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TECHNICAL DEVELOPMENT REPORT NO. 164

CHARACTERISTICS OF A REPRESENTATIVE GROUP OF CAA ILS FACILITIES

FOR LIMITED DISTRIBUTION

By

Lawrence N. Spinner
and
John W. Watt

Electronics Division
Technical Development

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CIVIL AERONAUTICS ADMINISTRATION
TECHNICAL DEVELOPMENT
AND EVALUATION CENTER
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Characteristics of a Representative Group of CAA ILS Facilities

This paper contains the results, a description of the methods employed, and some conclusions regarding the data which were compiled on a selected group of ILS facilities.

The flight tests were started on August 18, 1951, and completed on August 29, 1951. The ILS installations at Minneapolis, Minnesota; Fargo, North Dakota; Spokane, Washington; Eugene, Oregon; San Francisco, California; Rock Springs, Wyoming; and Cheyenne, Wyoming were checked. Airplane N-10, which is a DC-3, was used for all flight testing. At each facility observed data were secured for determining course shape, linearity, course width, and field strength for both localizer and glide slope. Also, the modulation depth and course clearance were measured on the localizer. The airplane was equipped with a Bendix Navigation Receiver Type MN-85 with a Collins Type 37J antenna, a glide slope receiver Type R89B with a Bendix cavity type antenna, and Esterline-Angus recorders for recording the course deviation indicator, flag alarm, and AVC currents. The equipment used on the ground consisted of a theodolite equipped with an electrical pick-off on the vertical and azimuth controls and arranged to record the movement of these controls.

The routine followed when checking a facility was as follows:

1. After takeoff the recorder speed was adjusted to synchronize with the ground recording and the recorder amplifiers were checked for correct calibration.
2. The localizer course width was determined by flying inbound with the crosspointer reading 150 microamperes "fly right," while the ground crew observed the angular departure of the airplane from the course. This procedure was repeated for the 150 microamperes fly "left" position, for the 75 microamperes "fly right," and for the 75 microamperes "fly left." The observations in each instance were made at the outer marker.
3. An accurate determination of ground speed was established by timing for two directions the flight of the aircraft between two check points on the ground of known distance apart. (Outer marker and glide slope shelter)
4. The localizer course width was determined by flying a perpendicular to the course in both directions at the outer marker using the same power setting which was established in (3) above. During this cross check, the ground crew using the theodolite tracked the airplane and marked the airborne recording at one degree intervals.
5. Starting at approximately eight miles from the approach end of the runway three low approaches were made. During these approaches the course deviation indicator current, flag alarm current, and AVC current were recorded. Also, on these approaches the ground crew tracked and recorded the position of the airplane using the specially-equipped theodolite.
6. A six mile circle around the localizer was flown and the course deviation indicator recorded to determine course clearance.

7. The aircraft was flown to center the glide slope pointer while the ground crew determined the glide slope angle using the theodolite.
8. The aircraft was flown first above the path then below the path to approximately one dot deflection to allow the ground crew to establish the amplifier gain for their recording.
9. Starting at approximately eight miles from the approach end of the runway, three low approaches were made. During these approaches the course deviation indicator current was recorded. Also, on these approaches the ground crew tracked and recorded the position of the airplane using the specially equipped theodolite.
10. Three 1,000 foot passes were made and during these passes the ground crew marked both the airborne and ground recordings at .1 degree intervals.

The calculations and interpretation of the data secured by the flight tests appear in tabulated form in this report. A brief explanation is included here to clarify the method used in arriving at the results.

Localizer Course Width

Two figures are shown, the course width as determined by the theodolite observations, and the course width as determined by scaling the recording and calculating the angle. Thus, the course width was measured independently by two methods and it will be noted that in most instances good agreement was secured.

Localizer Linearity

The tabulation shown and secured by theodolite observations is self-explanatory. The localizer linearity, as determined by scaling the airplane crossover is shown on the attached curves. Poor visibility at Eugene, Oregon and San Francisco, California prevented the taking of accurate data on linearity at these sites.

Localizer Modulation on Course

From the flag alarm current recording the modulation depth was determined by referring to a previously prepared calibration curve on the receiver of flag alarm current versus modulation depth.

Localizer Field Strength

Localizer field strength was determined by noting the AVC voltage developed at the points indicated and referring to a calibration curve of the receiver. The field strength is in terms of the equivalent signal generator microvolts required to develop the AVC voltage indicated.

Localizer Course Shape

The localizer course shape shown plotted for the three approaches made at each facility were secured by superimposing the aircraft course deviation indicator recording on the ground recording of the theodolite.

Glide Slope Course Width

Tabulated under this heading are glide slope course widths as determined by two independent methods in a manner similar to the methods used in determining localizer course width.

Glide Slope Linearity

The data for the glide slope linearity curves were secured by noting the position of the airplane at each .1 degree during the level pass. The attached curves plotted are the average secured during three level passes.

Glide Slope Field Strength

The glide slope field strength was determined by noting the AVC voltage developed over the check points indicated. The field strength is in terms of the equivalent signal generator microvolts required to develop the AVC voltage observed.

Some of the results are summarized for easy reference. It will be noted that on the glide slope course shape curves, while ther is a general agreement among the three curves on any facility, these do not coincide exactly. A possible explanation for this discrepancy is that this could be accounted for if the ground track of the airplane were not the same with reference to the localizer course on successive approaches.

The above results were secured by the coordinated efforts of the following:

Evans, Jim W. - Representing W-345, Development Coordinator, Office of Federal Airways, Ground Crew Theodolite Observer

Hodkinson, Norman R. - W-344, Flight Inspection Division, Pilot

Odneal, Harry - 4-577, Flight Operations Branch, Safety Operations Division, Ground Crew Theodolite Observer

Proctor, Robert - W-288, Special Operations Branch, Office of Aviation Safety, Copilot

Schur, Fred E. - 3-344, Flight Inspection Division, Flight Engineer

Spinner, Lawrence N. - TDEC, Flight Engineer

Watt, John W. - TDEC, Ground Crew Theodolite Observer

Location	Localizer Course Width		Theodolite				Calculated From Recording of Level Pass				Localizer Modulation Depth On Course	Glide Slope Field Strength	
	Recorder	Theodolite	Above Path	Below Path	Total	Path Angle	Above Path	Below Path	Total	Path Angle		Four Miles	One Mile
Minneapolis, Minn.	4.76	4.70	.43	.84	1.27	2.47	.48	.75	1.23	2.50	13.5	1100	4150
Fargo, N. D.	6.34	6.08	.40	.62	1.02	2.72	.40	.70	1.10	2.80	18.5	740	3200
Spokane, Wash.	4.07	3.88	.55	.73	1.28	2.82					14.0	2500	10000
Eugene, Oregon	3.56	3.65	.57	.72	1.29	2.72	.62	.91	1.53	2.94	18.5	1850	8000
San Fran., Calif.	3.50	3.56	.43	.80	1.23	2.70	.46	.82	1.28	2.78	17.7	1250	4150
Rock Springs, Wyo.	4.00	4.09	.51	.88	1.39	2.72	.53	.98	1.51	2.75	17.0	3100	14000
Cheyenne, Wyo.	4.76	4.77	.54	.69	1.23	2.38	.49	.65	1.14	2.28	14.3	1600	7500

Minneapolis, Minn.

Checked

August 18, 1951

Localizer Course Width

Measured by theodolite observations - 4.70 degrees

Measured by recording crossover - 4.76 degrees

Localizer Linearity

Measured by theodolite observations

Deviation Indicator (microamps)	Angular Departure From Course (degrees)
-150	2.40
- 75	1.34
0	0
+ 75	1.17
+150	2.30

Localizer Linearity

As determined by recording and scaling airplane crossover
(Shown plotted in last part of this report)

Deviation Indicator (microamps)	Angular Departure From Course (degrees)
-150	2.37
-112.5	1.86
- 75	1.18
- 37.5	.55
0	0
+37.5	.52
+ 75	1.13
+112.5	1.76
+150	2.36

Minneapolis, Minn. (Continued)

Localizer Modulation on Course

Measured by noting flag alarm current

Flag alarm current - 320 microamps

Modulation Depth - 18.5 per cent each, 90 and 150 cycles

Localizer Field Strength

(Data not obtained on Minneapolis)

Localizer Course Shape

Shown plotted in last part of this report.

