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PILOT PREFERENCE AND PROCEDURES AT UNCONTROLLED AIRPORTS

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16. Abstract

The report presents the results of a pilot questionnaire utilized at the 1974 Reading, Pennsylvania Air Show to obtain data on pilot procedures and preference in the terminal airspace of uncontrolled airports.

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PILOT PREFERENCE AND PROCEDURES

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INTRODUCTION

The National Aeronautics and Space Administration is conducting studies (reference 1) of the general aviation air traffic environment at uncontrolled airports. During 1971 and 1972, approximately 1500 three-dimensional radar tracks were accumulated at three different uncontrolled airports. To provide supplemental data on general aviation piloting procedures and air traffic pattern preference, pilot questionnaires were offered to pilots attending the 1974 Reading Air Show at Reading, Pennsylvania from June 4-7. A questionnaire (figure 1) was designed to provide data for correlation with radar tracks obtained at the Reading Air Show, and to determine pilot preference and procedures at uncontrolled airports for utilization in future air traffic math models. Pilots were requested to fill out a questionnaire at either our radar data van or the NASA display booth. The television presentation of this study at the display booth and the radar system attracted many pilots who took time to fill out this questionnaire. Although many pilots did not fill in all the data requested, a total of 430 questionnaires were received during the 4-day air show of which only two were found to be non-responsive.

RESULTS AND DISCUSSION

Aircraft and Pilot

In order to reflect the pilot experience and background responding to this questionnaire, histograms illustrating the type aircraft flown, pilot ratings and pilot hours are presented in figures 2, 3, and 4. Figure 2 shows that the pilots responding are primarily single-engine high or low wing aircraft pilots. A histogram of pilot ratings is shown by figure 3 which illustrates that a wide variety of pilot skills were involved in supplying the questionnaire data. Figure 4 indicates that most of the respondents had less than 1,000 hours, however, approximately 11 percent had greater than 3,000 hours experience.

Pilot Procedures

Pilots were asked to record how close they fly to the established pattern altitude, their preferred pattern altitude and why. These results are presented in figures 5 and 6 and in Appendix A. Most pilots indicated (figure 5) that they flew within 100 ft (30.5 m) of the pattern altitude and over 95 percent indicated they flew within 150 ft (45.7 m). The pattern altitude preferred by pilots is shown by the histogram of figure 6. Over 80 percent indicated a pattern altitude between 800 ft (244 m) and 1000 ft (305 m) was desirable. Responses to why they prefer the pattern altitude cited are included in Appendix A. The reasons vary from height for engine failure to prior training. In general, those who preferred a pattern altitude above 1000 ft (305 m) did so to avoid or see other aircraft. The same reasons cited by pilots for one pattern altitude were also cited for other pattern altitudes. One reason cited often for the 1000 ft (305 m) pattern was to simplify height above the ground altimeter readings.

To provide insight and math modelling parameters for the uncontrolled pattern, pilots were asked when gear and flaps were lowered and what speed, descent rate and bank angles they used in flying the pattern. Figure 7 indicates that most (70%) pilots lower their retractable landing gears on the downwind leg, although 23 percent do so before pattern entry. Pilots also indicated (figure 8) that increased flap angles are used for each successive pattern leg. Before pattern entry, 85 percent of the pilots used a flap setting of less than 10 degrees. On downwind leg, 75 percent of the pilots used more than 10 degrees of flap setting. Very few (1-2%) pilots used less than 10 degrees flap on base and final pattern legs, and most pilots used a flap setting of more than 20 degrees.

Most pilots indicated they used a pattern airspeed between 70 and 90 knots (figure 9) and predominately preferred a descent rate of 450-500 FPM (2.29 - 2.54 m/sec) as shown by figure 10. The average airspeed and descent rate were 82.3 knots and 479 FPM (2.43 m/sec), respectively.

The bank angles used by pilots turning downwind (figure 11), from downwind to base (figure 12) and from base to final (figure 13) illustrate that between 15 degrees and 35 degrees of bank angle are normally used for these turns. Bank angles of 15-25 degrees and 30-35 degrees predominate and the mean bank angle determined for each of these turns is approximately 25 degrees.

Pilot estimates of their longitudinal and lateral (if used) separation distances from other aircraft in the uncontrolled traffic pattern are shown on figures 14 and 15. Longitudinal separation distances from 0.5 n. mi. to 1.5 n. mi. predominate and the mean separation distance was 1.16 n. mi. Additionally 55 percent of the pilots responding to this question, indicated they used the lateral separation distances shown in figure 15. The lateral separation indicated was predominately less than 1.0 n. mi. with a mean of 0.77 n. mi.

The mean and standard deviation of select parameters were included on the figures. The means were analyzed to determine if significant differences occurred as a function of pilot experience. This analysis indicated that the average response to the various pilot experience categories was correlated within one standard deviation of the mean value cited on each figure. Only a few pilots who operate turbo-prop or turbo-jet aircraft responded to this survey. Although they indicated higher pattern altitudes and larger separation distances, their reply did not significantly affect the mean values determined.

Traffic Pattern Preference

Each pilot was requested to select the air traffic pattern(s) which would in their opinion reduce the mid-air collision hazard in uncontrolled terminal airspace. Many pilots marked more than one pattern and each was tabulated as one vote for the pattern indicated. The results of this tabulation are shown by the histogram of figure 16. Pilots comments on the uncontrolled air traffic pattern concepts are contained in Appendix B. From figure 15 it is noted that approximately 85 percent of the pilots prefer a left hand pattern, 11 percent prefer right hand and 4 percent indicated a straight-in approach.

The majority (approximately 45%) of pilots favored the standard pattern concept which has been used for many years. However, a large number (approximately 30%) of pilots indicated the proposed uncontrolled air traffic pattern was desirable. Approximately five percent of the pilots selected the base entry and circling patterns and less than two percent indicated the instrument approach procedure would be suitable.

CONCLUSIONS

Pilot questionnaires were utilized to obtain data on general aviation piloting procedures and preference within the uncontrolled terminal airspace. The following conclusions were drawn from the results obtained:

(1) The pilot experience factors and types of airplanes flown by those pilots provided a representative general aviation population typical of those using uncontrolled airports.

