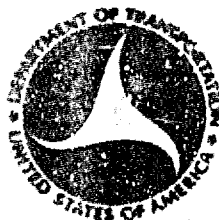


AD 742631

Evaluation of Executive Jet Approach Angles

Frank Parr



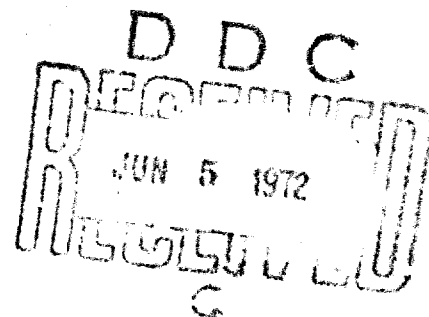
April 1972
FINAL REPORT

Availability is unlimited. Document may be released to the Clearinghouse for Scientific and Technical Information, Springfield, Virginia 22151 for sale to the public.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Flight Standards Service
Washington, D. C. 20591

Exported by
NATIONAL TECHNICAL
INFORMATION SERVICE
100-270-255-22151

Best Available Copy



The contents of this report reflect the findings of the Standards Development Branch, National Flight Inspection Division, Flight Standards Service, which is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policy of the Department of Transportation. This report does not constitute a standard, specification, or regulation.

ACCESSION 1st	
DPSTI	WHITE SECTION ☒
DOC	DIFF SECTION ☐
UNANNOUNCED	☐
JUSTIFICATION	
DISTRIBUTION/AVAILABILITY CODES	
DISC.	AVAIL. and/or SPECIAL
A	

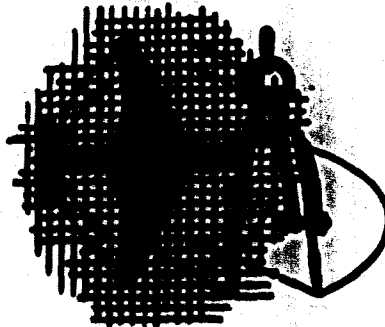
1. Report No. FAA-FS-600-7	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Evaluation of Executive Jet Approach Angles		5. Report Date April 1972	6. Performing Organization Code FS-640
		8. Performing Organization Report No. FAA-FS-600-7	
7. Author(s) Frank Parr		10. Work Unit No. FS-600-71-5	11. Contract or Grant No.
9. Performing Organization Name and Address Standards Development Branch, FS-640 National Flight Inspection Division Post Office Box 25082 Oklahoma City, Oklahoma 73125		13. Type of Report and Period Covered FINAL REPORT	
		14. Sponsoring Agency Code DOT	
12. Sponsoring Agency Name and Address Department of Transportation Washington, D. C. 20591			
15. Supplementary Notes			
16. Abstract Evaluations were flown in the Aero Jet Commander, Gates Lear Jet, North American Sabreliner, and Lockheed JetStar. Approach slope angles were varied from approximately 3 degrees up to almost 7 degrees. Flight parameters were measured in the areas of descent airspeed, power requirements in flare, flyability, sink rates, threshold crossing heights, and touchdown distances. Objective and subjective measurements were made. It was found that when approach slope angles above 4 degrees (approximate minimums of 400 feet altitude - 1 mile visibility) were used they were accompanied by problems of power requirement, flyability, high sink rates, and long touchdown distances.			
17. Key Words IFR procedure Instrument Approach Non-precision Approach Navigation procedure Approach angle		18. Distribution Statement Distribution unlimited	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 72	22. Price

CONTENTS

Abstract.....	Page 1
Introduction.....	iii
Statement of the Problem.....	1
Objectives.....	1
Methodology.....	1
Data Reduction and Analysis.....	2
Findings.....	14
Appendix.....	15

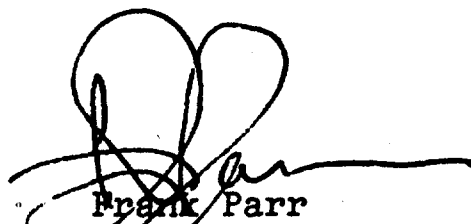
FIGURES

1	Will Rogers World Airport.	Page v
2	Data Camera and Theodolite Location.	vi
3	Test Aircraft - Aero Jet Commander.	vii
4	Test Aircraft - Gates Lear Jet.	viii
5	Test Aircraft - North American Sabreliner.	ix
6	Test Aircraft - Lockheed JetStar.	x
7	Typical Approach Path.	xi



Project Report on Evaluation of Executive Jet Approach Angles

Project Officer



Frank Parr
Technical Assistant,
Standards Development
Branch

Concur



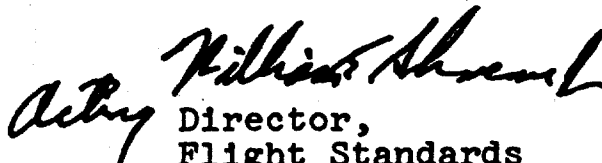
E. E. Callaway
Chief, Standards
Development Branch

Approved



E. E. Blanchard
Chief, National
Flight Inspection
Division

Released



Director,
Flight Standards
Service

April 1972



INTRODUCTION

In 1966 an evaluation was performed to identify the maximum approach slope gradient which could be tolerated by light aircraft. This evaluation was documented in the final report of the Standards Development Branch, March 1966, "Project Downhill. An Evaluation of the Non-precision Approach Angles for Light Aircraft with Approach Speeds Less than 95 Knots."

The joint DOD-DOT Handbook "United States Standard for Terminal Instrument Procedures (TERPs)" * is scheduled for regular review to update and refine standards. Information similar to that derived from Project Downhill is considered to be essential to the development of TERPs non-precision approach minimums which apply to executive jet type aircraft. Accordingly, a follow-on evaluation was requested which would provide that information. This is the final report of the project which was established to accomplish the task.

Reproduced from
best available copy.



* U. S. Army TM 11-2557-26. U. S. Navy OPNAV Inst. 3722.16A
USAF JAFM 55-9 USCG CG 318
FAA Handbook 8260.3

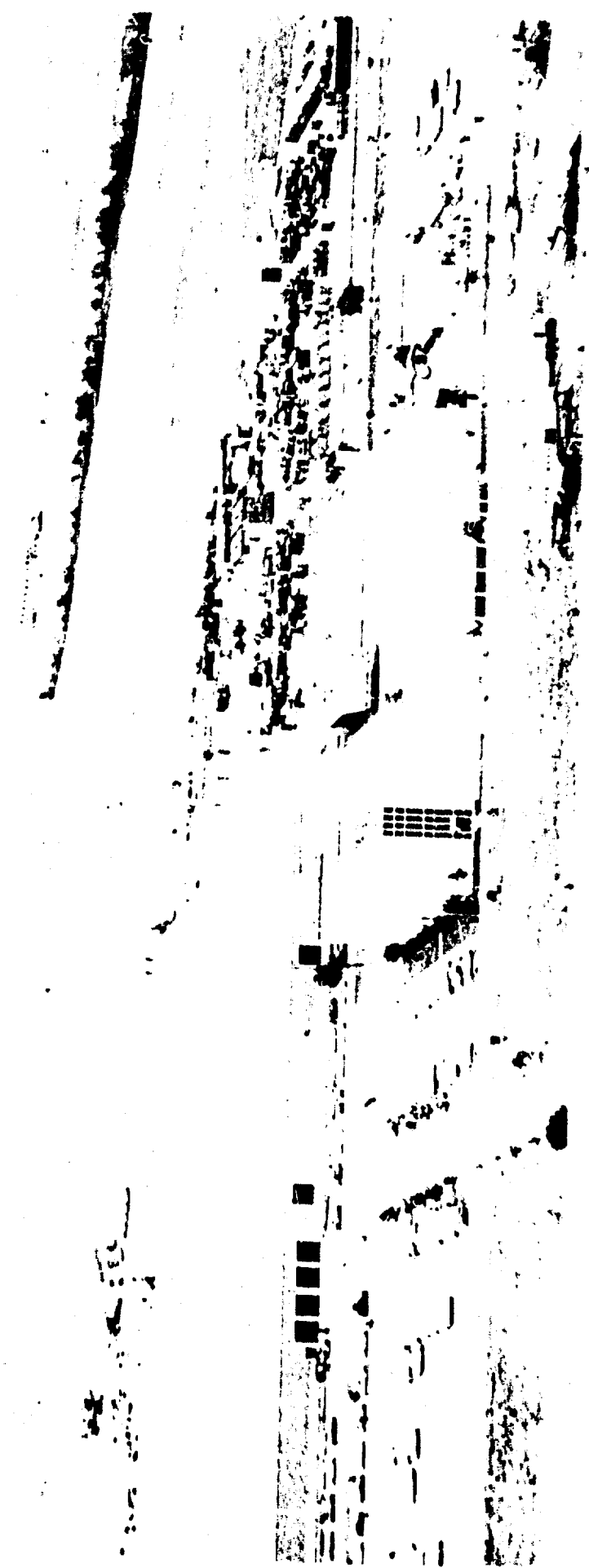


Figure 1. Will Rogers World Airport

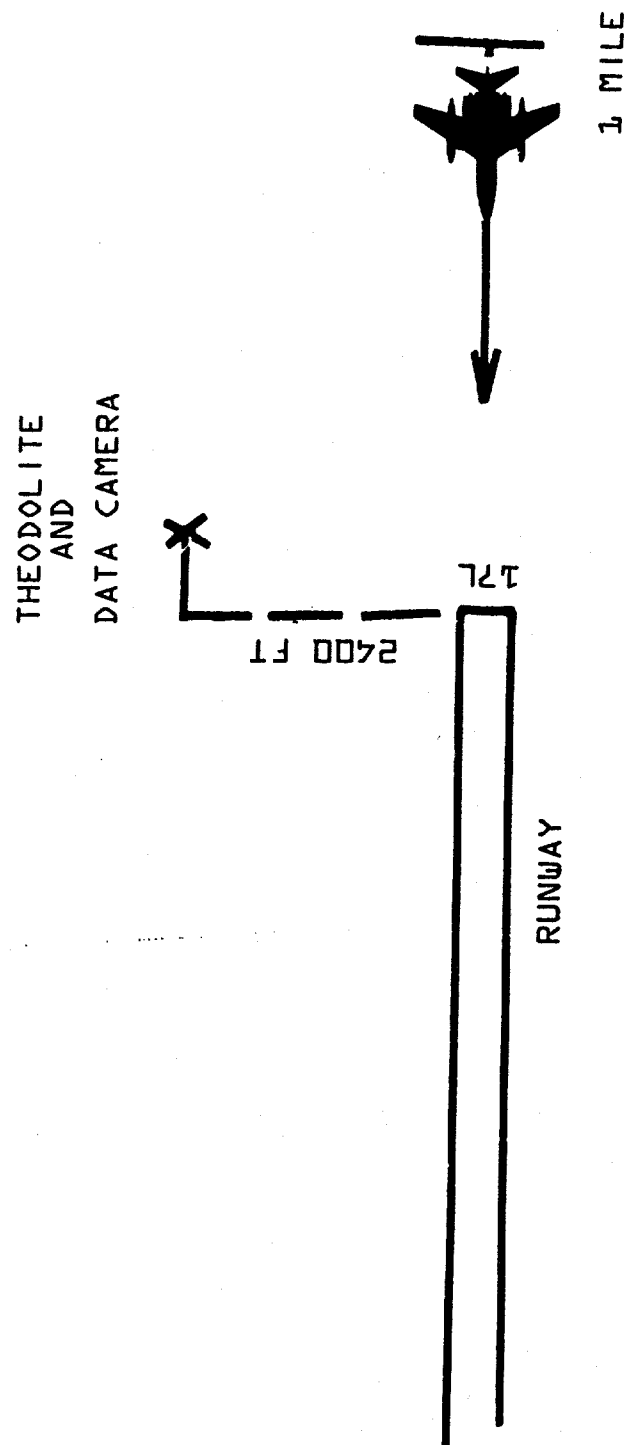


Figure 2. Data Camera and Theodolite Location



Figure 3. Test Aircraft - Aero Jet Commander

N268P

v111

Test Aircraft - Gates Lear Jet



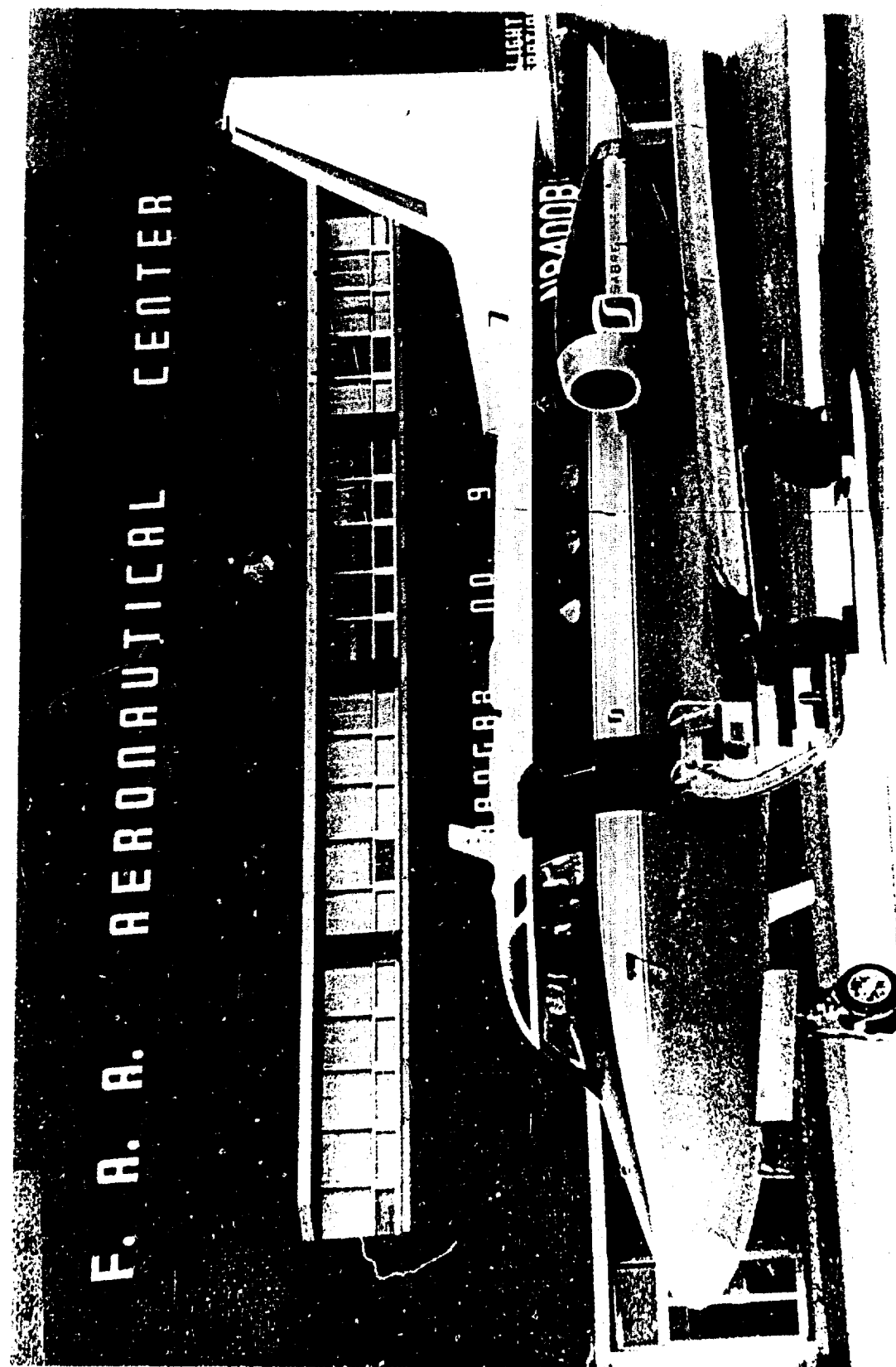


Figure 5. Test Aircraft - North American Sabreliner

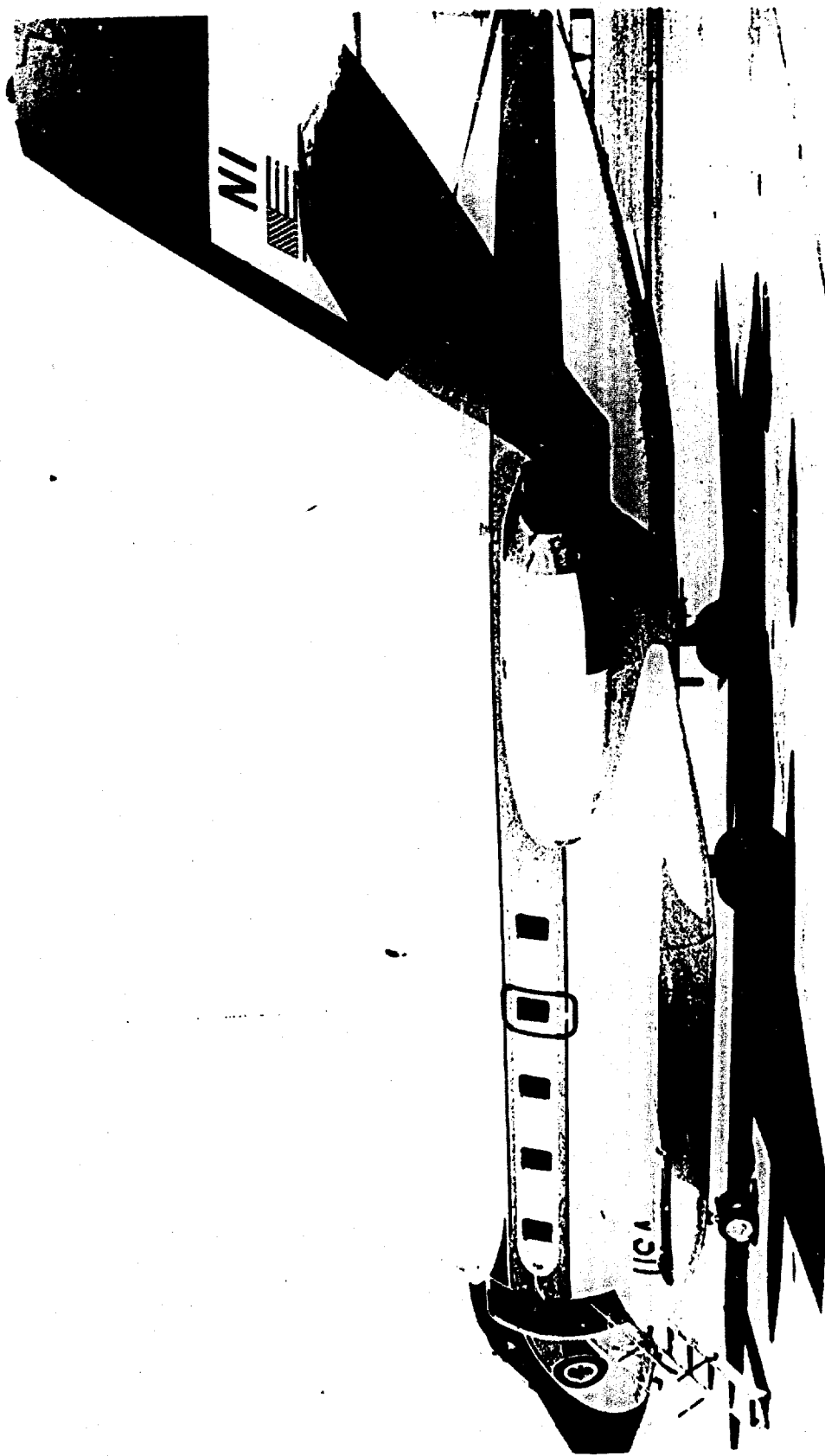


Figure 6. Test Aircraft - Lockheed JetStar

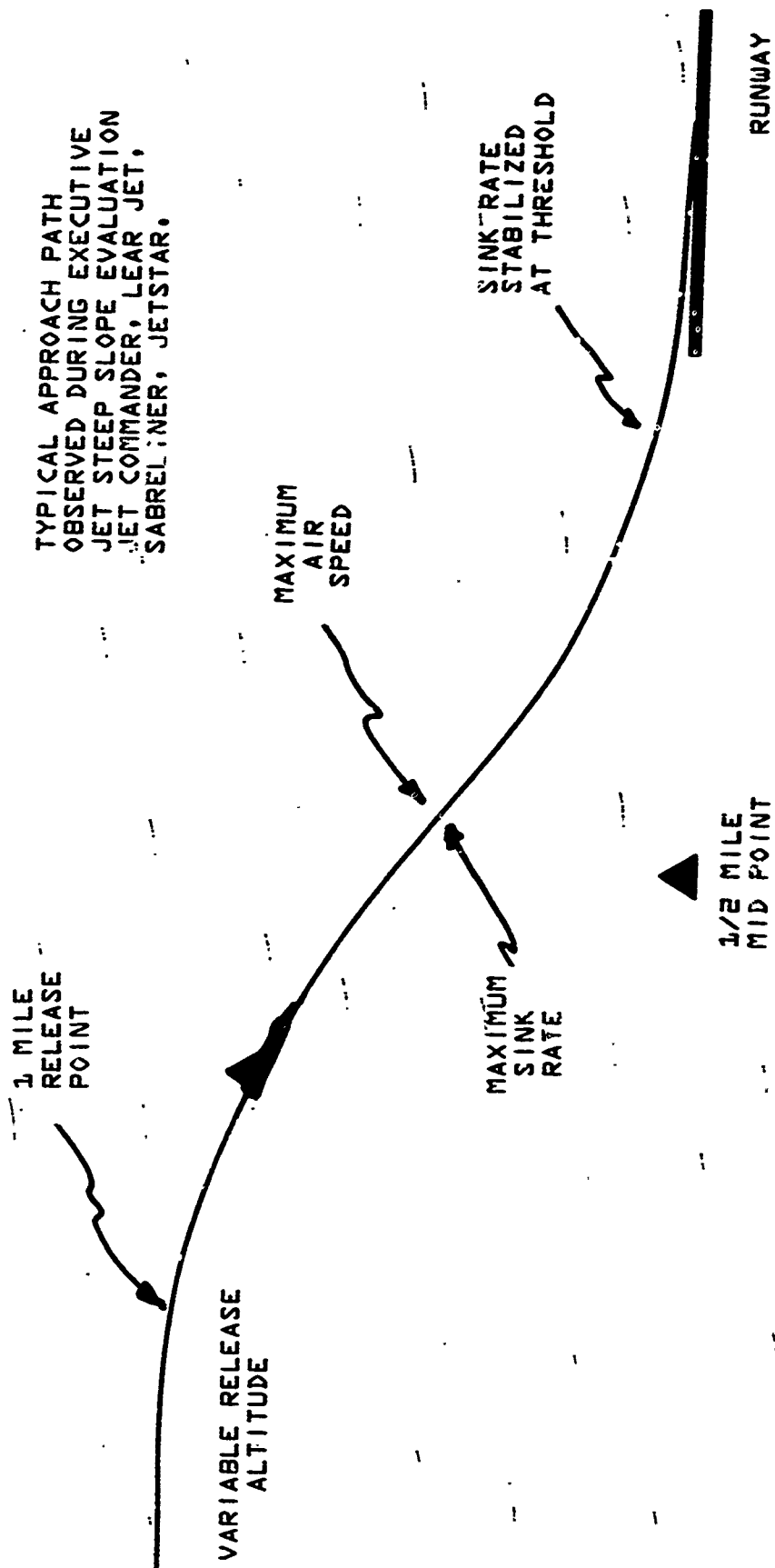


Figure 7. Typical Approach Path.

ACKNOWLEDGEMENT

Participation of project pilots, electronics engineer and technician, and the cooperation of Air Traffic and of the Oklahoma City Airport Management is gratefully noted.

Jet Commander

Jack P. Ervin, AC-958
Richard A. Fournier, AC-958
E. E. Callaway, FS-640

Lear Jet

Richard W. Blondefield, AC-958
J. Lee Jarvis, AC-958

Sabreliner

Charles L. Hall, FS-620
L. F. Abernathy, FS-620
Earl L. Rowe, FS-620
James H. McMaster, FS-620

Jetstar

John Newell, EA-GADO-16 Richmond
Douglas B. Moore, SO-GADO-1 Atlanta
John T. Crouse, FS-754

Observers

Norman C. Heidger, FS-640
Allan W. Hunting, NE-GADO Norwood

Electronics Specialists

Russell S. Fleming, FS-640
Robert C. Chadwick, FS-640

Oklahoma City Airport Trust

John D. Solomon, Airports Director
R. F. Traub, Airports Engineer

Air Traffic Service

Howard H. Murphy, OKC Rapcon/Tower

STATEMENT OF THE PROBLEM

Approach procedures are designed to assure a landing on each approach. An unreasonable descent rate from the visual contact point cannot, therefore, be required in a procedure. Tests have been made of the descent capability of heavy jet and prop aircraft, and of light prop aircraft. None have as yet been documented which identify the descent capability of the group of aircraft categorized as "executive jets".

OBJECTIVES

The objective of this study is to provide information on the descent slope capability of executive jet aircraft. Tests will include the Aero "Jet Commander", the Gates "Lear Jet", the North American "Sabreliner", and the Lockheed "Jetstar". Specific areas of study include:

1. Determine the operational safety and practicality of descent angles over 3 degrees during the visual portion of a non-precision approach.
2. Determine the effect of increased approach angles on descent airspeed, flare, flyability, sink rates, height over the threshold, and touchdown distance.

METHODOLOGY

The test site was Will Rogers World Airport, Oklahoma City, Oklahoma. Runway 17L was used for all approach runs.

Each series of runs began at 300 feet above the threshold, with pilots making a run "on centerline" toward the runway. As the aircraft reached a point one statute mile from the runway threshold, a ground controller using a precision theodolite for position reference transmitted the word "release" to the pilot. The pilot then executed a visual approach to landing using normal procedures for the aircraft.

Data were recorded using the Runk Takeoff and Landing Camera and by an observer in the aircraft.

After the run at 300 feet, the pilot was asked to fly the same approach at 400, 500, 600, etc., feet above the runway threshold height until the limits of the aircraft/pilot were

reached. In some cases additional runs were made at levels 50 feet below the maximum level to check in-between angles.

