NASA Contractor Report 3576

Study To Determine the IFR Operational Profile and Problems of the General Aviation Single Pilot

G. S. Weislogel

CONTRACT NAS1-15969
FEBRUARY 1983

NASA

NASA Contractor Report 3576

Study To Determine the IFR Operational Profile and Problems of the General Aviation Single Pilot

G. S. Weislogel
The Ohio State University
Columbus, Ohio

Prepared for
Langley Research Center
under Contract NAS1-15969

NASA
National Aeronautics
and Space Administration

Scientific and Technical
Information Branch

1983

TABLE OF CONTENTS

STUDY TO DETERMINE THE IFR OPERATIONAL PROFILE AND PROBLEMS OF THE GENERAL AVIATION SINGLE PILOT

G.S. Weislogel*

INTRODUCTION

General aviation, all civil flying activity except that performed by the air carriers, is an important component of the nation's air transportation system. During 1980, general aviation accounted for 98% of the nation's 214,850 civil aircraft and 80% of the 49 million hours flown. General aviation serves all of the nation's 15,161 airports, the airlines only 714 (5%). (1)

General aviation's participation in instrument flight rules (IFR) operations is impressive. Instrument operations at airports with FAA Traffic Control Service included 10.6 million air carrier and 19.6 million general aviation operations in 1980. By 1992 the FAA forecasts 12.8 million air carrier (21% increase) and 30.5 million general aviation (56% increase) instrument operations. The number of instrument rated pilots is expected to increase 48% during the same period. (2)

General aviation (GA) single pilot IFR (SPIFR) operations account for a significant proportion of the total IFR operations. Many SPIFR operations are conducted by highly trained and experienced pilots flying modern, well equipped airplanes. However, it is thought that a larger number of SPIFR operations involve relatively inexperienced single pilots, often having limited equipment, who are expected to perform at the same level of competency as the professional air carrier crews. Concern has been expressed by aviation agencies and user organizations that the level of competency expected of the future SPIFR pilot will not be attained unless significant improvements in the design of the aviation system to better accommodate the SPIFR pilot are achieved. Indeed, user organizations have recommended that programs be undertaken to research and find viable solutions to the problems and difficulties encountered by the SPIFR pilot.

An analysis of the safety record of the SPIFR operation provided evidence that he is having some difficulty. As a whole, general aviation is safer now than in the past. The total number of general

*Professor of Aviation, The Ohio State University, Columbus, Ohio.

aviation accidents has decreased while the activity has increased. However, the number of accidents involving the SPIFR pilot has consistently increased, which is of concern to the aviation community. The cause of SPIFR accidents is most often assigned to pilot error. A detailed examination of NTSB accident reports for the period 1964 through 1975 revealed that there were 877 single pilot pilot error accidents, 446 of which occurred during the landing phase, of which 335 were on an IFR flight plan. It was also found that the SPIFR pilot error landing accidents increased three times faster than dual pilot error accidents. (3)

As a result, NASA has initiated a SPIFR research program to provide the background research and develop the technology required to improve the safety and utility of the single pilot general aviation aircraft operating under instrument flight rules. The SPIFR program includes, as one of its elements, a continuing effort at problem identification. This study is part of the problem identification effort.

The objectives of the study were to (1) develop a SPIFR operational profile, (2) identify problems experienced by the SPIFR pilot, and (3) identify research tasks which have the potential for eliminating or reducing the severity of the problems. To obtain the information necessary to accomplish these objectives, a mail questionnaire survey of instrument rated pilots was conducted.

A copy of the questionnaire, developed by five Ohio State University faculty members in association with NASA Langley Researchers, appears in Appendix A. All five faculty members are experienced in general aviation research and are active instrument rated general aviation pilots.

The value of the information provided by the survey respondents lies in the ability of researchers to use it to gain quantitative insights into the nature of the GA SPIFR pilot and the problems he is experiencing, which point the way to future research, the objective of which is to improve the safety and utility of the GA SPIFR operation.

Information supplied by a respondent of course reflects his personal perceptions of problems and solutions, resulting from his own background in terms of acquired knowledge, skill, and experience. The "real world" of GA SPIFR flight is what the respondent perceives it to be. To him, perceived problems are real problems. The solutions which he has suggested to the problems which he has identified may or may not be appropriate given the state of technology. Having been provided with pilots' own perceptions about what problems exist in the GA SPIFR operation, researchers knowledgeable about the state of technology in a specific area and the probability of being able to successfully apply it, should be able to recommend reasoned and practical solutions.