(2) Establishment of a standard pattern altitude between 800 ft (244 m) and 1000 ft (305 m) would be satisfactory to a very high percentage of the general aviation population.

(3) It is reasonable to expect pilot deviations from the established pattern altitude of $\pm$ 150 ft (45.7 m).

(4) Pilot procedures for lowering landing gear, flaps and in controlling airspeed, descent rate, and bank angle are remarkably consistent for a wide variety of aircraft and pilot experience.

(5) A separation distance of approximately one nautical mile is comfortable to the average general aviation pilot.

(6) Either the existing standard traffic pattern concept or the proposed standard pattern (reference 2) would be accepted by a majority of the general aviation pilots.

(7) The tremendous response to this questionnaire - more than 15 questionnaires were filled out by pilots each hour of the air show - leads us to conclude that this method should be utilized more often to solicit information from the general aviation community.

Wallops Flight Center
National Aeronautics and Space Administration
Wallops Island, Virginia 23337, January 31, 1975.

REFERENCES

1. Parker, Loyd C.: General Aviation Air Traffic Pattern Study Analysis. NASA TM-X-6955, 1974.

2. Annon.: Operations at Airports Without Control Towers. Federal Register, Volume 36, No. 138, FAA Proposed Rule Making Notice 71-20, p. 13275, July 1971.

APPENDIX A

PATTERN ALTITUDE PREFERRED AND REASON STATED

Less Than 800 ft (244 m)

1. Less climb for in pattern work
2. Nothing below which is more difficult to scan
3. Good visibility to runway with close-in downwind leg
4. Doesn't matter
5. Reference to the traffic
6. Prescribed for small fields - good ground visibility
7. Easier to visualize
8. 700 feet to 800 feet is adequate forced landing and noise abatement altitude
9. More altitude in case of problems - more time

800 ft (244 m)

1. Altitude to glide to landing, if engine fails
2. Habit
3. Habit
4. Believe that more uncontrolled airports use it
5. Standard pattern altitude
6. To determine wind and see traffic
7. Light aircraft
8. Good glide path
9. Habit
10. High enough
11. What I learned
12. Training
13. Most accepted altitude for pattern at M/V Airport (N.J.)
14. Useful zero power landing

15. Habit
16. Taught that way
17. Good visibility
18. Habit and seems to work
19. 800 feet was the pattern altitude at the field where I do most of my flying
20. Tradition
21. Used to it
22. Normal procedure for me
23. Is comfortable for Cessna 172 and 182 that I fly
24. Below minimum altitude of 1000 feet AGL
25. Allows proper man configuration to landing
26. Uniformity
27. It is a standard that all aircraft should use
28. That's what I was taught
29. Standardized
30. Tradition
31. That is where everyone else is likely to be
32. Convenient and fairly standard
33. Standard
34. Traffic - uncon. fields
35. Safety - visibility
36. Room for error
37. Trained that way
38. Standardized pattern altitude
39. Standard
40. Standard
41. Convention
42. Visibility
43. Published in AIM
44. Better visibility of APT environment

45. Good for our plane and consistent with other aircraft

46. Its convenient and somewhat standard

47. Generally accepted as standard

48. Comfortable, trained that way

49. Standard

50. Seems to be standard

51. It gives good clearance, but isn't too high

52. Taught that way

53. Best suits, performance allows set up on final if heavy crosswind

54. Good visibility yet safe enough

55. Consistent with other aircraft

56. No reason

57. Standard

58. Trained that way

59. Habit

60. Used to it, pattern where I learned

61. Tends to be standard altitude

62. Habit

63. It just feels right

64. Follow traffic and stay out of heavy patterns

65. I'm conditioned

66. 800 at airport close to controlled field (Twin Pine, N.J.)

67. Not too high - enough clearance

68. Required at Flushing

69. Used it most

70. Stay below heavy aircraft

71. Habit

72. High enough to have chance to make airport if engine quits

73. Standard TPA

74. Trained that way

75. Usually specified

76. Seems sufficient if there was an engine failure (light planes)

77. Published rules

78. Allows sufficient time/alt for decisions

79. No preference

80. Used to it

81. Good judgment

82. I learned at this altitude

83. Assumed this was "standard"

84. Enough alt for proper approach

85. Best approach and final

86. A good standard

87. The way I learned to fly

88. Have grown accustomed since standard

89. Habit pattern

90. Been flying 800 for years and I like it

91. Most a/c fly this altitude there - can see more a/c

92. Because of increase clarity of obstacles

93. Habit - altitude most airplanes fly

94. Safety

95. Somewhat standard

96. Training

97. No need for higher in any but pure jet traffic

98. Habit

99. Visibility

100. Because it is more or less standard

101. Standard at my airport (uncontrolled)

102. It is a safe distance from the ground, engine out glide

103. Good hedging altitude

104. Used to it

105. Gliding distance safety

106. I feel that many people overfly air fields at 1000 feet while stooging around, at least you have 200 feet clearance from guy above you and 300 feet from the 500 feet flyer

107. Close in per landing - not drug out approach

108. Usually fly slow single engine aircraft

109. Ease of approach and glide

110. Best single standard value to cover busy and not busy air fields

111. Standard procedure

112. Good visibility, access from power failure

113. What I was taught years ago

114. Habit

115. It conforms with others - making them visible

116. It's standard

117. Keep closer pattern

118. That is FAA standard

119. I have always used and most others do

120. Custom

121. Sufficient for a power off landing

122. Safe altitude for engine failure

123. As a standard

124. Habit

125. Visibility of aerodrome

126. Used to same

127. Adequate height

128. Most used

129. To stay away from other aircraft faster

130. Trained at this altitude

131. Comfortable altitude

132. Safe eng-out altitude in pattern

133. Shortens approach

134. Taught approach at that altitude

135. Works fine

136. Used to it

137. Comfortable

138. Seems to be right alt for my type flying

139. Habit

140. Helps to see and be seen

141. Adequate ground clearance

142. Best sight of target

143. So I can get in if power fails

144. Thus trained

145. Best for alt loss

146. It is very suitable to light aircraft safe time and distance allowed for needs

147. Training

148. Safety

801 ft to 999 ft (244.1 m to 304.5 m)

