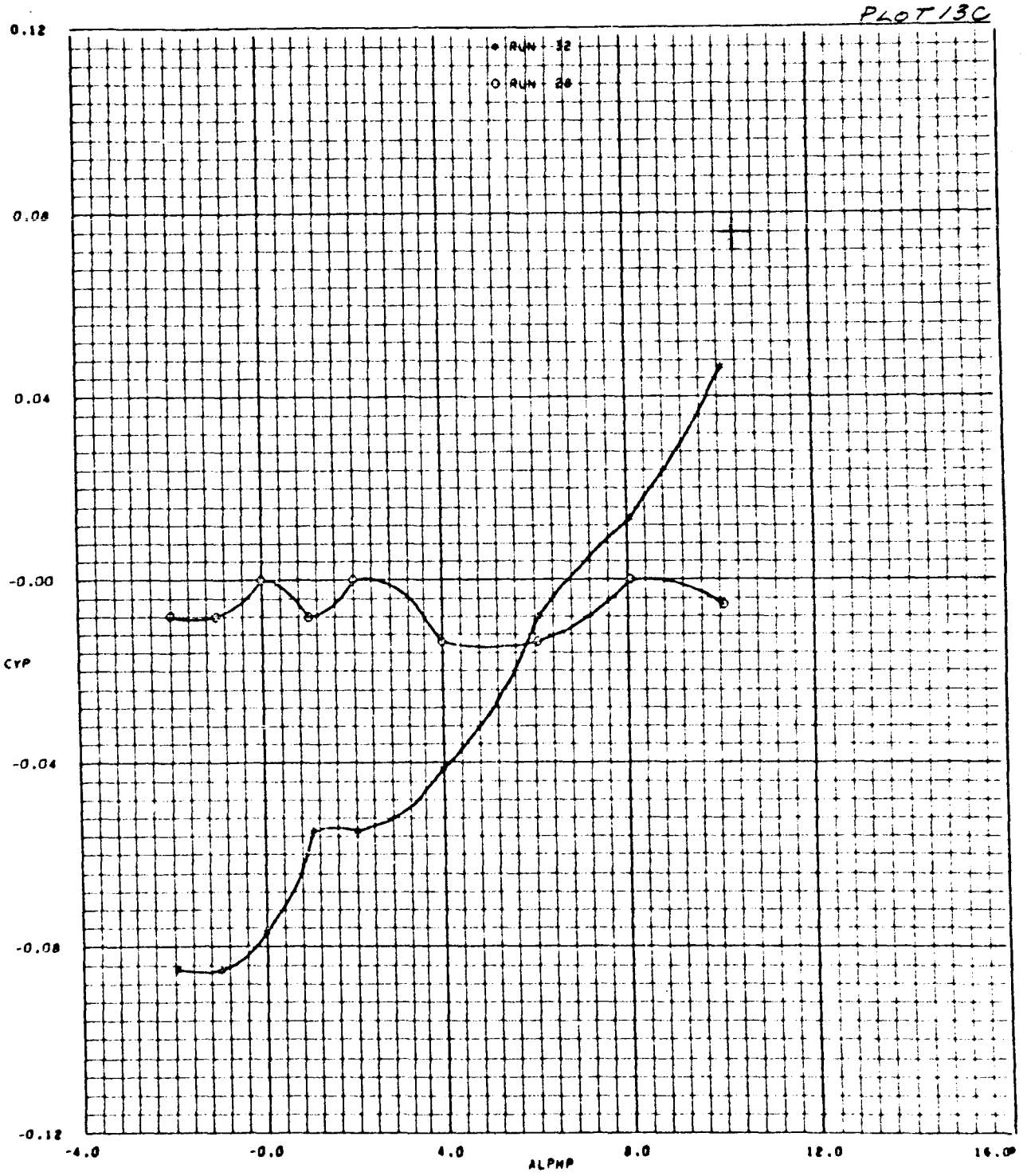
85

PLOT 136



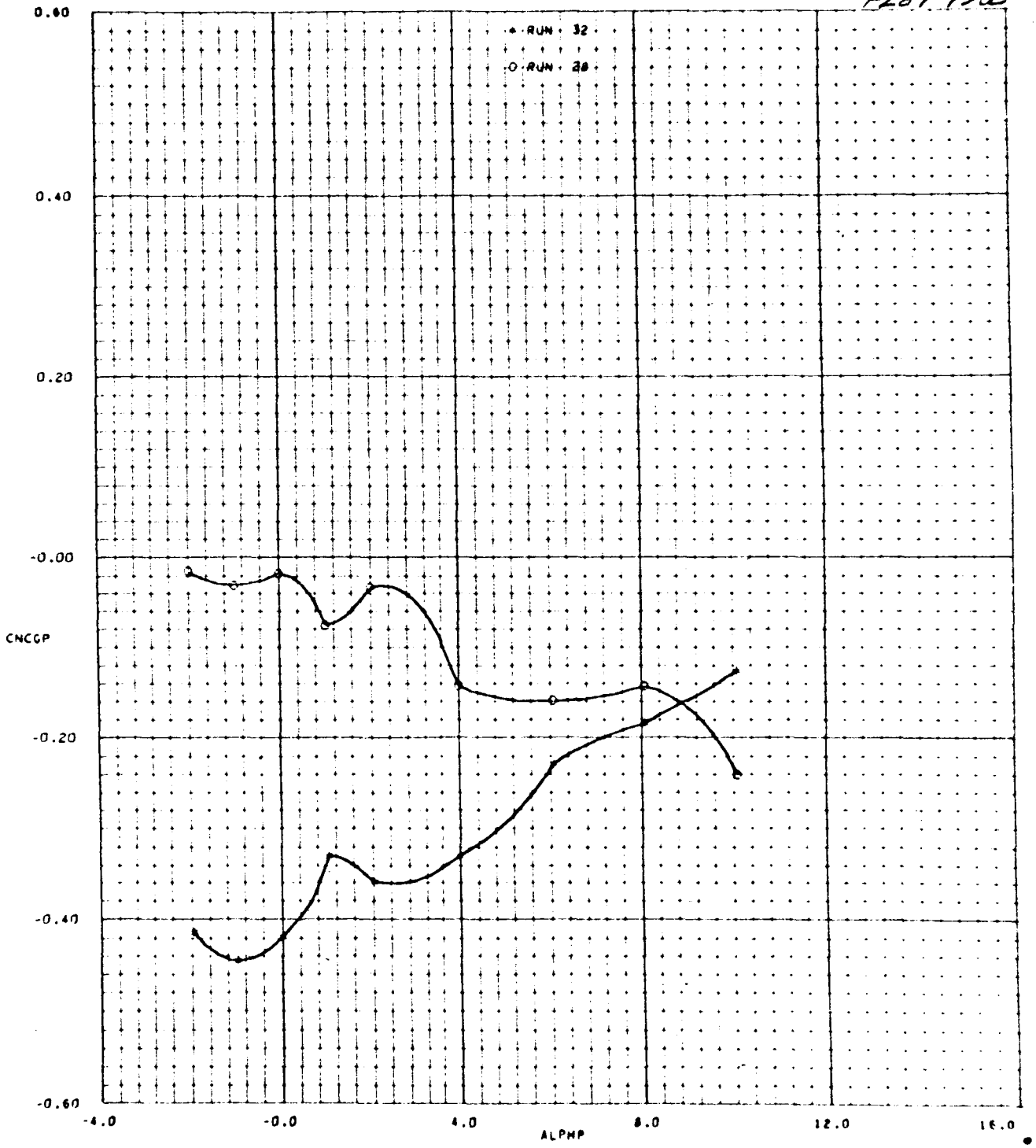
86

PLOT 13C


RUN 32
RUN 28
0.12
0.08
0.04
-0.00
CYP
-0.04
-0.08
-0.12
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

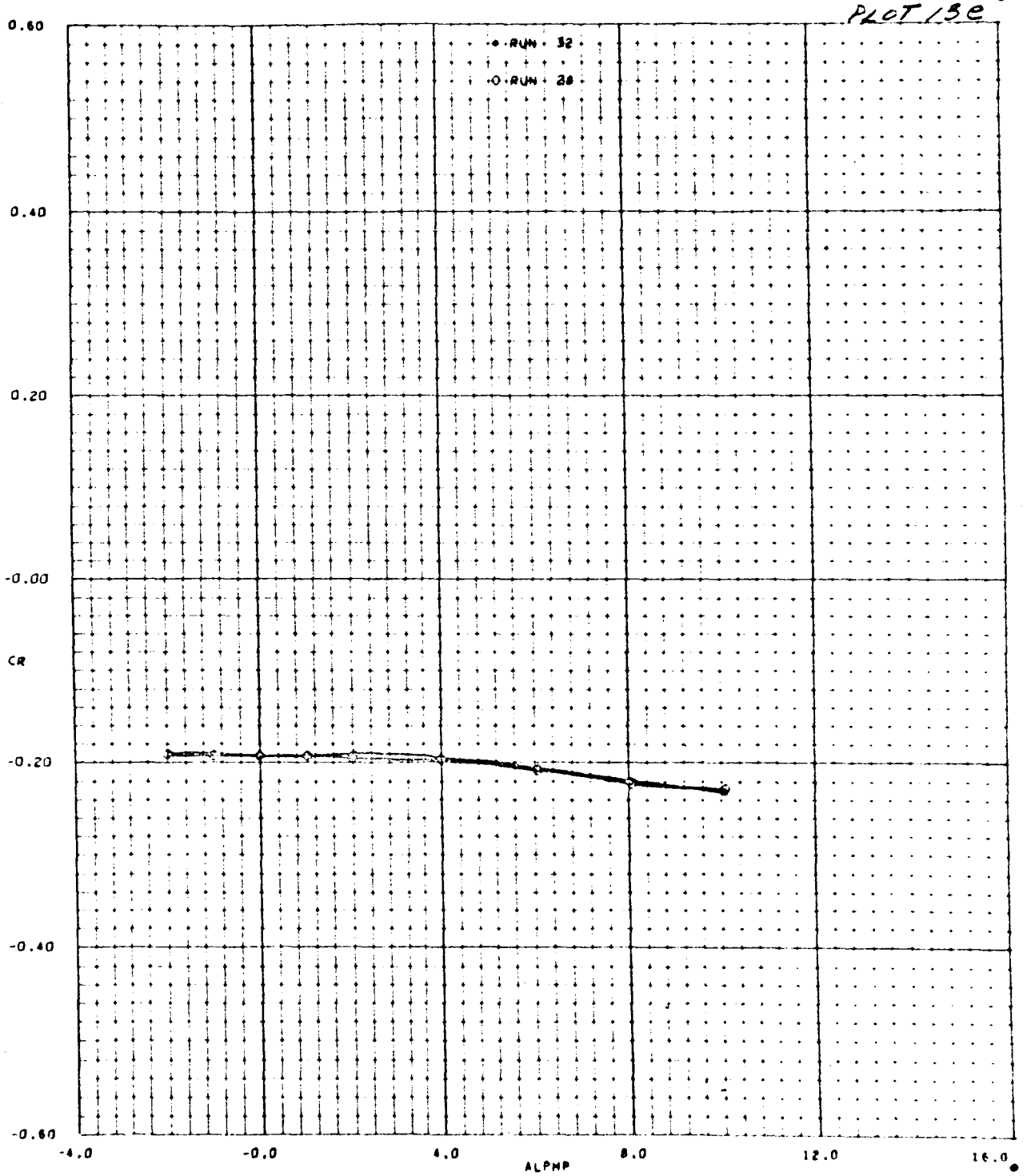
87

PLOT 13d


0.60
0.40
0.20
-0.00
-0.20
-0.40
-0.60
CNCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
RUN 32
RUN 28