Preliminary runs were made to full-stop landings to check ground roll, but most runs were touch-and-go landings. Day and night approaches were made.

Sixty-three approaches were recorded in the four aircraft by twelve qualified pilots. Thirty-eight runs were made during daylight, and twenty-five were flown at night. One run was forced to discontinue because of conflicting traffic, and was therefore unusable.

Pilot comments were solicited during each approach.

DATA REDUCTION AND ANALYSIS

Several measurements were used in an attempt to define the point at which an approach slope angle becomes difficult. An objective view of maximum angle was thus made possible. The measurement parameters were as follows:

Condition	Tolerance Limit
Airspeed during descent	V_{ref} plus 5 knots.
Flare	Power not required.
Flyability	No special techniques. Pilot comments favorable.
Maximum sink rate	1000 feet per minute.
Sink rate at threshold	1000 feet per minute.
Threshold crossing height	20 to 60 feet.
Touchdown distance	2000 feet.

All data were taken from cockpit instrument readings with the exception of threshold crossing height, which was read from Runk data camera film. Readings were tabulated, and are seen on Pages A1 and A2 of the Appendix.

Actual approach angles were computed as follows:

1. The "set" descent gradient was computed using the distance to the threshold and height above desired touchdown point at the release point.
2. The "effective" gradient was established by correcting for wind using the formula:

$$\text{Effective Gradient} - (\text{set gradient} \times \frac{\text{ground speed}}{\text{airspeed}})$$

3. Effective gradient was converted to approach slope angle.

Effect of Approach Angle on Descent Airspeed

Jet Commander. Airspeed ranged from V-ref to 10 knots above V-ref, but no correlation can be seen between the change in airspeed and the change in descent angle. See Chart 6, Appendix Page A-3.

Lear Jet. Airspeed ranged from V-ref to 10 knots above V-ref with no apparent correlation between changes in speed and changes in angle. See Chart 7, Appendix Page A-4.

Sabreliner. Airspeed ranged from V-ref to 15 knots above V-ref. Airspeed in descent increased generally with increase in approach angle. See Chart 8, Appendix Page A-5.

Jetstar. Airspeed remained very close to V-ref on all runs. See Chart 9, Appendix Page A-6.

All Data. Airspeeds of all aircraft are plotted together on Chart 10, Appendix Page A-7. Except for data recorded by the Sabreliner, high airspeeds on final approach did not appear to occur increasingly as approach angles were increased. One point is apparent, however; closer control over descent airspeed was maintained during the night runs. Only one out-of-tolerance airspeed occurred during night runs while many were recorded during day operations. See Appendix Page A-2 and Charts 42 and 43, Appendix Pages A-39 and A-40.

Effect of Approach Angle on Requirement for Power to Flare.

Jet Commander. At 3.5 degrees the requirement for power in flare began. It became necessary on over 50 percent of the runs at 4 degrees and over. See Chart 11, Appendix Page A-8.

Lear Jet. At 4 degrees nearly 70 percent of the runs required power to flare. Over 4 degrees the requirement went to 100 percent. See Chart 12, Appendix Page A-9.

Sabreliner. The power requirement began at 5 degrees. See Chart 13, Appendix Page A-10.

Jetstar. One power application was made at approximately 4 degrees, and considerable power was required at angles above 6.5 degrees. See Chart 14, Appendix Page A-11.

All Data. The power requirement in flare shows a sharp increase at 4 degrees and this requirement remains at higher angles. See Chart 15, Appendix Page A-12.

Effect of Approach Angle on Flyability.

Jet Commander. Moderate difficulty occurred at angles of 3.5 and 4.5 degrees. See Chart 16, Appendix Page A-13.

Lear Jet. No special difficulty below 5 degrees. See Chart 17, Appendix Page A-14.

Sabreliner. No flyability problems up to 6.5 degrees. At higher angles exceptional techniques were required to effect a landing. See Chart 18, Appendix Page A-15.

Jetstar. Angles above 4 degrees were generally considered by project pilots to be acceptable if the approach is to be conducted under VFR conditions. See Chart 19, Appendix Page A-16.

All Data. See Chart 20, Appendix Page A-17. Flyability problems began at 3.5 degrees, but did not affect most aircraft until angles went above 4 degrees. Comment of subject pilots indicated that when the aircraft was equipped with thrust reversers and anti-skid brakes higher approach angles were of less concern than to pilots of less sophisticated aircraft.

Effect of Approach Angle on Maximum Sink Rate.

Jet Commander. Most approaches resulted in sink rates over 1000 feet per minute. The majority of the high readings were observed at approach angles over 4 degrees. See Chart 21, Appendix Page A-18.

Lear Jet. As approach angles increased, so did maximum sink rates. Most runs at angles over 4 degrees resulted in sink rates over 1000 feet per minute. See Chart 22, Appendix Page A-19.

Sabreliner. Maximum sink rates increased as approach angles increased. Above 4 degrees all approaches resulted in sink rates which were out of tolerance. See Chart 23, Appendix Page A-20.

Jetstar. Rates increased with approach angles. All runs exceeded the tolerance when angles were above 4 degrees. See Chart A-24, Appendix Page A-21.

All Data. Up to a 4 degree approach slope angle only 20 percent of the runs had maximum sink rates over 1000 feet per minute. Over 4 degrees 98 percent were out of tolerance. Sink rates in general increased as approach angles increased. See Chart 25, Appendix Page A-22.

NOTE: Maximum sink rate occurred at or near a point 1/2 mile out from the landing threshold.

Effect of Approach Angle on Threshold Sink Rate.

Jet Commander. Over 70 percent of the runs had threshold sink rates within tolerance. Sink rates increased with the approach angle increases. See Chart 26, Appendix Page A-23.

Lear Jet. Above 4 degrees the threshold sink rate was out of tolerance on most runs. In general, sink rate increased as approach slope angles increased. See Chart 27, Appendix Page A-24.

Sabreliner. Sink rate increased with increases in approach slope angle. Threshold sink rate appeared more controllable in this aircraft than in the Jet Commander and Lear Jet, and it was kept within tolerance at angles up to 6 degrees. See Chart 28, Appendix Page A-25.

Jetstar. Threshold sink rate was closely controlled. Only one approach had out of tolerance sink. All others remained well below the tolerance limit. See Chart 29, Appendix Page A-26.

All Data. The general trend was for increases in approach slope angle to result in increases in threshold sink rates. Above 4 degrees the threshold sink rates went to 1300-1400 feet per minute. See Chart 30, Appendix Page A-27.

Effect of Approach Angle on Threshold Crossing Height.

Jet Commander. No significant correlation is apparent between TCH and approach angle. Height was above the upper

limit at angles above 3.5 degrees. See Chart 31, Appendix Page A-28.

Lear Jet. Above 4 degrees some TCH values went out of tolerance. These values were apparently not correlated with increases in approach slope angle. See Chart 32, Appendix Page A-29.

Sabreliner. More runs had TCH values below the 20 foot lower limit than above the 60 foot upper limit. No significant or apparent correlation between TCH and approach slope angle. See Chart 33, Appendix Page A-30.

All Data. Threshold crossing heights do not appear to be correlated with approach slope angles. 13 percent were low and 26 percent were high. Low readings occurred from 3.5 to 6.7 degrees. High readings occurred from 3.5 to 6.2 degrees. See Chart 34, Appendix Page A-31.

Approach Slope Effect on Touchdown Distance.

Jet Commander. A general trend can be seen indicating that higher approach angles result in longer distances for touchdown. Some touchdowns were beyond the 2000 foot tolerance at lower angles (to 3.5 degrees), but MOST exceeded the tolerance when the approach slope angle was increased to 4 degrees and over. See Chart 35, Appendix Page A-32.

Lear Jet. There was an increase in touchdown distance as the approach angles were increased. As the angle went above 4 degrees the touchdown distance increased out of tolerance. See Chart 36, Appendix Page A-33.

Sabreliner. As approach angles increased there was a general increase in touchdown distance. While one sample was outside at 3.5 degrees, most were still within tolerance at angles up to 5 degrees. See Chart 37, Appendix Page A-34.

Jetstar. No touchdown distances in this aircraft were out of tolerance, even though the approach slope angles were above 6.5 degrees. There were indications that higher angles result in longer touchdown distances. See Chart 38, Appendix Page A-35.

All Data. There is a general trend toward longer touchdown distances with higher approach slope angles as shown in the data distribution on Chart 39, Appendix Page A-36. The trend becomes suddenly stronger at approximately 4 degrees. Below 4 degrees less than 17 percent were out of tolerance, while above 4 degrees over 50 percent were out.

Night versus Day Approaches.

Charts 40 through 43, Appendix Pages A-37 through A-40, show runs during which conditions were out of tolerance, with the run identified as to whether it was made during day or night operation. No in-tolerance conditions are plotted on these charts.

During daylight operation, pilots accepted higher angles than they did at night. Only two night approaches were made at approach slope angles above 5.5 degrees, as opposed to 11 day runs. Highest night angle was just over 6.0 degrees, while day angles went almost to 7 degrees.

During night operation only one airspeed went out of tolerance as opposed to 13 instances during day operation, some at angles of 4 degrees and below. This means that in the absence of outside visual cues, there is some apparent increase in reliance on airspeed to provide approach information to the pilot.

Early Set. (Establish Landing Configuration Prior to 1 Mile).

Normal operating procedures in the Jet Commander and the Lear Jet involve waiting until a landing is assured before setting up in landing configuration. This resulted in airspeeds 20 knots above Vref at the one-mile-out release point. On some of the approaches landing configuration was set up early (at a point prior to reaching the release point) to determine whether a significant change in operating limits would result. As expected, having the airspeed stabilized at Vref prior to the release point resulted in an easier and more comfortable approach in both aircraft. Pilots of the Jet Commander accepted approach angles nearly one degree higher when this method was used. They also did NOT identify even night approaches above 5 degrees as having flyability problems using this technique when some approaches made using the normal technique were deemed problems at just over 4 degrees.

Altimeter reading versus Actual Aircraft Height.

With threshold altimeter readings logged in the cockpit for comparison with actual aircraft height recorded with the Runk Data Camera, it was possible to check these differences. See Charts 44 through 47, Appendix Pages A-41 through A-44. Only 5 approaches showed indicated altitude to be at or lower than the actual aircraft height. All other approaches had cockpit indications of altitude higher than the actual height at the threshold. Differences were as much as 130 feet.

Summation of Conditional Parameters.

Jet Commander. Chart 1, Page 9, shows a summation of out of tolerance conditions. Problems began at 3.5 degrees and became prevalent at 4 degrees.

Lear Jet. Chart 2, Page 10 shows that out of tolerance conditions began at 4 degrees.

Sabreliner. Chart 3, Page 11. Out of tolerance situations occurred at 3.5 degrees, then increased markedly at and over 4 degrees.

Jetstar. Chart 4, Page 12. Out of tolerance conditions began at 4 degrees.

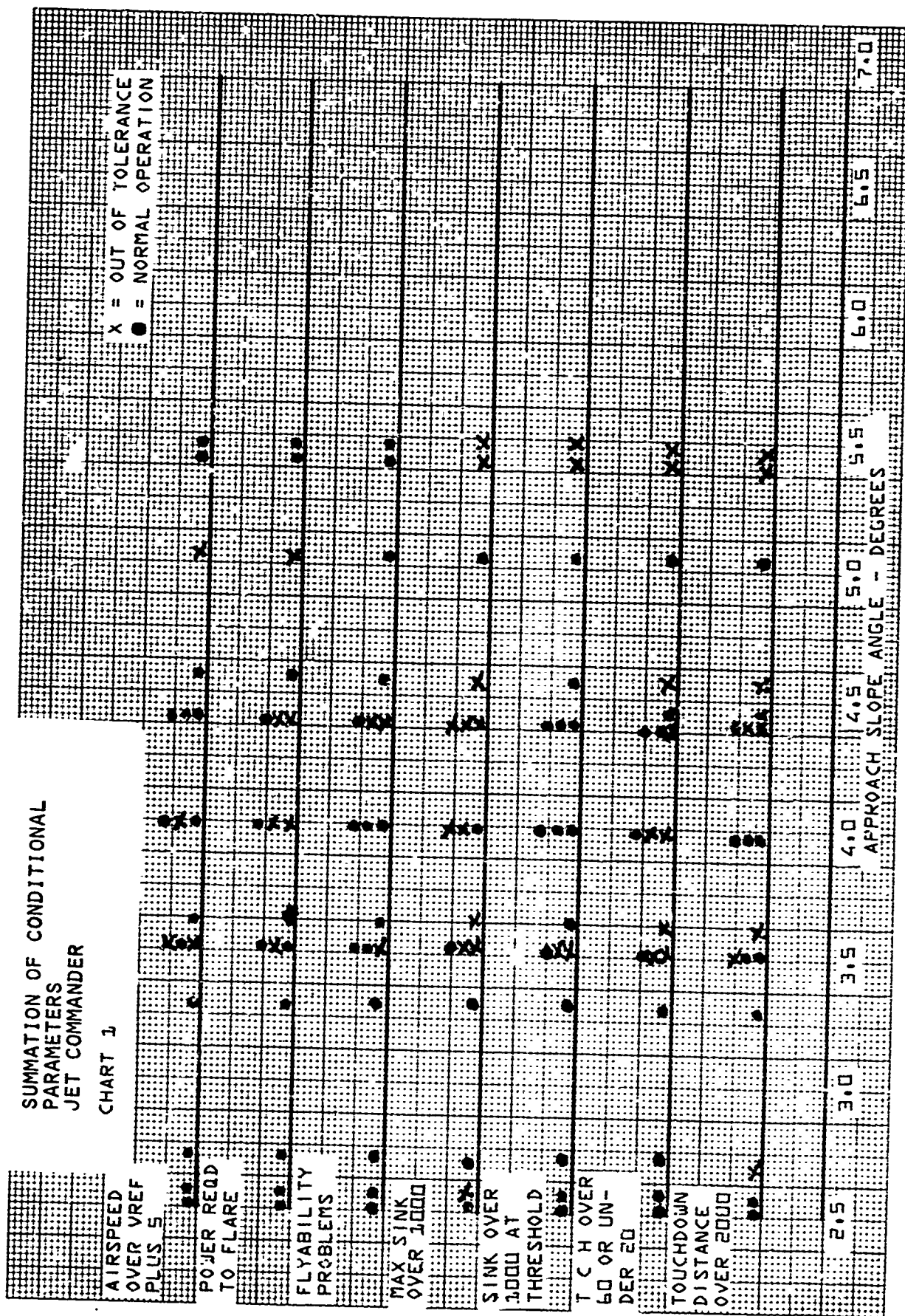
All Data. Chart 5, Page 13. Combined data. Some out of tolerance conditions begin showing themselves at 3.5 degrees, then at 4 degrees. Above 4 degrees, however, these conditions increase rapidly. Based upon the approaches flown in these test aircraft, it would appear that approach slopes in excess of 4 degrees can be expected to be accompanied by problems of flyability, power requirement in flare, high sink rates, and long touchdown distances.

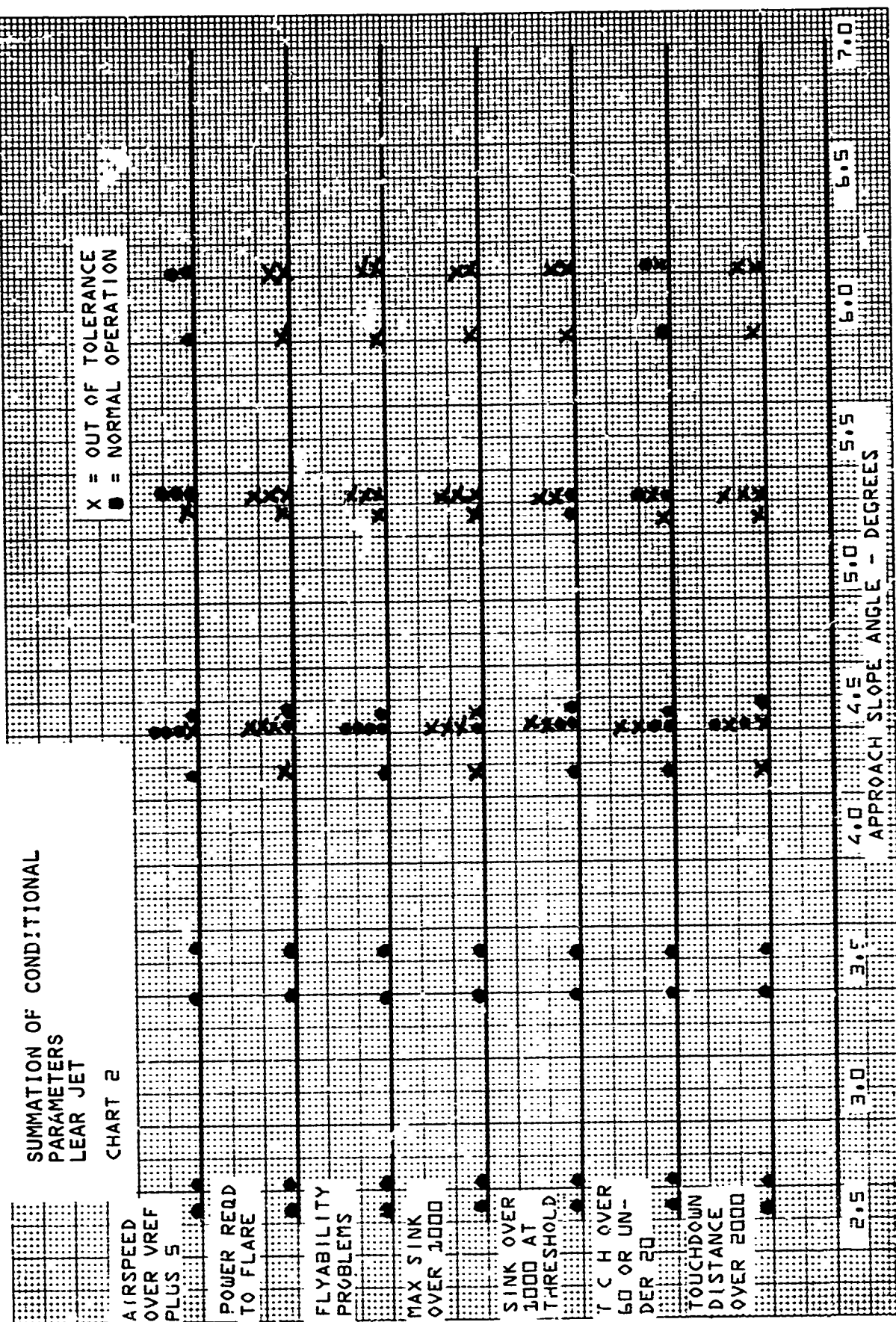
Reproduced from
best available copy.