1. High enough
2. Slow aircraft are at this alt and can be seen
3. Comfortable in C-130
4. Low enough to see ground clearly and high enough to set up approach
5. Gives you time required for any circumstances
6. Good air and ground height

1000 ft (305 m)

1. Easy to remember, can make field if engine quits
2. Engine out

3. Better visibility than 800 feet
4. Easy to figure
5. Greater gliding distance in event of power failure
6. Easy to spot
7. Need maneuvering altitude for various conditions
8. Easy to remember, standardization
9. Terrain
10. Easy to see airport surface and wind indicators
11. Most comfortable
12. 1000 would be easier to calculate
13. Roominess
14. Habit
15. Time
16. Easy to figure and remember
17. Less despondence on power to make threshold
18. Easy to calculate pattern altitude just to add 1000
19. More room for corrections
20. Higher altitude for greater margin of safety
21. Best visual judgment AGL
22. Safer if emergency
23. Provides more time to set up approach
24. More glide distance than 800 or 600
25. More time for decisions and accurate maneuvers
26. Just feels comfortable
27. More time to react in turb
28. Easier to see proper runway
29. I have a heavy aircraft which sinks readily
30. Time
31. Terrain - hilly around home airport

32. Safe

33. Ground clearance, visibility

34. Safety

35. Easy addition to field elevation and convenient let down

36. They should be standard

37. In case of engine failure you have gliding altitude

38. Glide if engine failure

39. Easy to remember

40. Easy to remember

41. More altitude in case of engine failure

42. Gives good clearance and allows good approach

43. Visibility safety factors that are involved

44. Reading gauges

45. Standard for setting up landing proc. and noise abatement

46. Above students

47. Many reasons

48. Easy to remember

49. Noise

50. Easier to teach students to add 1000 to airport elevation

51. Safety in case of power failure

52. Easier

53. Used it home field and it's a nice round number to remember

54. Visibility

55. Safety of altitude

56. Easy to add to the airport elevation on the chart

57. Choice of options in case of emergency

58. Habit

59. Easy to remember

60. Naval training

61. Greater margin for safety, in case of power failure

62. Easier to compute

63. Steeper glide path

64. Better fit of all aircraft types

65. Easy compute from field elevation and comfortable altitude

66. Easy to compute

67. Less confusing (I don't think enough pilots use the standard rule)

68. Used to it

69. Safe altitude considering aircraft characteristics

70. Taught by instructor

71. Prefer high approach and quick descent to clear any possible obstacle

72. Potential engine - out safety

73. Can glide to runway from down wind leg

74. More time to glide if engine failure

75. Easy to relate to MSL indicated

76. Easy to add it to field elevation to get pattern altitude

77. More room for maneuvering

78. Glide to airport

79. Provides for emergencies

80. Above smaller, slower aircraft

81. Bad habit

82. Easy to remember - about right for landing

83. Easiest to figure and closest to airport

84. It's easy to add to field altitude to get pattern altitude

85. Ground clearance particularly at night

86. Safety

87. More standard, easier to train people to remember

88. Easy to arrive at

89. Vision and clearance of traffic

90. Ease of number plus or minus for AFL and MSL

91. It allows you time to make normal approach and correct if necessary

92. If engine fails you can still land

93. Safety or established pattern altitude

94. Good visibility all around

95. Easy to use

96. Round numbers

97. Terr. obs. vis.

98. Easy to figure

99. Standardization

100. Can land on hard surface (r/w) from anywhere in pattern

101. Rounded off to next 100 easy to figure and fly

102. Learned that way

103. FAA regulation

104. Provides good location with respect to active runway

105. Safe allowance for engine failure, etc.

106. High wing aircraft (slightly above other pattern aircraft)

107. Best visibility standard or 1000 feet

108. Just add to field elevation

109. Safer than 800 and easier to add above airport altitudes

110. Safety and noise

111. More flexibility

112. See airport layout better

113. Easy to remember

114. Standardization

115. Obstruction clearance

116. Easy to figure out pattern altitude and remember

117. More chance if forced to land

118. Home field TPA - 1000 feet due to mountain at 800 feet

119. More time to adjust for other aircraft and wind

120. Used to it

121. Judgment

122. View of field

123. Easier to figure - more safety higher

124. Good time for app planning, good visibility

125. Standardized and taught that way

126. Convenient

127. Because of engine out glide

128. Better for spacing and planning

Greater than 1000 ft (305 m)

1. More flexible
2. So I don't collide with anyone
3. Better view of field
4. Generally calm and you stay out of student traffic
5. Habit
6. Safety of additional altitude
7. Visibility
8. Time to set up
9. Use major fields, O'Hare, MIA, JFK
10. Proper visibility
11. No one else is there
12. It's high enough to survey surrounding terrain
13. Can make the field if engine quits
14. Above and clear of small S/E aircraft
15. Airport trained at, had that pattern altitude
16. To be above small aircraft
17. Down hill run to airport
18. Because its 500 feet above norm light traffic

19. 1500 feet is high for tight 140 KT pattern

20. Safety factor

APPENDIX B

COMMENTS OR SUGGESTIONS ON AIR TRAFFIC PATTERN STUDY

1. Do not think the proposed FAA pattern with multiple entry points and angles is good. Keep the 45^{o} downwind entry.

2. I prefer a straight out departure.

3. Too much radio chatter, more frequencies would help.

4. It is desirable to pass over the field above traffic to check wind and traffic.

5. Rotary pattern, any entry or exit.

6. For controlled and uncontrolled fields: all aircraft intending to land, switch landing lights on as you enter pattern - day or night. For uncontrolled fields: Neon tube lighting at end of active runway lit and controlled by auto wind delay system.