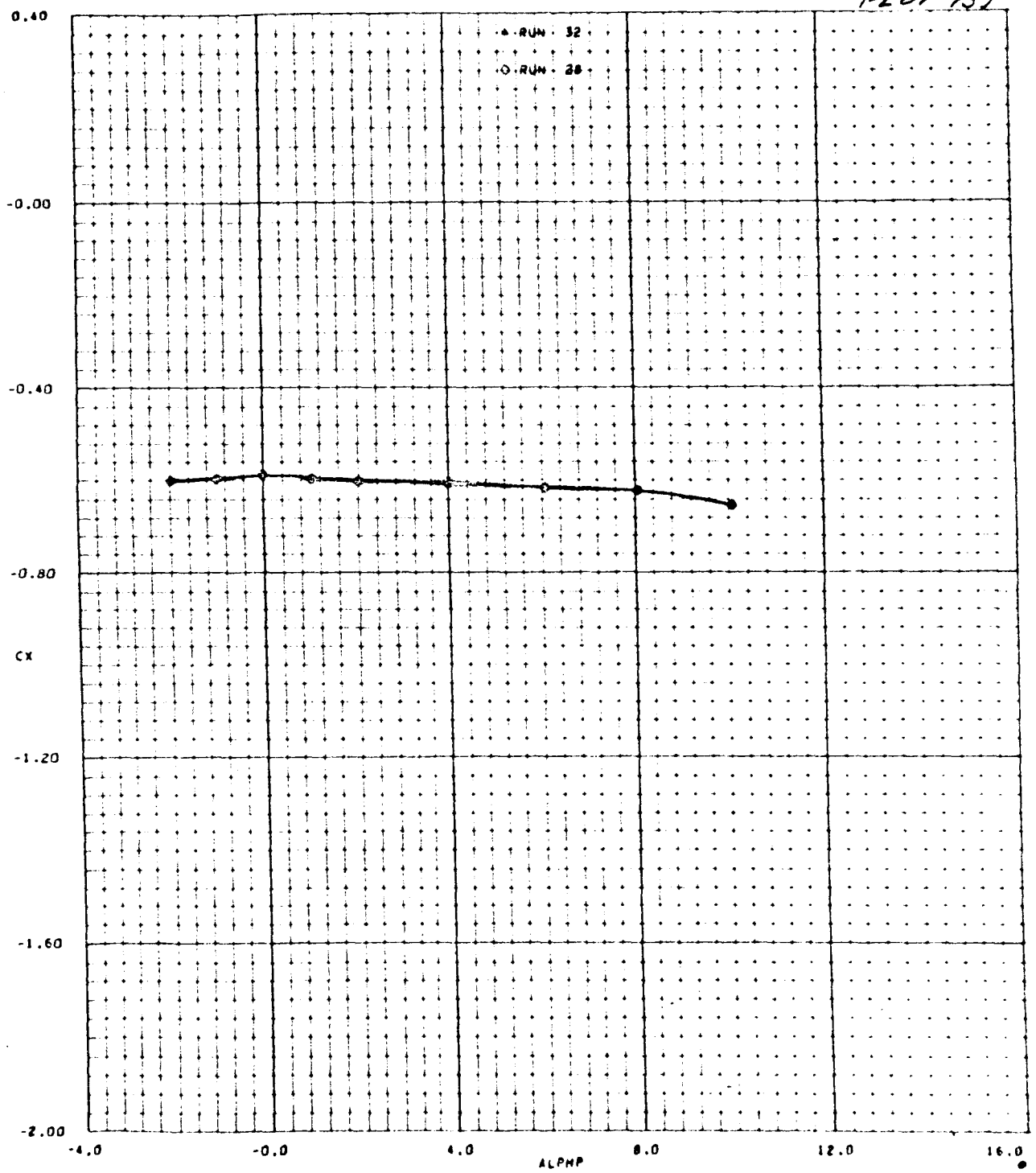
88

PLOT 13e


0.60
0.40
0.20
-0.00
CR
-0.20
-0.40
-0.60
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
• RUN 32
O RUN 28

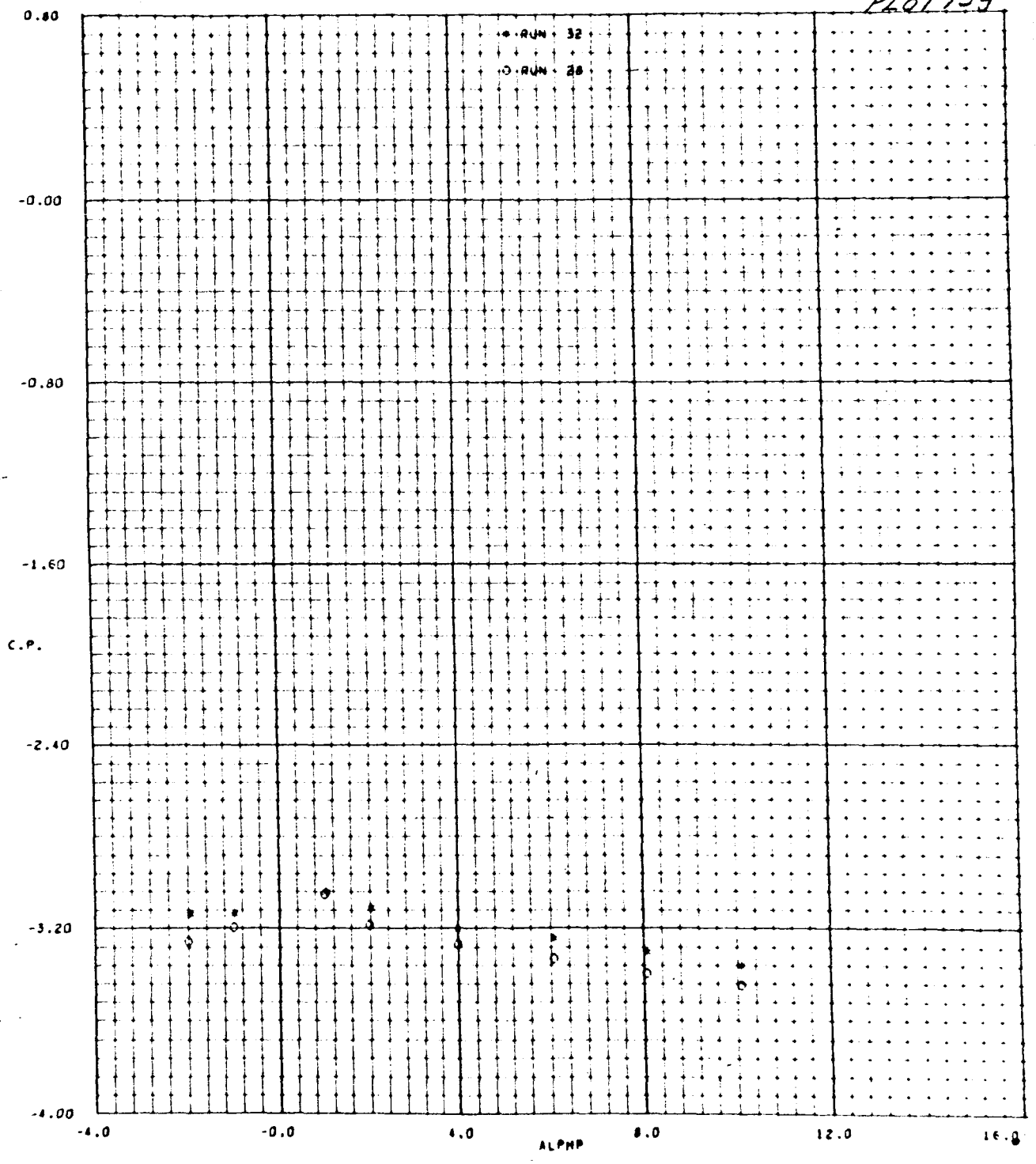
89

PLOT 13F°


0.40
-0.00
-0.40
-0.80
CX
-1.20
-1.60
-2.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
RUN 32
RUN 28

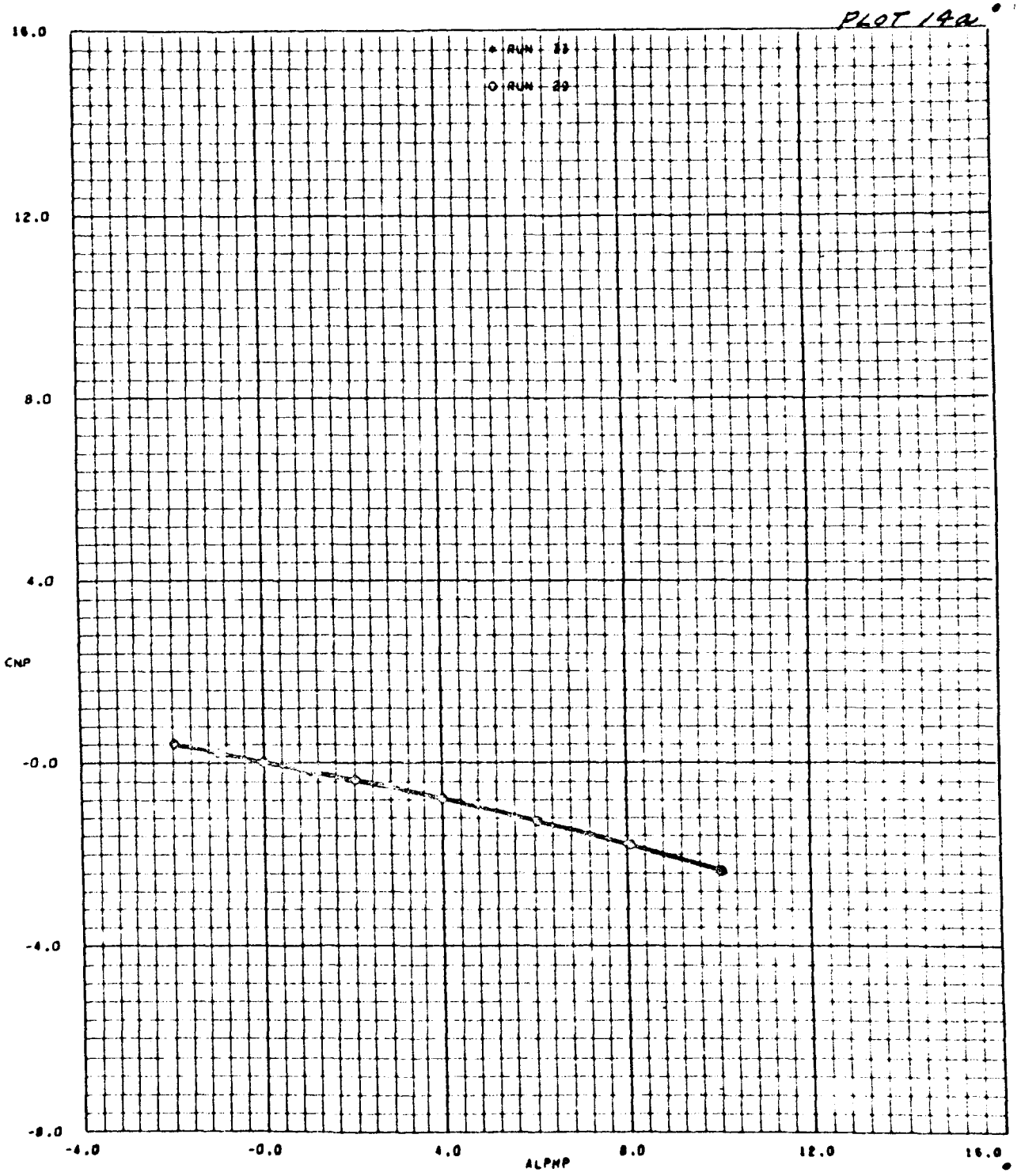
90

PLOT 139


RUN 32
RUN 28
0.80
-0.00
-0.80
-1.60
C.P.
-2.40
-3.20
-4.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