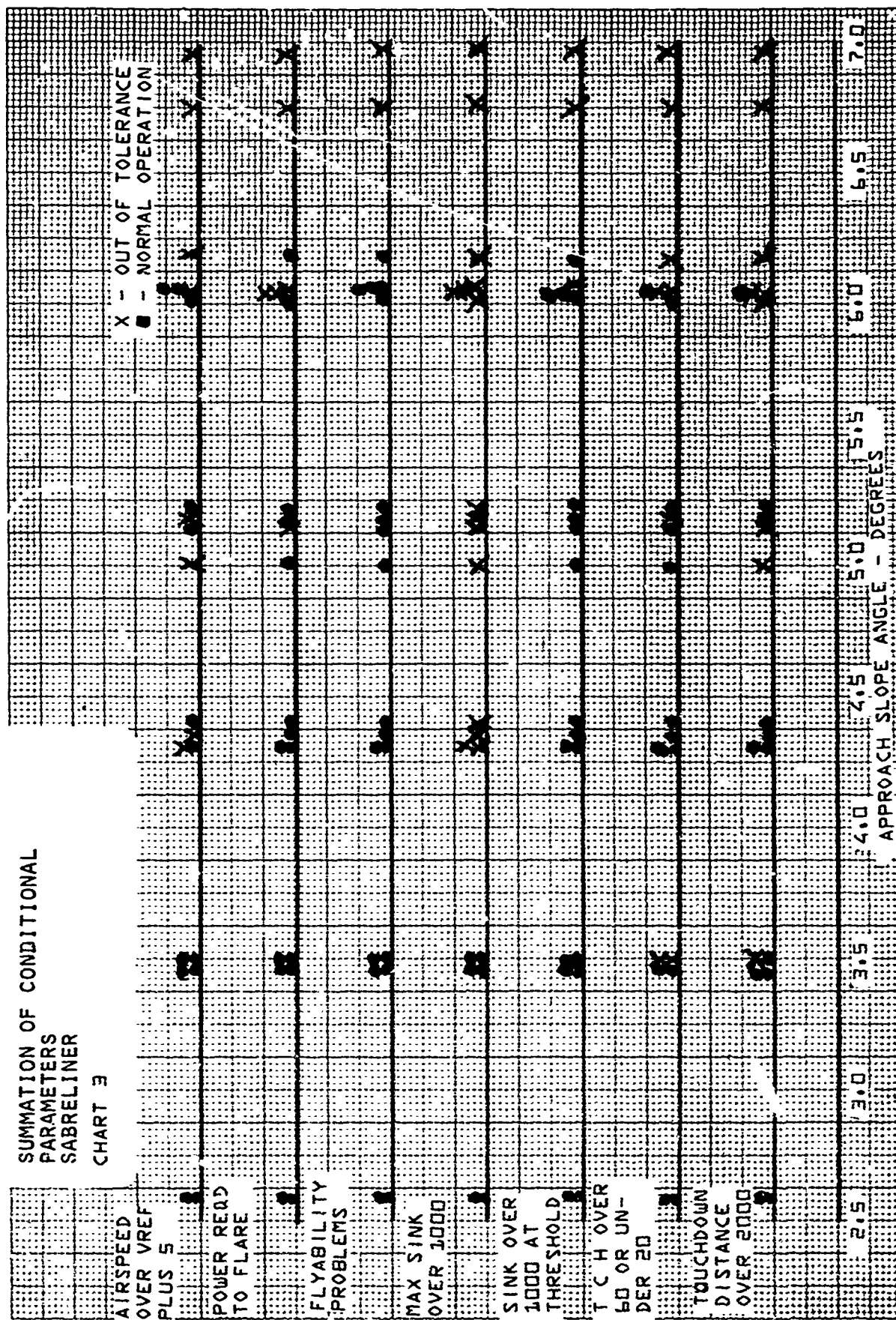
SUMMATION OF CONDITIONAL PARAMETERS JET COMMANDER

CHART 1

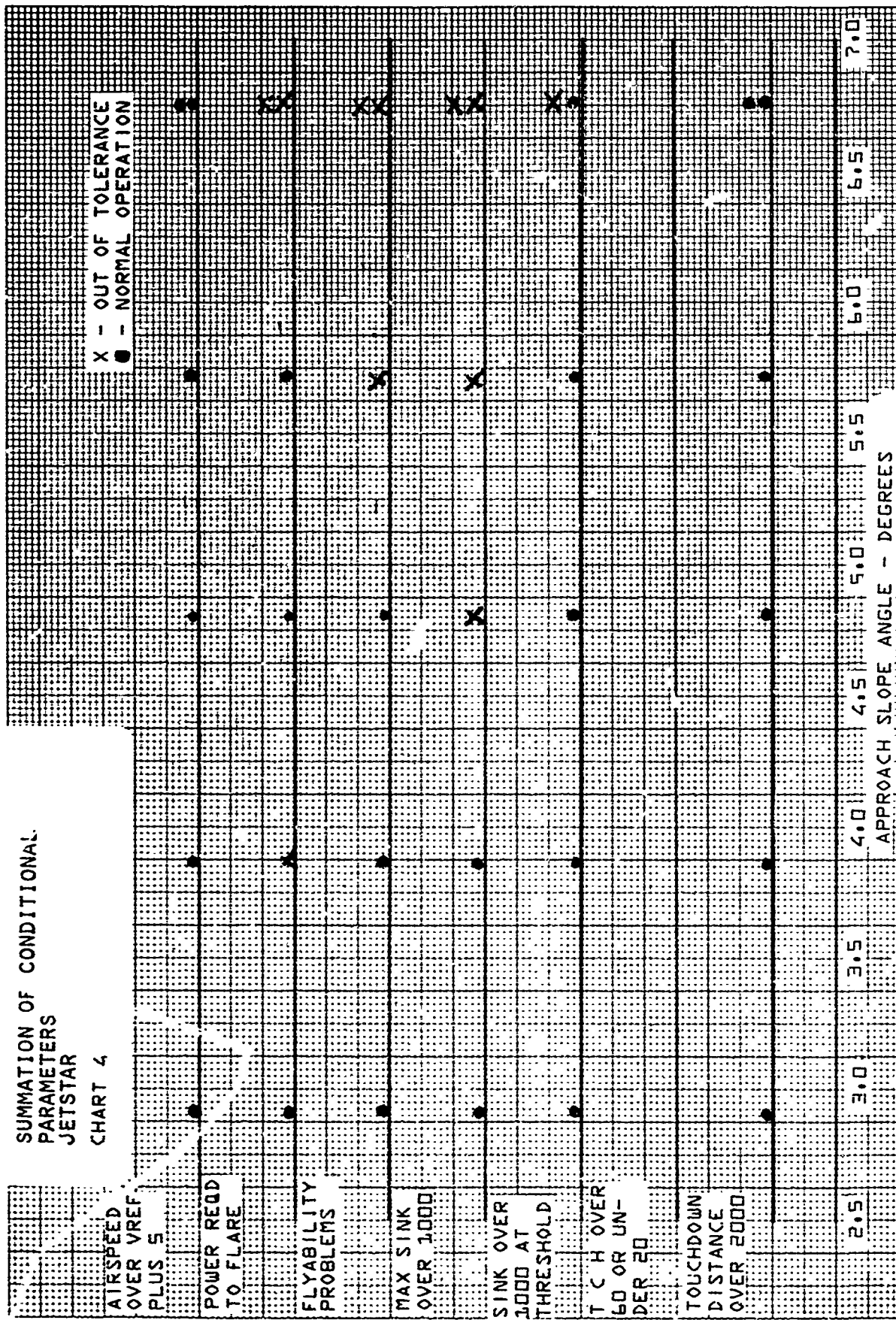




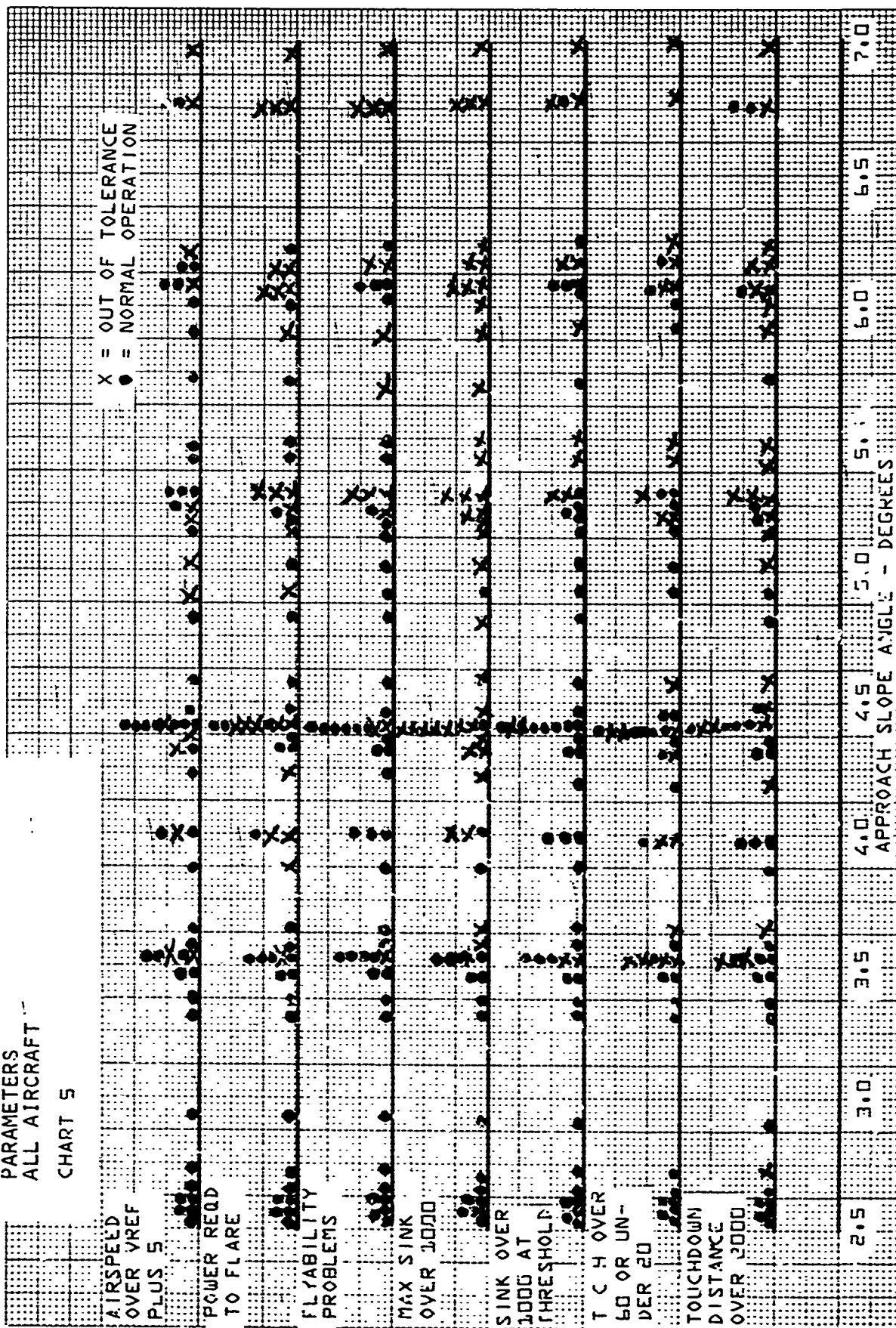
SUMMATION OF CONDITIONAL
PARAMETERS
SABRELINER
CHART 3



SUMMATION OF CONDITIONAL
PARAMETERS
JETSTAR
CHART 4



SUMMATION OF CONDITIONAL
PARAMETERS
ALL AIRCRAFT
CHART 5



FINDINGS

1. Some aircraft tested showed excursions outside tolerances at 3.5 degree approach angles. These excursions became frequent and general at angles above 4 degrees.
2. Specific effect on assigned tolerances were as follows:
 - a. Airspeed during descent was affected directly only in the Sabreliner.
 - b. At 4 degrees power application for the flare became a requirement.
 - c. Problems in flyability began to manifest themselves at and over 4 degrees.
 - d. Maximum sink rate and sink rate at the threshold increased out of tolerance at and over 4 degrees.
 - e. Threshold crossing height appeared NOT to be affected by approach angle.
 - f. Touchdown distances increase with increased approach slope, markedly so at and over 4 degrees.
3. Pilots accepted higher approach angles during day approaches than at night. Airspeed was more carefully held within tolerances at night. No other special differences between day and night operation was indicated.
4. Putting the aircraft in final approach configuration prior to reaching the one-mile point (Jet Commander and Lear Jet) provided a lower beginning airspeed at the start of descent resulting in more stable speed through the approach. This resulted in a better controlled and more comfortable approach for the pilot. In the Jet Commander an approach one degree higher was acceptable to the pilot using this technique.
5. Altimetry system lag causes indicated altitude to be higher than actual height at the threshold on final approach.

APPENDIX

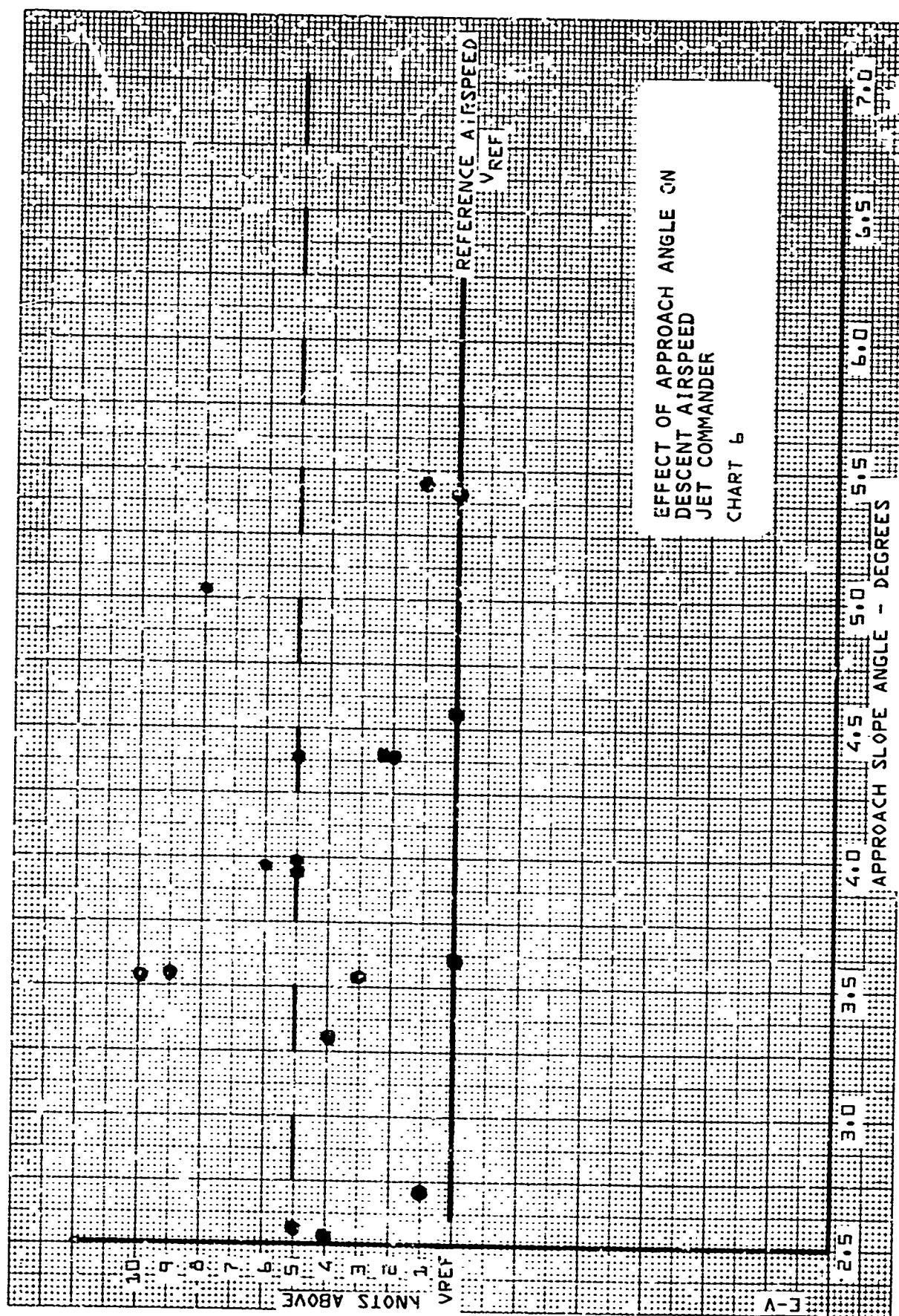
A-1 & 2	Data Tabulation
A-3 - 7	Effect of Approach Angle on Descent Airspeed
A-8 - 12	Effect of Approach Angle on Power Required in Flare
A-13 - 17	Effect of Approach Angle on Flyability
A-18 - 22	Effect of Approach Slope on Max Sink Rate
A-23 - 27	Effect of Approach Slope on Threshold Sink Rate
A-28 - 31	Effect of Approach Slope on T C H
A-32 - 36	Effect of Approach Slope on Touchdown Distance
A-37 - 40	Comparison of Night vs Day Approaches
A-41 - 44	Comparison of Indicated vs Actual altitude at TH
A-45	Conversion of Approach Slope Angle to Descent Gradient.

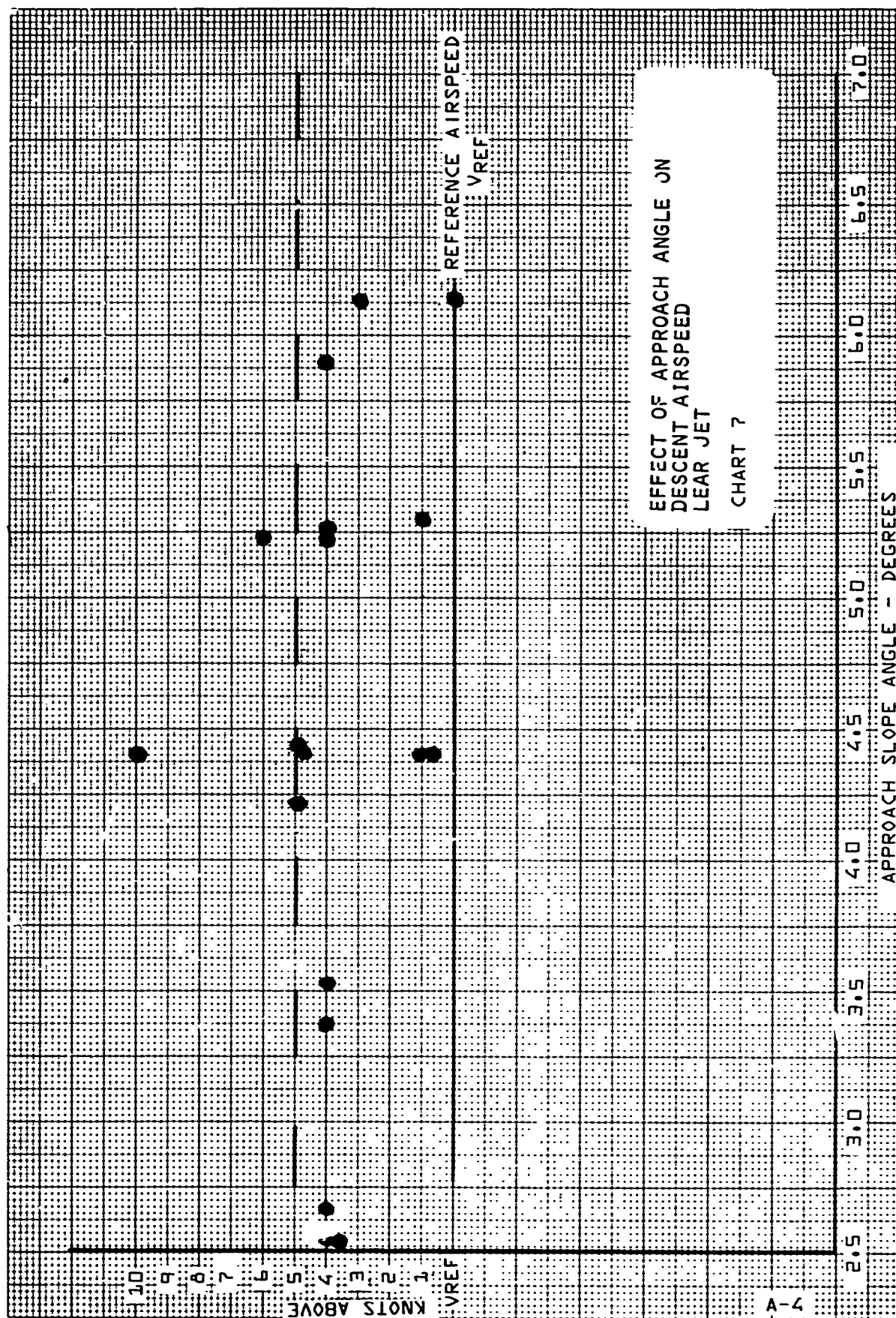
Reproduced from
best available copy.

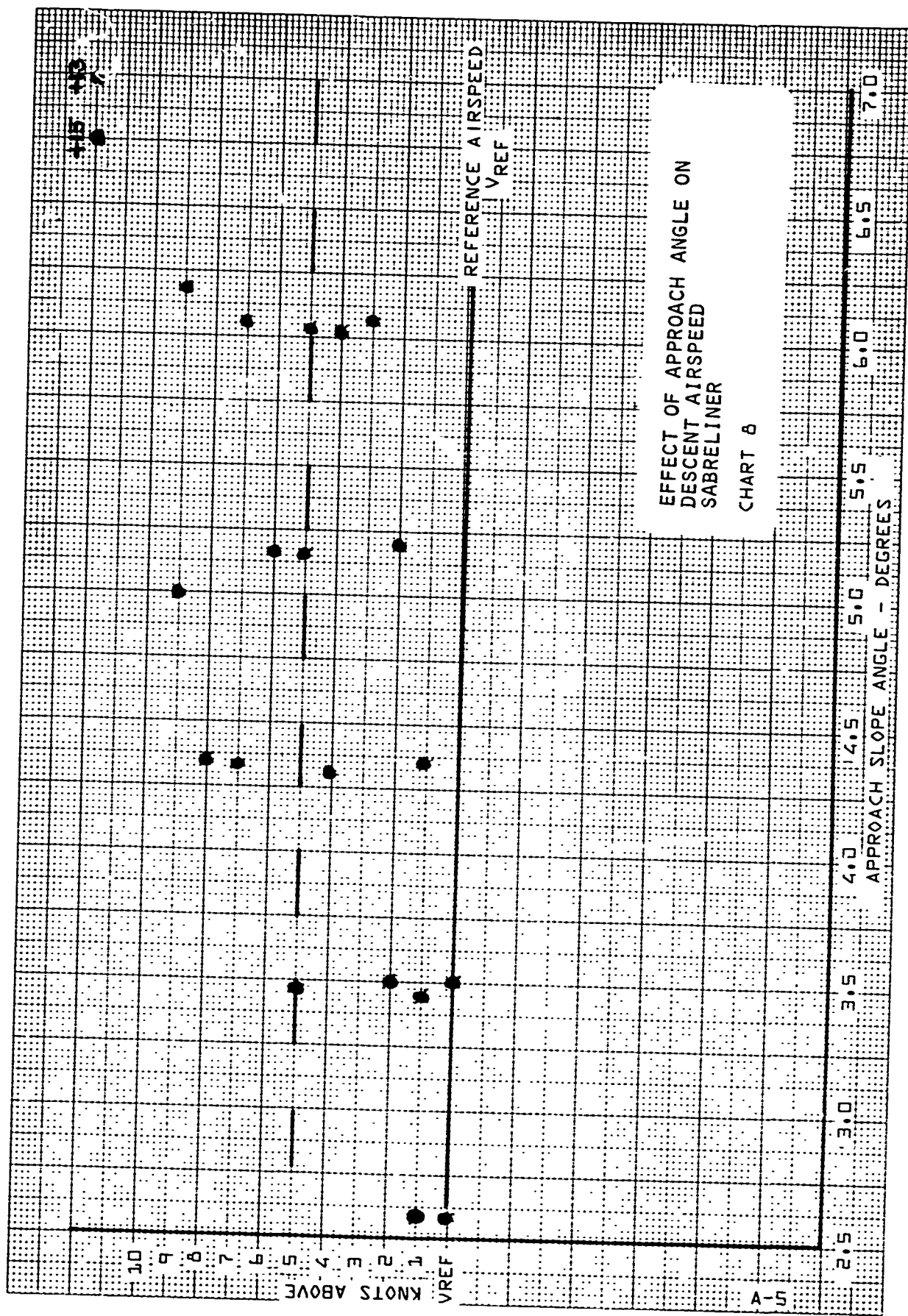


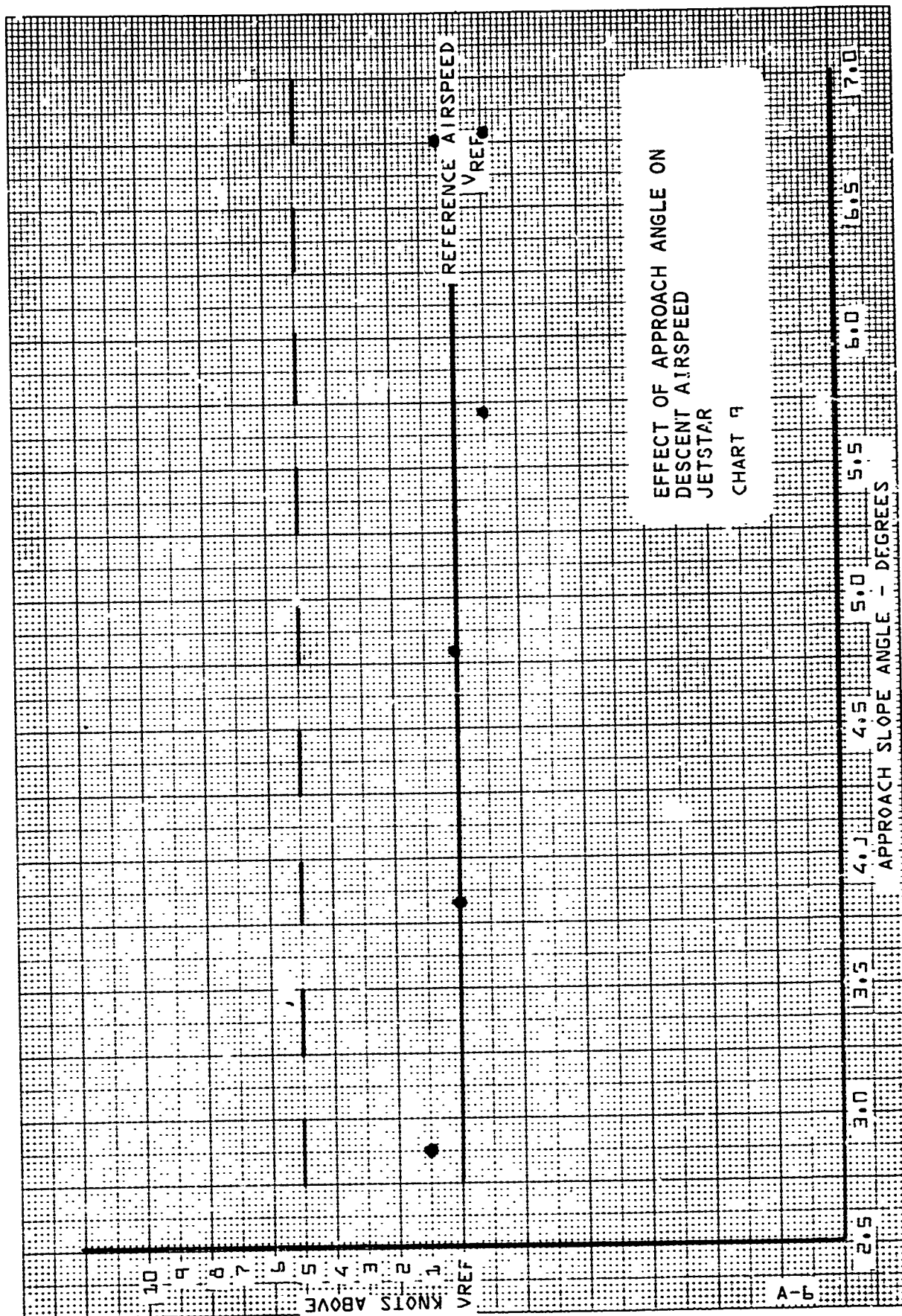
RUN	APPROACH	CONDITION	ACFT	AIR	REF	POWER	DIFFICULT	MAX	THRESH	TCH	TD	LIST	REMARKS
	ANGLE		TYPE	SPEED	SPEED	REQ'D	APPROACH	SINK	SINK				
1	2.52	Day	JC	125	121					22		1250	
2	3.30	Day	JC	125	121					30		1320	
3	3.98	Day	JC	125	120	YES				19		720	
4	5.03	Day	JC	125	118	YES				22		920	
5	2.56	Day	JC	125	120			600		28		1000	
6	3.54	Day	JC	130	120			1100		28		2000	
7	4.40	Day	JC	120	118	YES	Missed Approach	1000		28		2000	
8	4.40	Day	JC	120	116	YES		900		49		2800	
9	3.97	Day	JC	120	114	YES		800		71		1800	
10	3.53	Day	JC	115	112	YES		1100		74		2000	Early set
11	3.55	Day	JC	120	111			800		53		2400	"
12	4.40	Day	JC	115	110			900		46		1800	"
13	3.90	Day	JC	115	110			500		53		2000	"
14	2.71	Night	JC	120	121			500		47		2300	"
15	3.12	Night	JC	120	120			600		77		2400	"
16	Missed approach												
17	4.56	Night	JC	116	116			900		66		2500	"
18	5.47	Night	JC	115	114			1100		90		3000	"
19	5.42	Night	JC	112	112			1100		71		2500	"
20	2.54	Day	LJ	135	131			500		27		1700	
21	3.37	Day	LJ	135	131			500		28		1500	
22	4.22	Day	LJ	135	130			500		23		2250	
23	5.23	Day	LJ	135	129	YES		800		63		2700	CK VFR
24	6.14	Day	LJ	128	128	YES		1100		97		3200	OK VFR
25	5.89	Day	LJ	130	125	YES		1100		20		2900	Early set
26	6.13	Day	LJ	128	125	YES		1200		50		3400	"
27	4.39	Day	LJ	125	125			800		44		2800	"
28	2.66	Night	LJ	135	131			400		22		1050	"
29	3.54	Night	LJ	135	131			500		41		1450	"
30	4.43	Night	LJ	135	130			800		36		1525	"
31	4.41	Night	LJ	130	129	YES		1000		31		1700	"
32	5.30	Night	LJ	130	129	YES		1000		58		2000	"
33	5.26	Night	LJ	130	126	YES		1100		63		2500	"
34	5.30	Night	LJ	130	126	YES		1300		58		2400	"