Glide Path Course Width

As measured by theodolite observations

150 microamps "Fly up" -	1.63 degrees
"on course" -	2.47 degrees
150 microamps "Fly down" -	2.90 degrees
course width below path -	.84 degrees
course width above path	.43 degrees
Total course width -	1.27 degrees

As measured by recording and scaling level pass

150 microamps "Fly up" -	1.75 degrees
"on course"-	2.50 degrees
150 microamps "Fly down"-	2.98 degrees
course width below path -	.75 degrees
course width above path -	.48 degrees
Total course width -	1.23 degrees

Glide Path Linearity

As measured by theodolite observations

Course Deviation Indicator (microamps)	Angle (degrees)	Angular Departure From Course (degrees)
150	1.60	.83
112.5	1.99	.44
75	2.18	.25
37.5	2.30	.13
0	2.43	0
37.5	2.52	.09
75	2.61	.18
112.5	2.72	.29
150	2.83	.40

Glide Path Field Strength

Location	Distance (Feet)	D C. (volts)	Field Strength (microvolts)
Outer Marker	25,872	1.1	800
Middle Marker	4395	1.8	4400
End of Runway	963	2.1	13500

Fargo, N. D.

Checked

August 19, 1951

Localizer Course Width

Measured by theodolite observations - 6.08 degrees

Measured by recording crossover - 6.34 degrees

Localizer Linearity

Measured by theodolite observations

Deviation Indicator (microamps)	Angular Departure From Course (degrees)
-150	2.88
- 75	1.35
0	0
+ 75	1.60
+150	3.20

Localizer Linearity

As determined by recording and scaling airplane crossover
(Shown plotted in last section of this report)

Deviation Indicator (microamps)	Angular Departure From Course (degrees)
-150	3.0
-112.5	2.1
- 75	1.3
- 37.5	0.7
0	0
+ 37.5	0.7
+ 75	1.4
+112.5	2.3
+150	3.2

Localizer Modulation on Course

Measured by noting flag alarm current

Flag alarm current - 320 microamps

Modulation depth - 18.5 per cent each, 90 and 150 cycles

Localizer Field Strength

Location	Field Strength (microvolts)
Outer marker	850
Middle marker	2000
End of runway	1200

Localizer Course Shape

(Shown plotted in last section of the report)

Glide Path Course Width

As measured by theodolite observations

150 microamps "Fly up" - 2.10 degrees

"on course"- 2.72 degrees

150 microamps "Fly down" - 3.12 degrees

course width below path - .62 degrees

course width above path - .40 degrees

Total course width - 1.02 degrees

As measured by recording and scaling level pass

150 microamps "Fly up" - 2.10 degrees

"on course"- 2.80 degrees

150 microamps "Fly down" - 3.20 degrees

course width below path - .70 degrees

course width above path - .40 degrees

Total course width - 1.10 degrees

Glide Path Linearity

As measured by theodolite observations.

Course Deviation Indicator (microamps)	Angle (degrees)	Angular Departure From Course (degrees)
150	-	-
142.5	2.15	.57
112.5	2.35	.37
75	2.48	.24
37.5	2.60	.12
0	2.72	-
37.5	2.80	.08
75	2.90	.18
112.5	3.05	.33
150	3.12	.40

Glide Path Field Strength

Location	Distance (Feet)	D.C. (volts)	Field Strength (microvolts)
Outer Marker	24024	.77	530
Middle Marker	3696	1.65	3400
End of Runway	750		10000

Spokane, Wash

Checked

August 22, 1951

<u>Localizer Course Width</u>

Measured by theodolite observations - 3.88 degrees

Measured by recording crossover - 4 07 degrees

<u>Localizer Linearity</u>

Measured by theodolite observations

Deviation Indicator (microamps)	Angular Departure From Course (degrees)
-150	1.78
- 75	67
0	0
+ 75	.90
+150	2 10

<u>Localizer Linearity</u>

As determined by recording and scaling airplane crossover (Shown plotted in last section of this report)

Deviation Indicator (microamps)	Angular Departure From Course (degrees)
-150	1 95
-112 5	1.40
- 75	92
- 37 5	.47
0	0
+ 37 5	28
+ 75	83
+112 5	1.28
+150	1.90

Spokane, Wash (cont'd)

Localizer Modulation on Course

Measured by noting flag alarm current

Flag alarm current - 260 microamps

Modulation depth - 14 percent each, 90 and 150 cps

Localizer Field Strength

Location	Field Strength (microvolts)
Outer marker	1200
Middle marker	1700
End of runway	1000

Localizer Course Shape

(Shown plotted in last section of this report)

Glide Path Course Width

As measured by theodolite observations

150 microamps "fly up" - 2.09 degrees

"on course" - 2 82 degrees

150 microamps "fly down" - 3.37 degrees

Course width below path - 73 degrees

Course width above path - .55 degrees

Total course width - 1.28 degrees

Spokane, Wash (cont'd)

Glide Path Linearity

As measured by theodolite observations

Course Deviation Indicator (microamps)	Angle (degrees)	Angular departure From Course (degrees)
150	2.09	.73
112 5	2.34	48
75	2 54	28
37.5	2 70	12
0	2 82	0
37.5	2.92	.10
75	3.05	23
112 5	3.20	38
150	3.37	55

Glide Path Field Strength

Location	Distance (feet)	D.C. (volts)	Field Strength (microvolts)
Outer Marker	25,067	1.7	2,000
Middle marker	4,968	2 1	10,000
End of runway	1,694	2.25	20,000

Eugene, Ore.

Checked
August 24, 1951

Localizer Course Width

Measured by theodolite observations - 3 65 degrees

Measured by recording crossover - 3 56 degrees

Localizer Linearity

Measured by theodolite observations

Deviation Indicator (microamps)	Angular Departure From Course (degrees)
-150	1.8
- 75	.9
0	0
+ 75	85
+150	1.85

Localizer Linearity

Poor visibility

Localizer Modulation on Course

Measured by noting flag alarm current

Flag alarm current - 320 microamps

Modulation depth - 18.5 per cent each, 90 and 150 cps

Localizer Field Strength

Location	Field Strength (microvolts)
Outer marker	760
Middle marker	5,000
End of runway	1,000

Localizer Course Shape

(Shown plotted in last section of this report)

Eugene, Ore. (cont'd)

Glide Path Course Width

As measured by theodolite observations

150 microamps "fly up"	-	2.00 degrees
"on course"	-	2.72 degrees
150 microamps "fly down"	-	3.29 degrees
Course width below path	-	.72 degrees
Course width above path	-	.57 degrees
Total course width	-	1.29 degrees

As measured by recording and scaling level pass

150 microamps "fly up"	-	2.03 degrees
"on course"	-	2.94 degrees
150 microamps "fly down"	-	3.56 degrees
Course width below path	-	.91 degrees
Course width above path	-	.62 degrees
Total course width	-	1.53 degrees

Glide Path Linearity

As measured by theodolite observations

Course Deviation Indicator (microamps)	Angle (degrees)	Angular Departure From Course (degrees)
150	2.00	.72
112 5	2.26	.46
75	2.45	.27
37.5	2.60	.12
0	2.72	0
37.5	2 92	.20
75	3.04	.32
112 5	3 15	43
150	3.29	57

Eugene, Ore. (cont'd)

Glide Path Field Strength

Location	Distance (feet)	D C. (volts)	Field Strength (microvolts)
Outer Marker	23,950	1 6	1,500
Middle Marker	4,058	2.1	9,500
End of runway	732	2 4	37,000

San Francisco, Calif.

Checked
August 26, 1951

Localizer Course Width

Measured by theodolite observations - 3.56 degrees

Measured by recording crossover - 3.50 degrees

Localizer Linearity

Measured by theodolite observations

Deviation Indicator (microamps)	Angular Departure From Course (degrees)
-150	1.70
- 75	.72
0	0
+ 75	.90
+150	1.86

Localizer Linearity

(Poor visibility)

Localizer Modulation on Course

Measured by noting flag alarm current

Flag alarm current - 310 microamps

Modulation depth - 17.7 per cent each, 90 and 150 cycles

Localizer Field Strength

Location	Field Strength (microvolts)
Outer Marker	370
Middle Marker	850
End of Runway	510

Localizer Course Shape

Shown plotted in last section of the report

Glide Path Course Width

As measured by theodolite observations

150 microamps "Fly up"-	1.90 degrees
"on course"-	2.70 degrees
150 microamps "Fly down"-	3.13 degrees
course width below path -	.80 degrees
course width above path -	.43 degrees
Total course width -	1.23 degrees

As measured by recording and scaling level pass

150 microamps "Fly up" -	1.96 degrees
"on course"-	2.78 degrees
150 microamps "Fly down"-	3.24 degrees
course width below path -	.82 degrees
course width above path -	.46 degrees
Total course width -	1.28 degrees

Glide Path Linearity

As measured by theodolite observations.