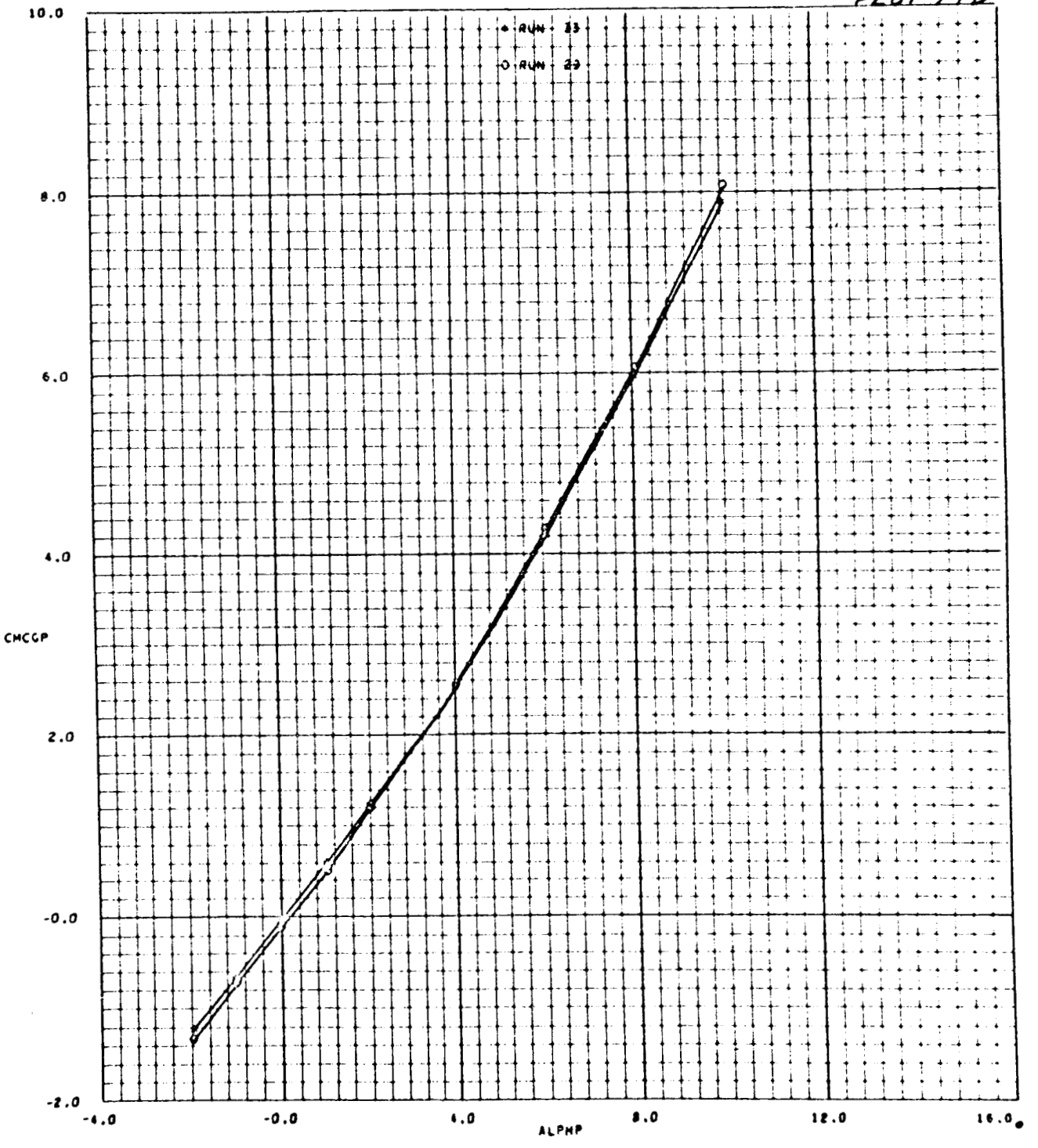
91

PLOT 14a

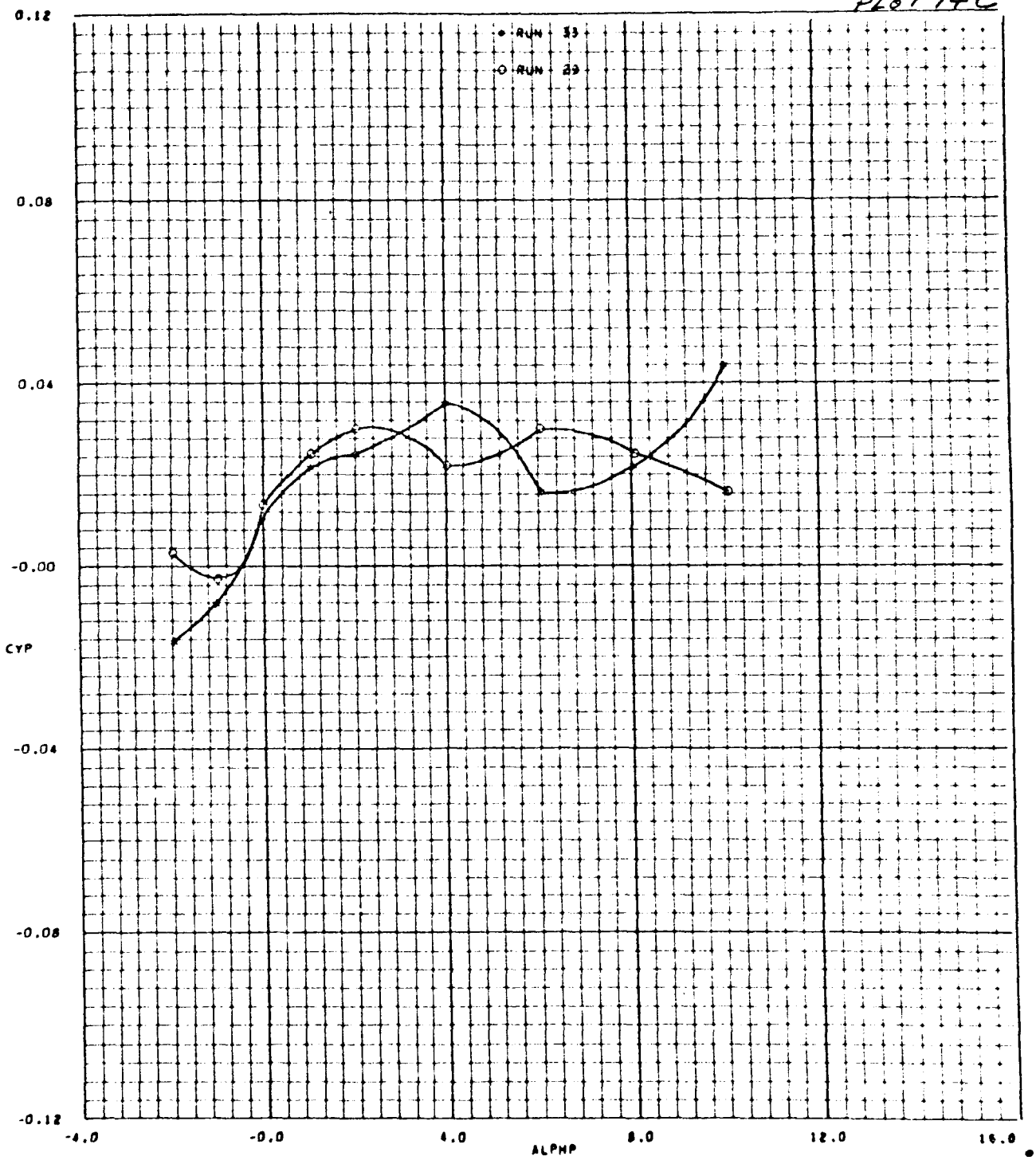


92

PLOT 14b

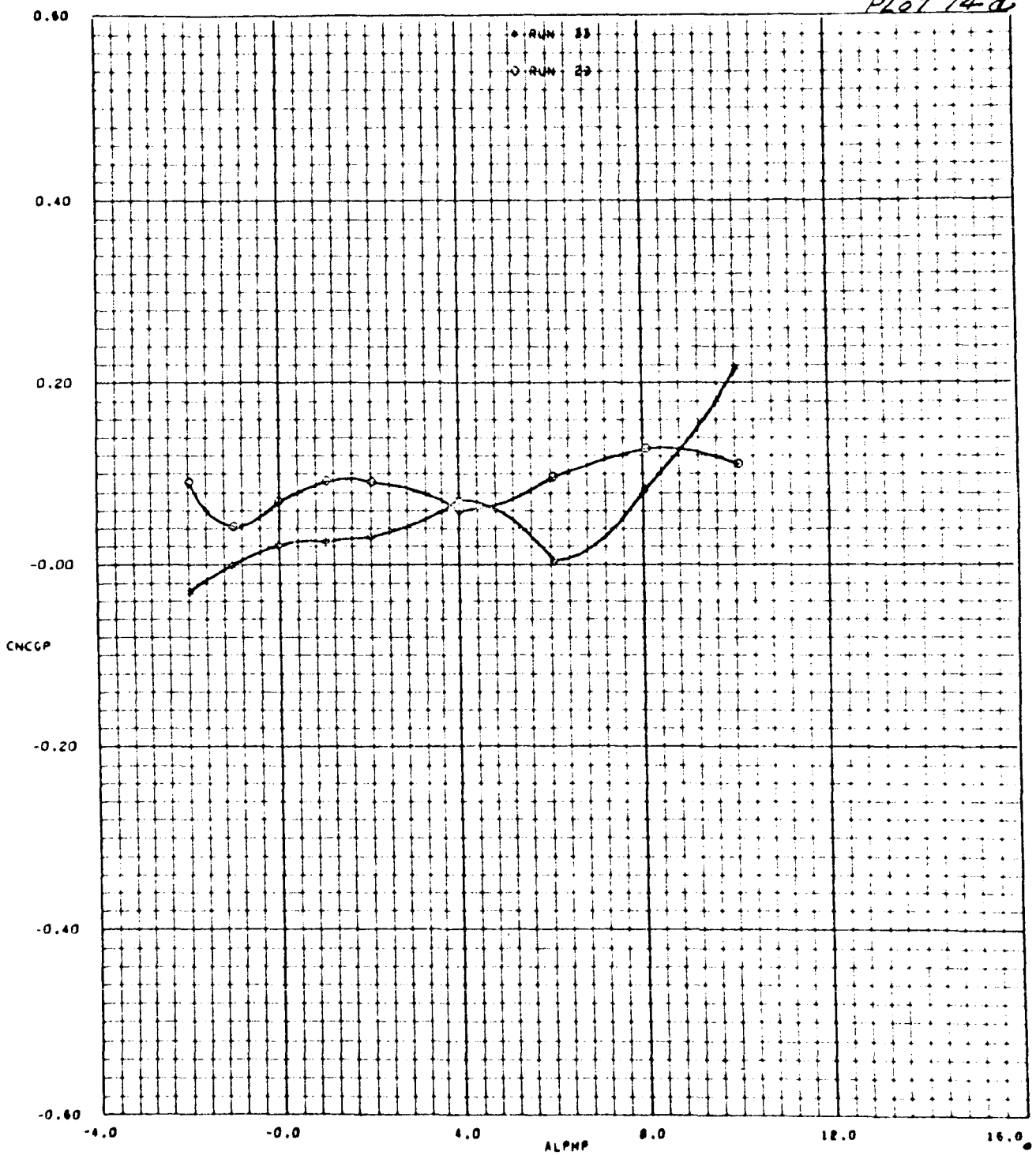


PLOT 14C

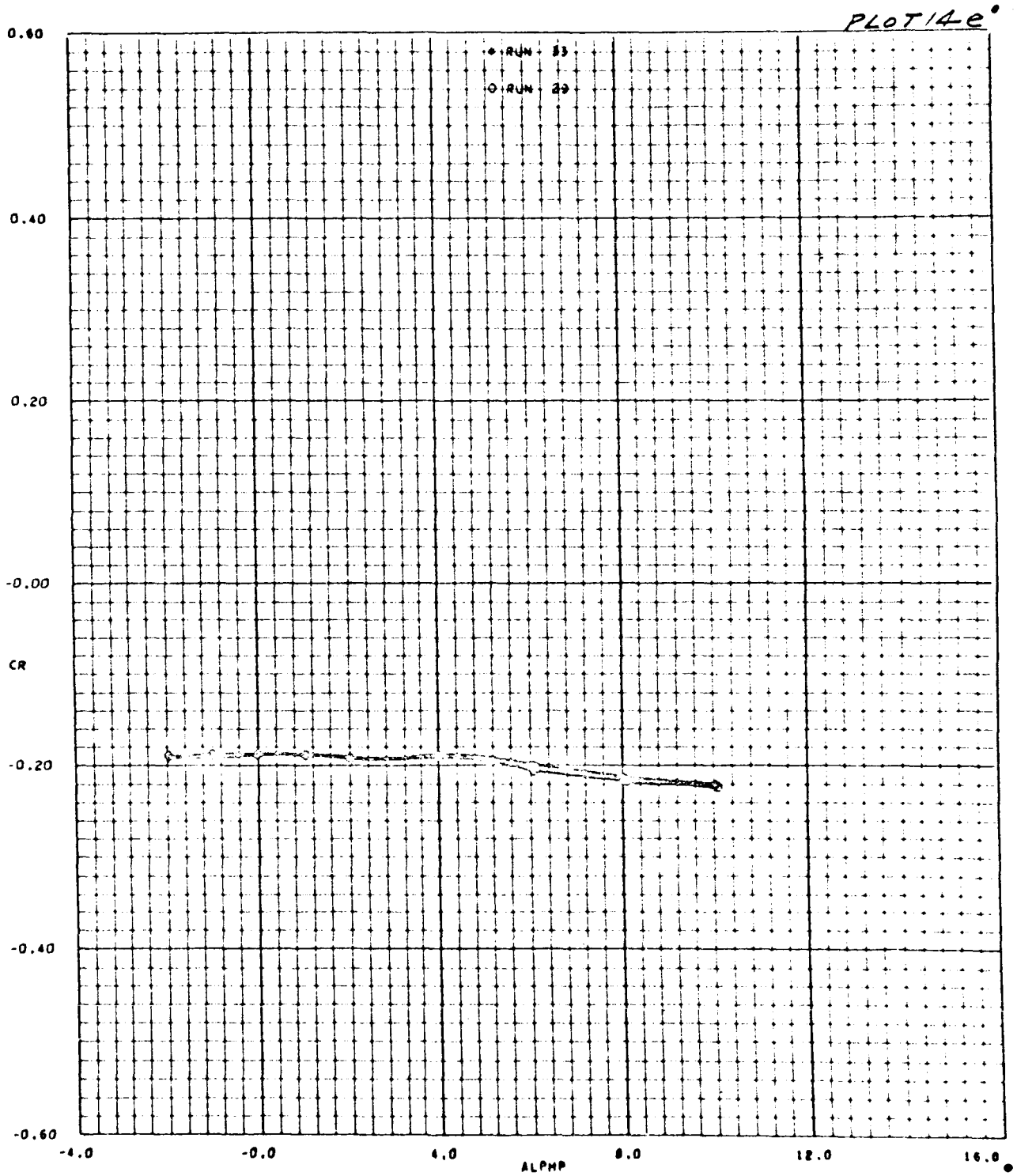

0.12
0.08
0.04
-0.00
CYP
-0.04
-0.08
-0.12
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
• RUN 33
O RUN 29

94

PLOT 14d°

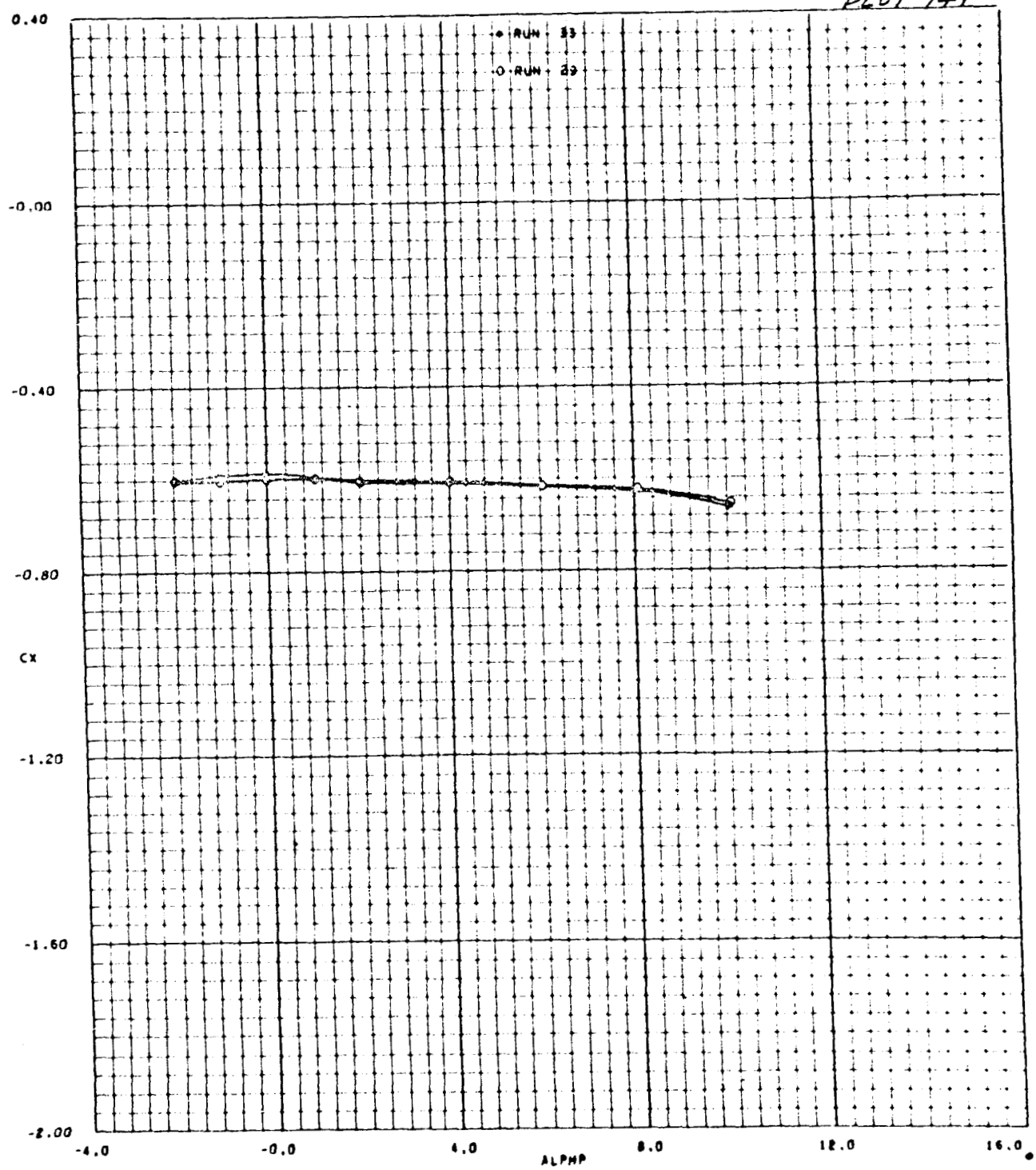

0.60
0.40
0.20
-0.00
-0.20
-0.40
-0.60
CNCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
• RUN 33