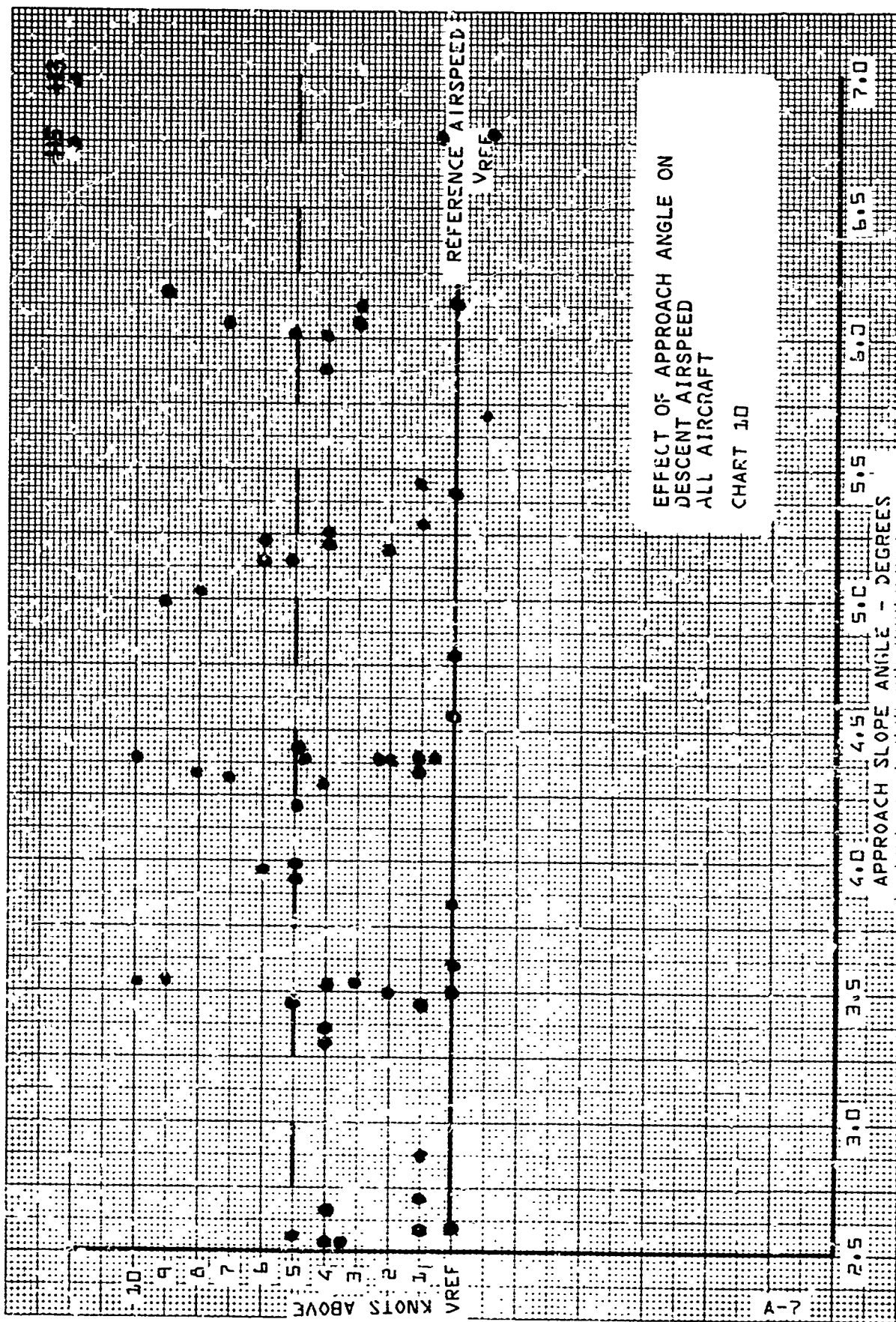
	Early set "	Exceptional techniques	Same	Max IFR VFR Only DME, then flare
35	2350			
36	2000			
37	1050			
38	1350			
39	1500			
40	1720			
41	2400			
42	2200			
43	1500			
44	2800			
45	2350			
46	2250			
47	2350			
48	1800			
49	2750			
50	1900			
51	2000			
52	2400			
53	1950			
54	1950			
55	1550			
56	2600			
57	1550			
58	1150			
59	1280			
60	1100			
61	1050			
62	1850			
63	1200			
64	64			
65	33			
66	16			
67	17			
68	13			
69	19			
70	33			
71	25			
72	35			
73	19			
74	16			
75	35			
76	74			
77	43			
78	52			
79	70			
80	40			
81	25			
82	25			
83	48			
84	40			
85	1400			
86	1100			
87	400			
88	600			
89	800			
90	700			
91	1100			
92	1100			
93	1000			
94	800			
95	700			
96	1300			
97	1000			
98	400			
99	500			
100	700			
101	700			
102	800			
103	500			
104	400			
105	500			
106	800			
107	800			
108	300			
109	300			
110	300			
111	300			
112	400			
113	1500			
114	2000			
115	1300			
116	500			
117	800			
118	1700			
119	1500			
120	1800			
121	500			
122	800			
123	1300			
124	1500			
125	1800			
126	500			
127	800			
128	1300			
129	1500			
130	1800			
131	500			
132	800			
133	1300			
134	1500			
135	1800			
136	500			
137	800			
138	1300			
139	1500			
140	1800			
141	500			
142	800			
143	1300			
144	1500			
145	1800			
146	500			
147	800			
148	1300			
149	1500			
150	1800			
151	500			
152	800			
153	1300			
154	1500			
155	1800			
156	500			
157	800			
158	1300			
159	1500			
160	1800			
161	500			
162	800			
163	1300			
164	1500			
165	1800			
166	500			
167	800			
168	1300			
169	1500			
170	1800			
171	500			
172	800			
173	1300			
174	1500			
175	1800			
176	500			
177	800			
178	1300			
179	1500			
180	1800			
181	500			
182	800			
183	1300			
184	1500			
185	1800			
186	500			
187	800			
188	1300			
189	1500			
190	1800			
191	500			
192	800			
193	1300			
194	1500			
195	1800			
196	500			
197	800			
198	1300			
199	1500			
200	1800			