Course Deviation Indicator (microamps)	Angle (degrees)	Angular Departure From Course (degrees)
150	1.90	.80
112.5	2.18	.52
75	2.39	.31
37.5	2.56	.14
0	2.70	0
37.5	2.82	.12
75	2.93	.23
112.5	3.03	.33
150	3.13	.43

San Francisco, Calif. (Continued)

Glide Path Field Strength

Location	Distance (Feet)	D.C. (volts)	Field Strength (microvolts)
Outer Marker	35529	1.25	580
Middle Marker	4850	1.90	4400
End of Runway	1365	2.1	10000

Rock Springs, Wyo.

Checked

August 28, 1951

Localizer Course Width

Measured by theodolite observations - 4.09 degrees

Measured by recording crossover - 4.00 degrees

Localizer Linearity

Measured by theodolite observations

Deviation Indicator (microamps)	Angular Departure From Course (degrees)
-150	2.24
- 75	1 14
0	0
+ 75	.85
+150	1.85

Localizer Linearity

As determined by recording and scaling airplane crossover (Shown plotted in last section of this report)

Deviation Indicator (microamps)	Angular Departure From Course (degrees)
-150	2.0
-112 5	1.5
-75	1.0
-37.5	6
0	0
+37.5	5
+75	.9
+112.5	1.3
+150	1.8

Rock Springs, Wyo. (cont'd)

Localizer Modulation on Course

Measured by noting flag alarm current

Flag alarm current - 300 microamps

Modulation depth - 17 per cent each, 90 and 150 cps

Localizer Field Strength

Location	Field Strength (microvolts)
Outer marker	2,000
Middle marker	5,000
End of runway	1,200

Localizer Course Shape

(Shown plotted in last section of this report)

Glide Path Course Width

As measured by theodolite observations

150 microamps "fly up" - 1.84 degrees

"on course"- 2.72 degrees

150 microamps "fly down" - 3.23 degrees

Course width below path - 88 degrees

Course width above path - .51 degrees

Total course width - 1.39 degrees

As measured by recording and scaling level pass

150 microamps "fly up" - 1.77 degrees

"on course"- 2.75 degrees

150 microamps "fly down" - 3.28 degrees

Course width below path - .98 degrees

Course width above path - .53 degrees

Total course width - 1.51 degrees

Rock Springs, Wyo. (cont'd)

Glide Path Linearity

As measured by theodolite observations

Course Deviation Indicator (microamps)	Angle (Degrees)	Angular Departure From Course (degrees)
150	1.85	.87
112.5	2.17	.55
75	2.38	.34
37.5	2.57	15
0	2.72	0
37 5	2.86	.14
75	3.00	.28
112 5	3.11	.39
150	3.25	.53

Glide Path Field Strength

Location	Distance (feet)	D.C. (volts)	Field Strength (microvolts)
Outer marker	33,280	1 6	2,400
Middle marker	4,504	2.15	16,000
End of runway	982	2 40	50,000

Cheyenne, Wyoming

Checked

August 29, 1951

Localizer Course Width

Measured by theodolite observations - 4.77 degrees

Measured by recording crossover - 4.76 degrees

Localizer Linearity

Measured by theodolite observations

Deviation Indicator (microamps)	Angular Departure From Course (degrees)
-150	2.27
- 75	.98
0	- -
+ 75	1.3
+150	2.5

Localizer Linearity

Omitted (data not sufficently accurate)

Localizer Modulation on Course

Measured by noting flag alarm current

Flag alarm current - 265 microamps

Modulation depth - 14.3 per cent each, 90 and 150 cycles

Localizer Field Strength

Location	Location	Field Strength (microvolts)
	Outer Marker	2000
	Middle Marker	8000
	End of Runway	5000

Localizer Course Shape

Shown plotted in last section of report.

Glide Path Course Width

As measured by theodolite observations

150 microamps "Fly up" - 1.69 degrees

"on course"-2.38 degrees

150 microamps "Fly down" -2.92 degrees

course width below path- .69 degrees

course width above path- .54 degrees

Total course width - 1.23 degrees

As measured by recording and scaling level pass

150 microamps "Fly up"- 1.63 degrees

"on course"-2.28 degrees

150 microamps "Fly down"- 2.77 degrees

course width below path - .65 degrees

course width above path - .49 degrees

Total course width - 1.14 degrees

Glide Path Linearity

As measured by theodolite observations.

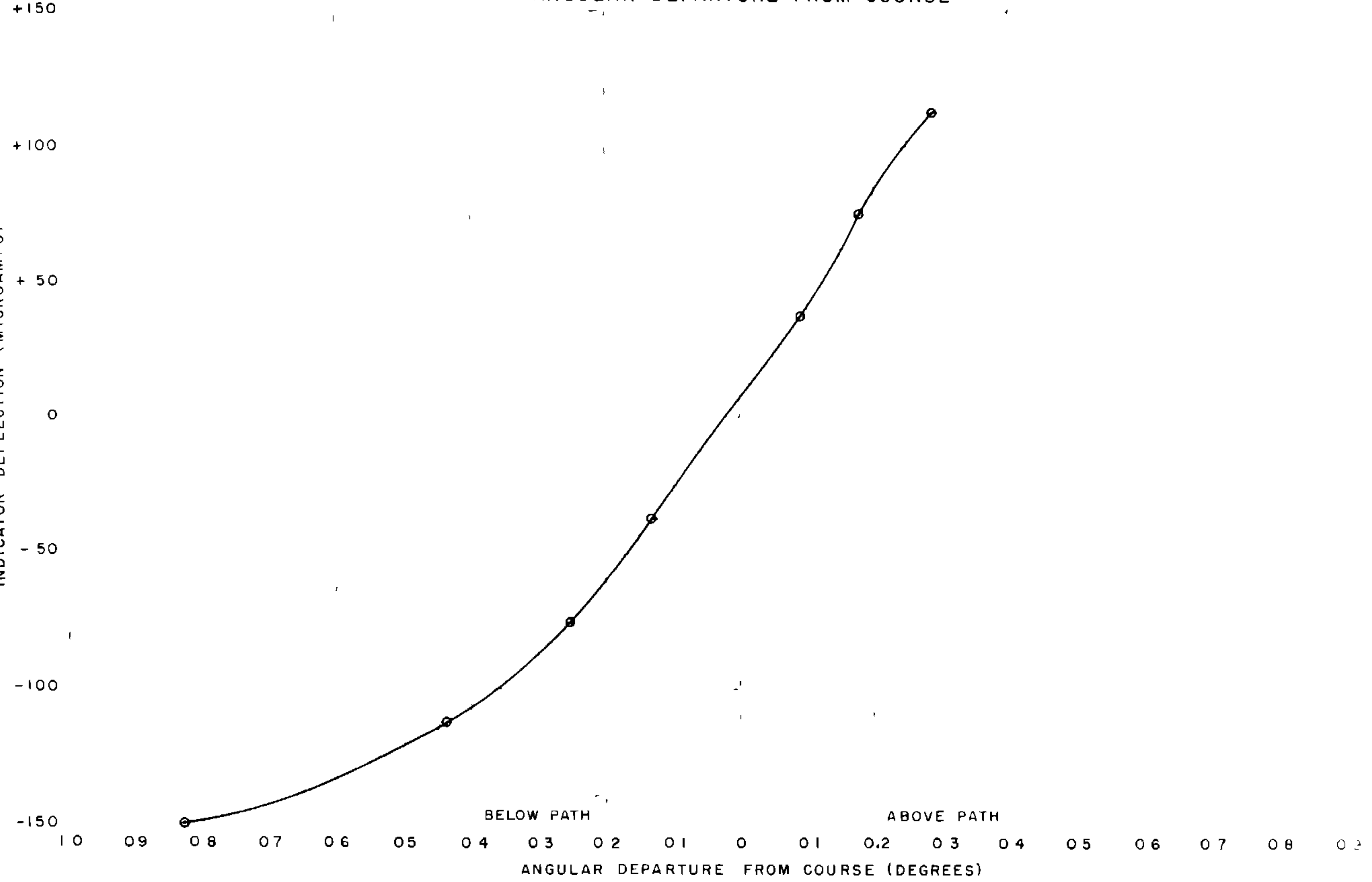
Course Deviation Indicator (microamps)	Angle (degrees)	Angular Departure From Course (degrees)
150	1.69	.69
112.5	1.92	.46
75	2.12	.26
37.5	2.24	.14
0	2.38	-
37.5	2.51	.13
75	2.63	.25
112.5	2.75	.37
150	2.92	.54