7. Everyone must use same pattern.

8. I believe your study is going to reduce accidents.

9. Just to adopt a standard so as to minimize unexpected aircraft positions.

10. In general would prefer a pattern that would allow entry 45^{o} downwind and 45^{o} upwind departure straight out to pattern altitude, then 45^{o} right, left or straight out. No turns until pattern altitude.

11. There should be some type of "standard" pattern - action should be taken to find one immediately.

12. Proposed left pattern - doesn't this pattern give you full view of everything at traffic pattern altitude, especially if you have 45^{o} left entry to initial or upwind leg? I think so, have flown FTRS/Bombers/Transports most recently T-39 sabre liners this was a comfortable pattern even though outside visibility is more limited in T-39 than in FTR aircraft.

13. Of standard pattern and straight-in pattern - Too many variables at uncontrolled fields.

14. I would prefer a pattern similar to the standard with some additional entry points in addition to downwind entry.

15. Standard landing patterns at uncontrolled airports should not be set without including standard <u>take-off</u> procedures.

16. Please eliminate patterns for a single runway; which are right hand for one runway and left for the opposite end; e.g, same side.

17. Because collision probability is proportional to N^2 where N = number of aircraft volume it figures that the time spent where other aircraft are most expected (around airports) should be minimized, therefore the straight-in approach is the optimum followed by pattern producing the shortest possible flight path in vicinity of airport.

18. Uncontrolled airport - no unicom.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WALLOPS FLIGHT CENTER

PILOT QUESTIONNAIRE

The following data is needed to give insight into pilot procedures and pilot preference in our study of the mid-air collision hazard in uncontrolled terminal airspace and to correlate our radar track of your arrival at the Reading Airport. Please fill out even if you did not fly-in.

Aircraft and Pilot

1. Aircraft N-Number or Manufacturers Make and Model____________________.

2. Date and Time of Arrival____________________________________.

3. Pilot rating held________________________ Hrs____________.

Uncontrolled Pattern Procedures

1. How close do you normally fly the pattern altitude ± ________Ft? What pattern altitude do you prefer?______________ Why?__________________________
____

2. When do you normally lower gear and flaps and what flap and power settings do you use?

	Flaps	Gear	Flap Setting	Power Setting (RPM or Manifold Press)
Before Pattern Entry	☐	☐	________	____________
Downwind	☐	☐	________	____________
Base	☐	☐	________	____________
Not Applicable	☐	☐	________	____________

3. What is your most comfortable base and final descent: Airspeed_____Kts? Descent Rate______F.P.M.?

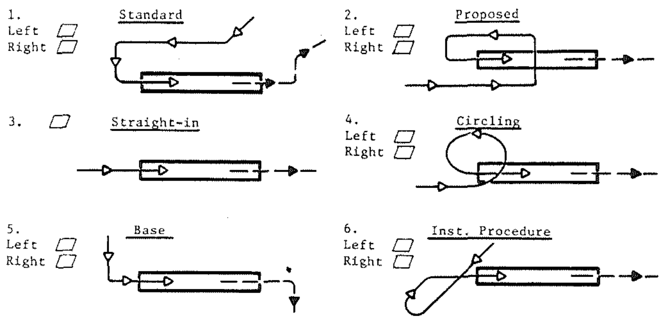
4. What are your approximate bank angles used in turning:

   a) Downwind_______________ c) Base to Final_______________
   b) Downwind to Base__________

5. What approximate separation distance do you use when following another aircraft in the traffic pattern __________NM? Do you also use lateral distance for separation ☐ Yes ☐ No? How much____________N.M.?

Pattern Preference

Which of the following Air Traffic Patterns do you think would minimize the mid-air collision hazard at uncontrolled airports?



7. On the back of this questionnaire, sketch the pattern you flew on arrival at Reading - place tick marks [(X) flaps and (O) gear] on your sketch where they occurred - and include any comments or suggestions you have on our air traffic pattern study.