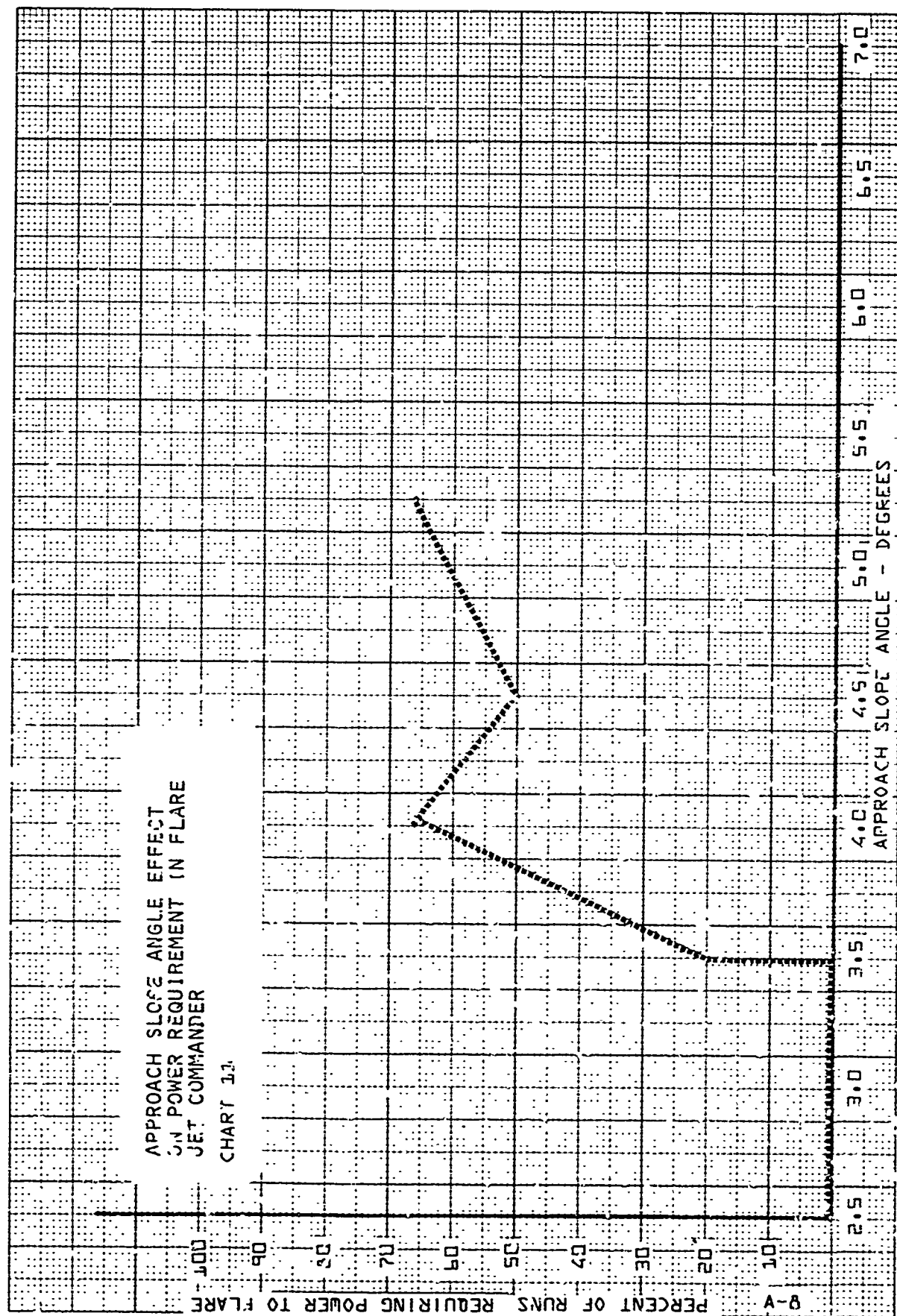


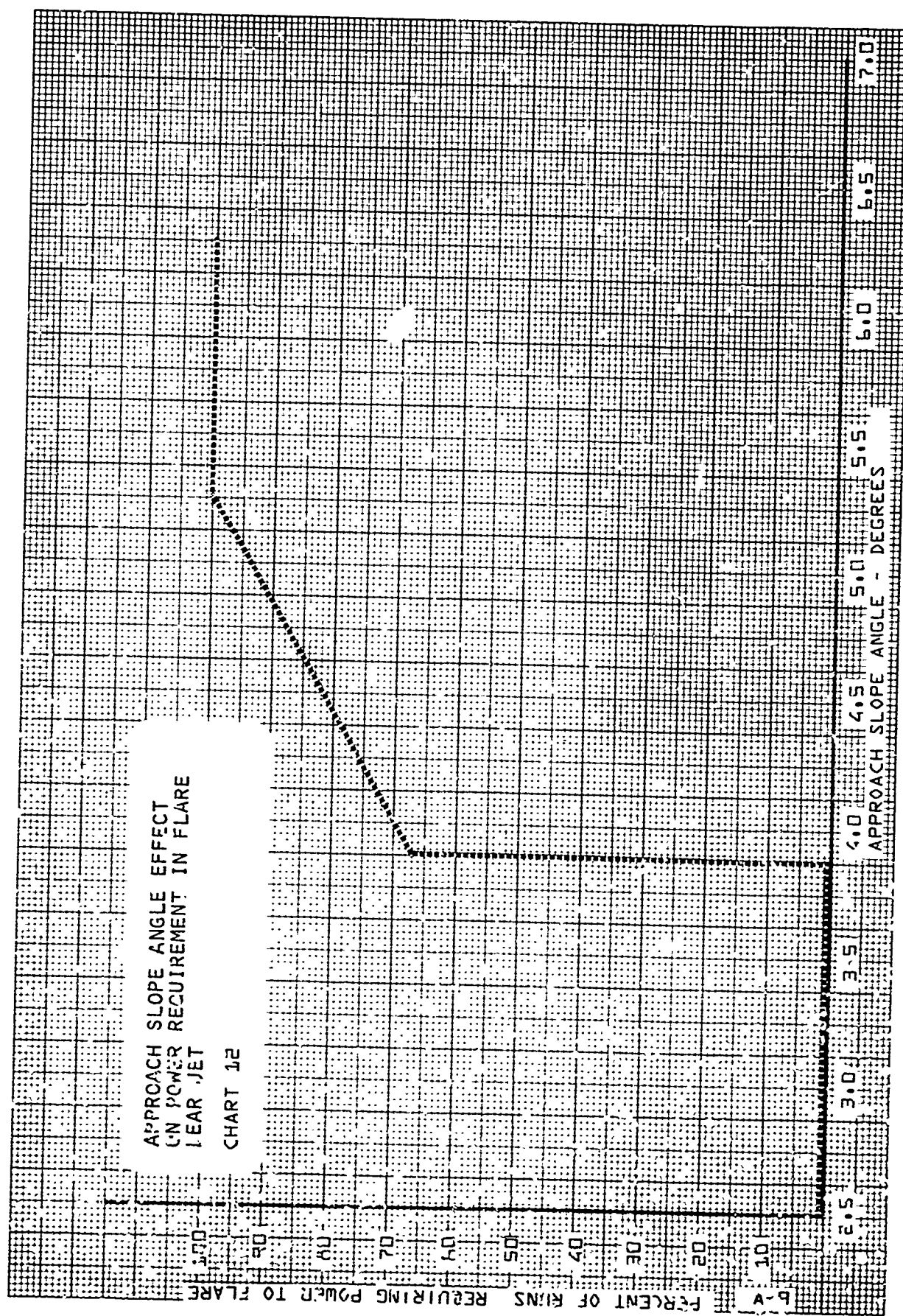






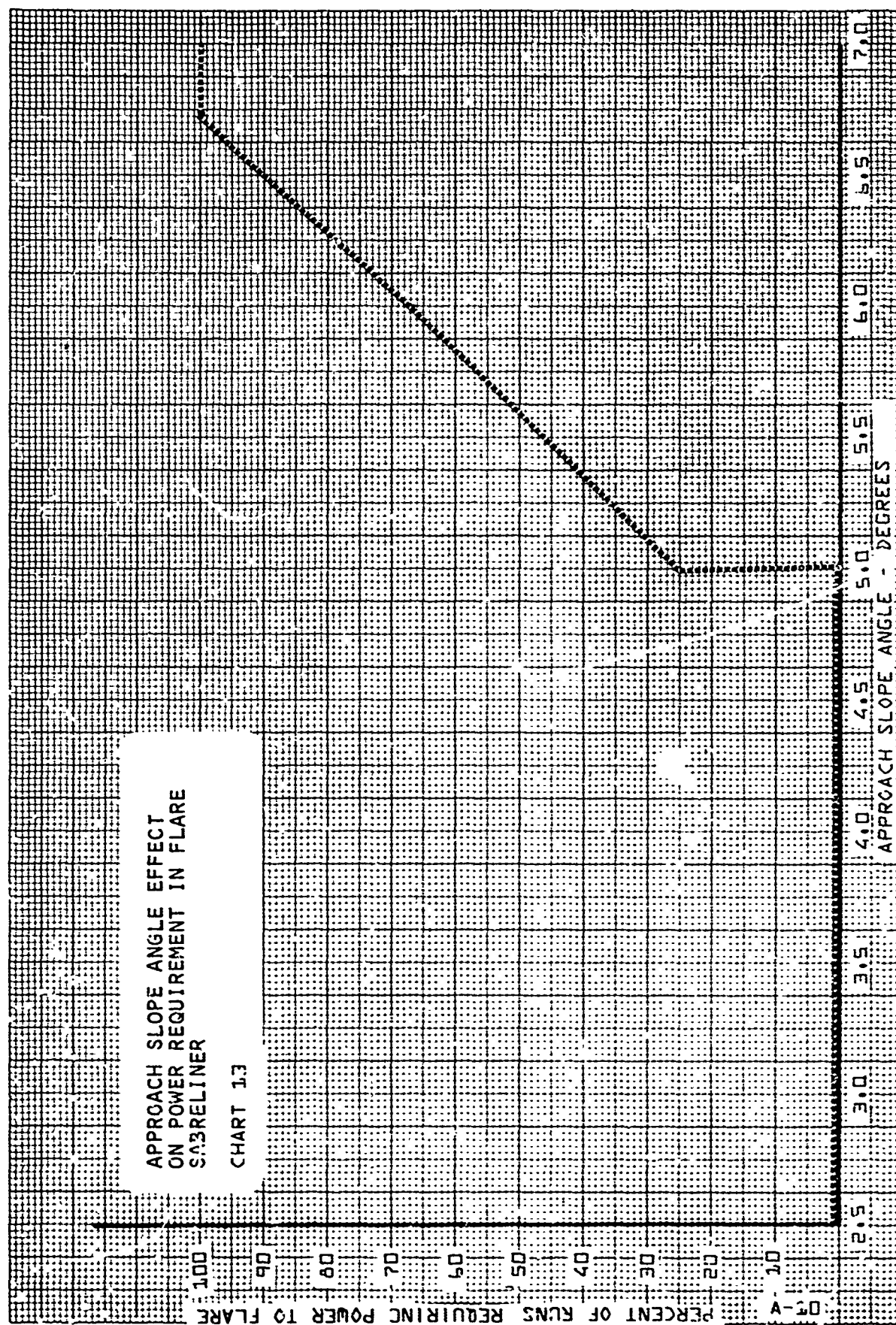


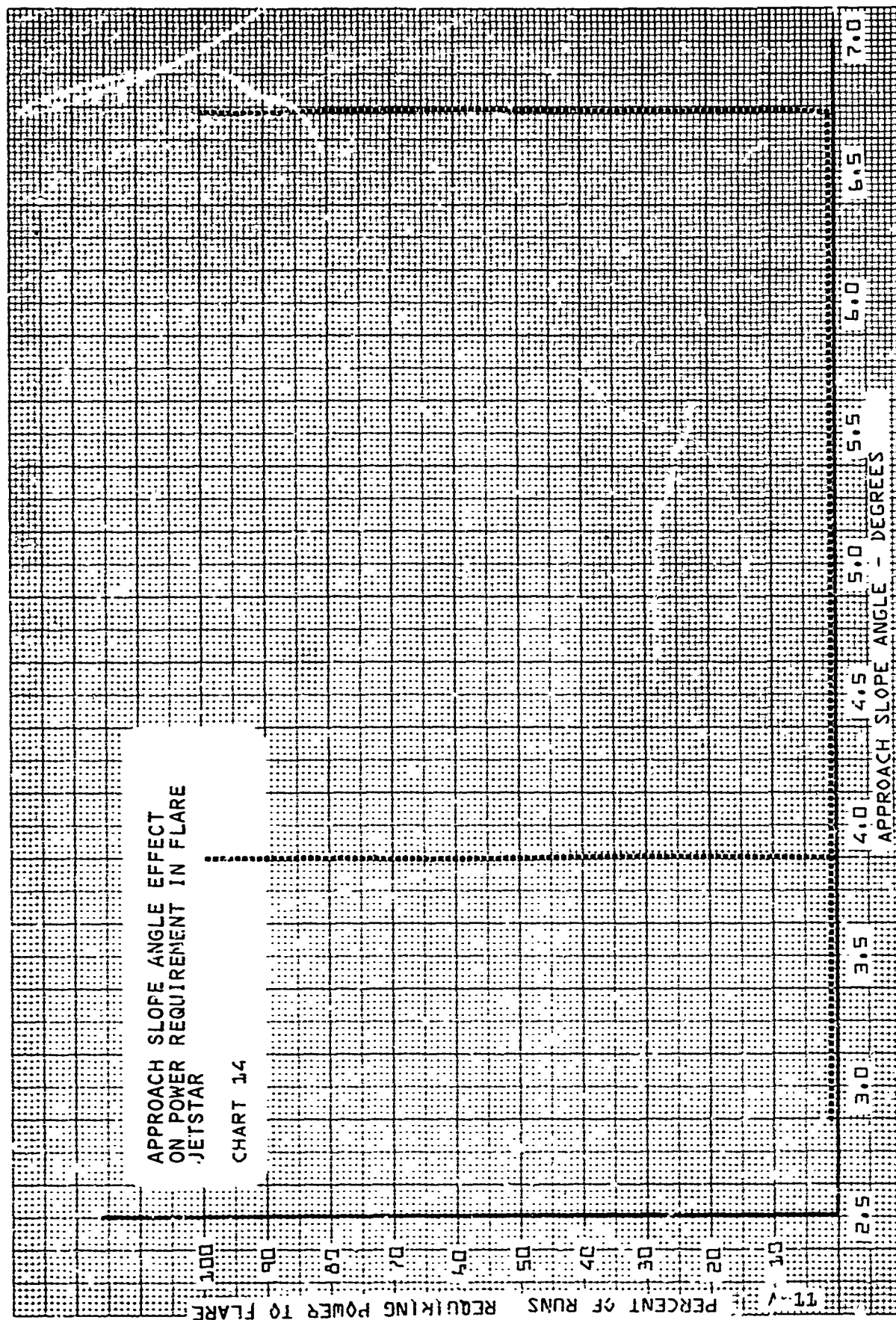


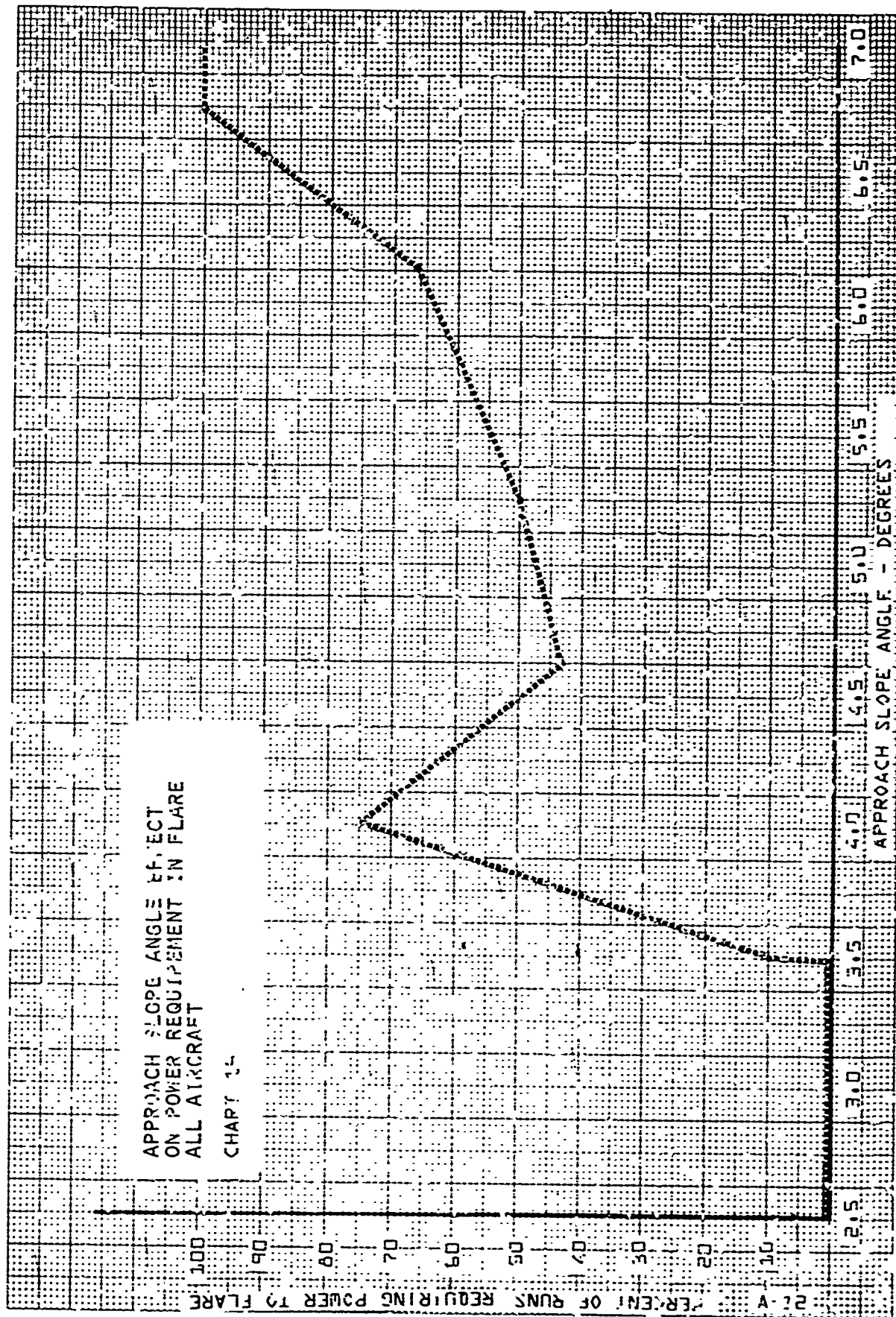


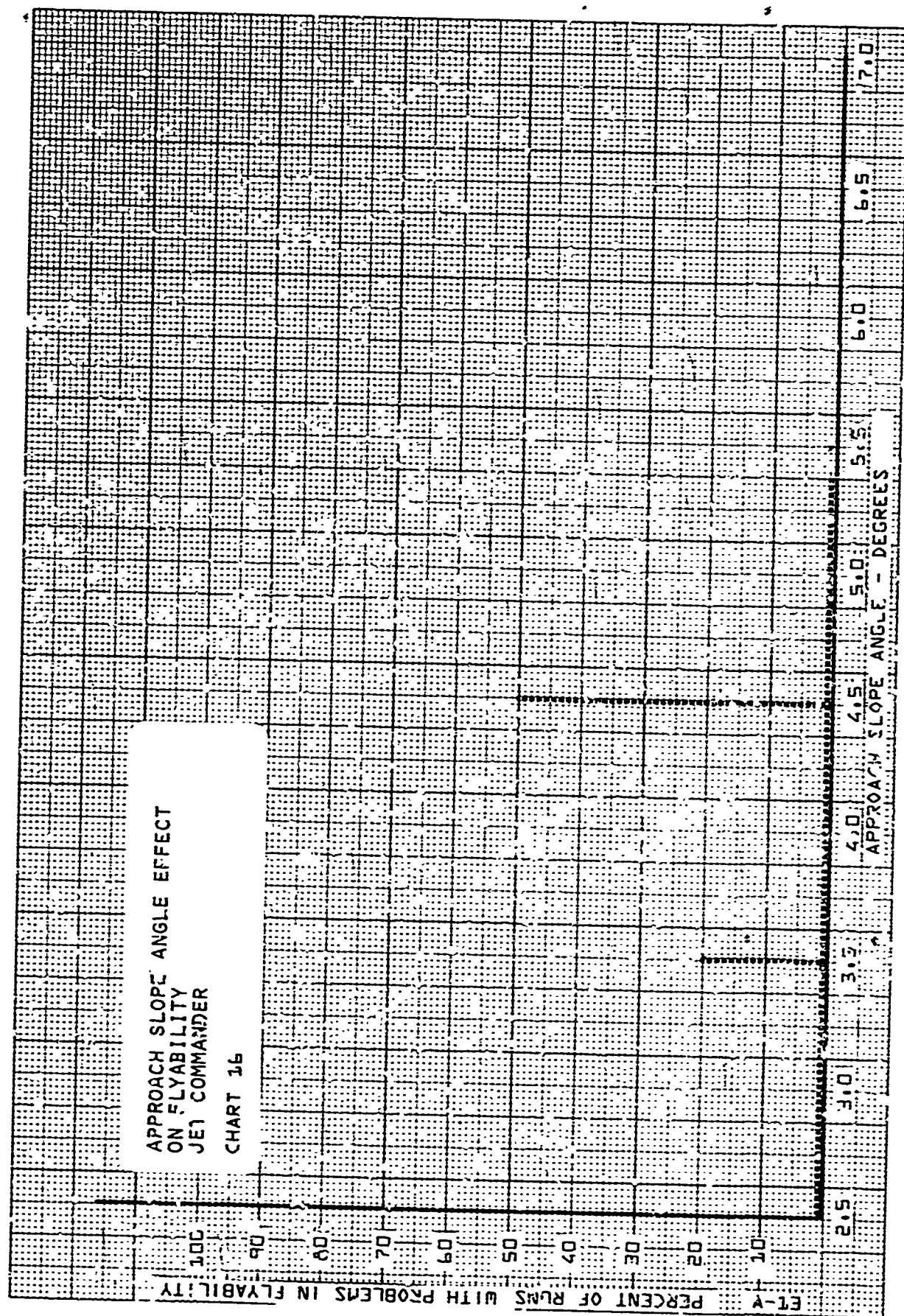
APPROACH SLOPE ANGLE EFFECT ON POWER REQUIREMENT IN FLARE SABRELINER

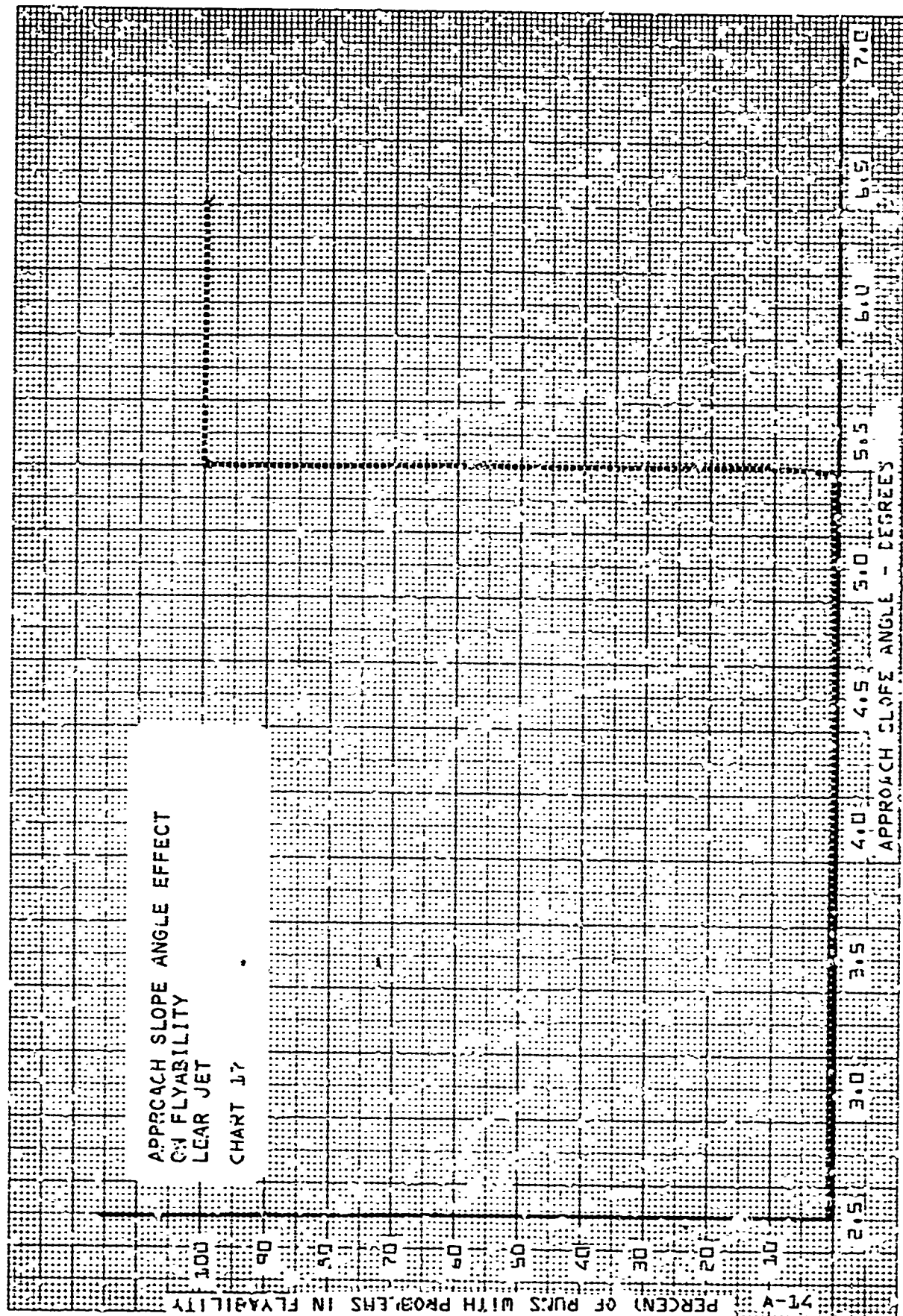
CHART 1.3







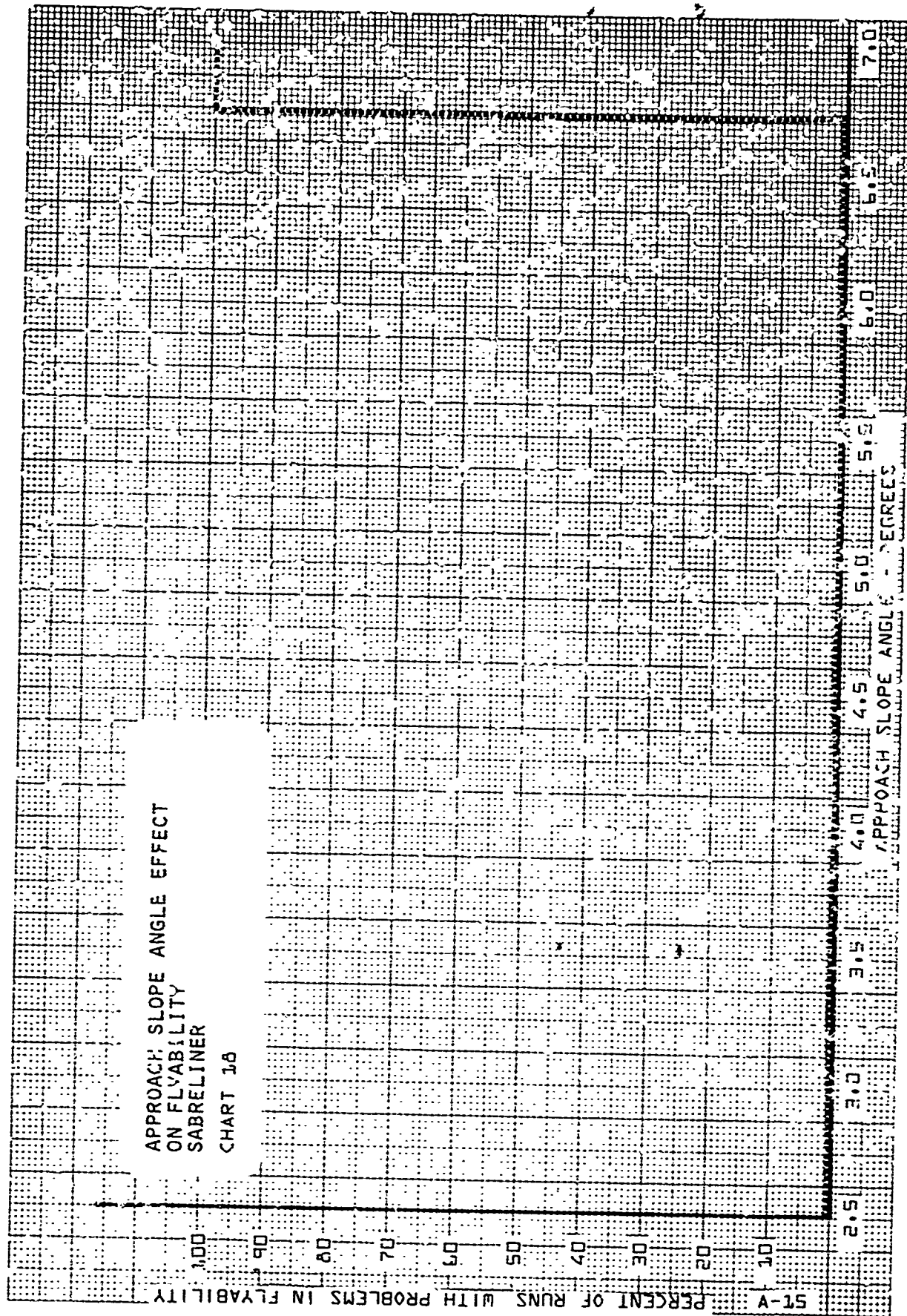


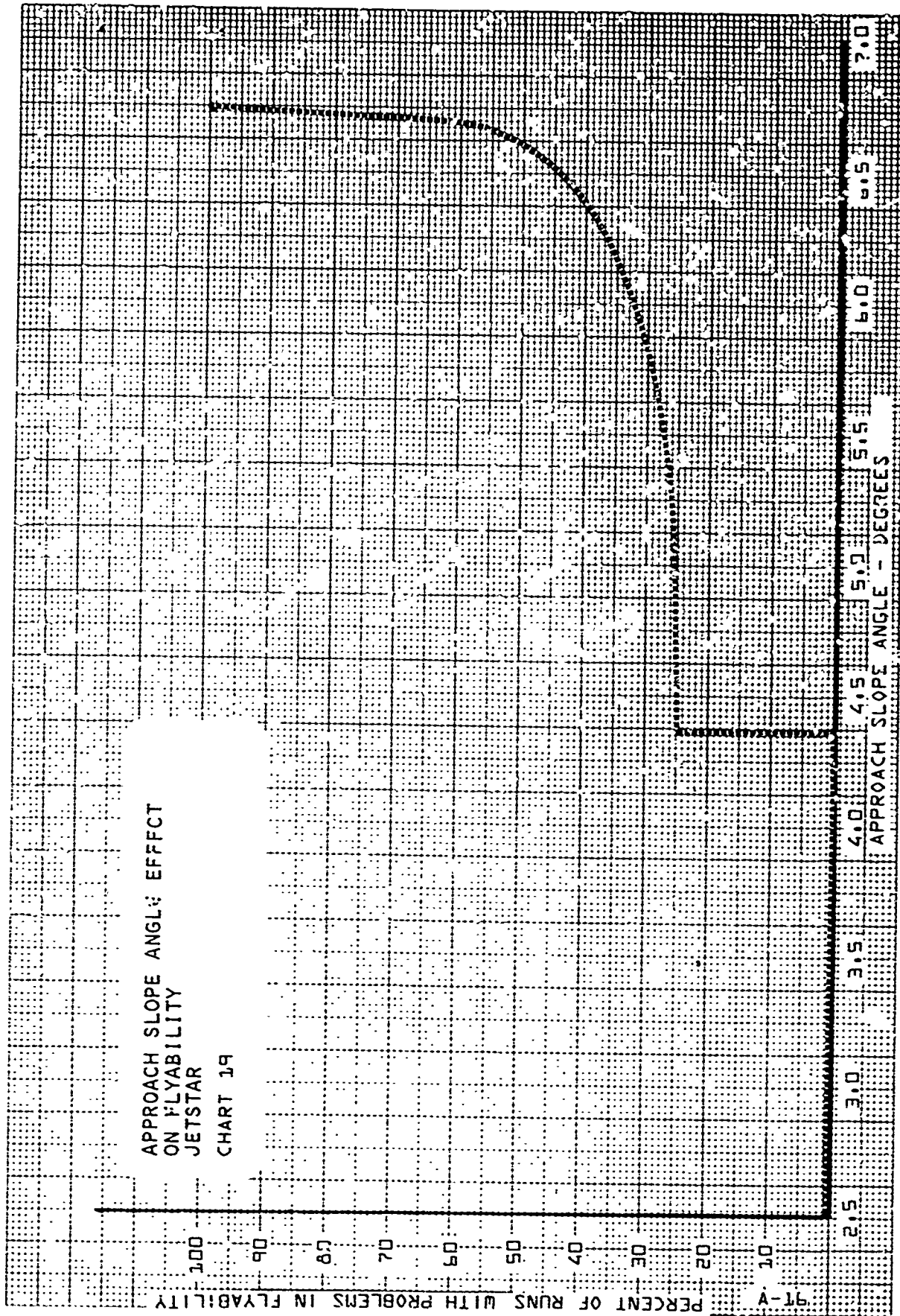


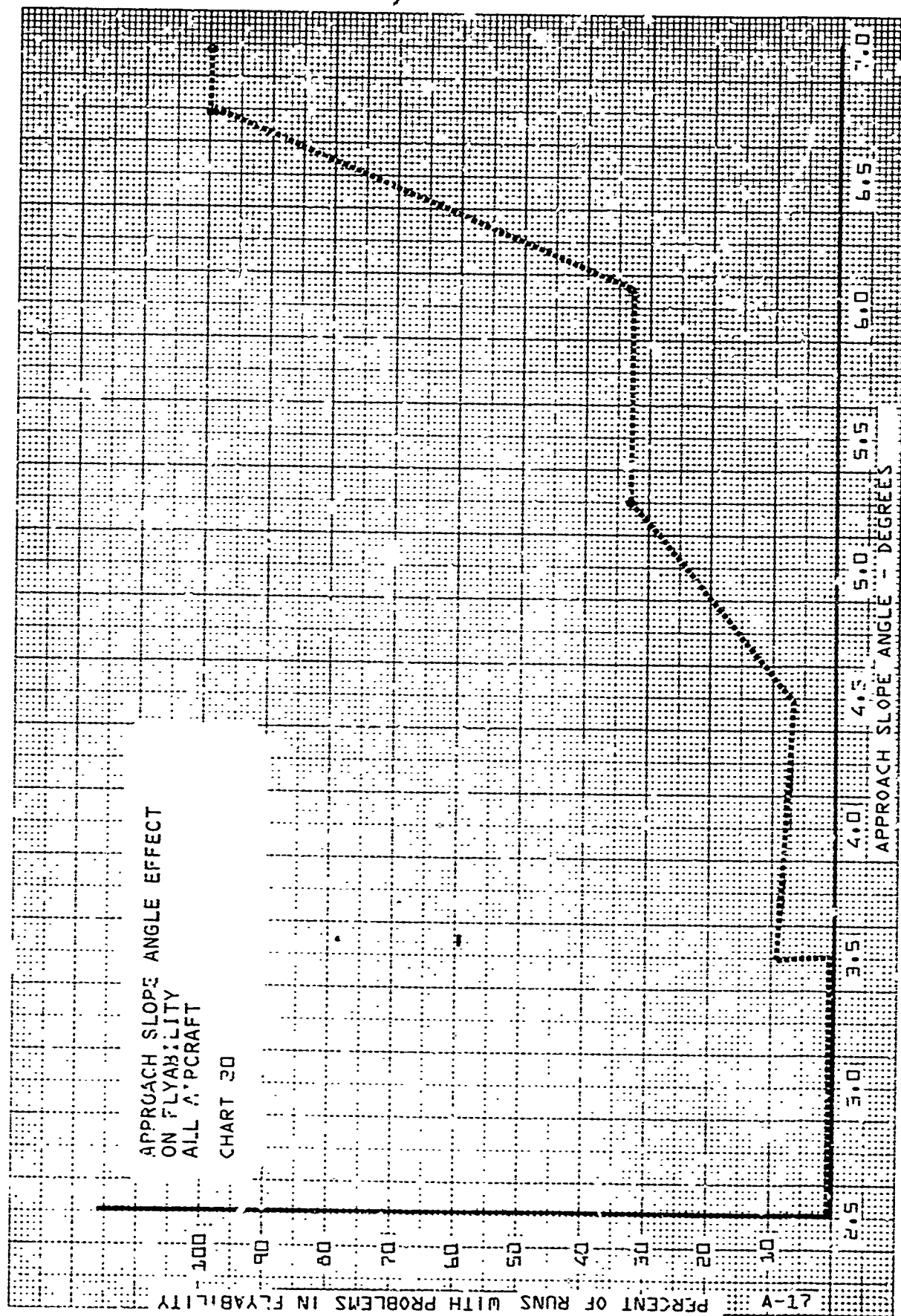
APPROACH SLOPE ANGLE EFFECT
ON FLYABILITY
LEAR JET
CHART 17

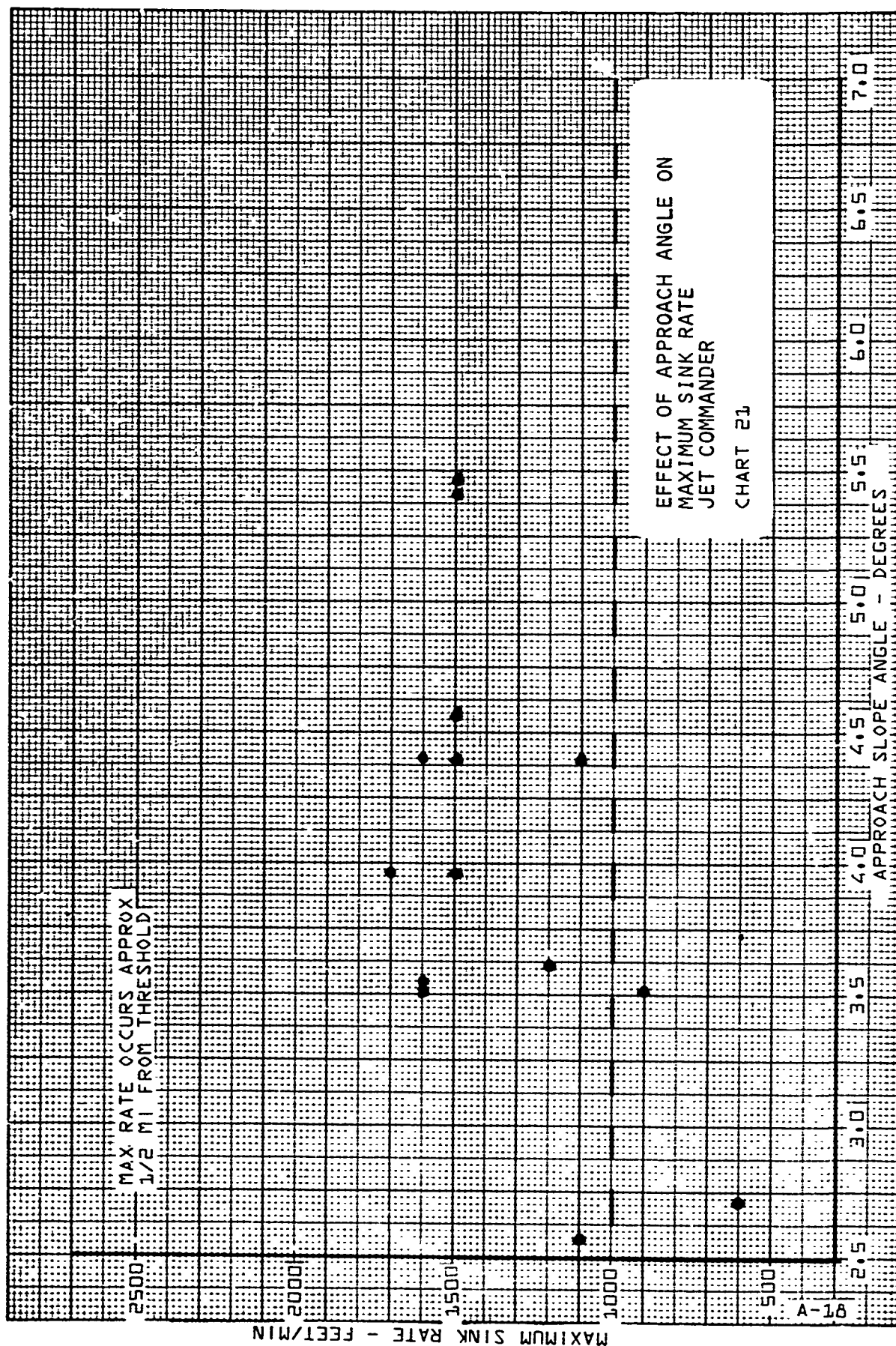
PERCENT OF RUNS WITH PROBLEMS IN FLYABILITY

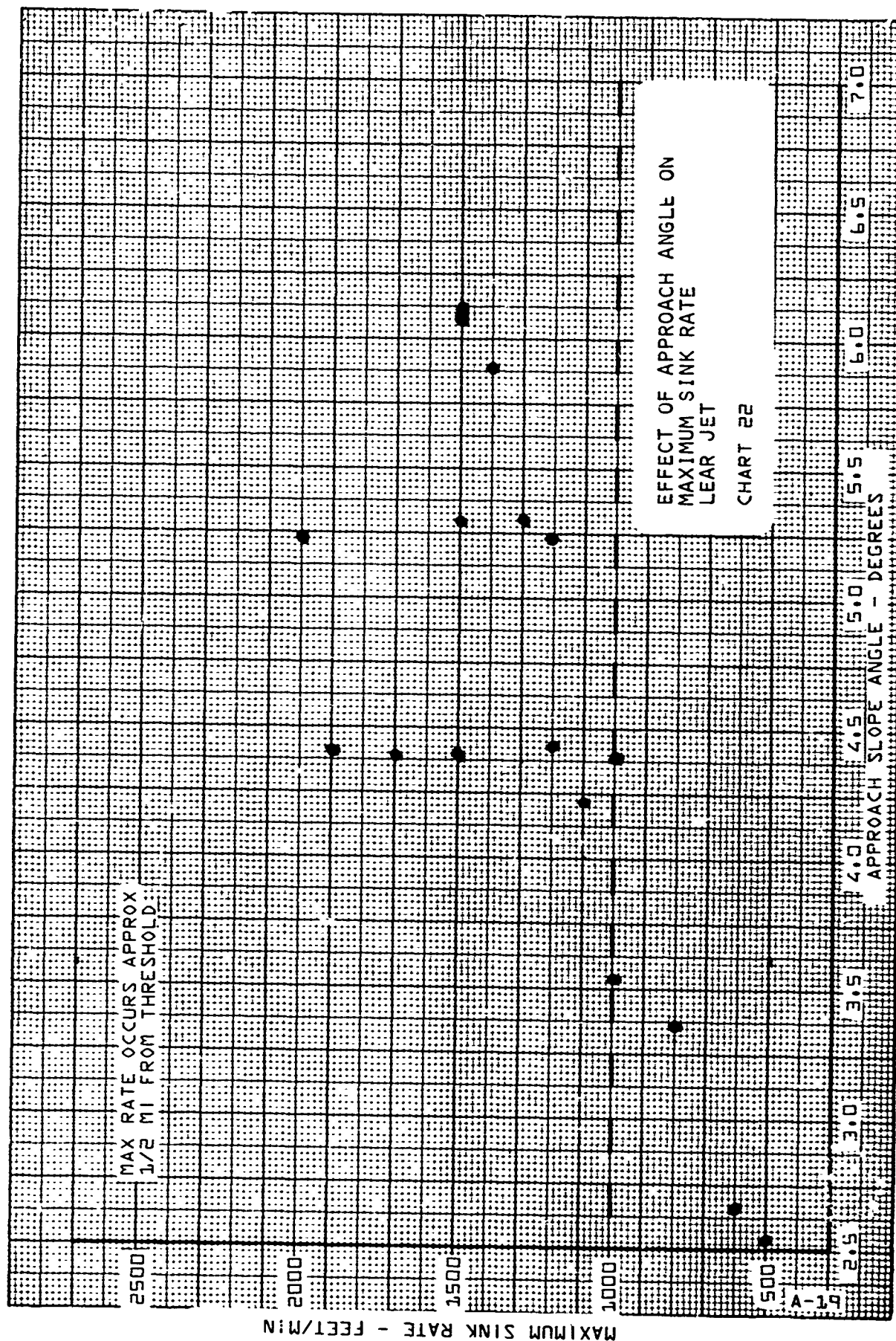
APPROACH SLOPE ANGLE - DEGREES

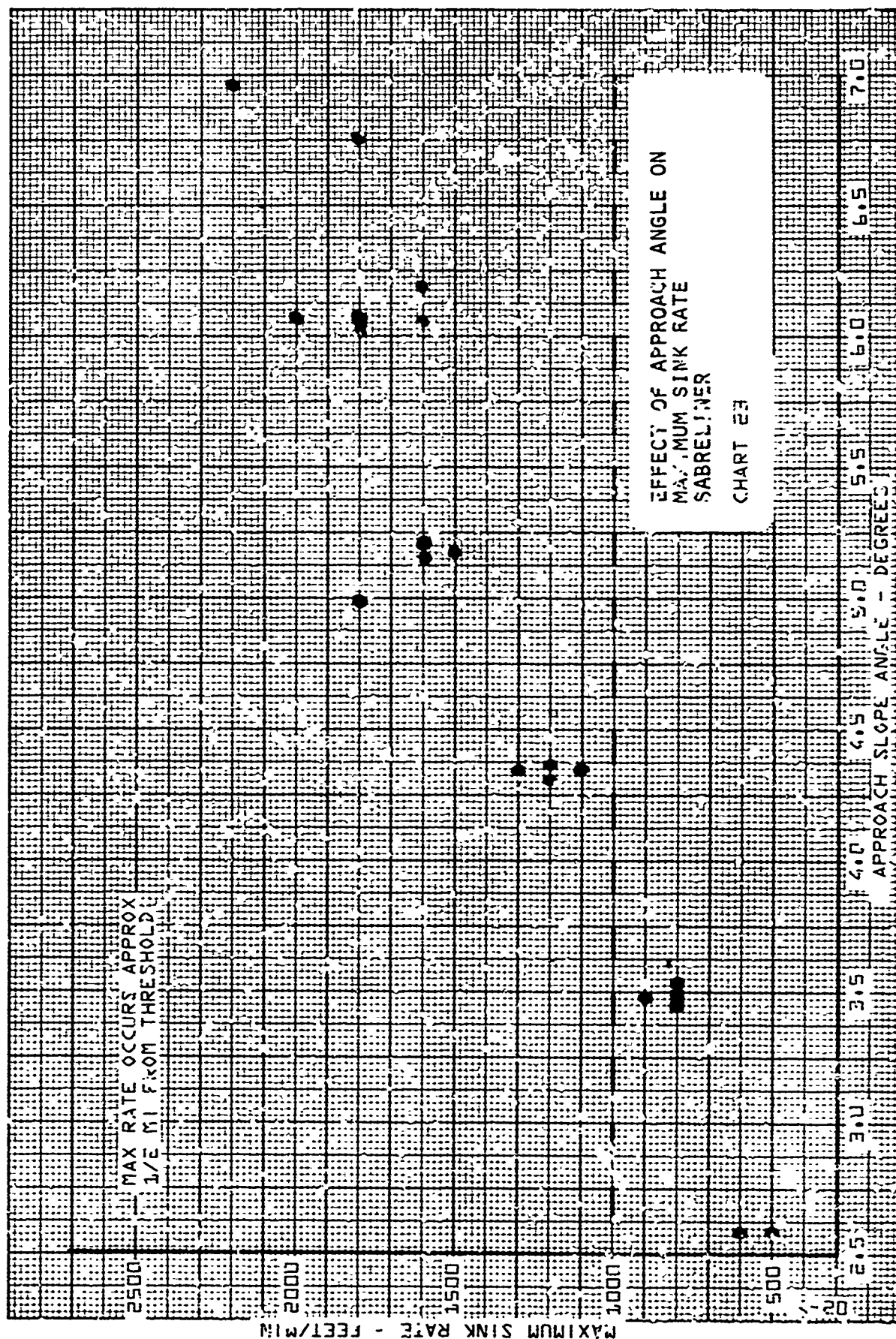


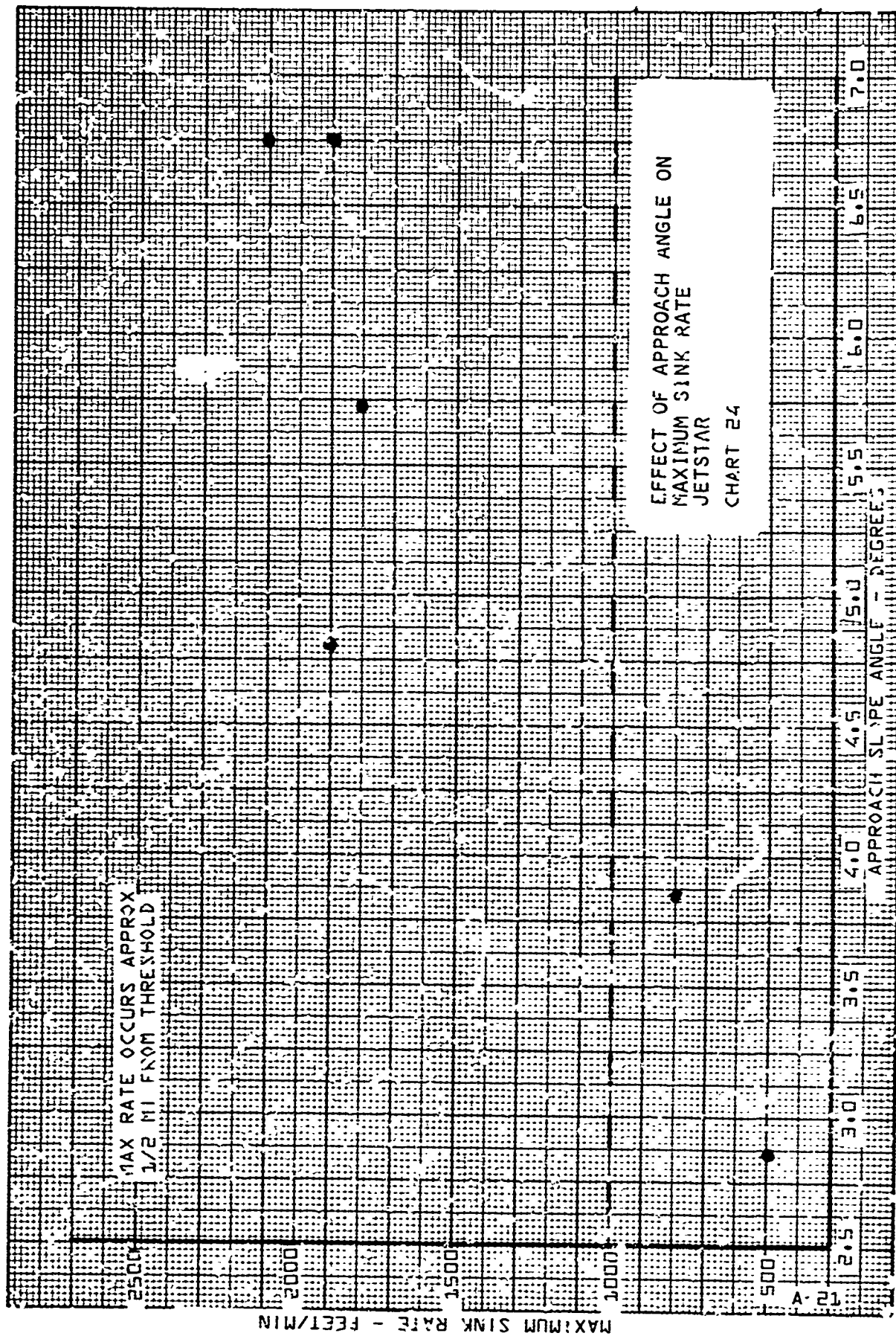


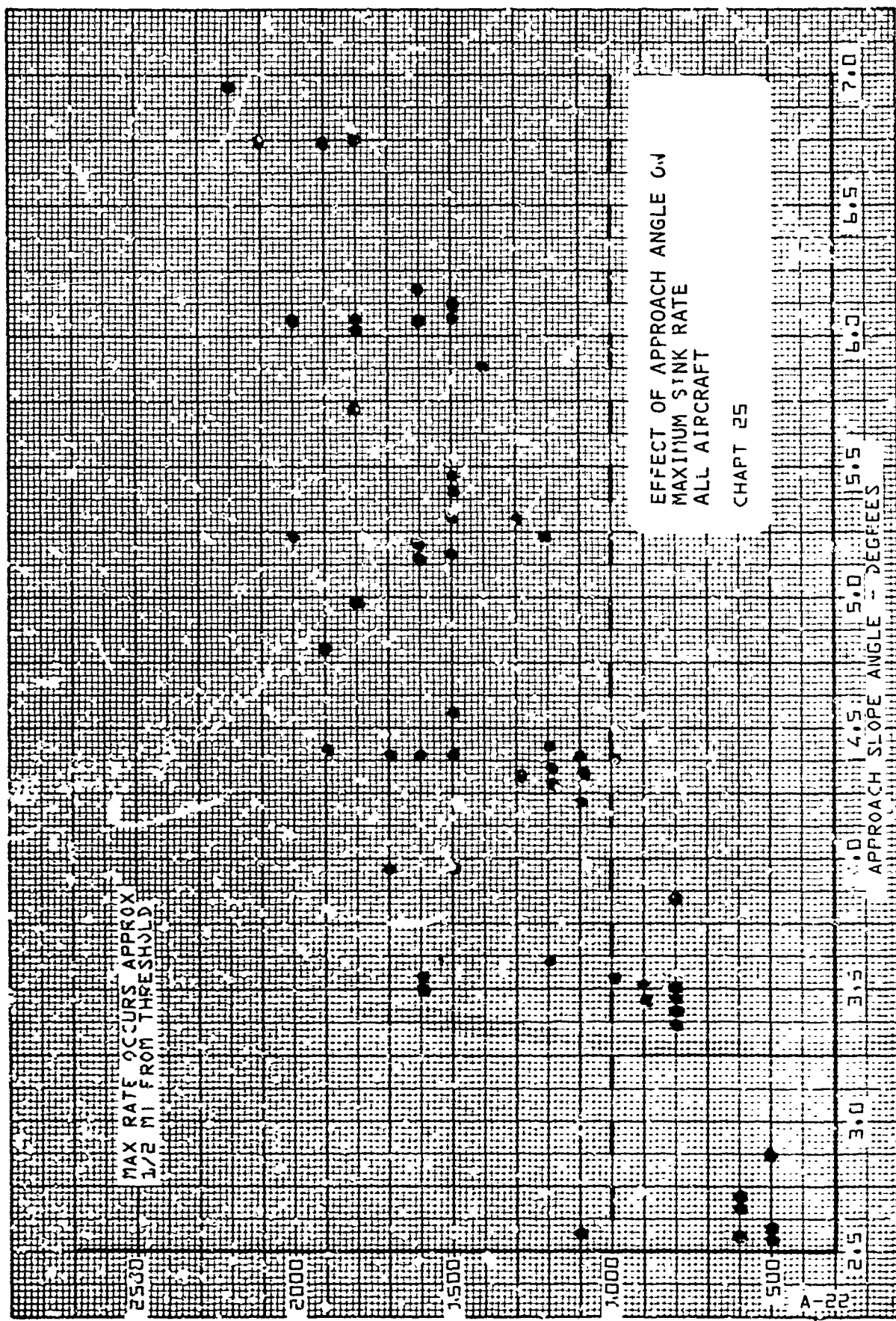