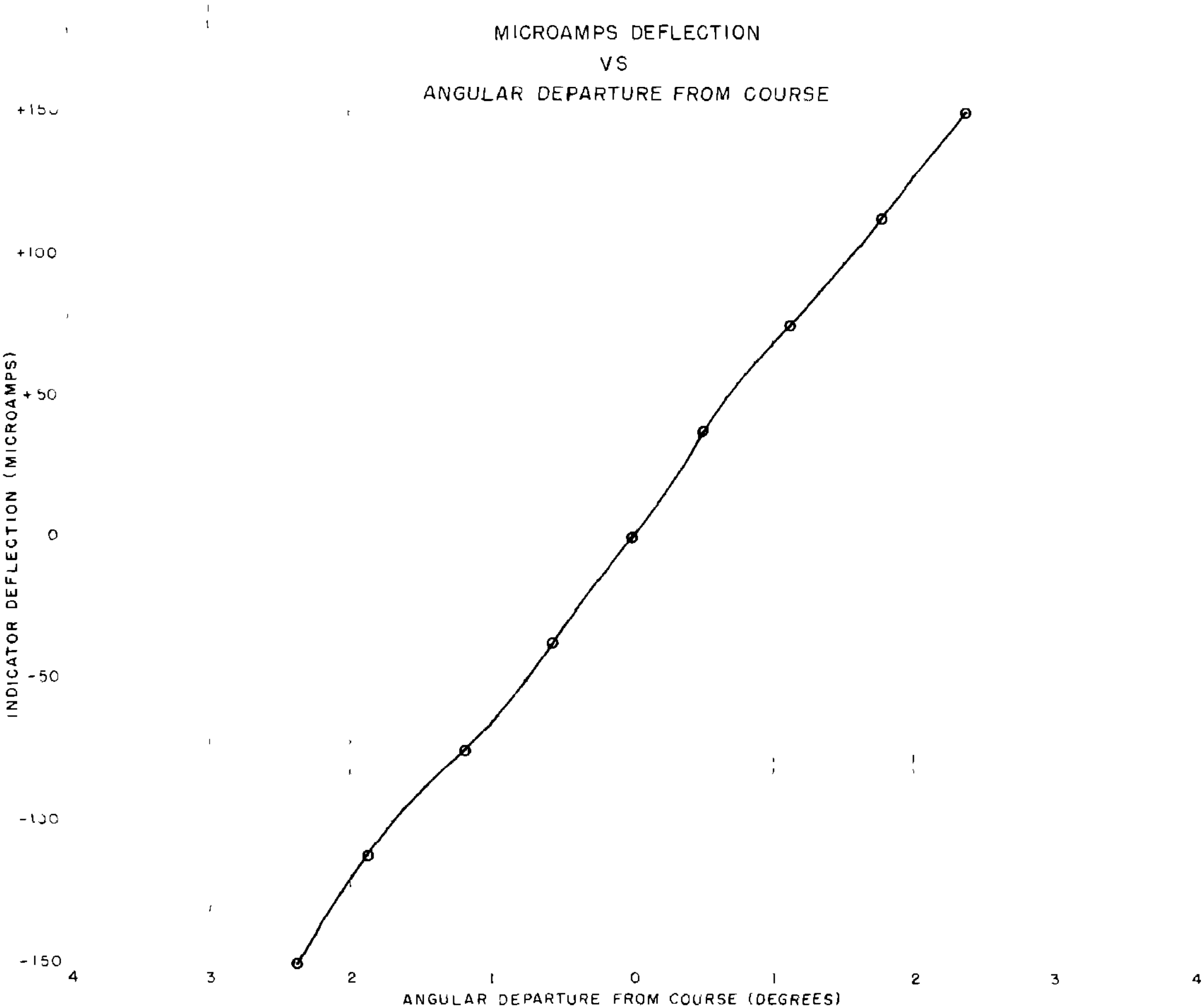
Cheyenne, Wyoming (Continued)

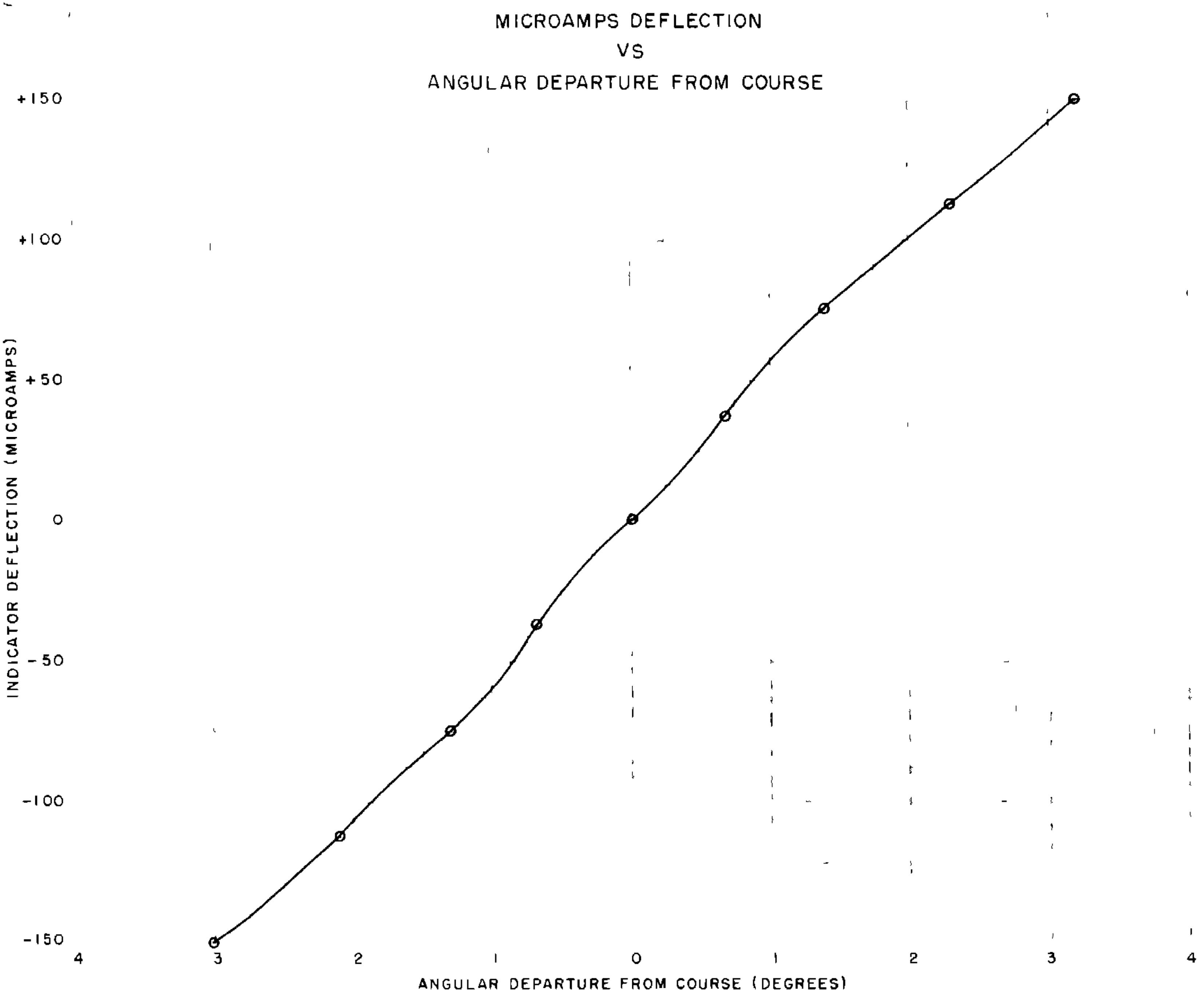
Glide Path Field Strength

Location	Distance (Feet)	D.C. (volts)	Field Strength (microvolts)
Outer marker	33280	1.1	700
Middle marker	4504	1.95	8200
End of runway	982	2.25	25000