THANK YOU

Figure 1. Pilot questionnaire

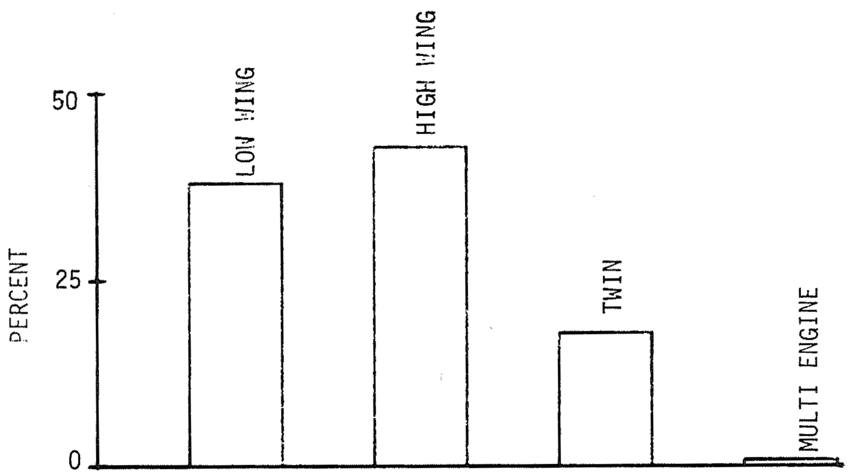


Figure 2. Histogram of aircraft type

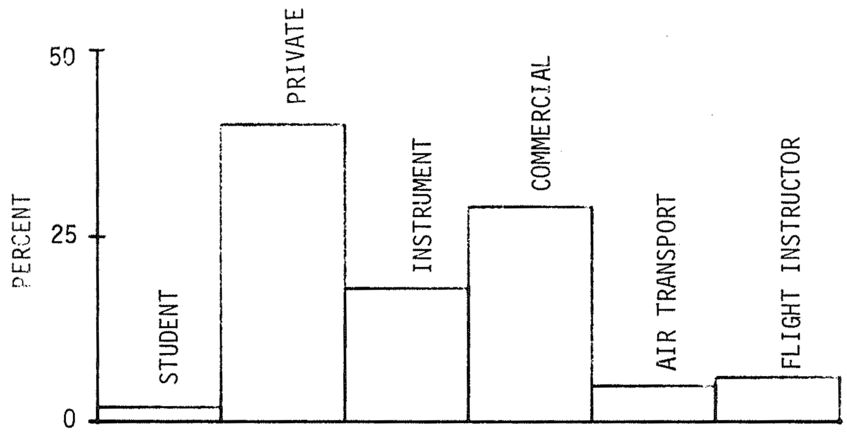


Figure 3. Histogram of pilot ratings

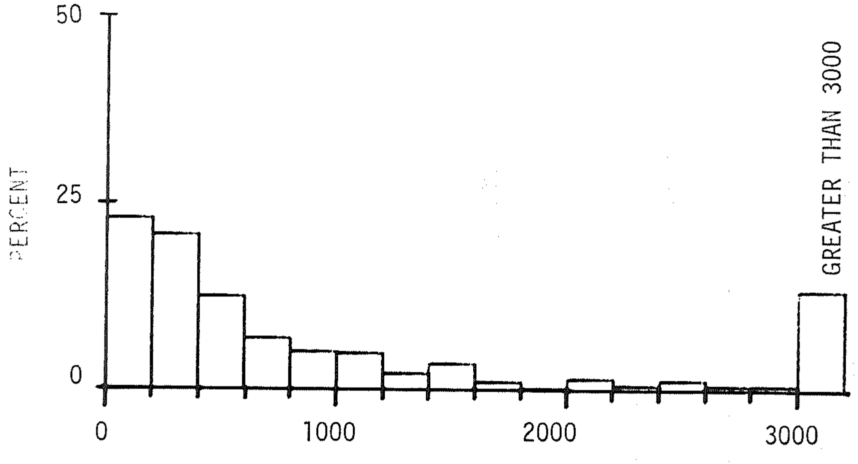


Figure 4. Histogram of pilot hours

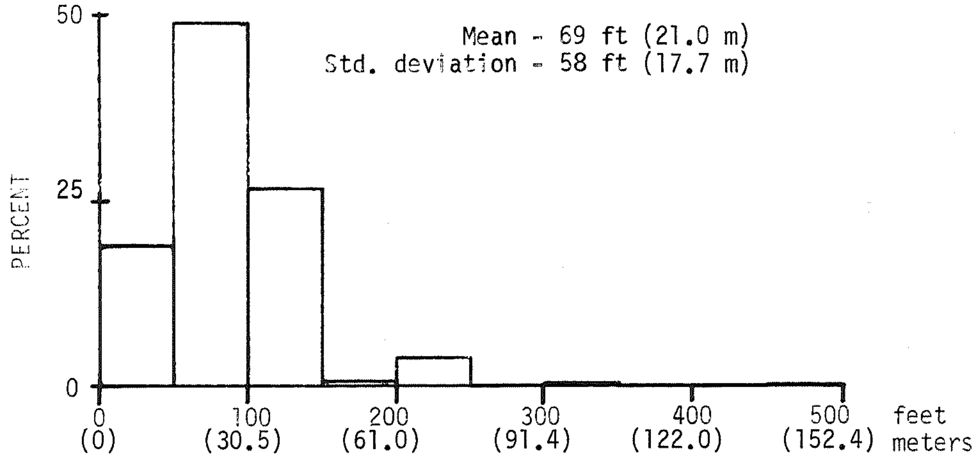


Figure 5. Histogram of deviation from pattern altitude