○ RUN 23

95


PLOT 14e
• RUN 53
O RUN 29
0.60
0.40
0.20
-0.00
CR
-0.20
-0.40
-0.60
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

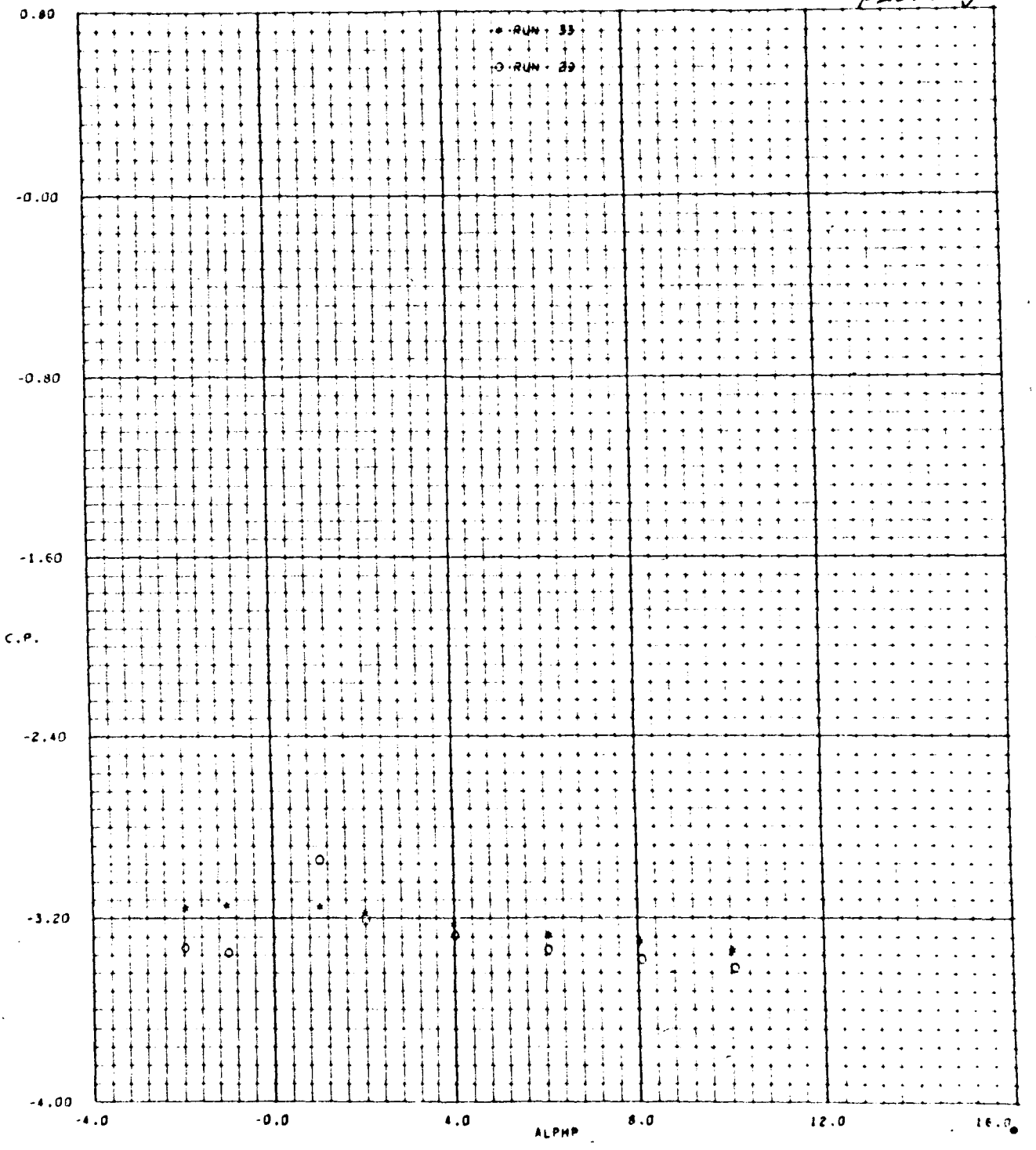
96

PLOT 14f


RUN 33
RUN 29
0.40
-0.00
-0.40
-0.80
CX
-1.20
-1.60
-2.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

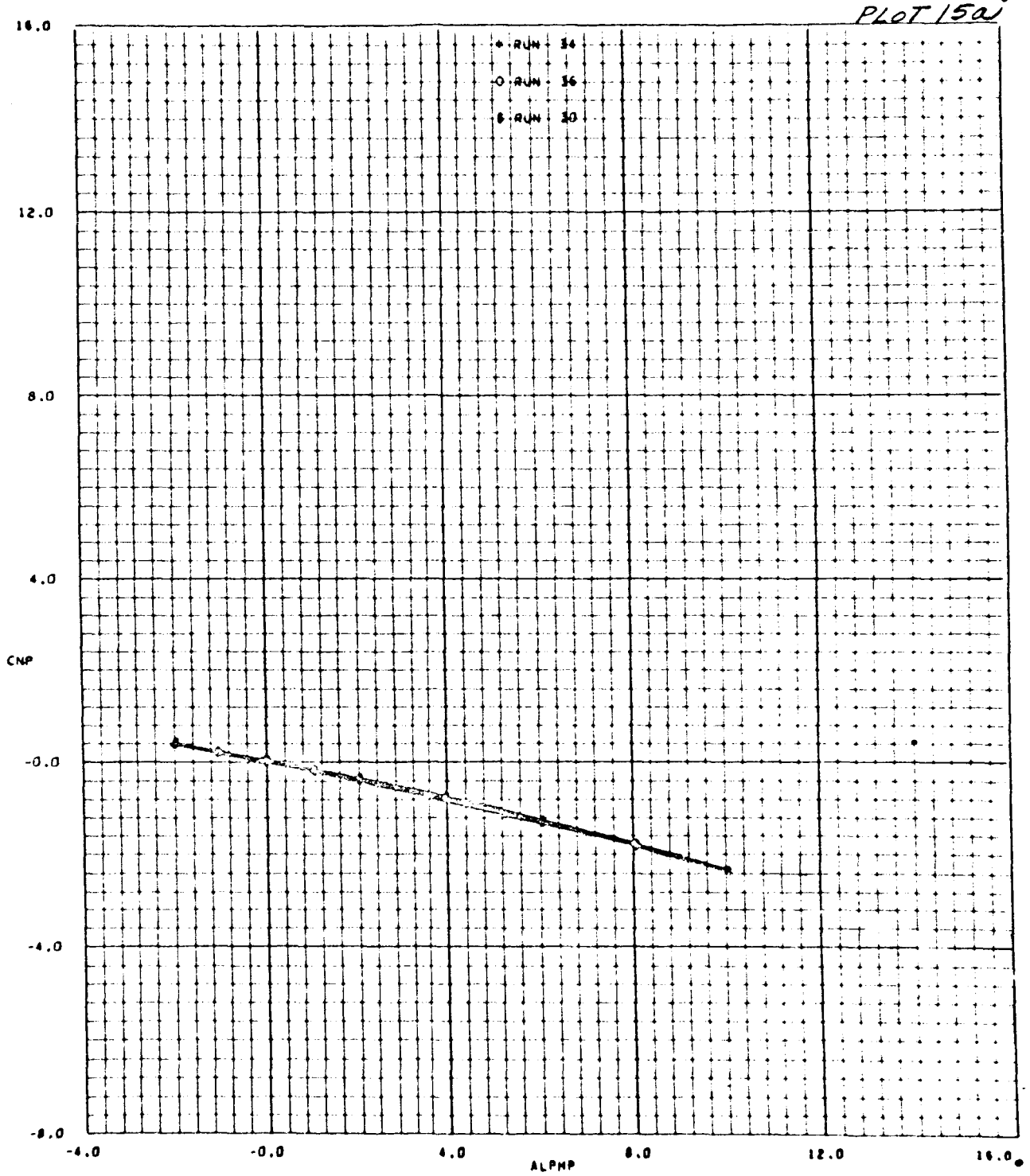
97

PLOT 149


* RUN 33
O RUN 29
0.80
-0.00
-0.80
-1.60
C.P.
-2.40
-3.20
-4.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