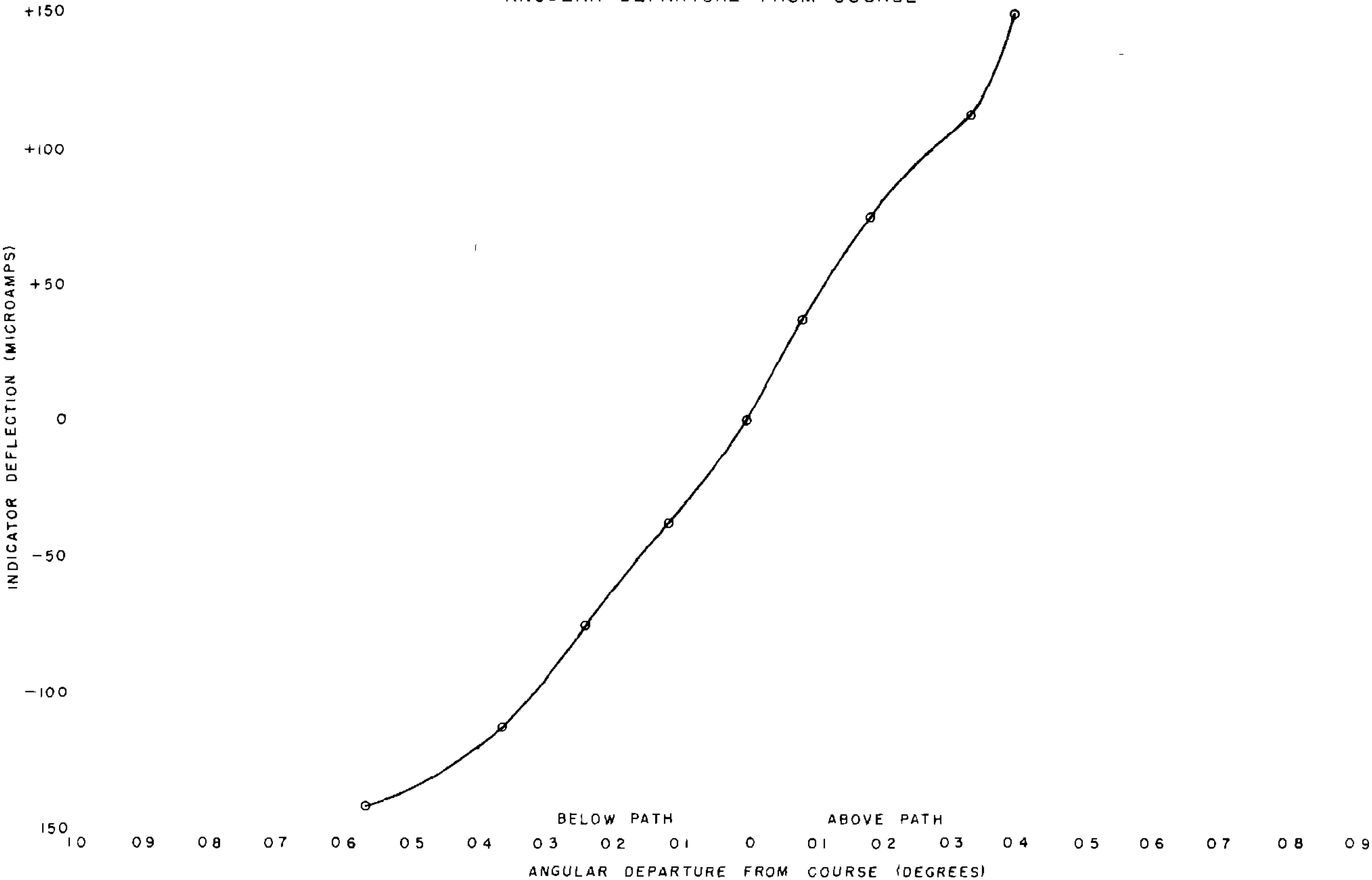
MICROAMPS DEFLECTION
VS
ANGULAR DEPARTURE FROM COURSE



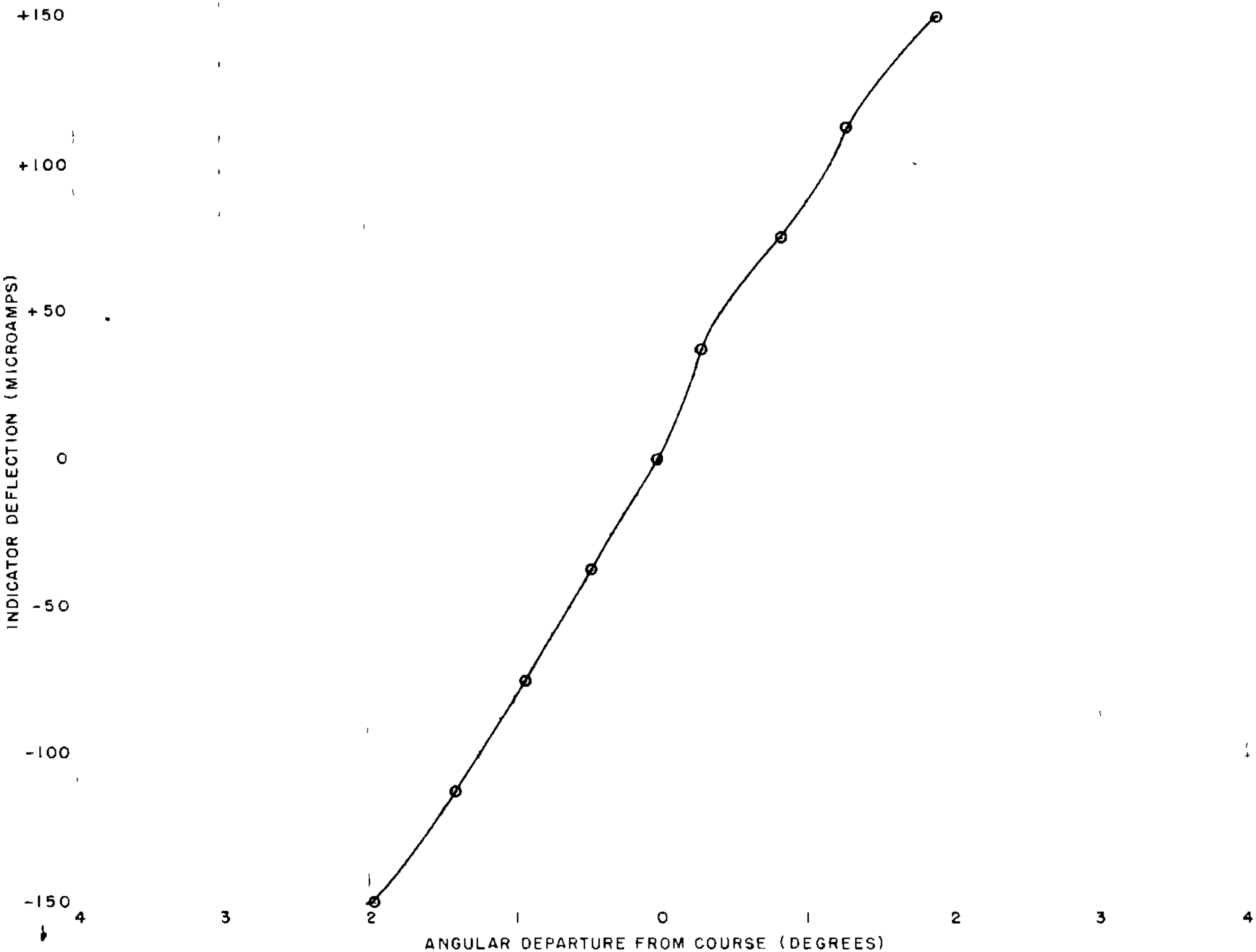

MICROAMPS DEFLECTION
VS
ANGULAR DEPARTURE FROM COURSE
INDICATOR DEFLECTION (MICROAMPS)
+150
+100
+50
0
-50
-100
-150
4
3
2
1
0
1
2
3
4
ANGULAR DEPARTURE FROM COURSE (DEGREES)