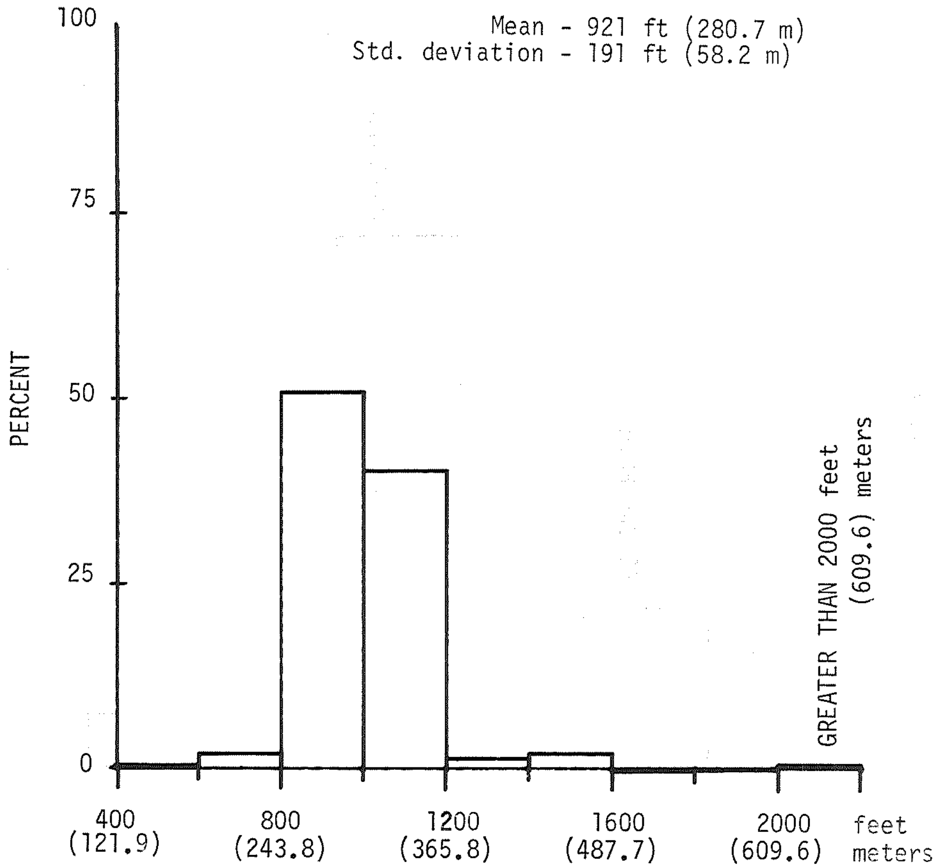


Figure 6. Histogram of preferred pattern altitude

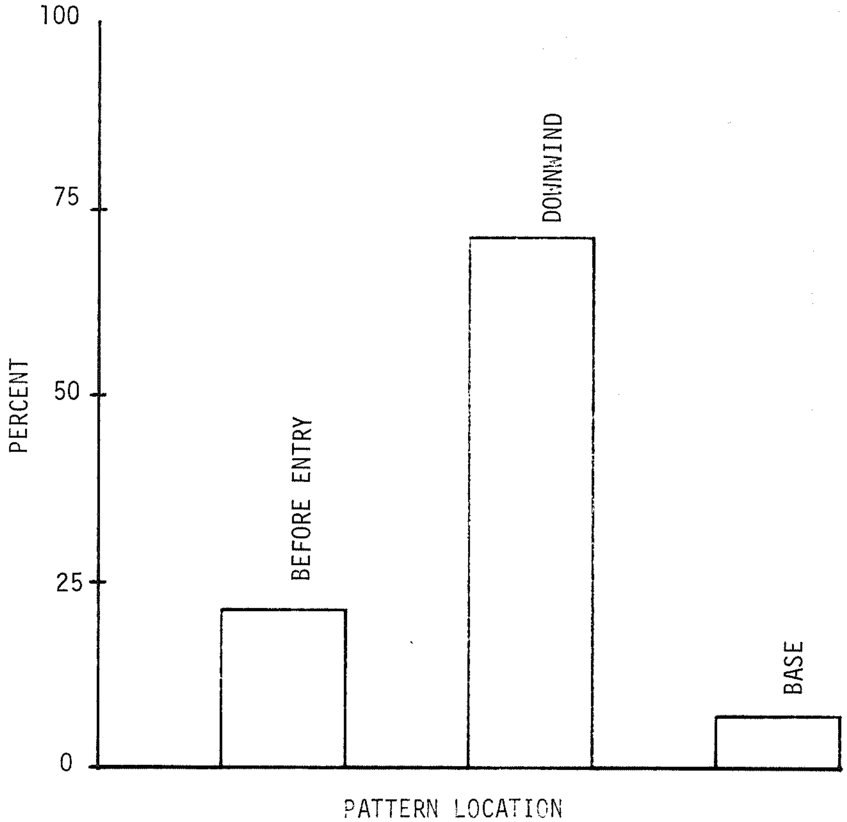


Figure 7. Histogram of pattern location when landing gear is lowered

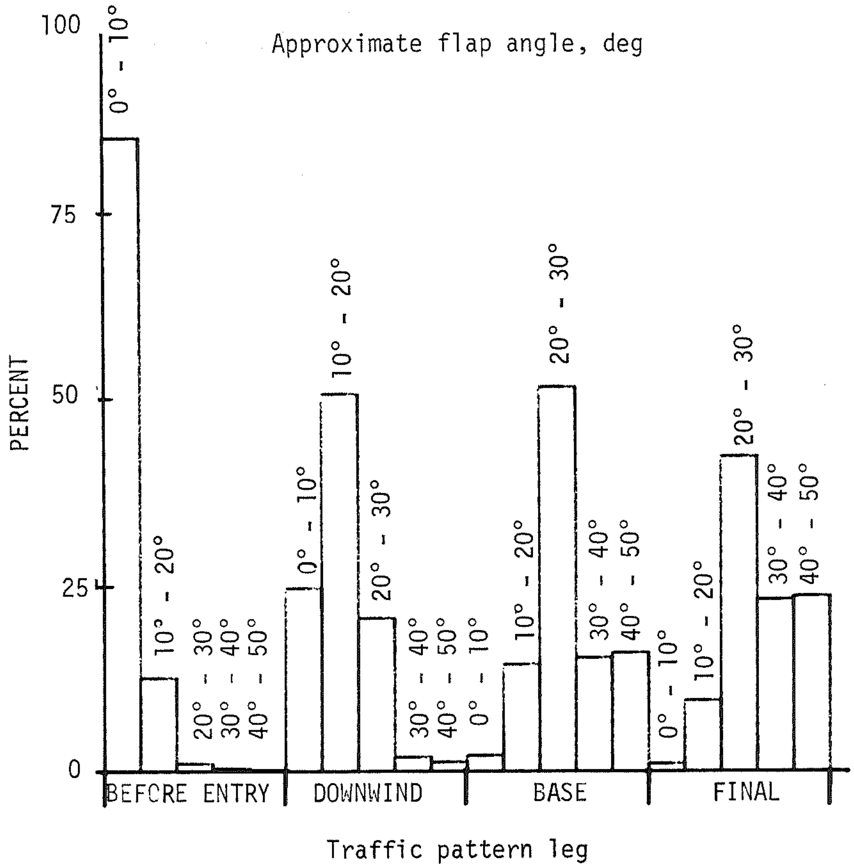


Figure 8. Histogram of approximate flap angle vs. traffic pattern leg

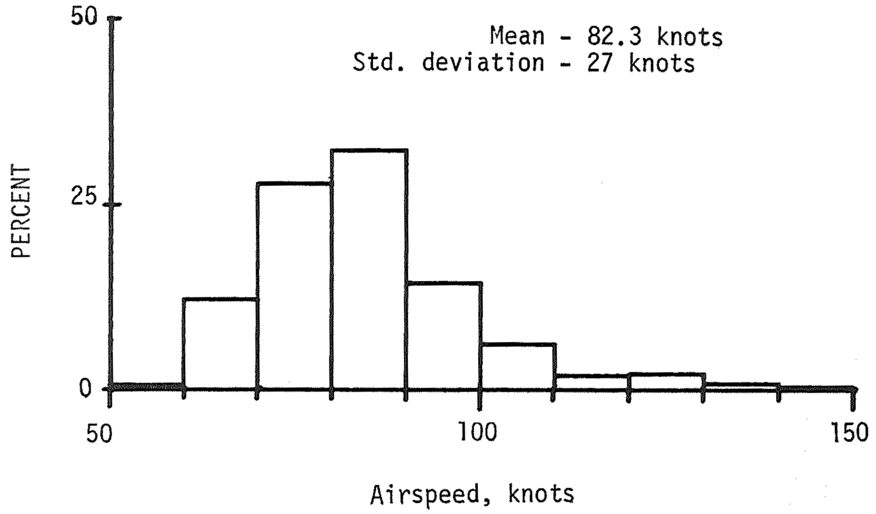


Figure 9. Histogram of airspeed