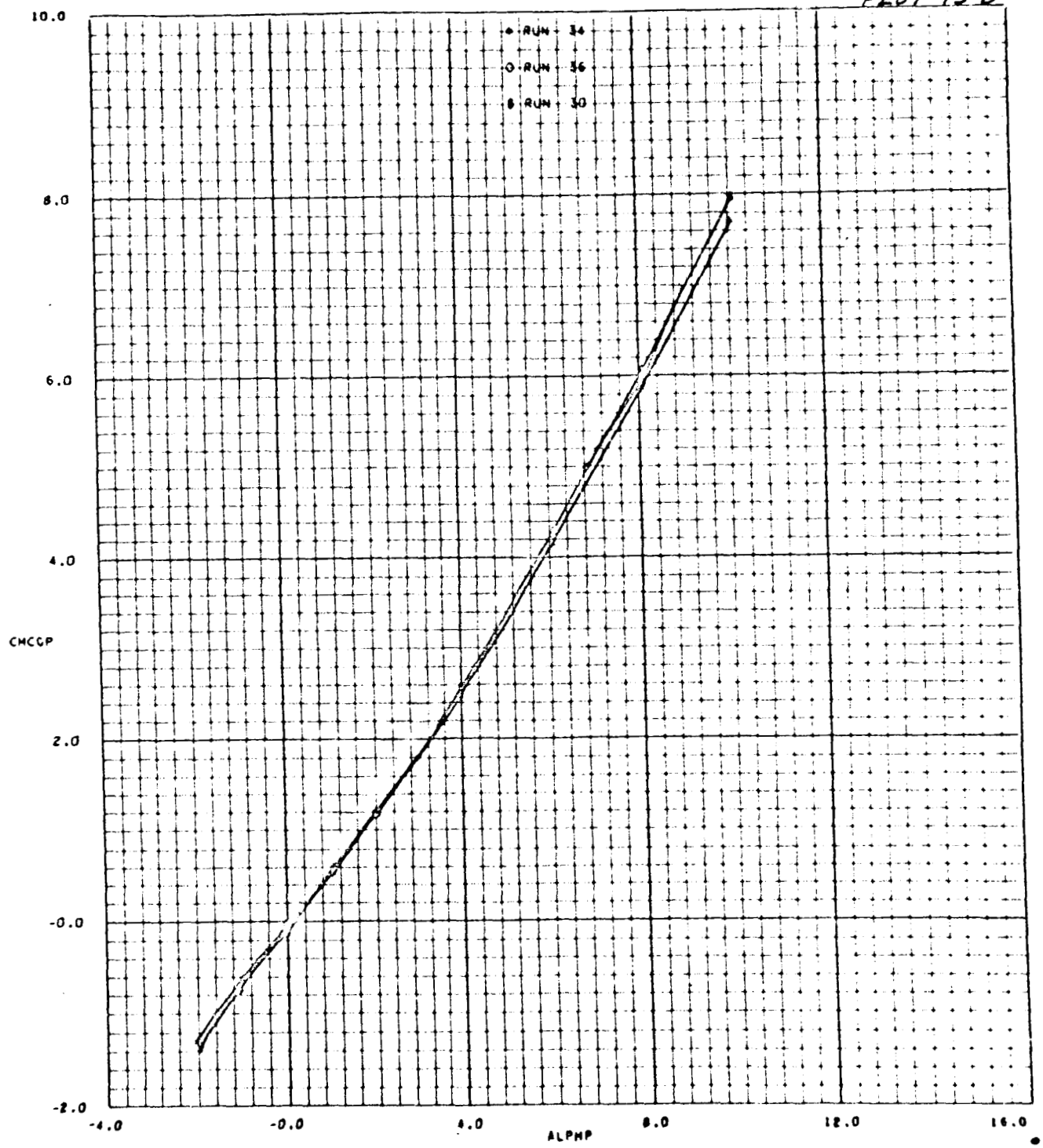
98

PLOT 15a


+ RUN 34
O RUN 36
δ RUN 30
16.0
12.0
8.0
4.0
CNP
-0.0
-4.0
-8.0
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

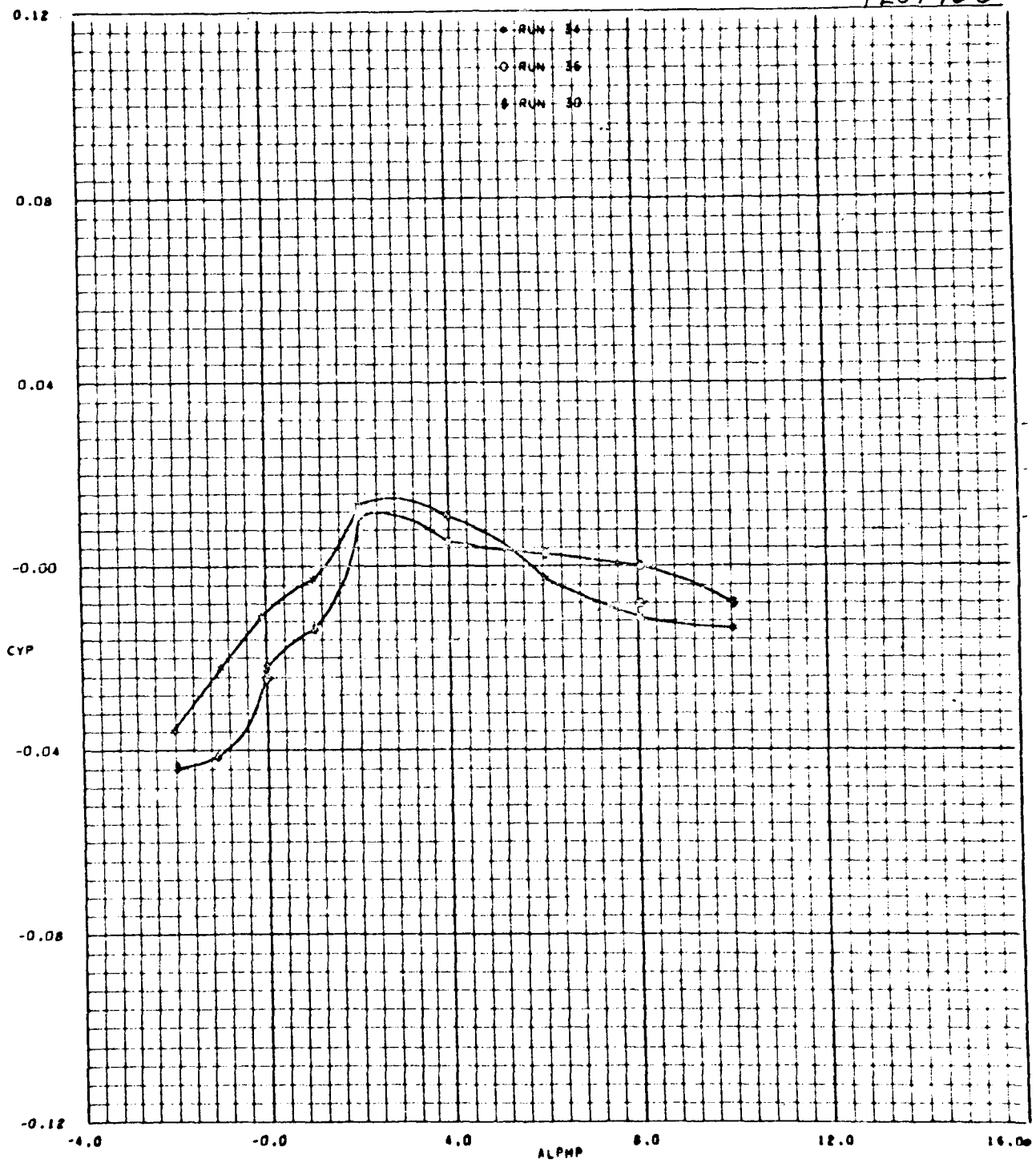
99

PLOT 15b


10.0
8.0
6.0
4.0
2.0
-0.0
-2.0
CMCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
• RUN 34
O RUN 36
B RUN 30

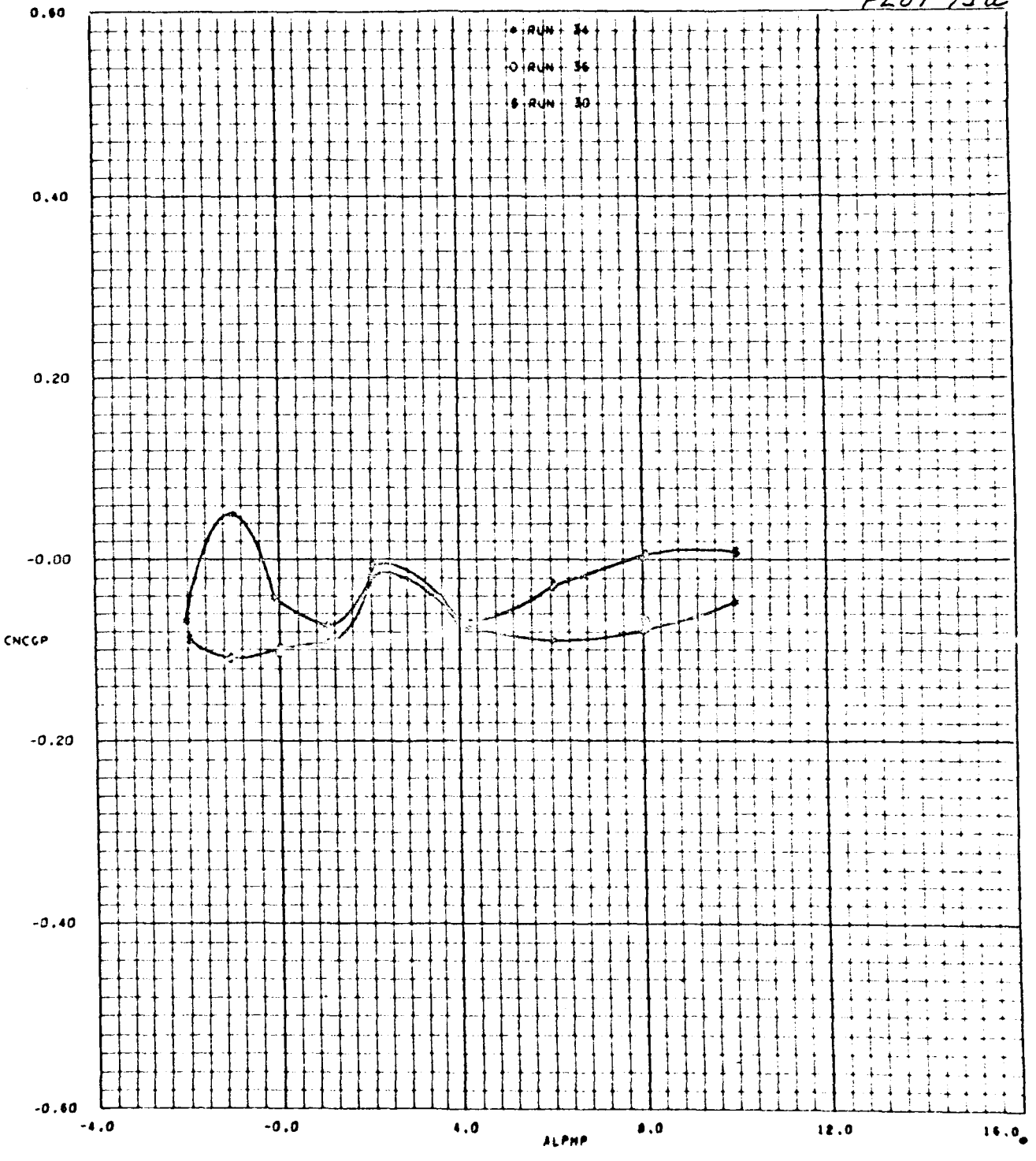
100

PLOT 15C


0.12
0.08
0.04
-0.00
CYP
-0.04
-0.08
-0.12
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
• RUN 34
O RUN 36
$ RUN 30