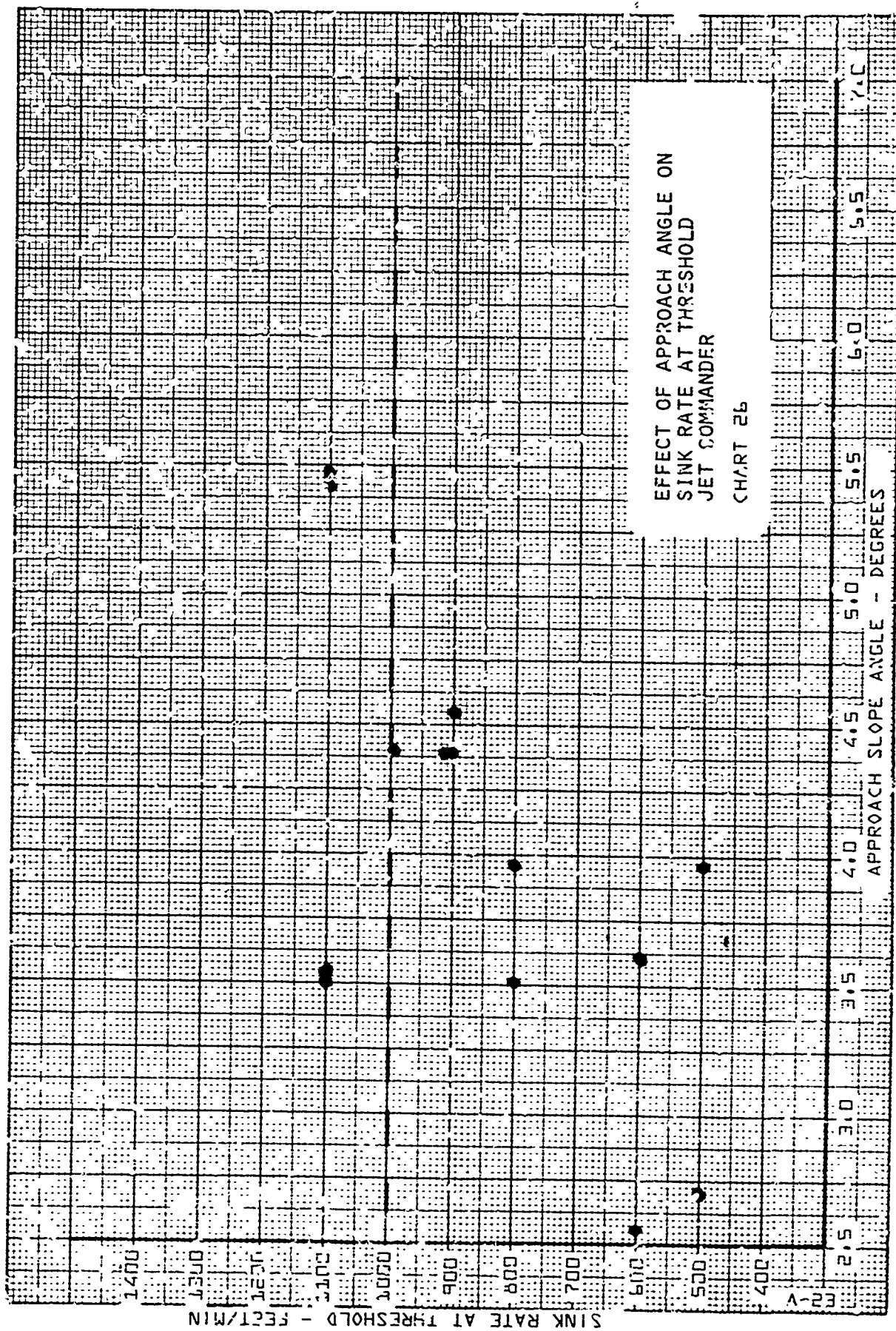


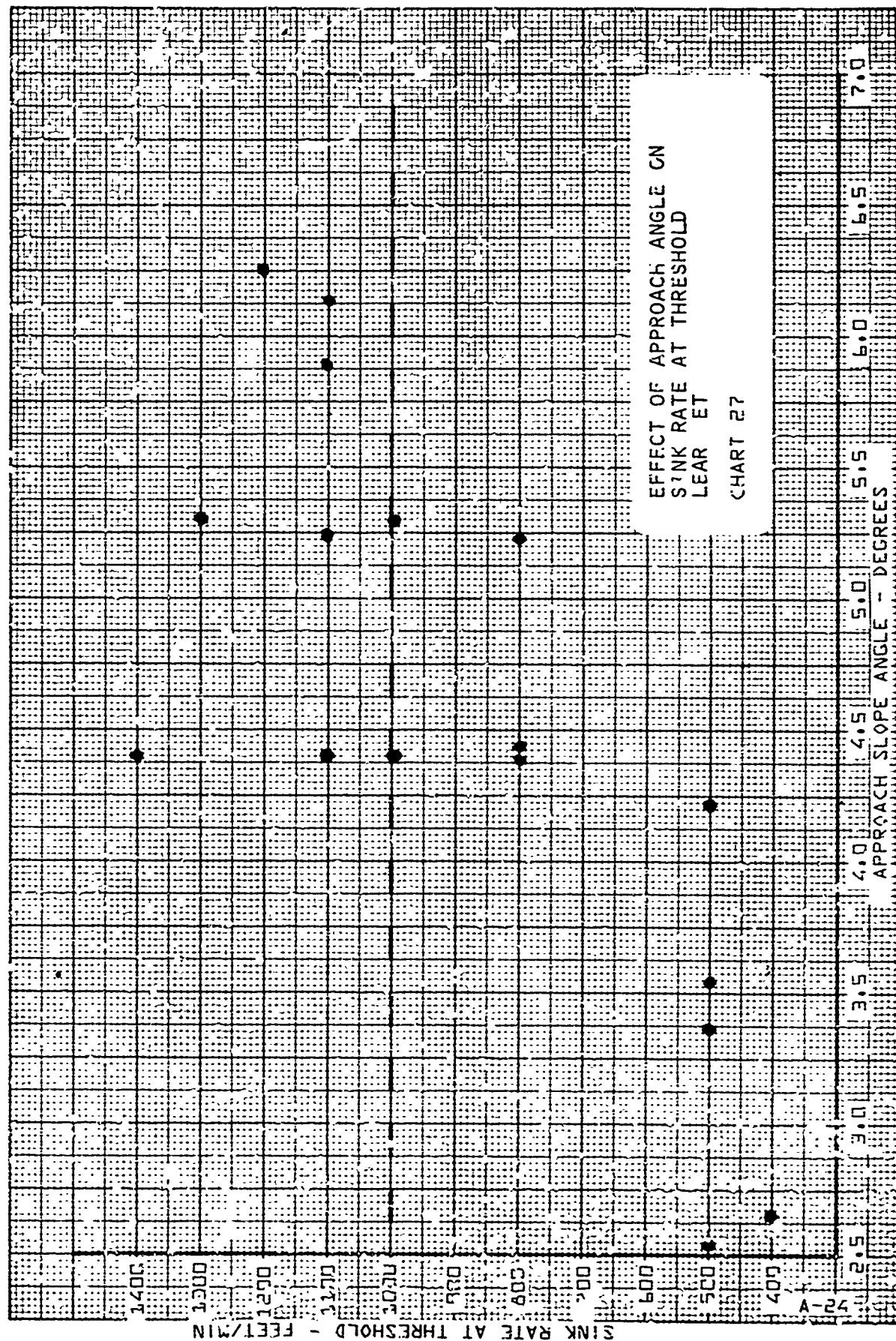


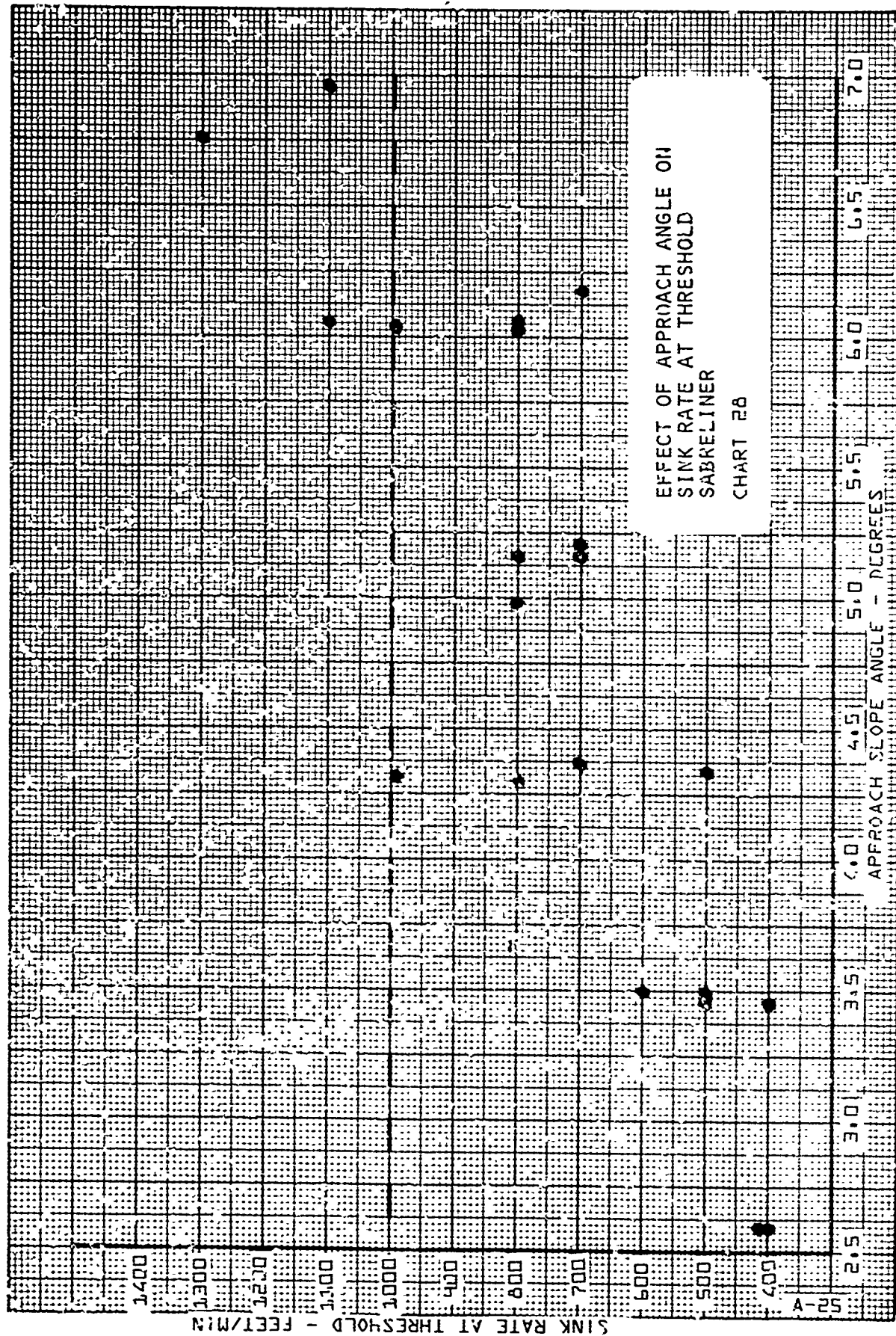
EFFECT OF APPROACH ANGLE ON
MAXIMUM SINK RATE
ALL AIRCRAFT
CHAPT 25

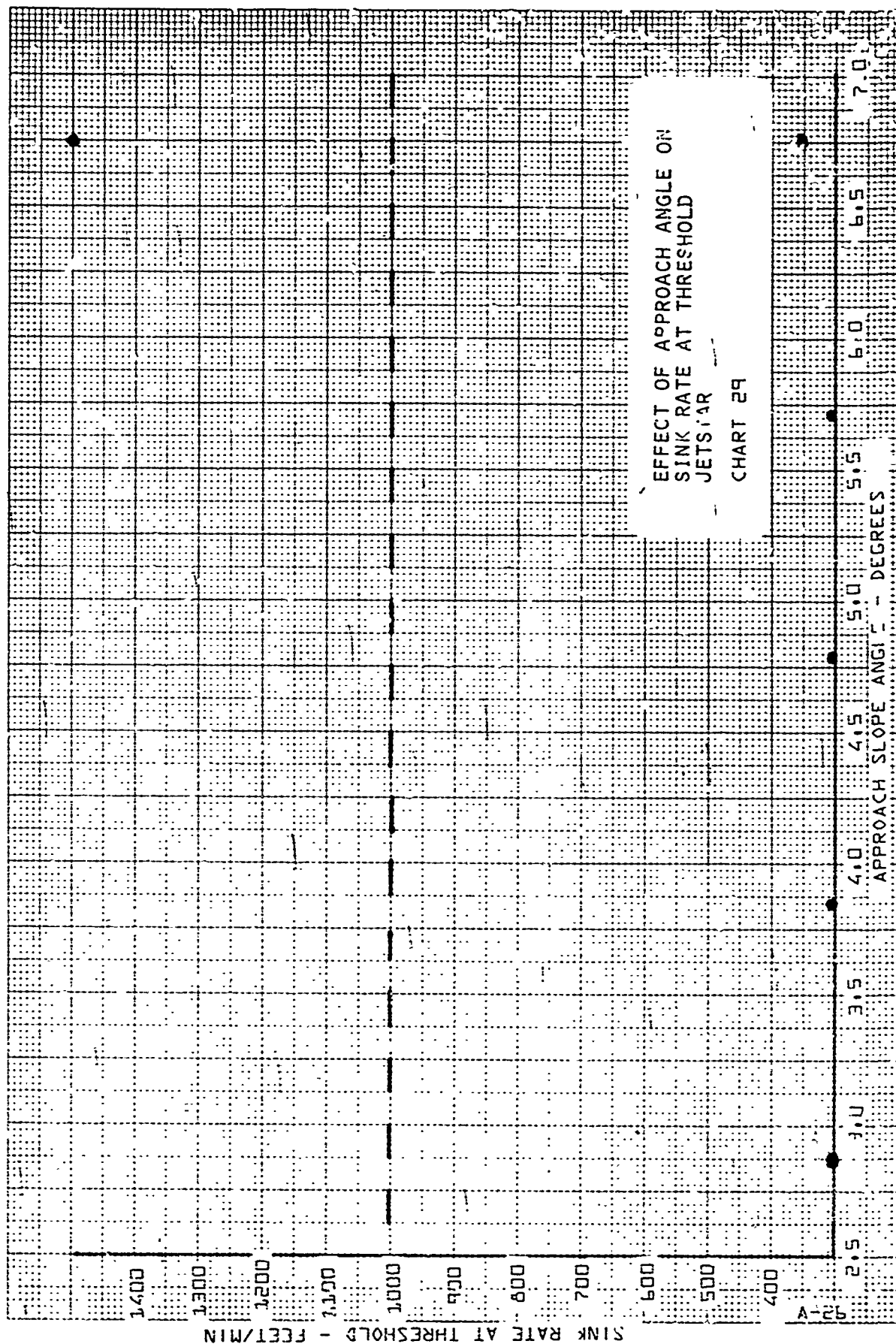
MAXIMUM SINK RATE - FEET/MIN

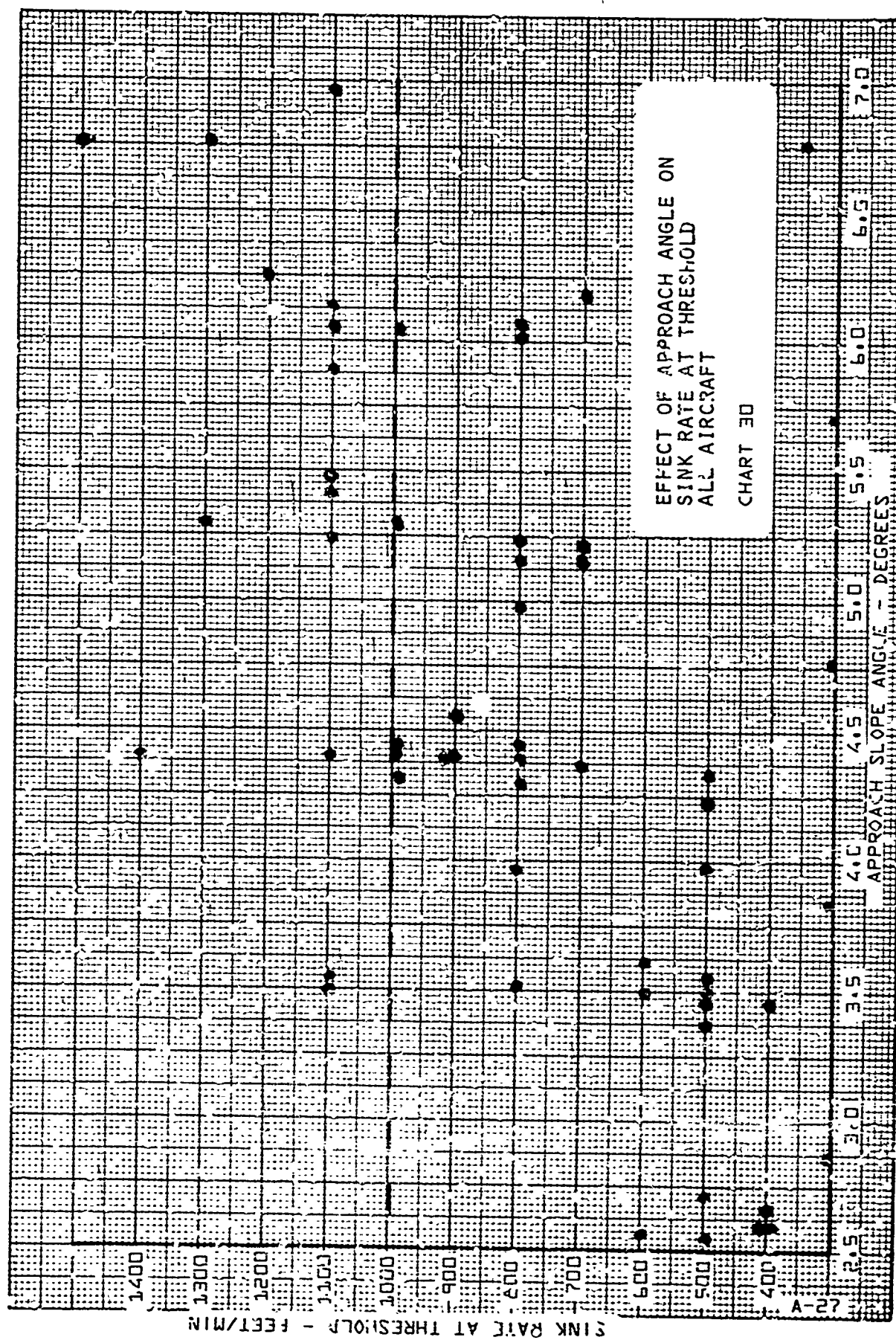
22-A





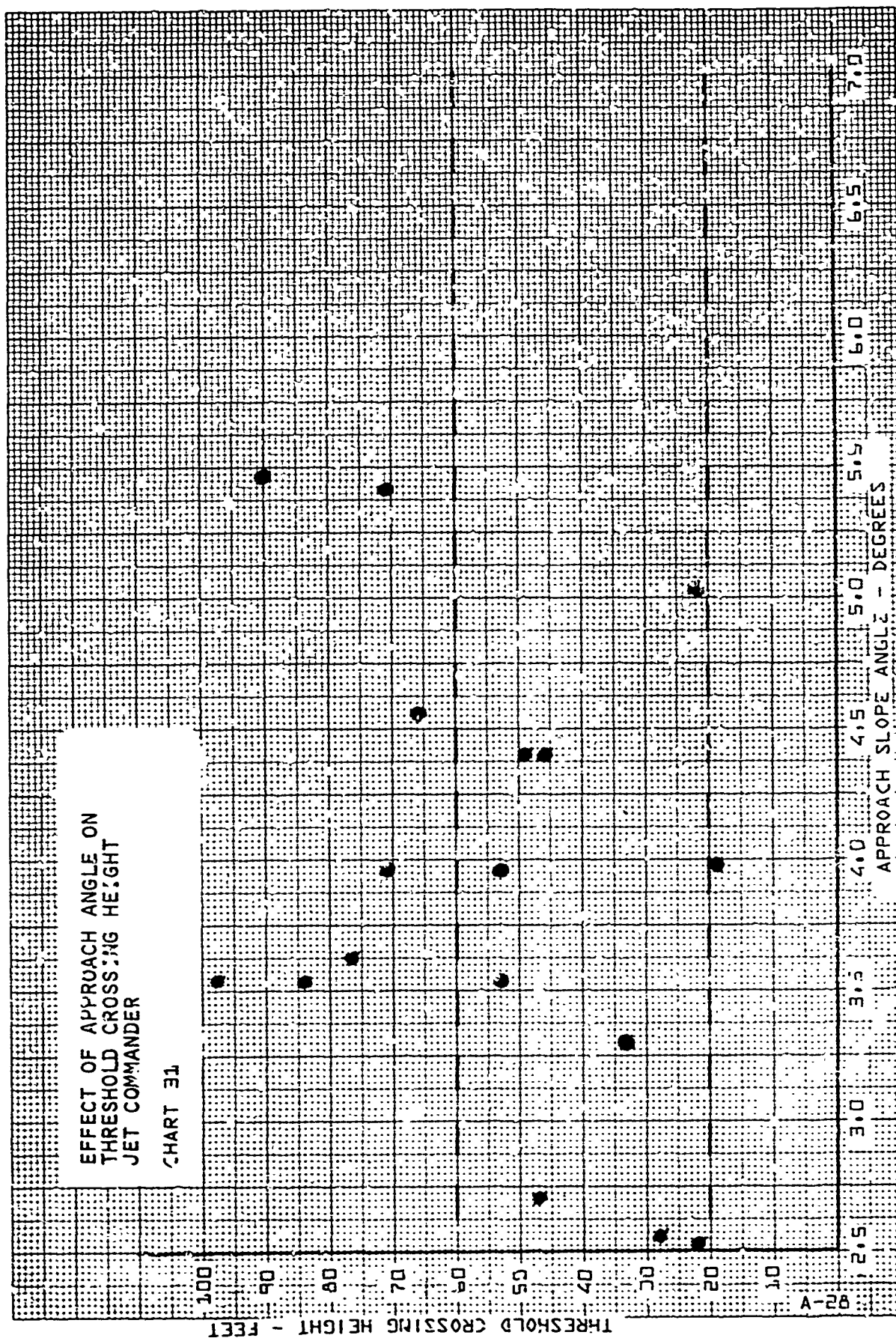




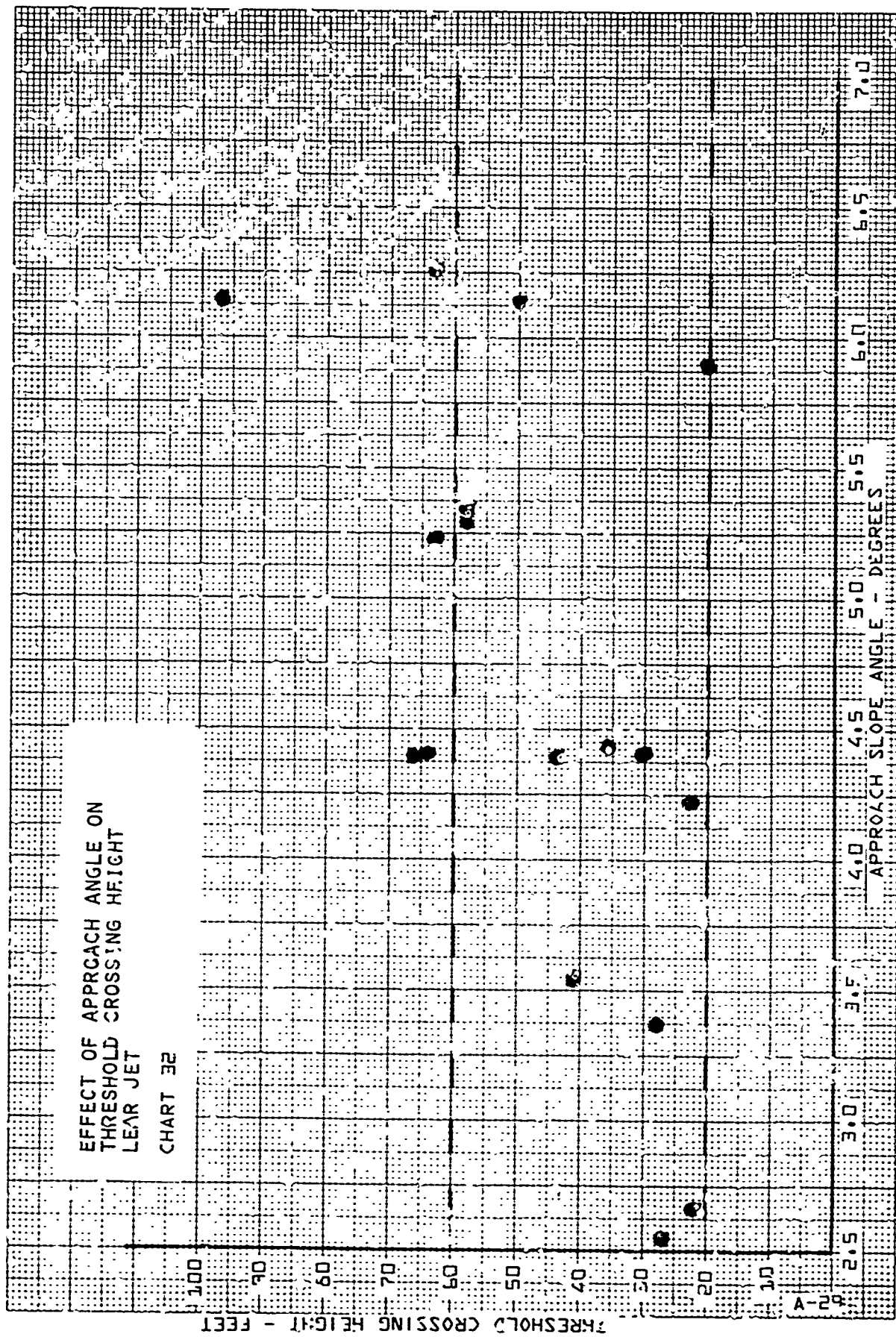


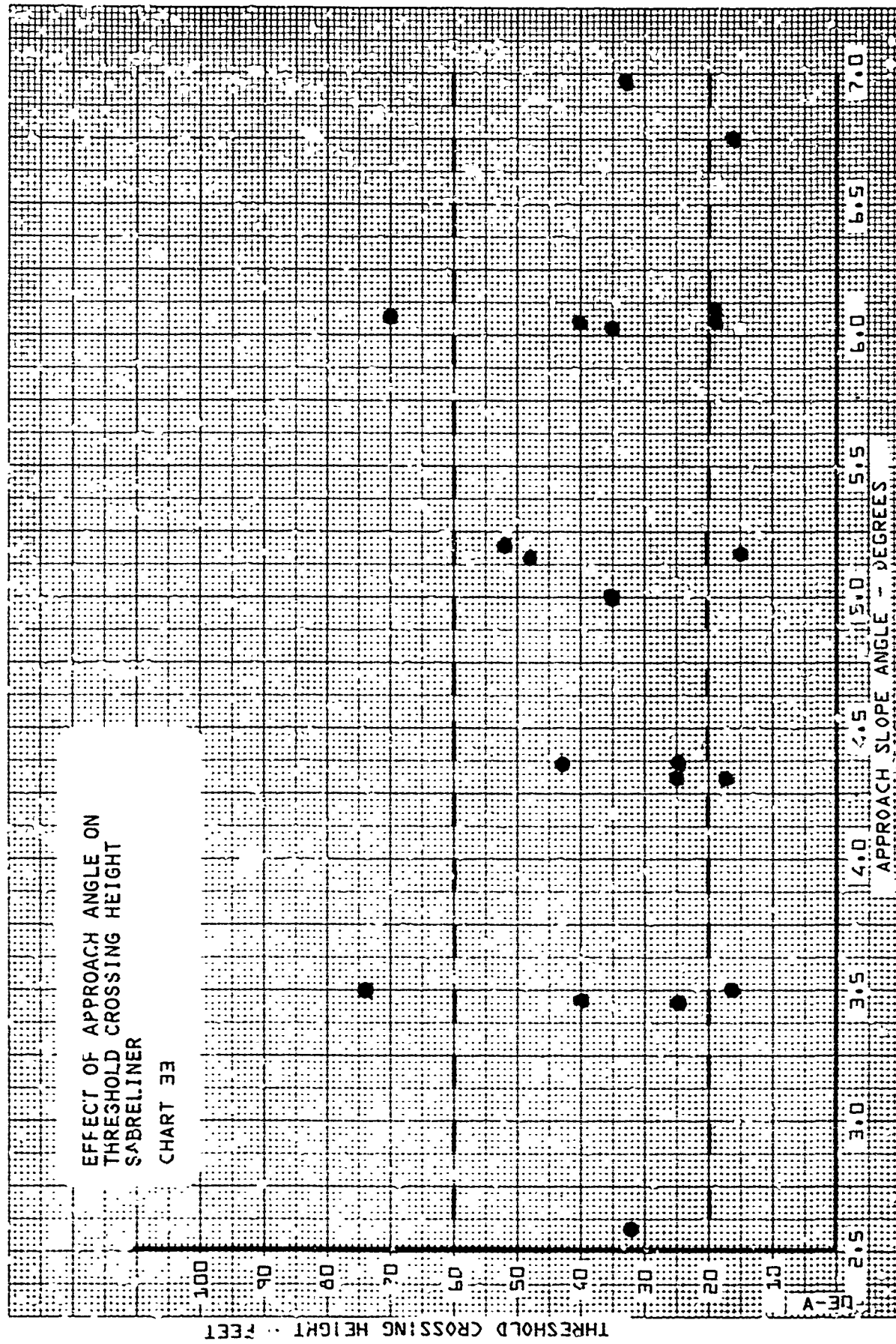
EFFECT OF APPROACH ANGLE ON
THRESHOLD CROSSING HEIGHT
JET COMMANDER

CHART 31

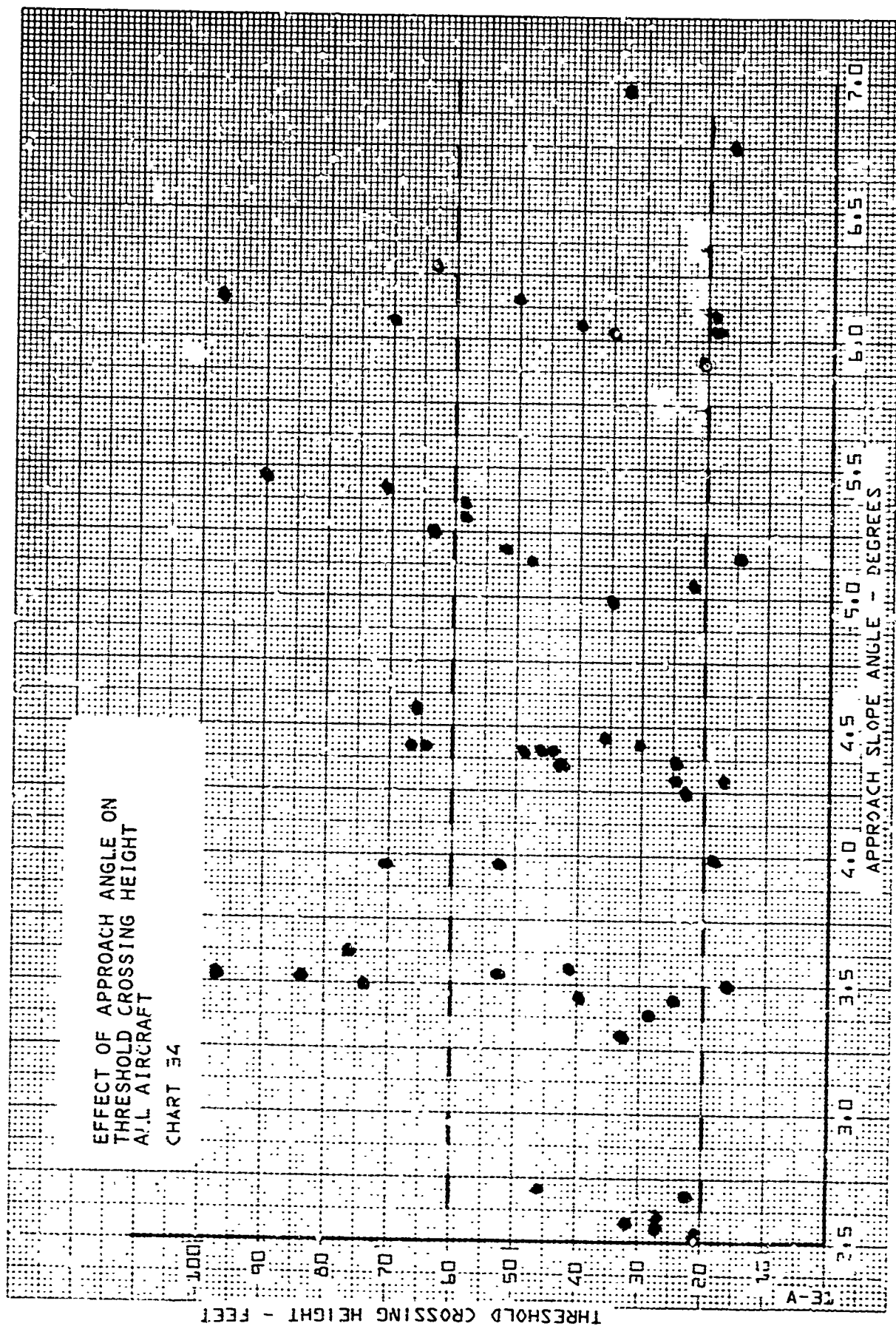


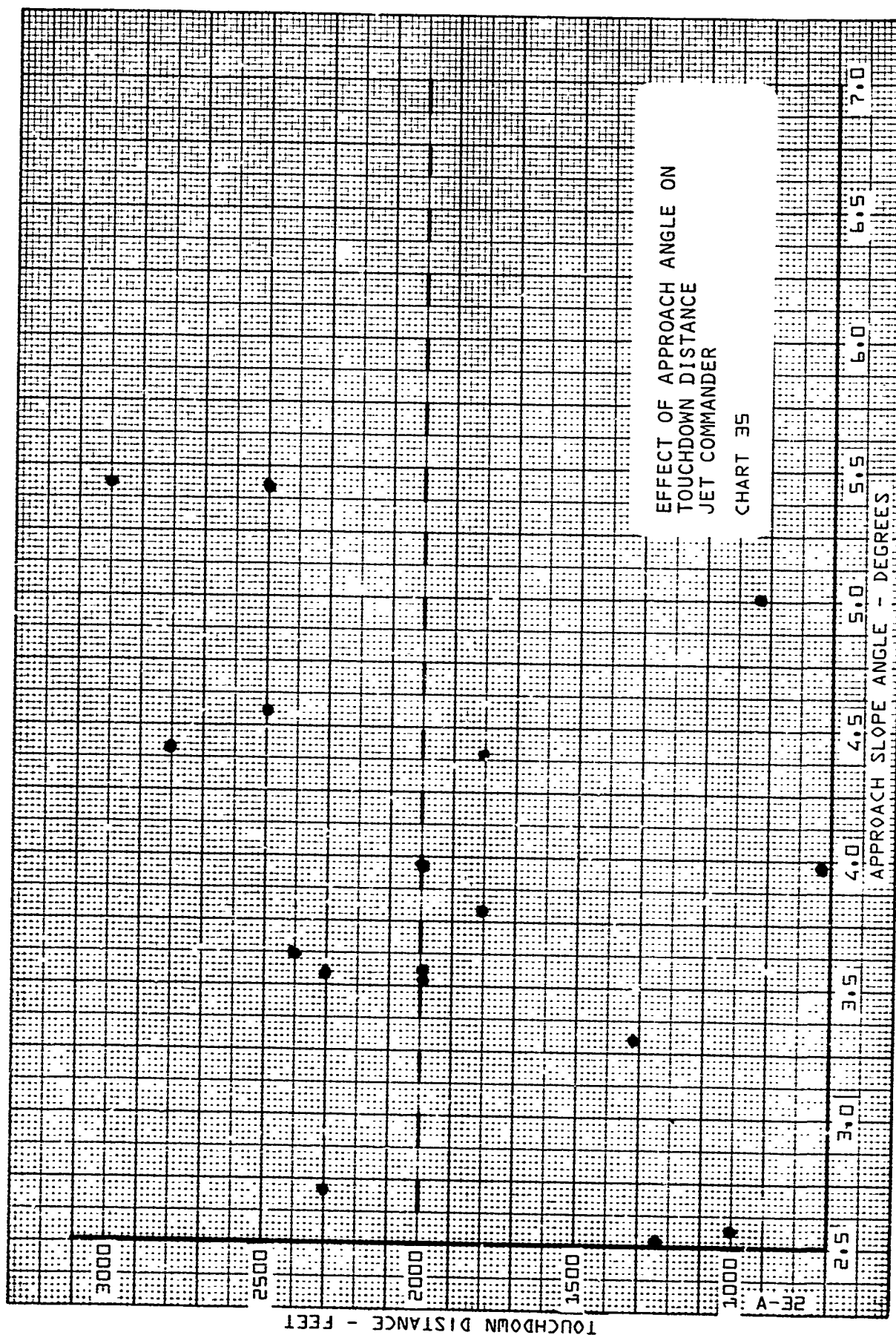
EFFECT OF APPROACH ANGLE ON
THRESHOLD CROSSING HEIGHT
LEAR JET
CHART 32

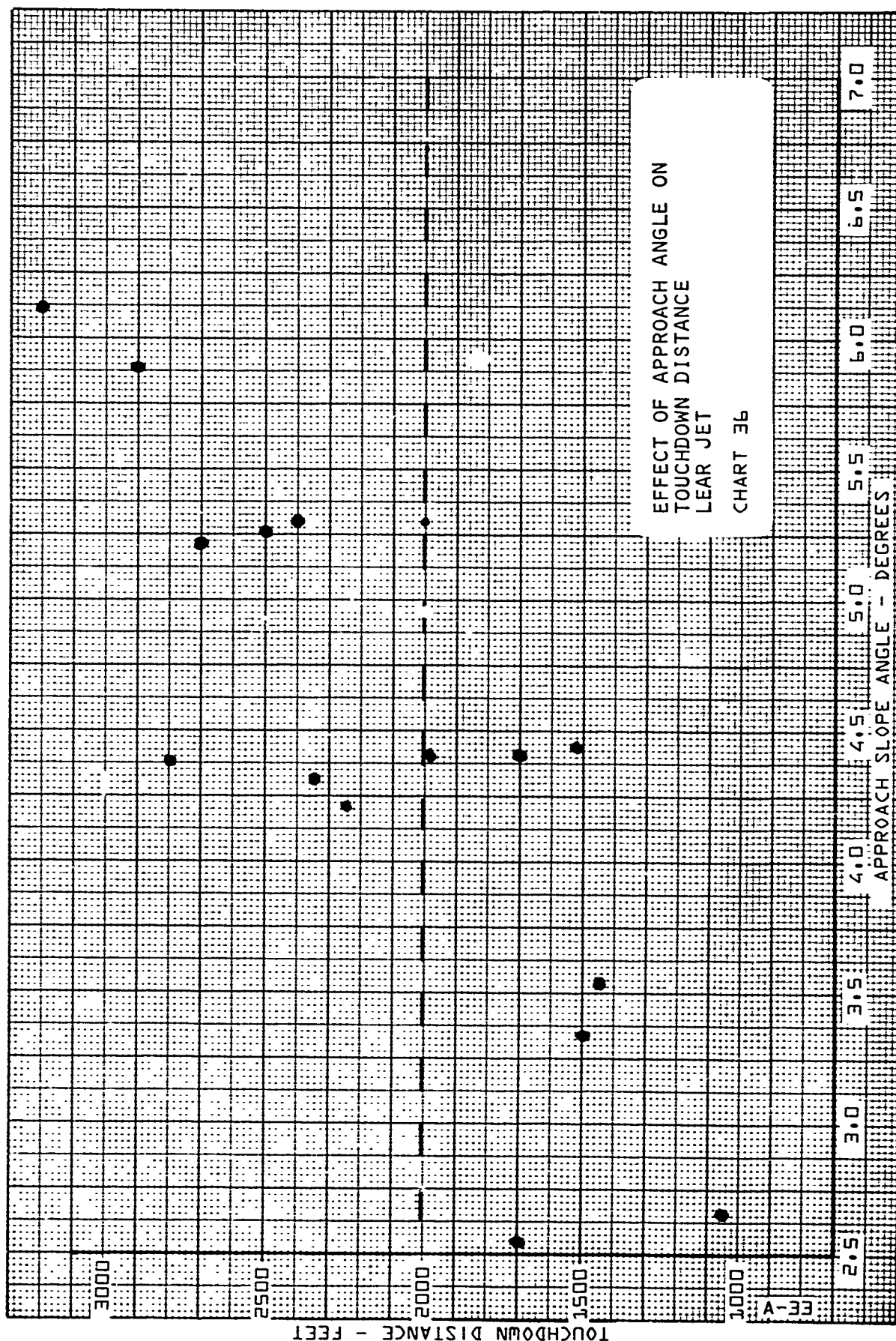


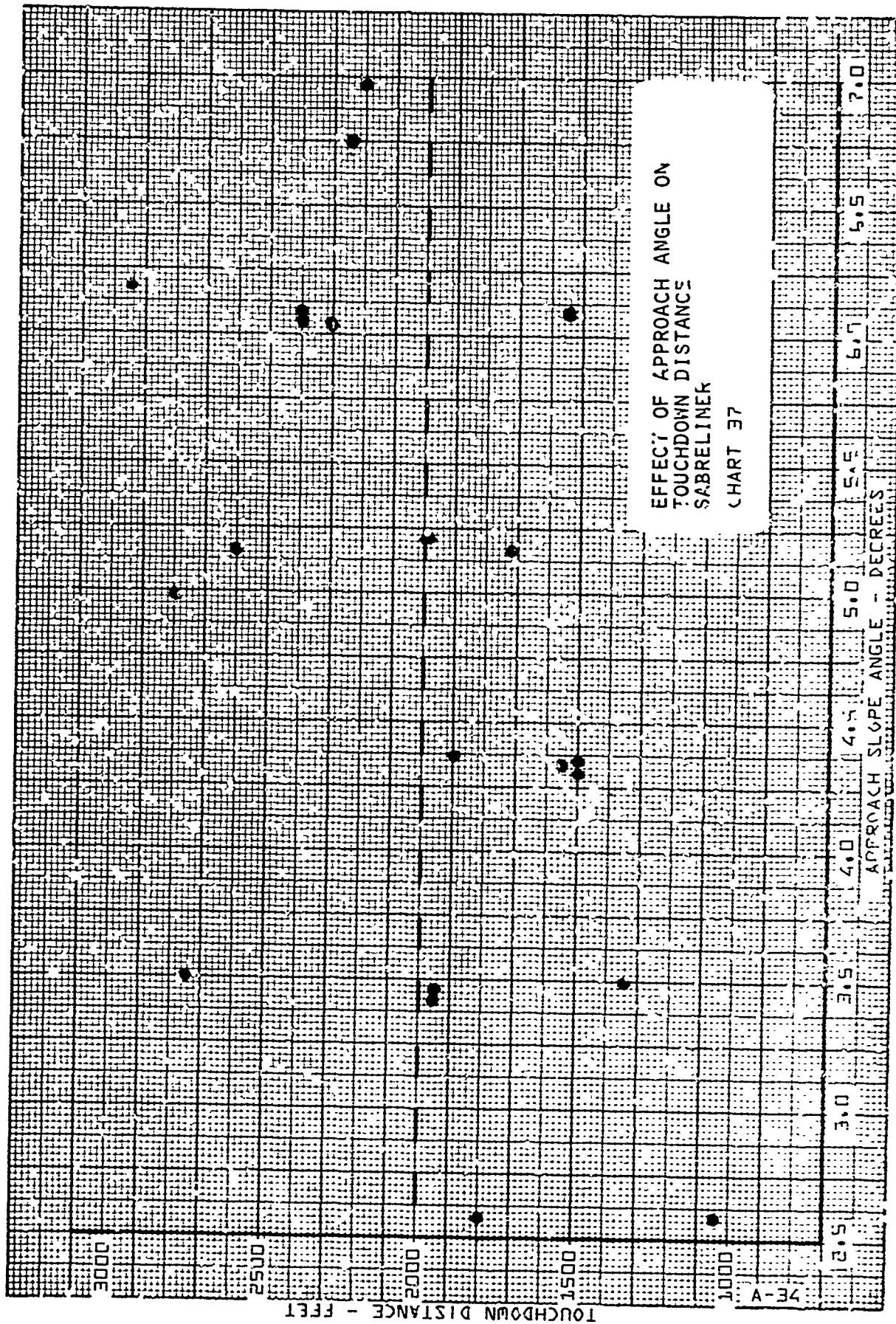


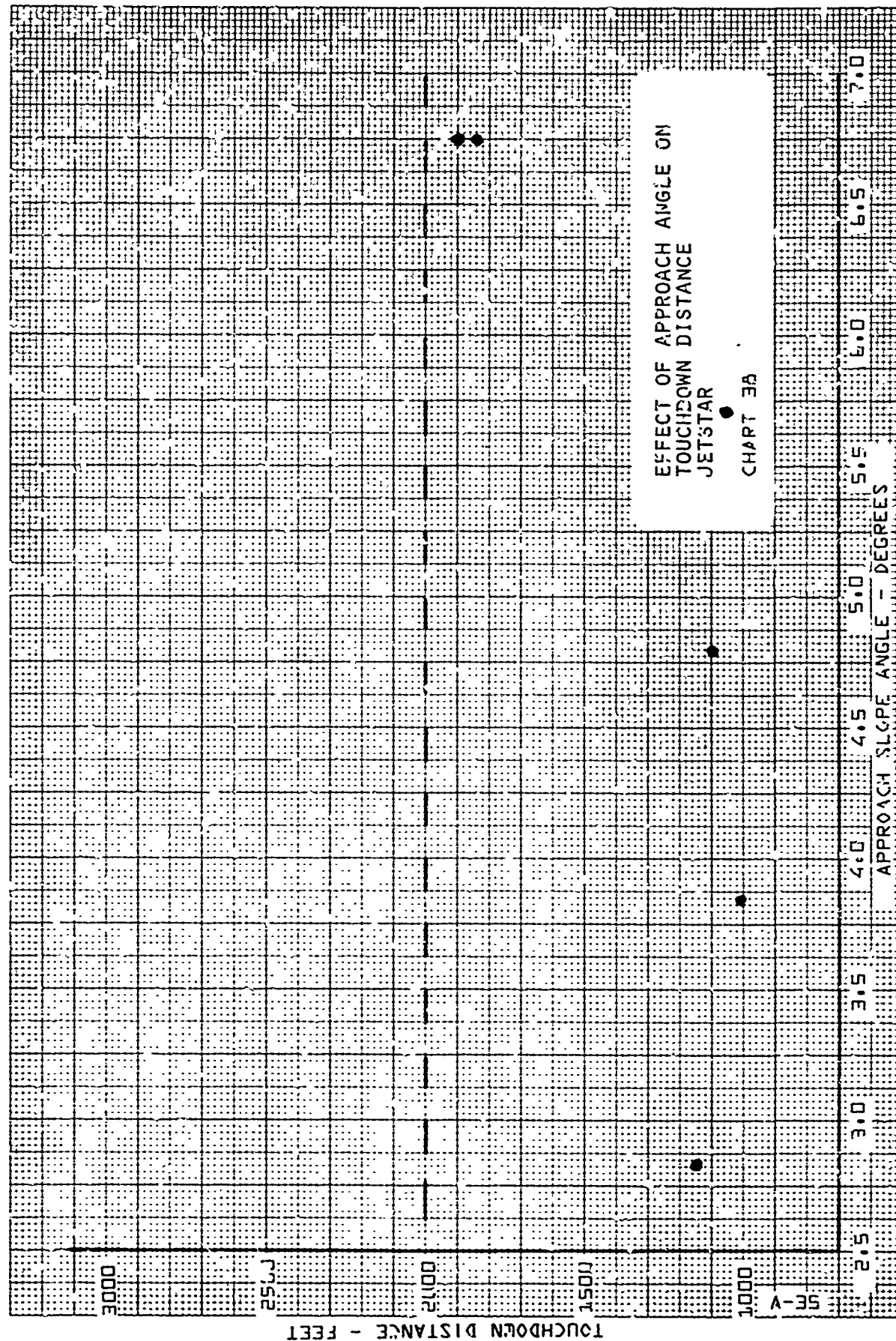
EFFECT OF APPROACH ANGLE ON
THRESHOLD CROSSING HEIGHT
A/L AIRCRAFT
CHART 34