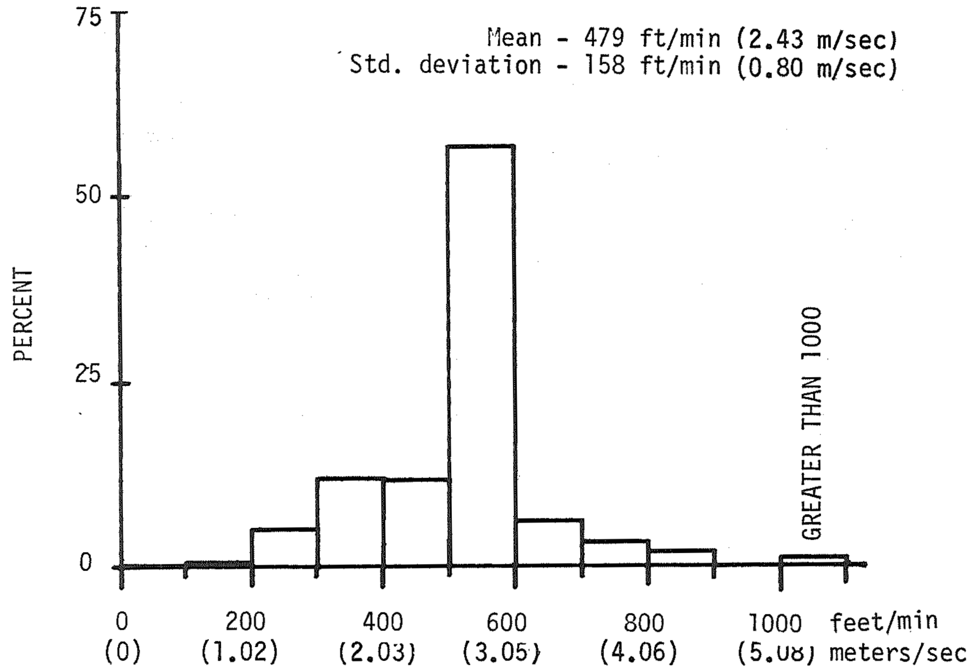


Figure 10. Histogram of descent rate

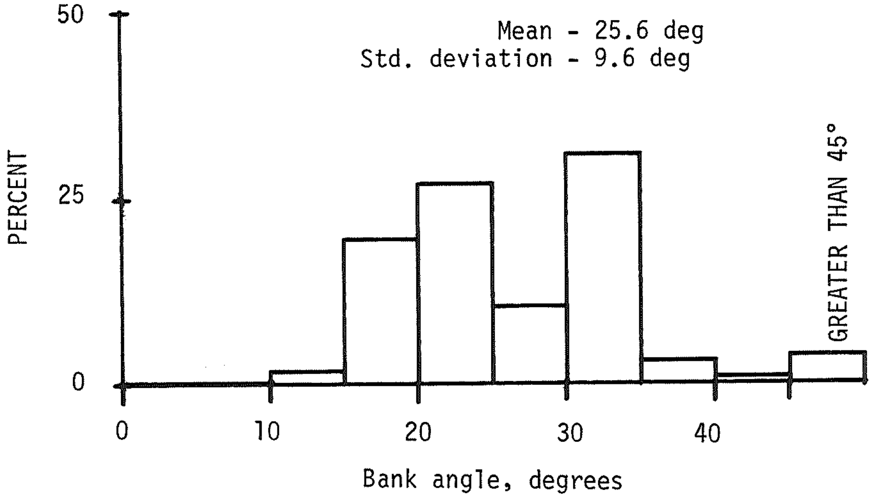


Figure 11. Histogram of bank angle on entry to downwind leg

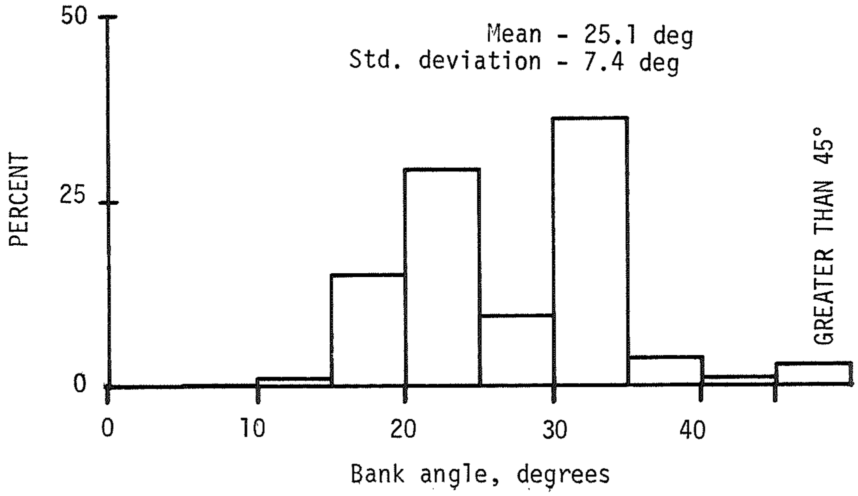


Figure 12. Histogram of bank angle on turn from downwind to base leg

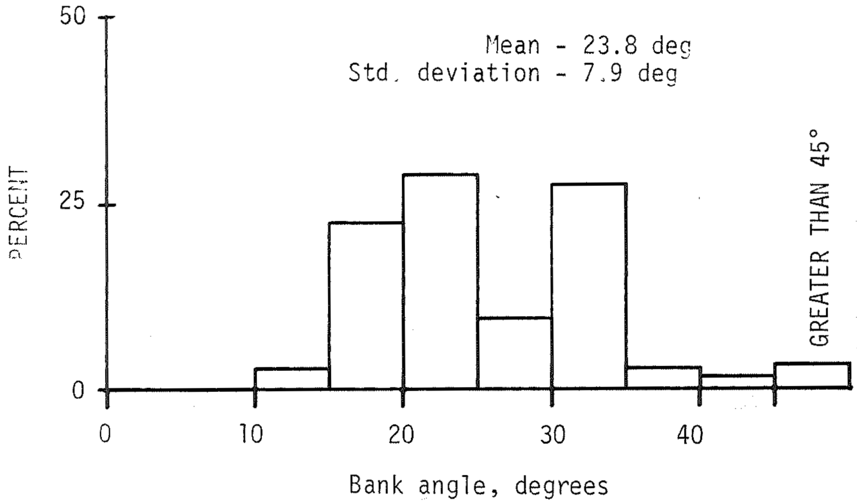