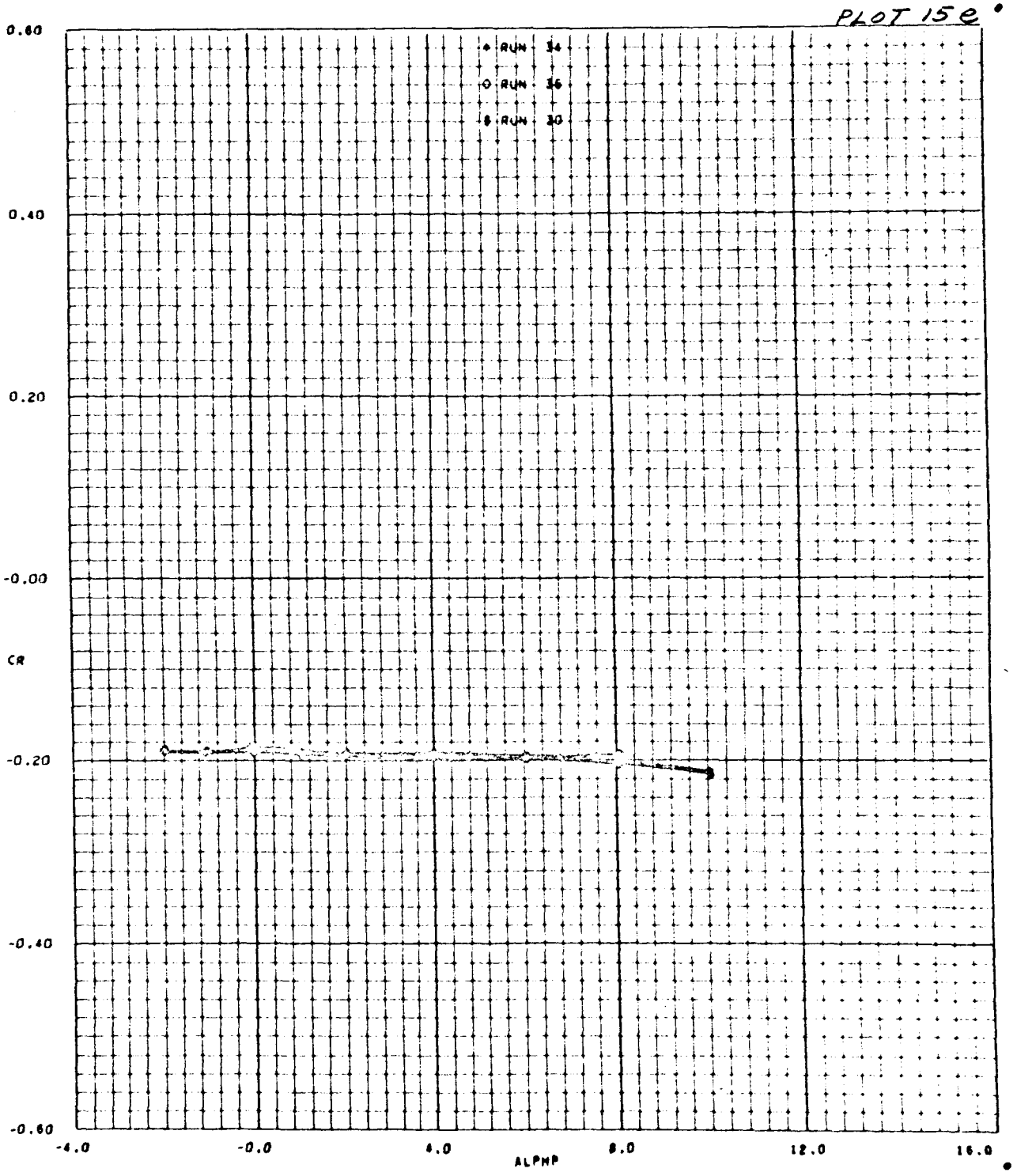
101

PLOT 15d

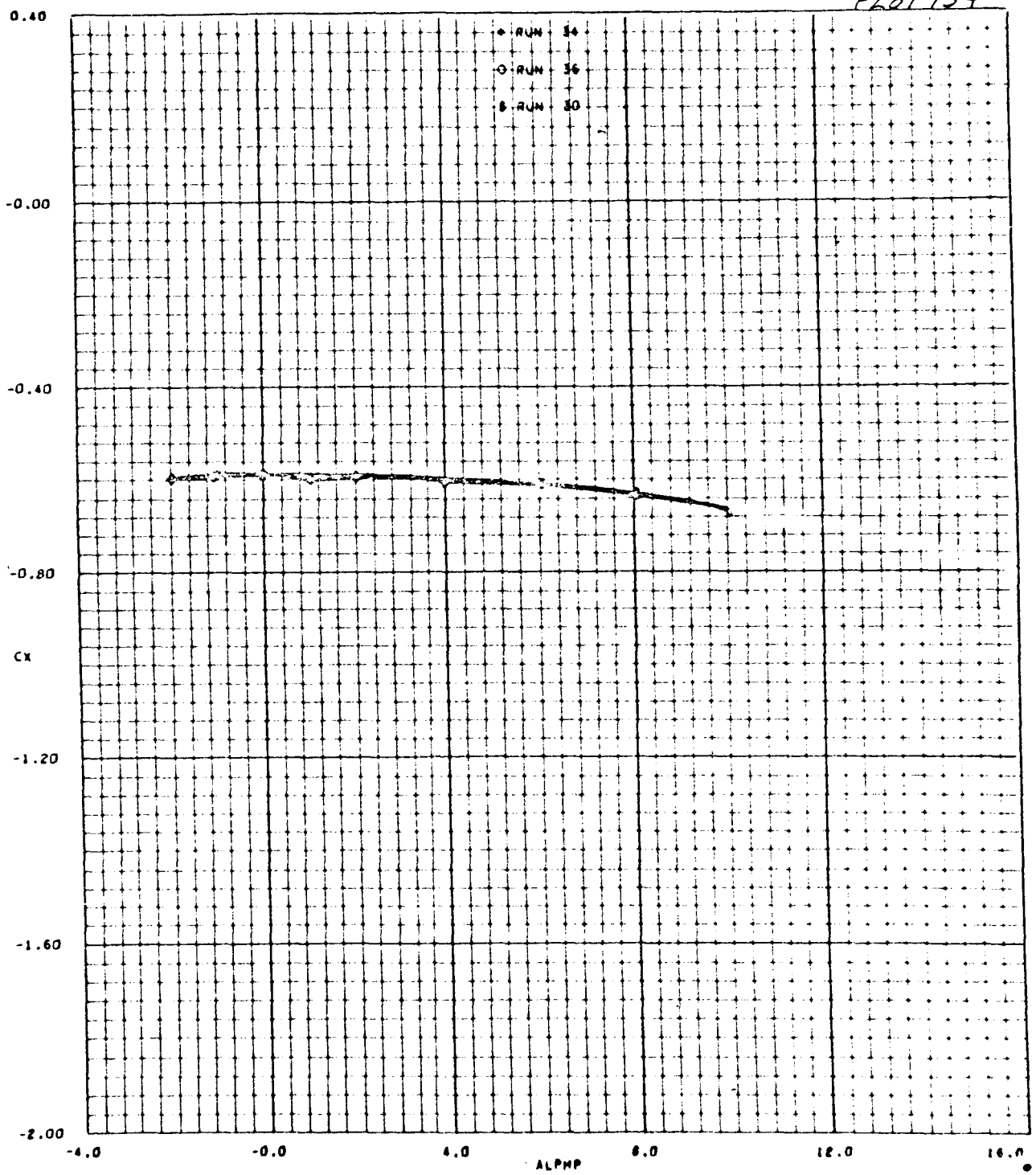

0.60
0.40
0.20
-0.00
-0.20
-0.40
-0.60
CNCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
• RUN 34
O RUN 36
$ RUN 30

102

PLOT 15e

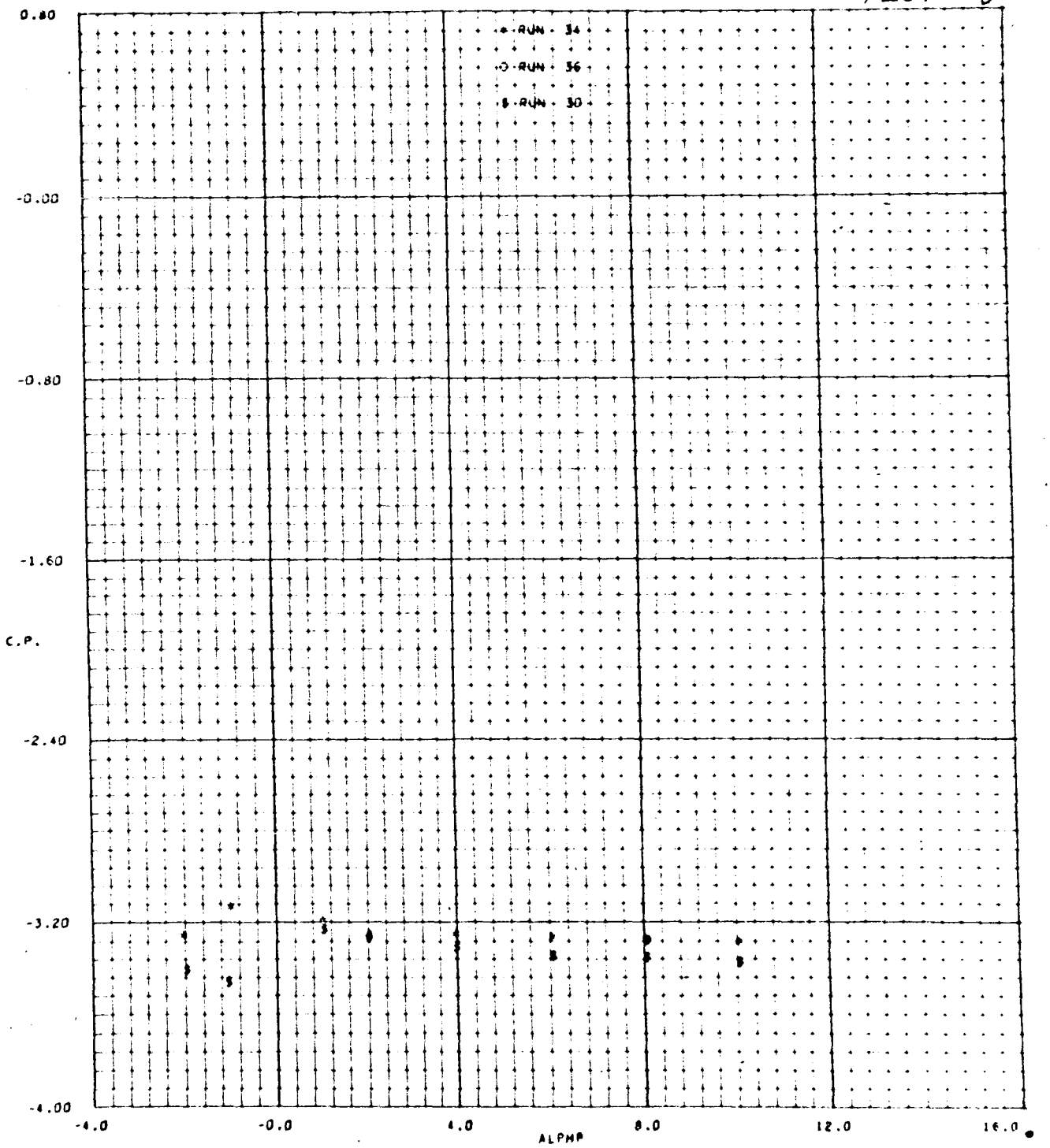

+ RUN 34
O RUN 36
$ RUN 30
0.60
0.40
0.20
-0.00
CR
-0.20
-0.40
-0.60
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