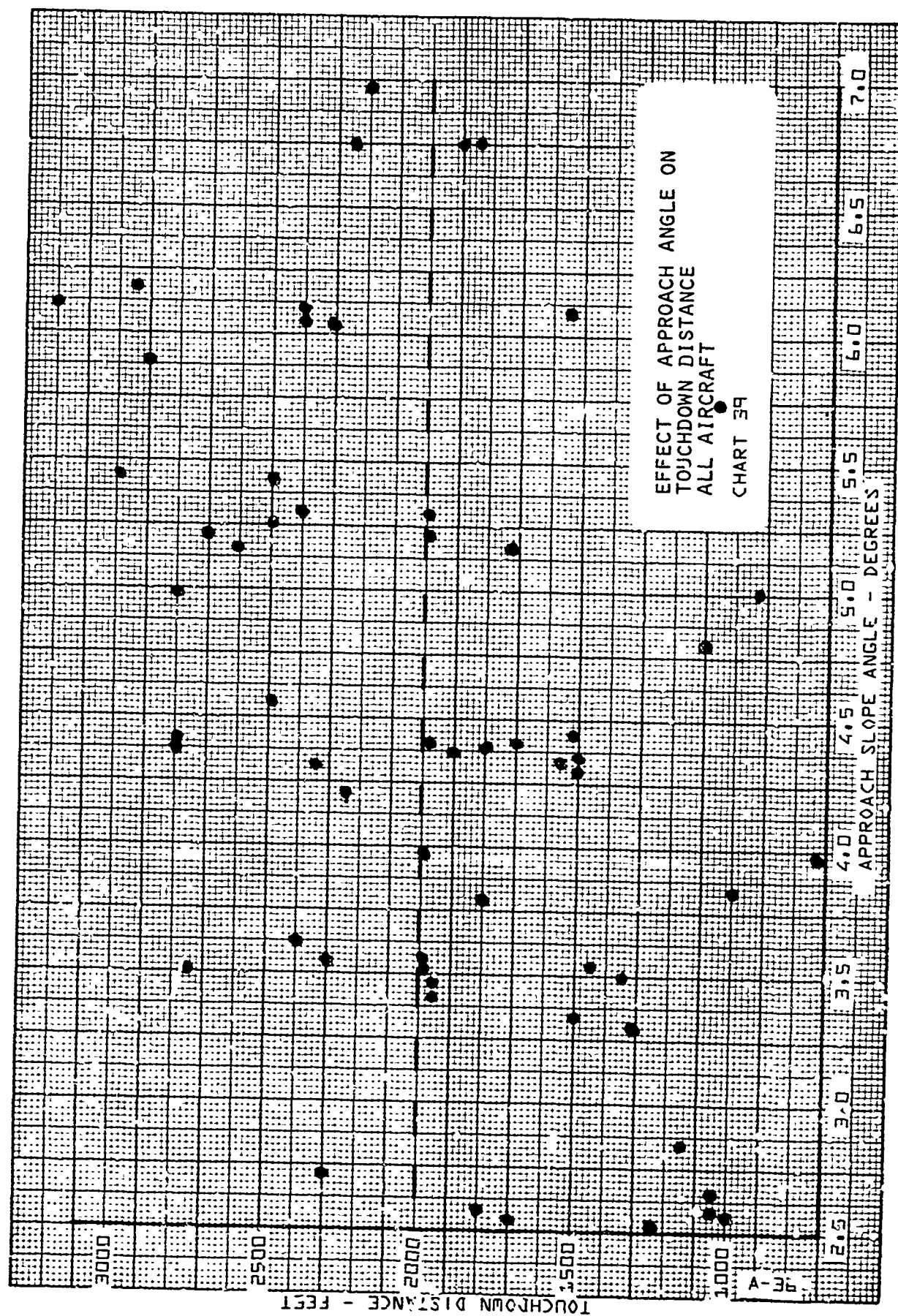












COMPARISON OF OUT-OF-TOLERANCE
CONDITIONS
NIGHT VERSUS DAY
JET COMMANDER
CHART 40

AIRSPEED
OVER VREF
PLUS 5

POWER REQD
TO FLARE

FLYABILITY
PROBLEMS

MAX SINK
OVER 1000

SINK OVER
1000 AT
THRESHOLD

TCH OVER
60 OR UN-
DER 20

TOUCHDOWN
DISTANCE
OVER 2000

PISTON

X - NIGHT OPERATION
● - DAY OPERATION

APPROACH SLOPE ANGLE - DEGREES

2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0

COMPARISON OF OUT-OF-TOLERANCE

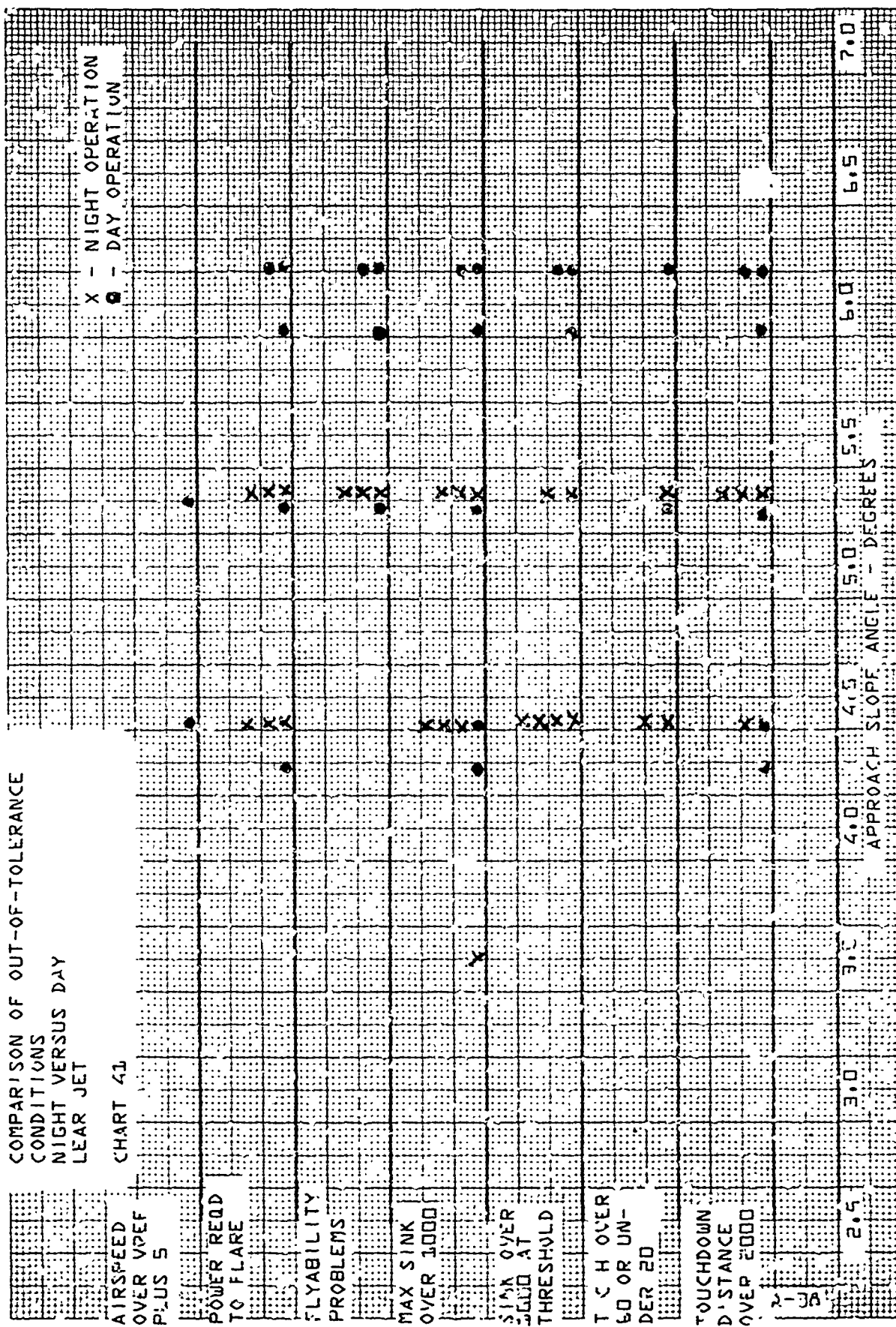
CONDITIONS

NIGHT VERSUS DAY

LEAR JET

CHART 41

X - NIGHT OPERATION
O - DAY OPERATION



COMPARISON OF OUT-OF-TOLERANCE
CONDITIONS
NIGHT VERSUS DAY
SABRELINER
CHART 42

AIR SPEED
OVER VREF
PLLS 5

POWER REQD
TO FLARE

FLYABILITY
PROBLEMS

MAX SINK
OVER 1000

SINK OVER
1000 AT
THRESHOLD

TCH OVER
60 OR UN-
DER 20

TOUCHDOWN
DISTANCE
OVER 2000

X - NIGHT OPERATION