Figure 13. Histogram of bank angle on turn from base to final leg

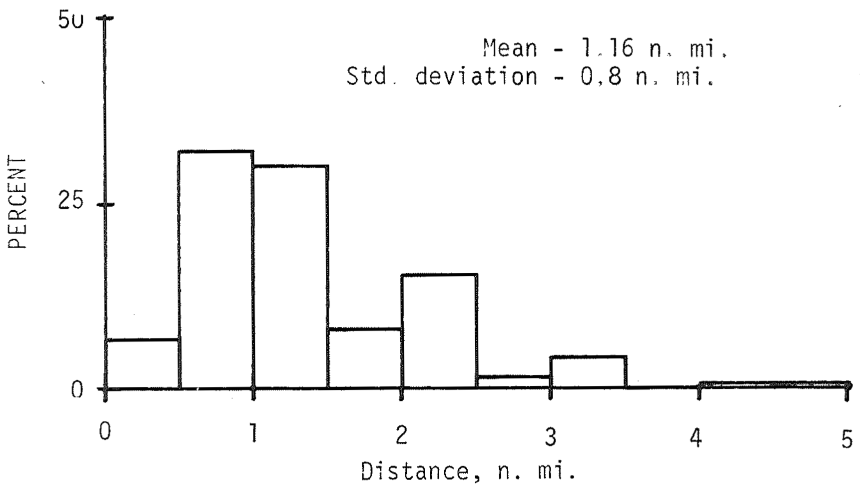


Figure 14. Histogram of longitudinal separation distance

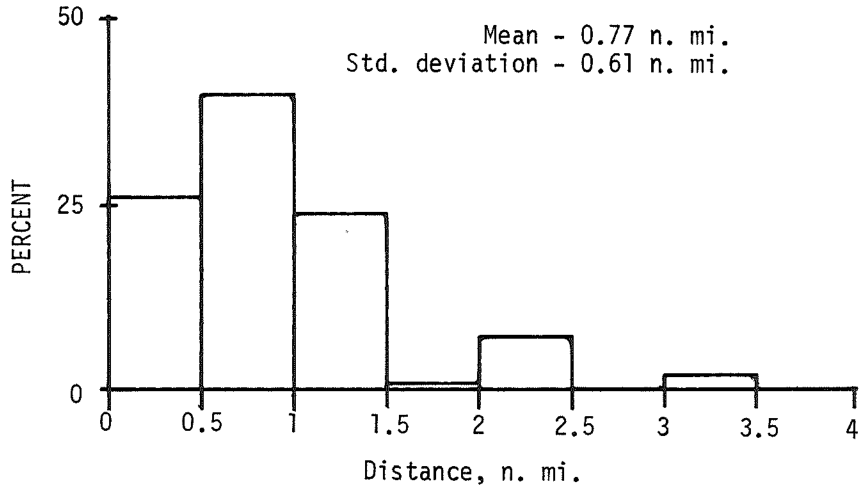


Figure 15. Histogram of lateral separation distance

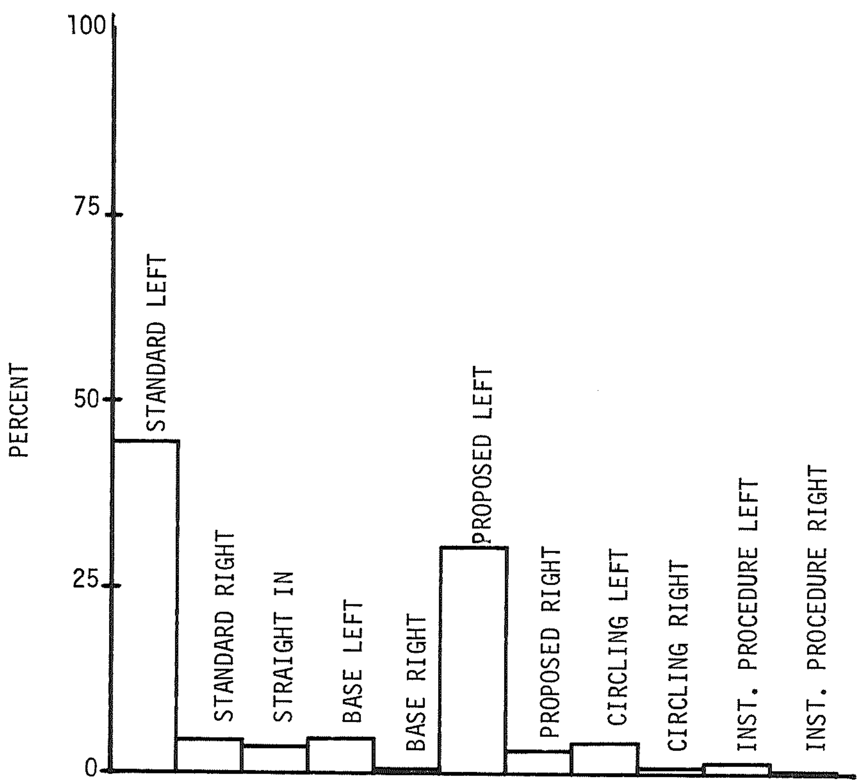


Figure 16. Histogram of air traffic pattern preference

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