PLOT 15f


+ RUN 54
O RUN 56
$ RUN 50
0.40
-0.00
-0.40
-0.80
CX
-1.20
-1.60
-2.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

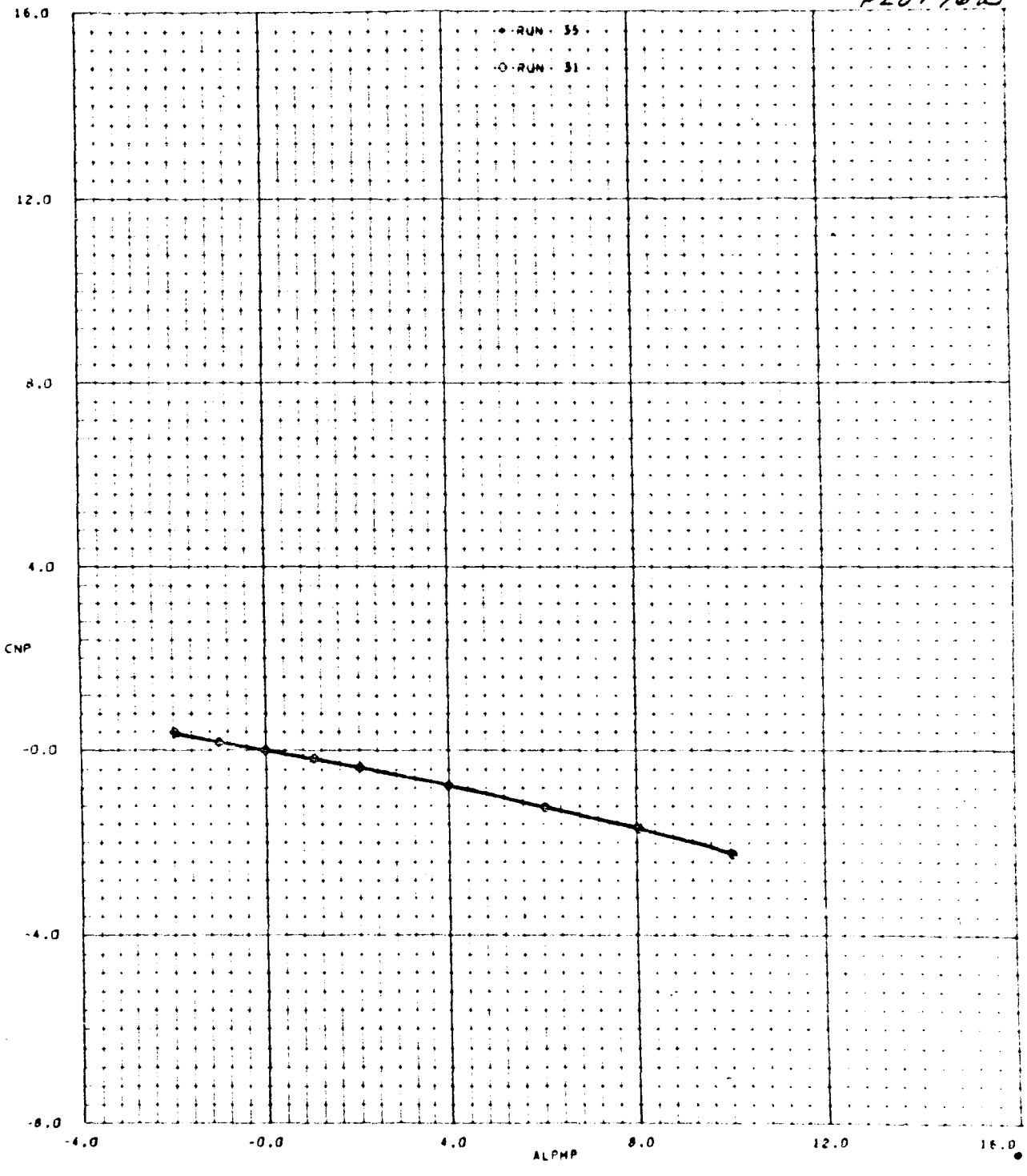
104

PLOT 159


+ RUN 34
O RUN 36
$ RUN 30
0.80
-0.00
-0.80
-1.60
C.P.
-2.40
-3.20
-4.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

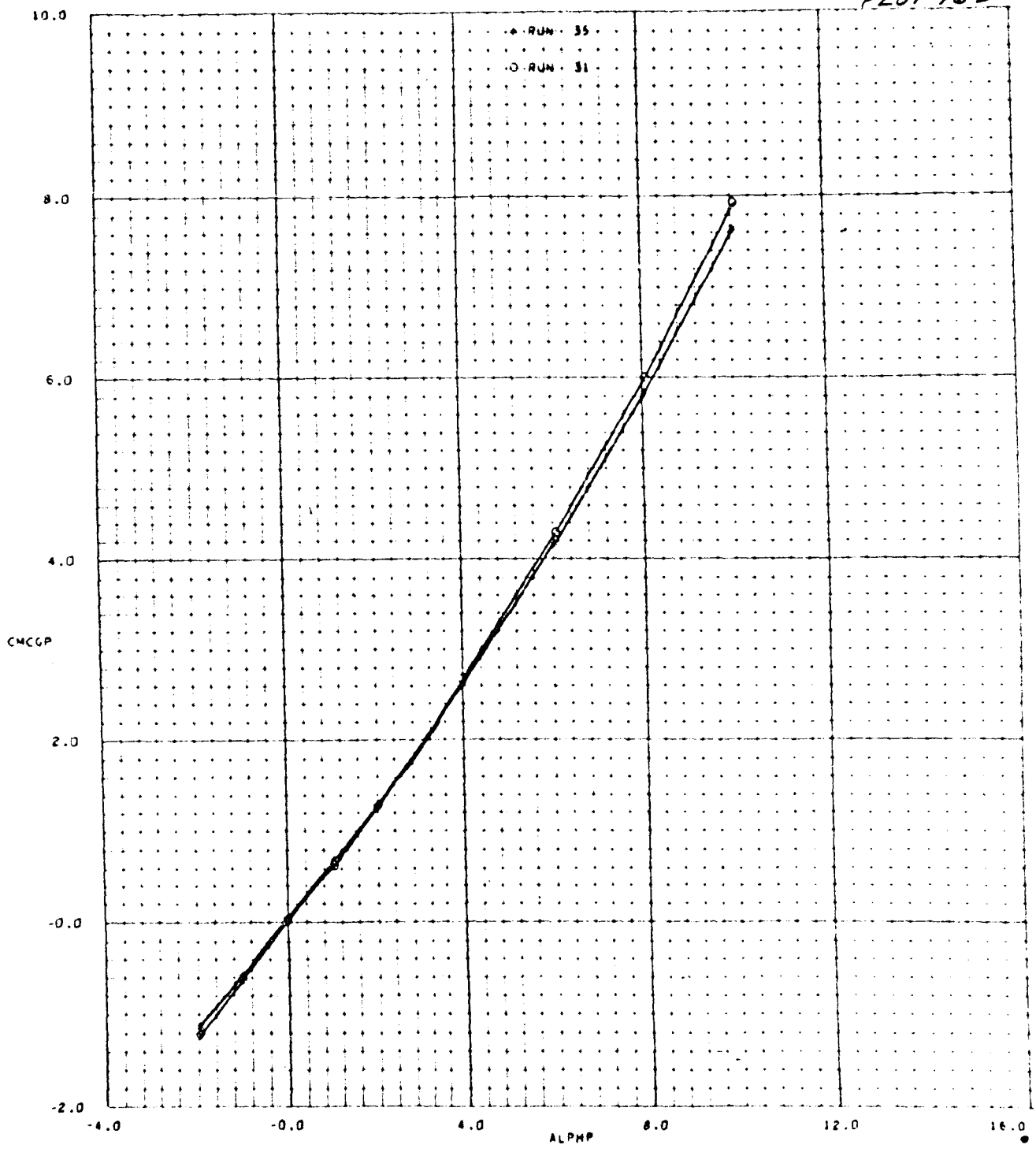
105

PLOT 16a



106

PLOT 16b


+ RUN 35
O RUN 31
10.0
8.0
6.0
4.0
2.0
-0.0
-2.0
CMCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

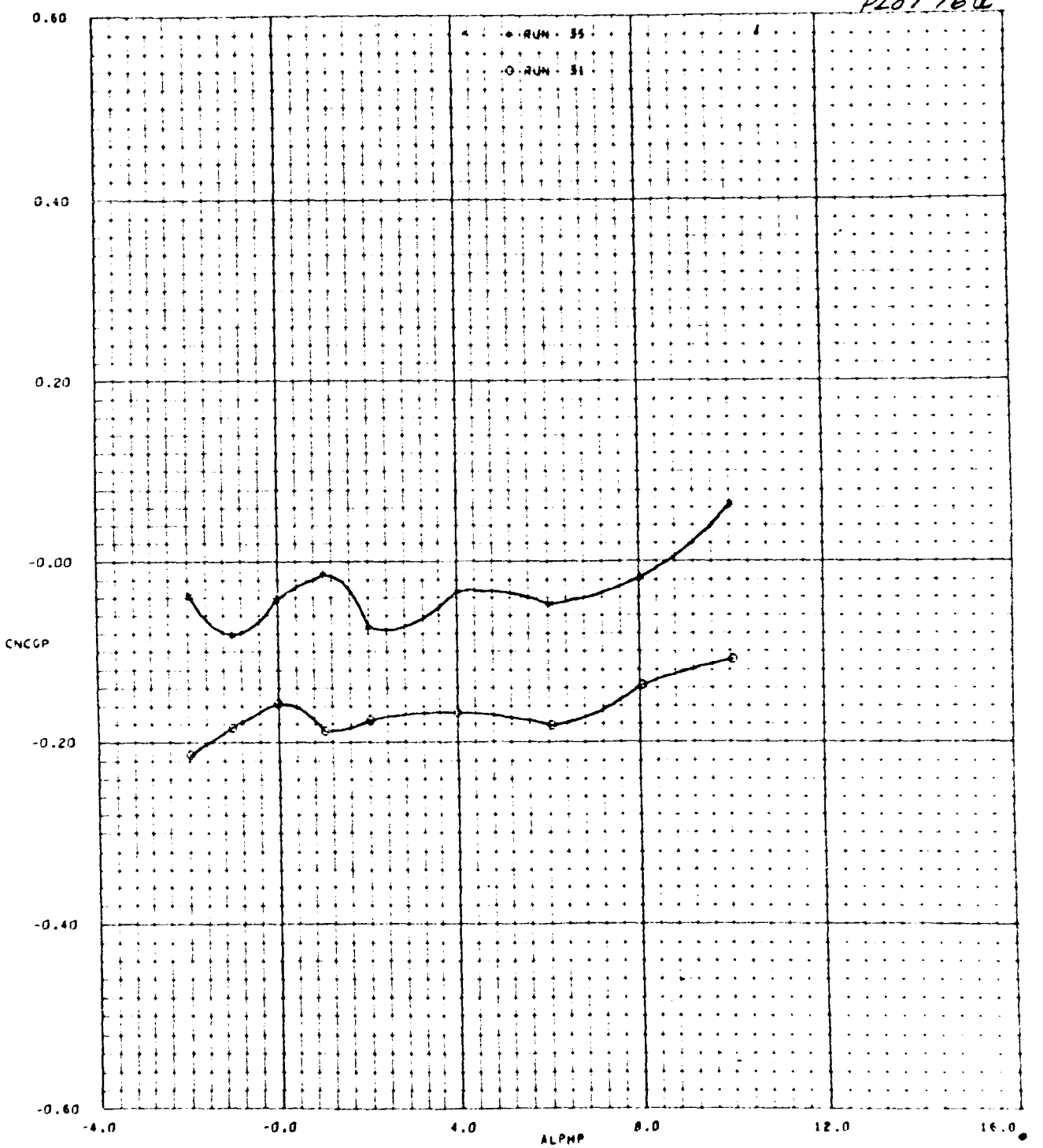
107

PLOT 16C

0.12
0.08
0.04
-0.00
CYP
-0.04
-0.08
-0.12
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
+ RUN 35
O RUN 31