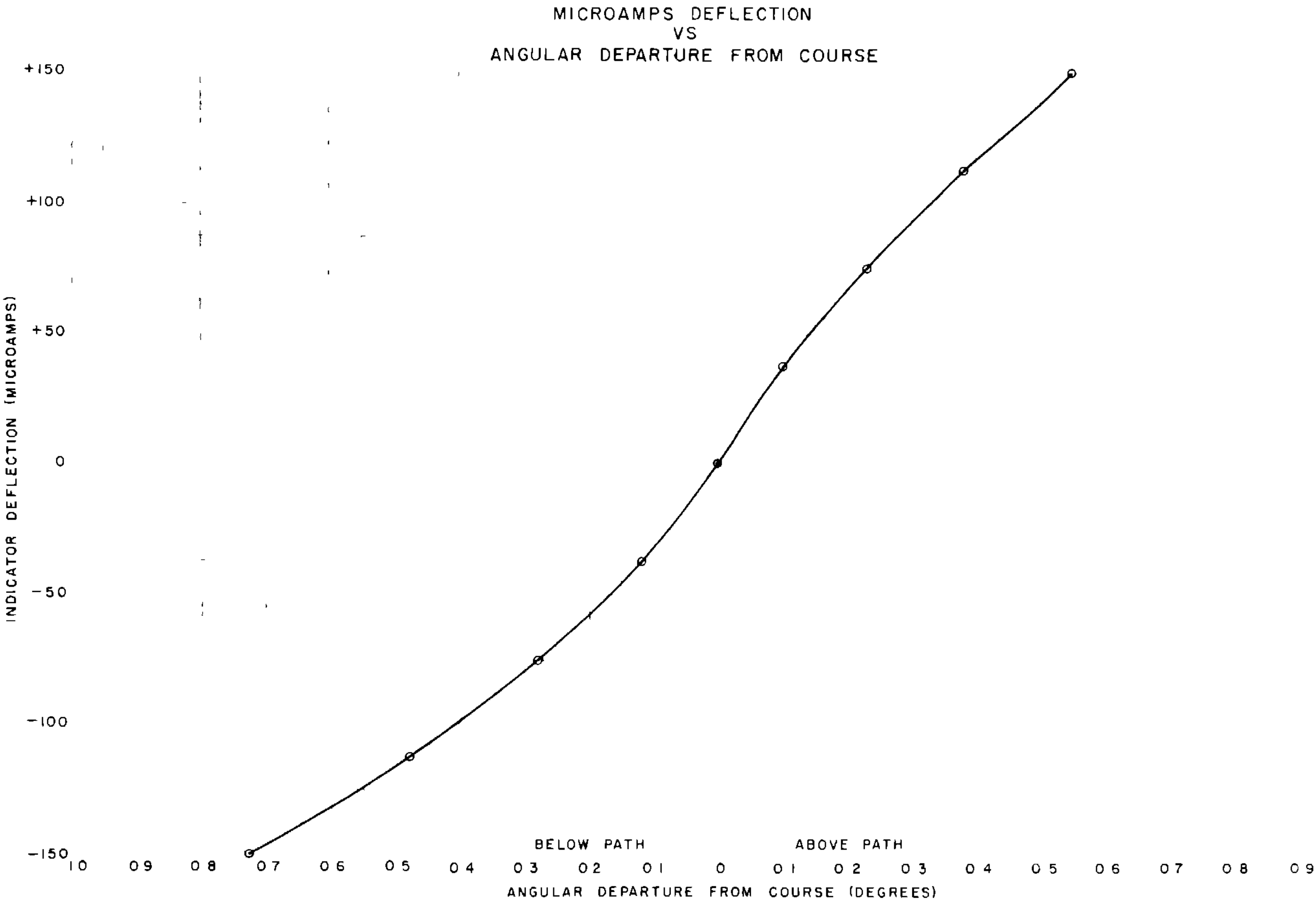

MICROAMPS DEFLECTION
VS
ANGULAR DEPARTURE FROM COURSE
+150
+100
+50
0
-50
-100
-150
INDICATOR DEFLECTION (MICROAMPS)
4
3
2
1
0
1
2
3
4
ANGULAR DEPARTURE FROM COURSE (DEGREES)