O - DAY OPERATION

APPROACH SLOPE ANGLE - DEGREES

2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0

COMPARISON OF OUT-OF-TOLERANCE CONDITIONS NIGHT VERSUS DAY ALL AIRCRAFT

CHART 43

AIR SPEED
OVER VREF
PLUS 5

POWER READ
TO FLARE

FLYABILITY
PROBLEMS

MAX SINK
OVER 1000

SINK OVER
1000 AT
THRESHOLD

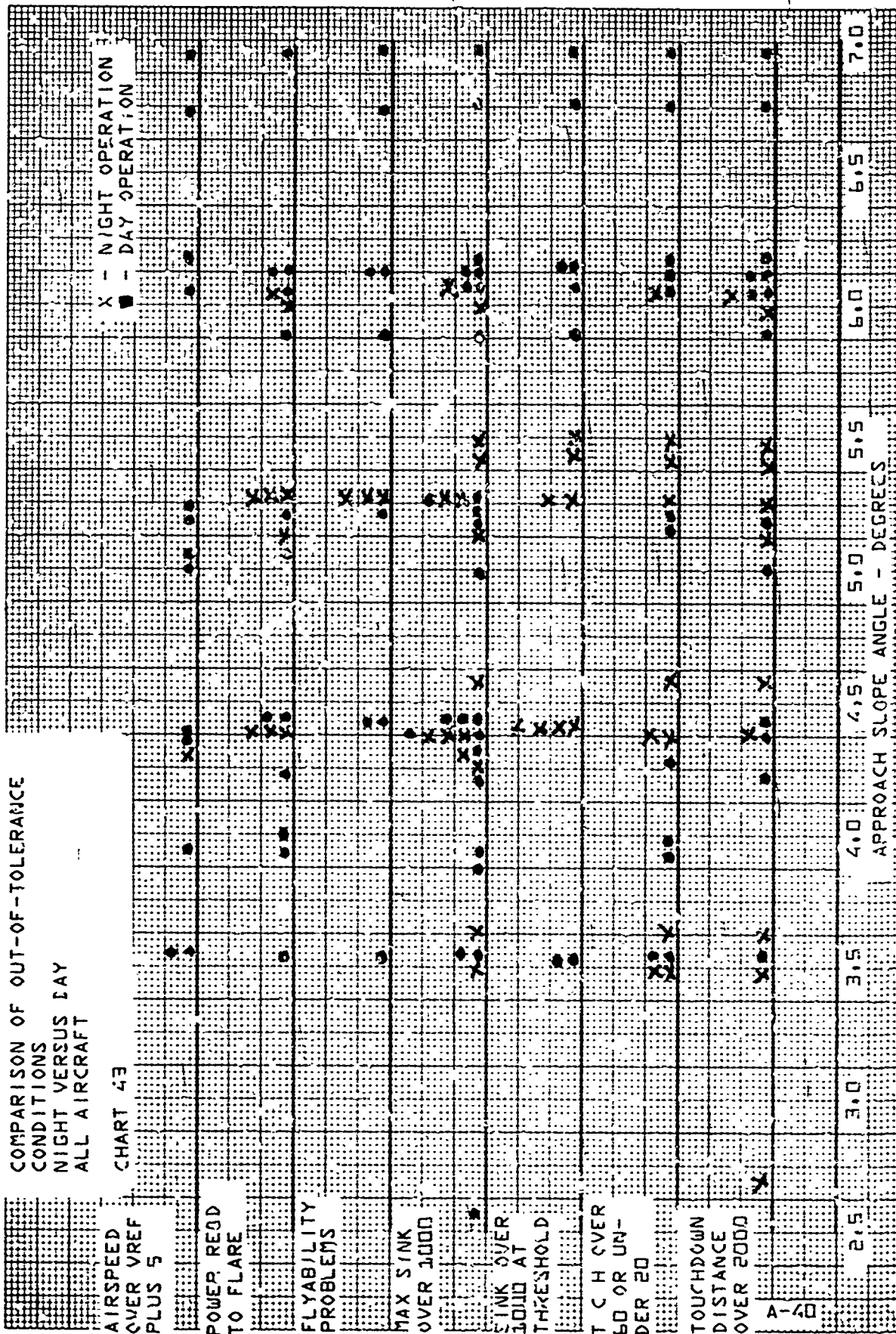
T C H OVER
50 OR UN-
DER 20

TOUCHDOWN
DISTANCE
OVER 2000

A-140

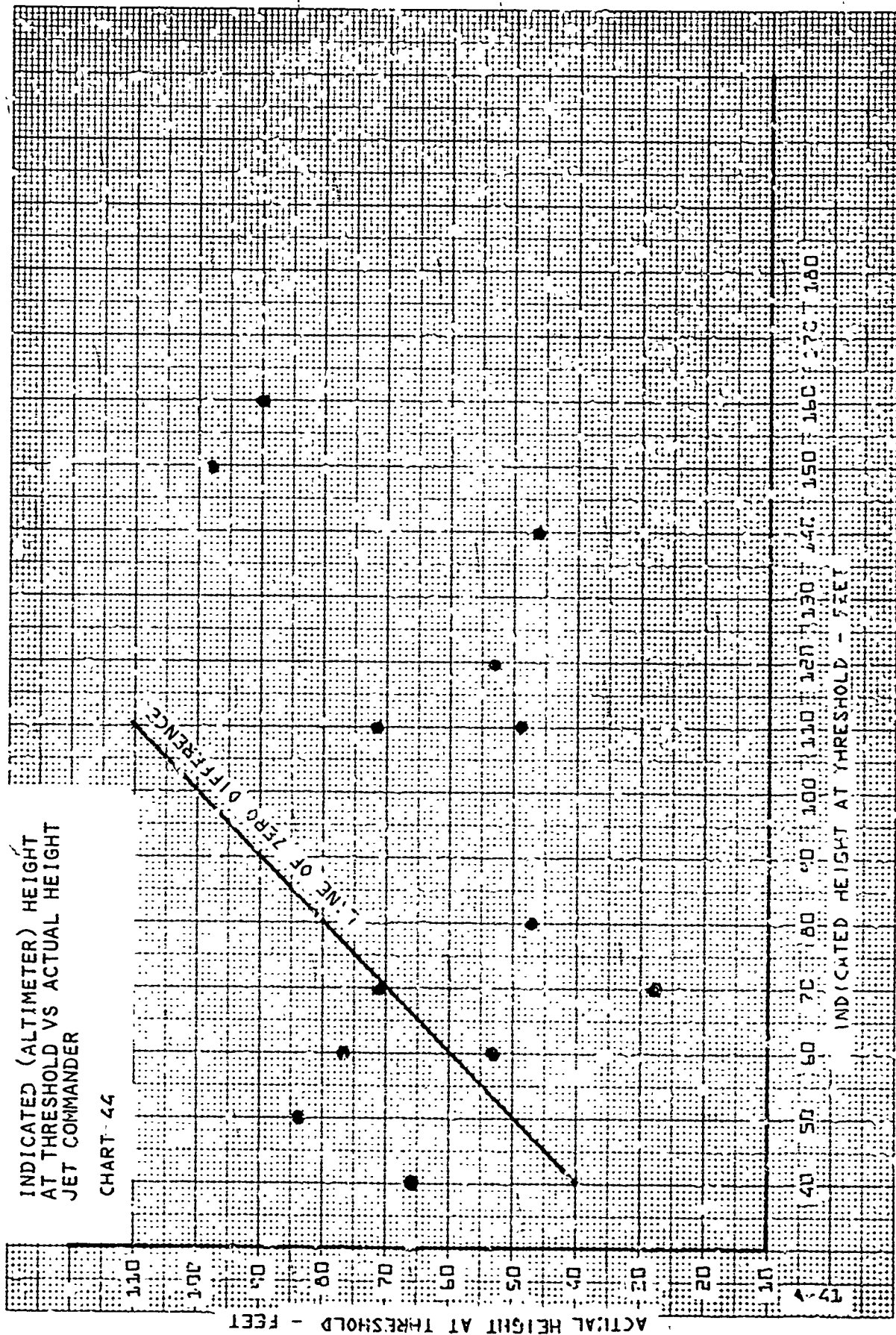
X - NIGHT OPERATION
• - DAY OPERATION

2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0
APPROACH SLOPE ANGLE - DEGREES



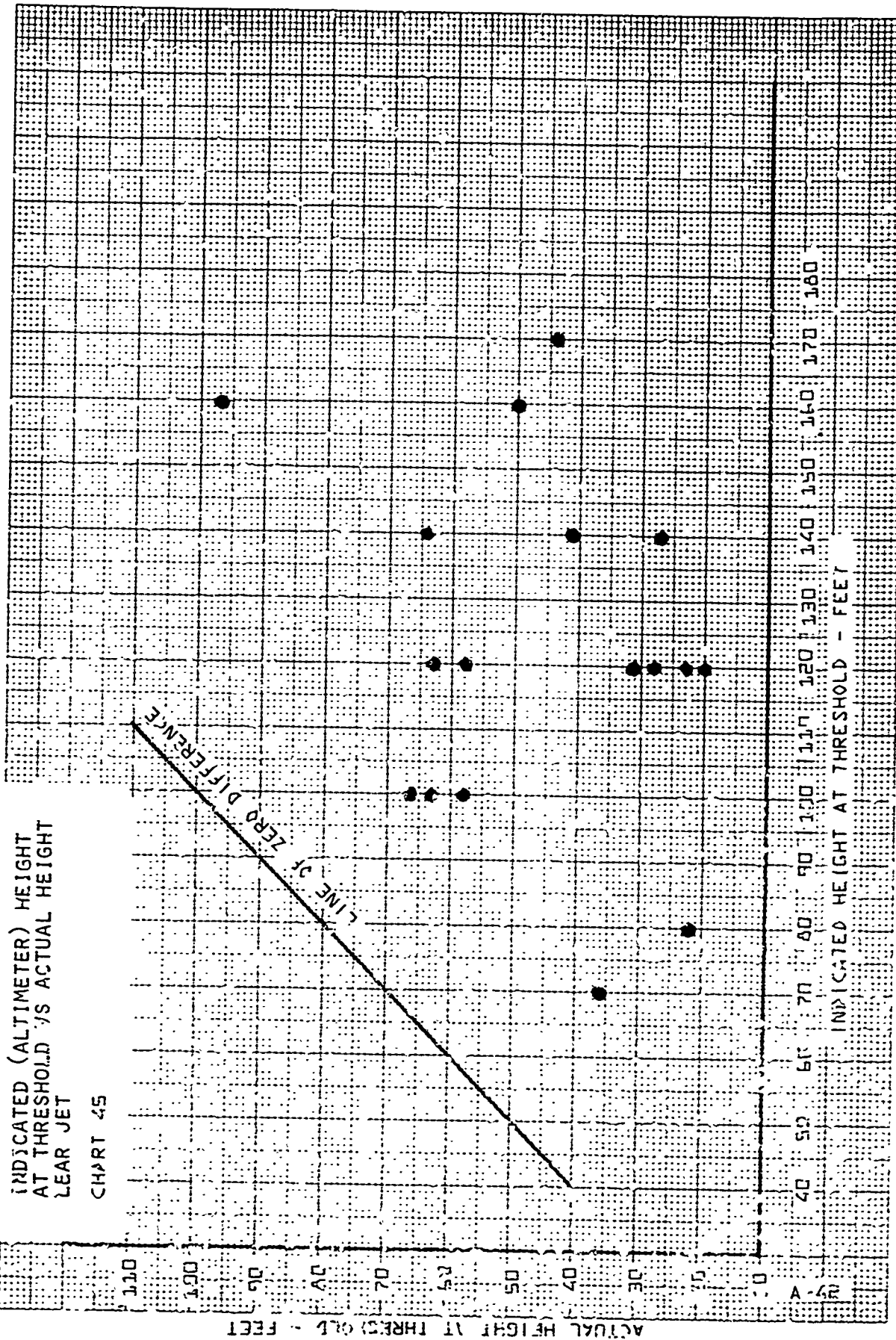
INDICATED (ALTIMETER) HEIGHT
AT THRESHOLD VS ACTUAL HEIGHT
JET COMMANDER

CHART 44



INDICATED (ALTIMETER) HEIGHT
AT THRESHOLD VS ACTUAL HEIGHT
LEAR JET

CHART 45



INDICATED (ALTIMETER) HEIGHT
AT THRESHOLD VS ACTUAL HEIGHT
SABRELINER
CHART 4b