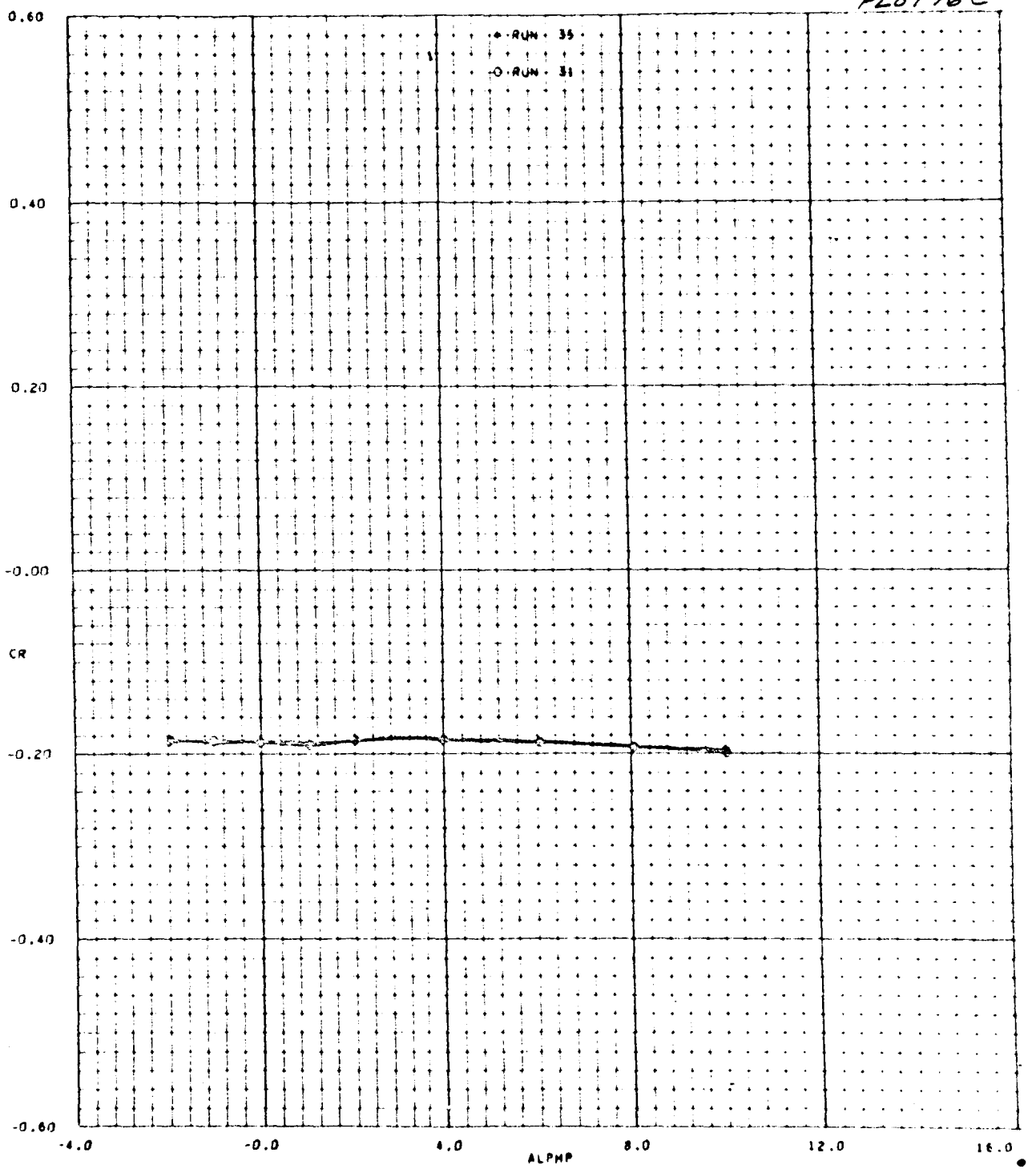
108

PLOT 16d


RUN 35
RUN 51
0.60
0.40
0.20
-0.00
-0.20
-0.40
-0.60
CNCGP
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

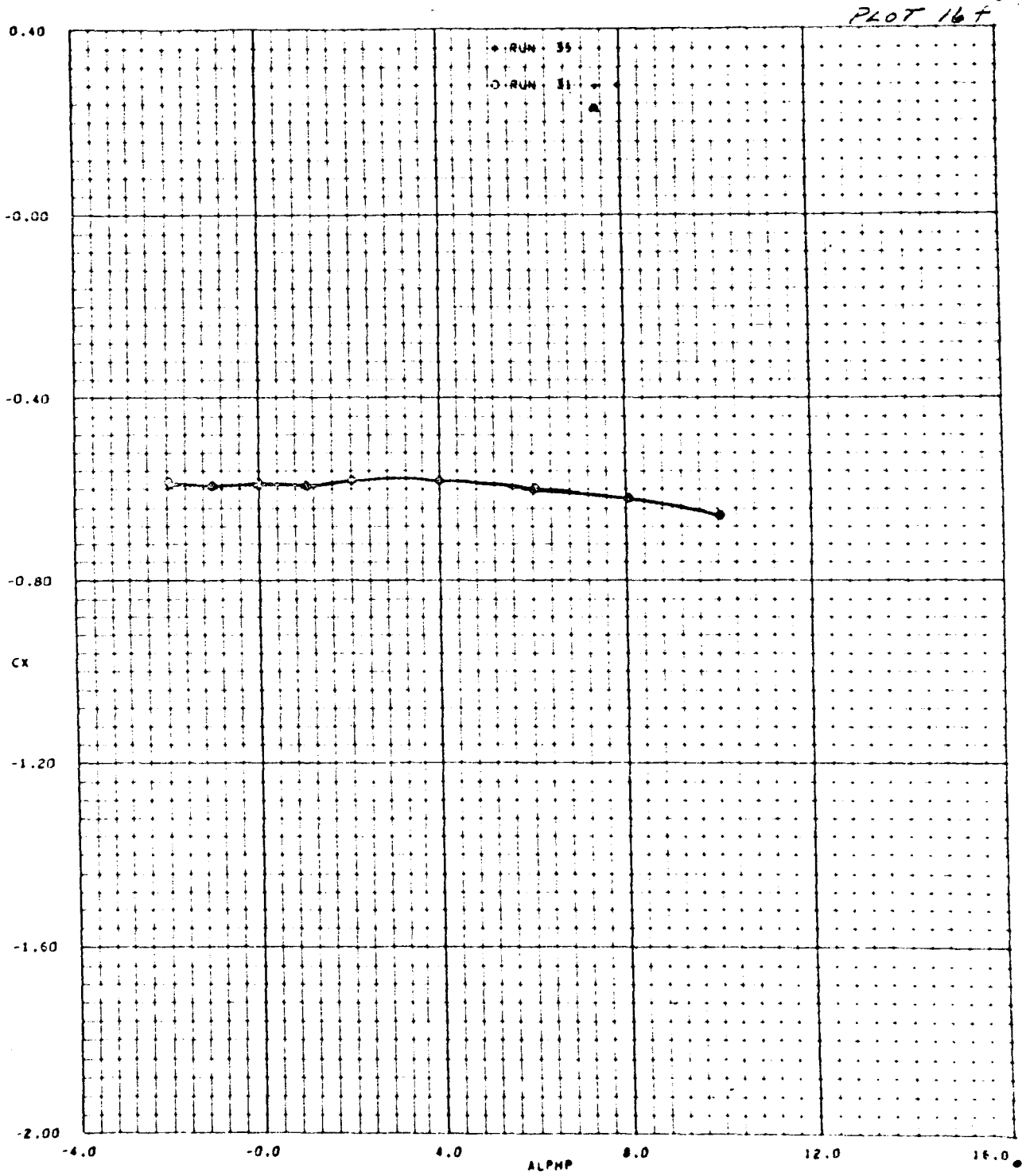
109

PLOT 16 e


0.60
0.40
0.20
-0.00
CR
-0.20
-0.40
-0.60
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP
+ RUN 35
O RUN 31

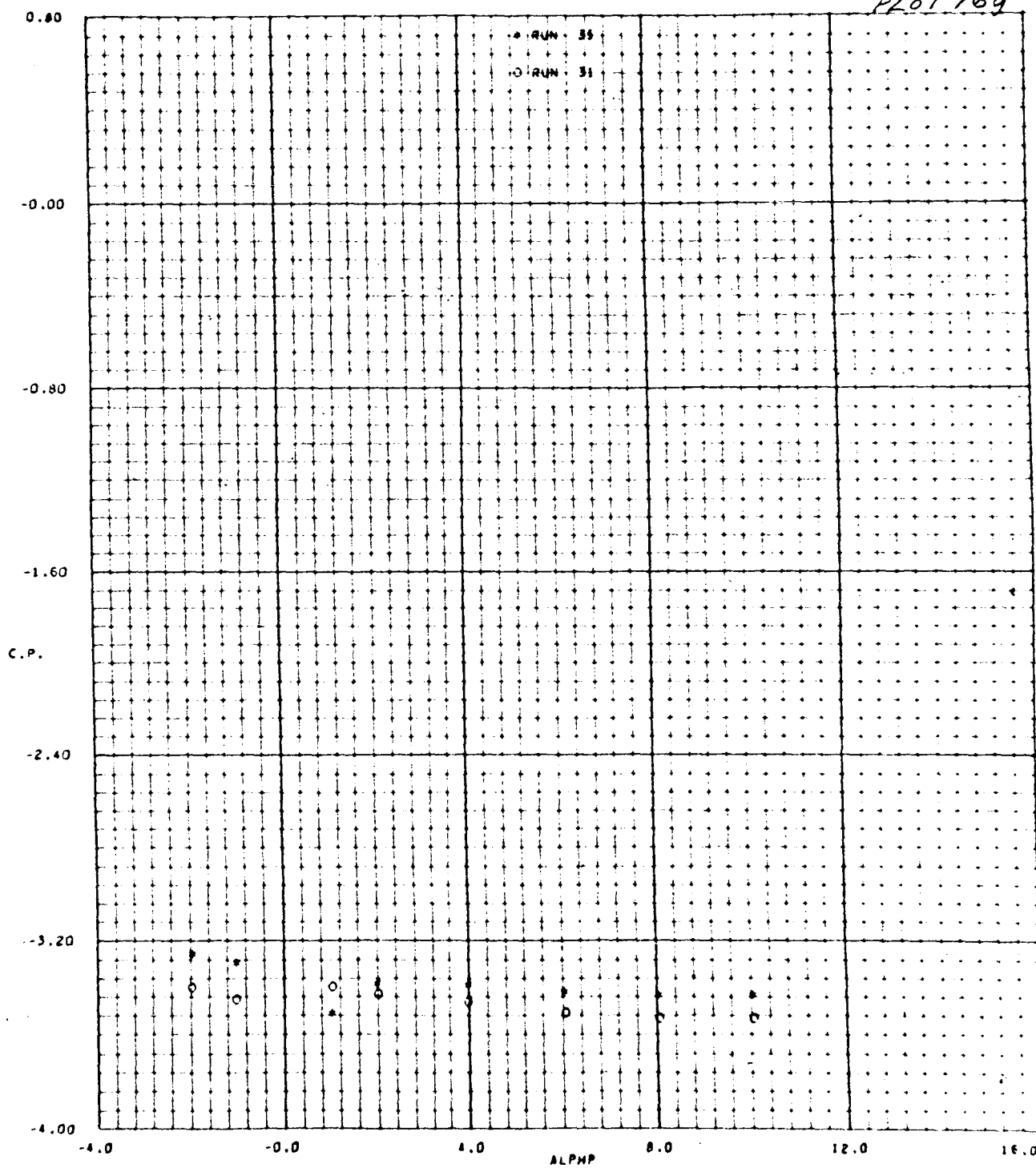
110

PLOT 16f


RUN 35
RUN 31
0.40
-0.00
-0.40
-0.80
CX
-1.20
-1.60
-2.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

111

PLOT 169


RUN 35
RUN 31
0.80
-0.00
-0.80
-1.60
C.P.
-2.40
-3.20
-4.00
-4.0
-0.0
4.0
8.0
12.0
16.0
ALPHP

112