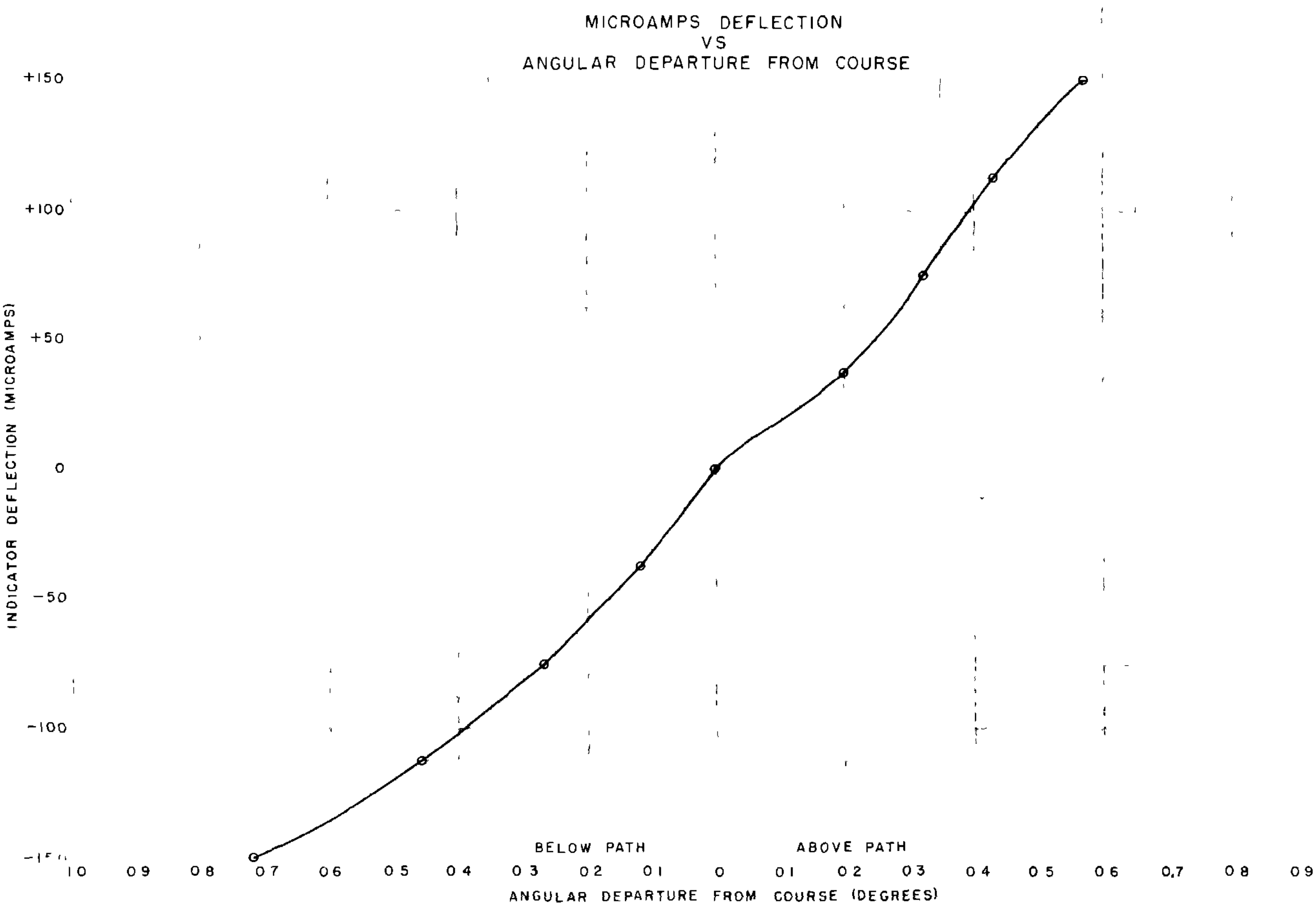
MICROAMPS DEFLECTION
VS
ANGULAR DEPARTURE FROM COURSE

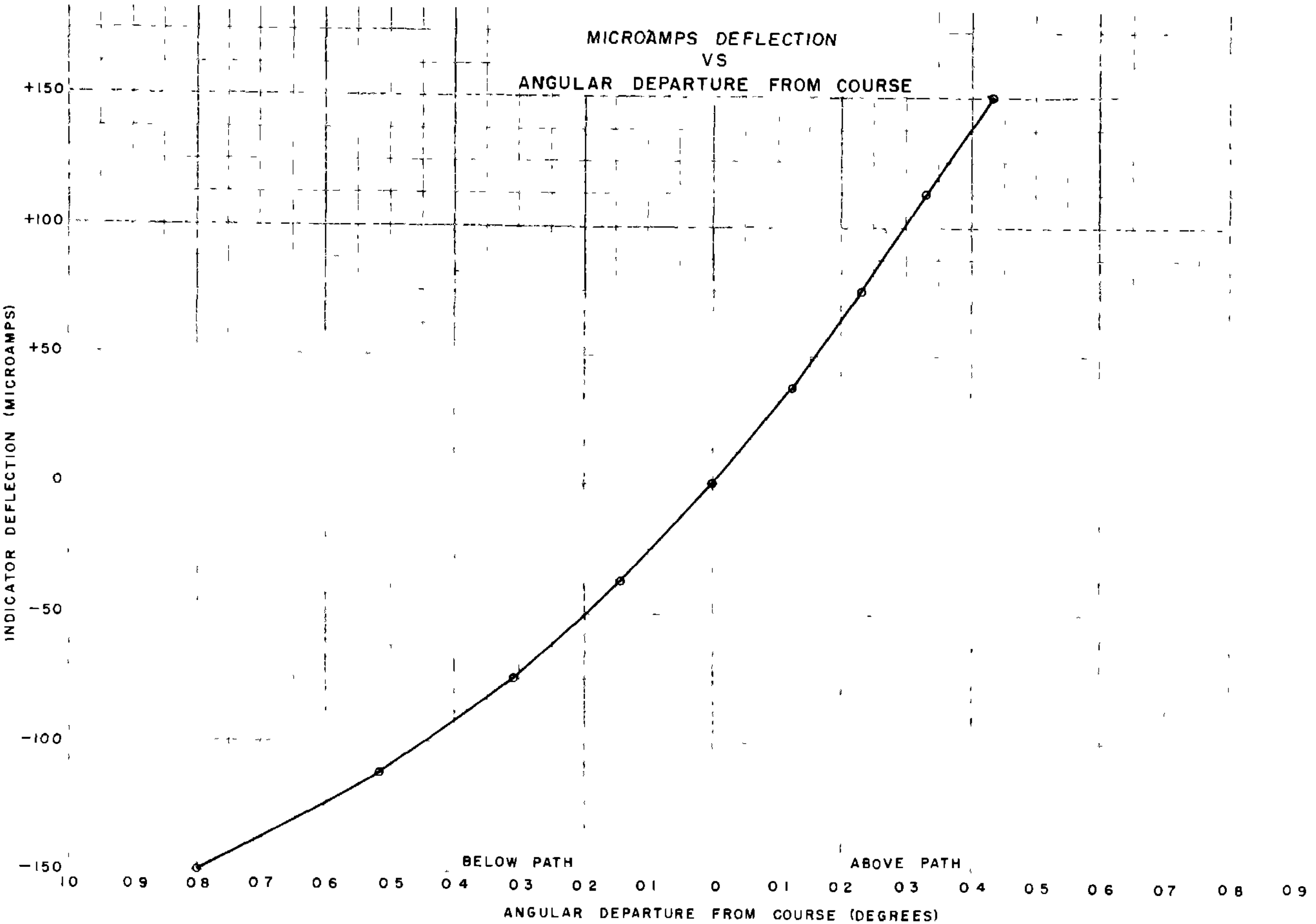


MICROAMPS DEFLECTION
VS
ANGULAR DEPARTURE FROM COURSE

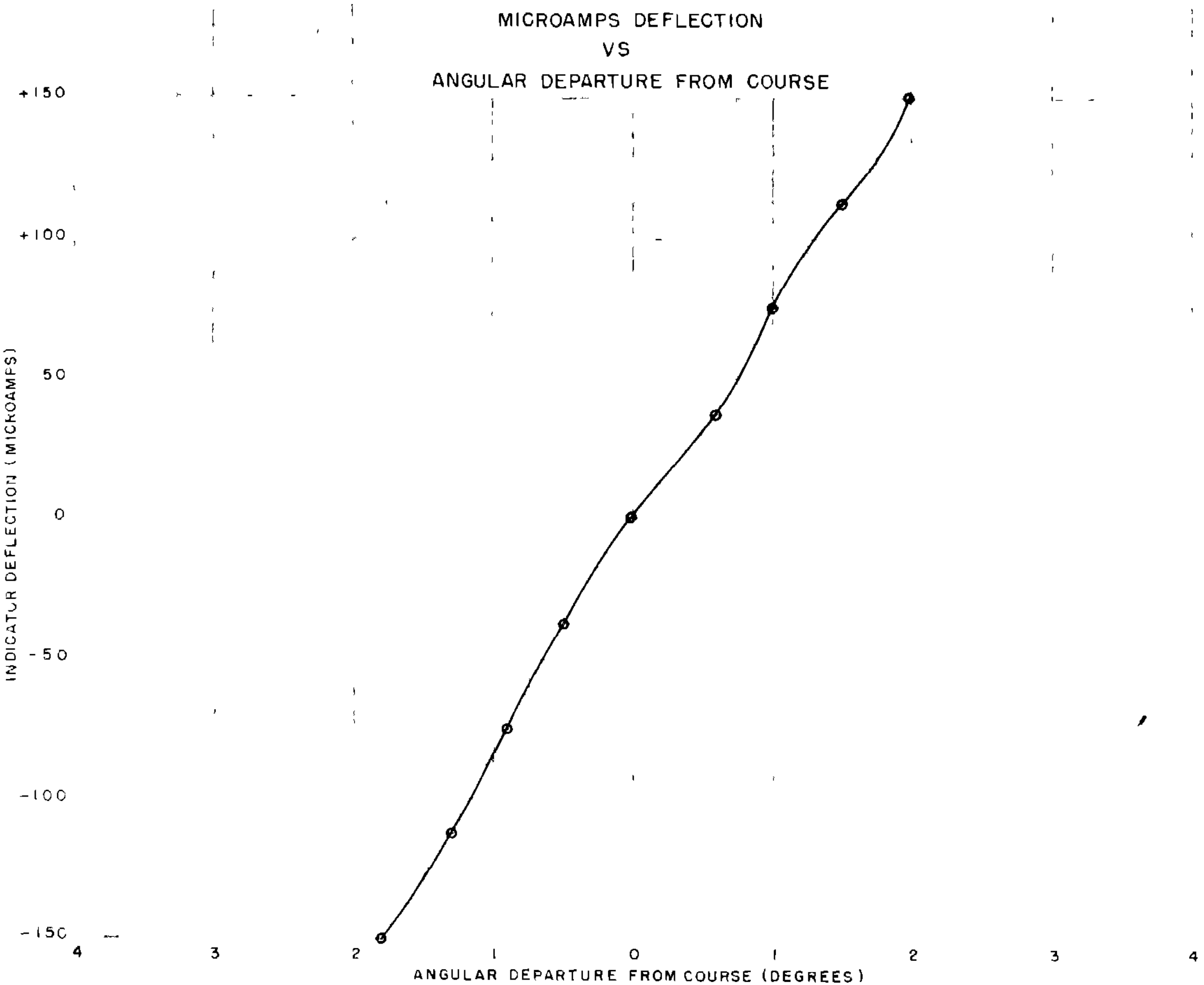



MICROAMPS DEFLECTION
VS
ANGULAR DEPARTURE FROM COURSE
INDICATOR DEFLECTION (MICROAMPS)
+150
+100
+50
0
-50
-100
-150
BELOW PATH
ABOVE PATH
1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9
ANGULAR DEPARTURE FROM COURSE (DEGREES)

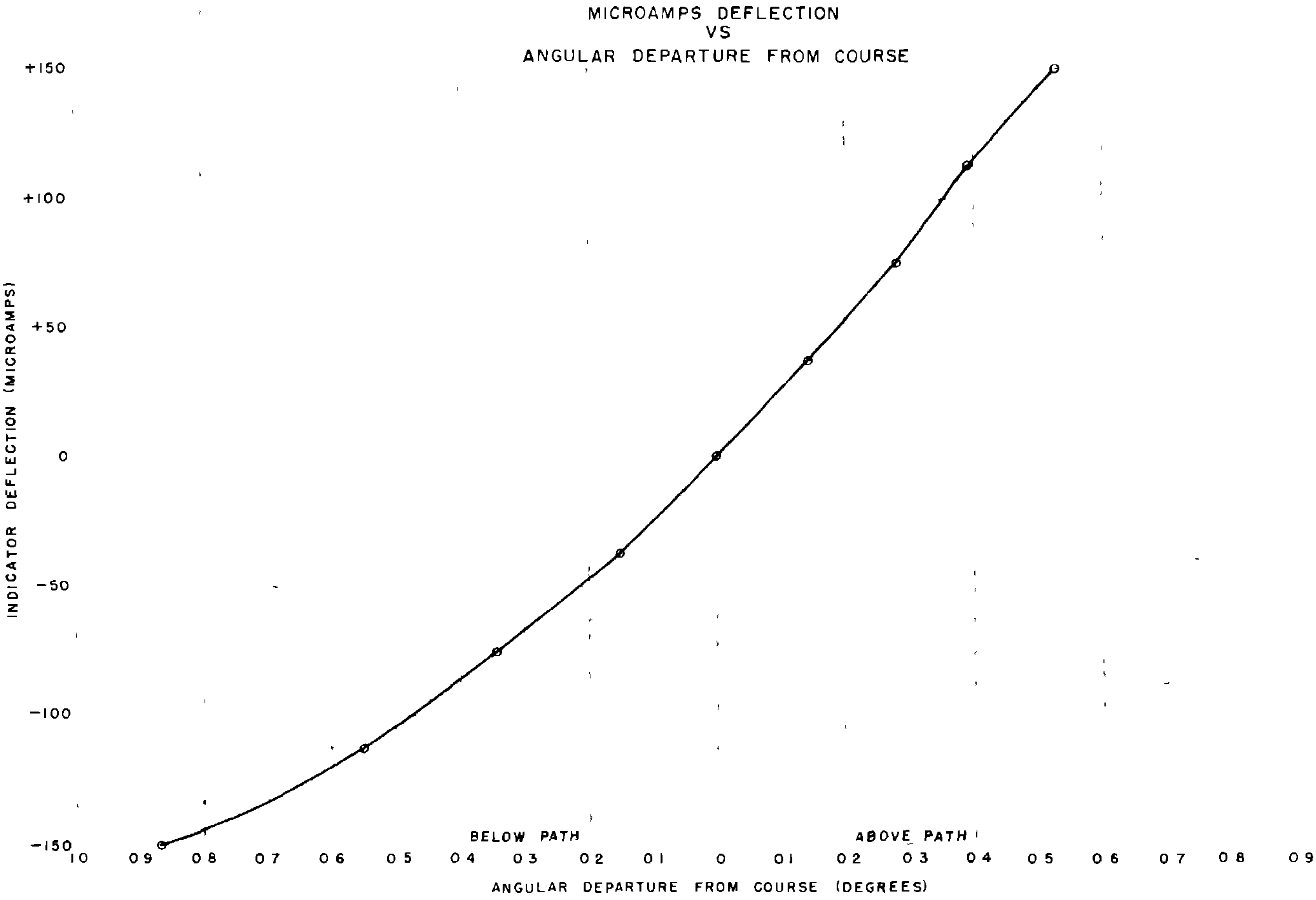

MICROAMPS DEFLECTION
VS
ANGULAR DEPARTURE FROM COURSE
INDICATOR DEFLECTION (MICROAMPS)
+150
+100
+50
0
-50
-100
BELOW PATH
ABOVE PATH
10 09 08 07 06 05 04 03 02 01 0 01 02 03 04 05 06 0.7 08 09
ANGULAR DEPARTURE FROM COURSE (DEGREES)

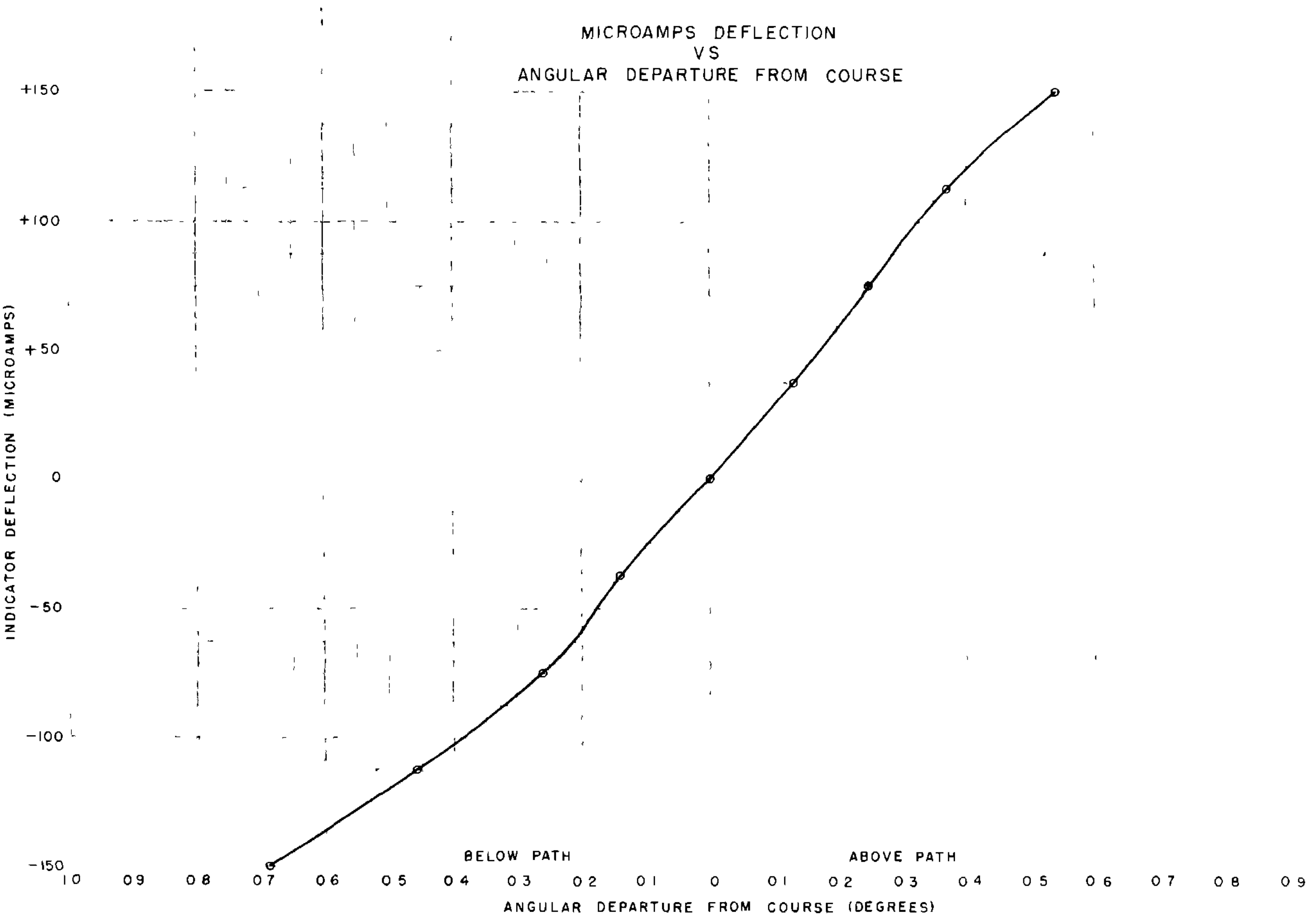


MICROAMPS DEFLECTION
VS
ANGULAR DEPARTURE FROM COURSE
INDICATOR DEFLECTION (MICROAMPS)
+150
+100
+50
0
−50
−100
−150
BELOW PATH
ABOVE PATH
1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9
ANGULAR DEPARTURE FROM COURSE (DEGREES)



MICROAMPS DEFLECTION
VS
ANGULAR DEPARTURE FROM COURSE
+150
+100
50
0
-50
-100
-150
INDICATOR DEFLECTION (MICROAMPS)
4
3
2
1
0
1
2
3
4
ANGULAR DEPARTURE FROM COURSE (DEGREES)


MICROAMPS DEFLECTION
VS
ANGULAR DEPARTURE FROM COURSE
+150
+100
+50
0
−50
−100
−150
INDICATOR DEFLECTION (MICROAMPS)
BELOW PATH
ABOVE PATH
1 0
0 9
0 8
0 7
0 6
0 5
0 4
0 3
0 2
0 1
0
0 1
0 2
0 3
0 4
0 5
0 6
0 7
0 8
0 9
ANGULAR DEPARTURE FROM COURSE (DEGREES)


MICROAMPS DEFLECTION
VS
ANGULAR DEPARTURE FROM COURSE
INDICATOR DEFLECTION (MICROAMPS)
+150
+100
+50
0
-50
-100
-150
BELOW PATH
ABOVE PATH
1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9
ANGULAR DEPARTURE FROM COURSE (DEGREES)