Detailed survey results are contained in the NASA Contractor Report 165805.(7) A summary of the IFR Single Pilot Survey Questionnaire data is presented in Appendix B. The mail questionnaire survey was conducted over the period October 24, 1980, through February 26, 1981, and included an original and two follow-up mailings. The FAA Airmen Directory File dated June 30, 1980, and updated through August 9, 1980, was used to systematically sample instrument rated private and commercial pilots and airline transport pilots (ATP pilots) yielding a proportional representation by geographic location in the sample drawn. The File contains records of each certificated airman who has been issued a valid airman medical certificate within the twenty-five months preceding the date of the file.

A total sample of 4,943 instrument rated pilots was produced, consisting of 750 private pilots, 2,889 commercial pilots, and 1,304 ATP pilots. A ratio of approximately one out of forty-seven instrument rated pilots were in the sample. The overall response rate of 2211 (47%) is considered very good for a survey of this nature. Anonymity of the respondent was assured.

As the questionnaires were returned, responses to the open ended questions were analyzed and a coding scheme developed. In all, some 61,400 items required manual coding. In addition, there were over 1300 descriptive statement categories assigned to the answers to open ended questions. Coding accuracy was determined to be well over 90%.

It was determined that some of the 1980 usable returns were from respondents who were not operating as general aviation SPIFR pilots. An elimination scheme was developed which removed these 361 respondents leaving a general aviation SPIFR data set containing 1619 questionnaires. Data, analyses, recommendations, and conclusions contained in this Final Report and data presented in the Statistical Summary are based upon these 1619 questionnaires.

All of the 1980 usable questionnaires and the 231 unusable questionnaires are now on file at NASA Langley Research Center. Further, two magnetic data tapes have been prepared, one containing data from the 1980 usable questionnaires returned, and the other containing data from the 1619 questionnaires forming the general aviation SPIFR data set. Individuals and organizations interested in obtaining a copy of the data tapes for further analysis are encouraged to do so. Copies of the data tapes may be obtained from the National Aeronautics and Space Administration, Langley Research Center, Attn: H.P. Bergeron, MS 152E, Hampton, VA, 23665, Telephone (804) 827-3917.

The purpose of this final report, based upon the results of the SPIFR survey, is to present the general aviation IFR single pilot operational profile, illustrate selected data analysis examples, identify the problems which he is experiencing, and recommend further research.

ABBREVIATIONS

ADF	Automatic direction finder
AMEL	Airplane multiengine land
ARTCC	Air route traffic control center
ASEL	Airplane single engine land
ATC	Air traffic control
ATIS	Automatic terminal information service
ATP	Airline transport pilot
ATX	Air taxi
BUS	Business
CC	Card column
COM	Commercial pilot or communications transceiver
CORP	Corporate
CR	Contractor report
DME	Distance measuring equipment
EFAS	En route flight advisory service
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FD	Flight director
FSS	Flight Service Station
GA	General aviation
GS	Glide slope
HI	High
HSI	Horizontal situation indicator
IFR	Instrument flight rules
ILS	Instrument landing system
IMC	Instrument meteorological conditions

LDA	Localizer type directional aid
LOC	Localizer
LOW	Low
MAX	Maximum
MED	Medium
MEP	Multiengine piston
MIN	Minimum
NASA	National Aeronautics and Space Administration
NAV	Navigation receiver
No.	Number
NOS	National Ocean Survey
PATWAS	Pilots automatic telephone weather answering service
PER	Personal
PIREP	Pilot weather report
PVT	Private pilot
Q.	Question
RMI	Radio magnetic indicator
RNAV	Area navigation
S	Sea
SDF	Simplified directional facility
SEP	Single engine piston
SPIFR	IFR flying by a single pilot
TBP	Turboprop
TWEB	Transcribed weather broadcast
VFR	Visual flight rules
VOR	Very high frequency omnidirectional range station
$\geq$	More than or equal to

GENERAL AVIATION IFR SINGLE PILOT OPERATIONAL PROFILE

The IFR Single Pilot Survey has produced information from which an operational profile of the general aviation single pilot operating under instrument flight rules could be developed. The profile is based upon an inspection of the data contained in the report "Statistical Summary: Study to Determine the IFR Operational Profile of the General Aviation Single Pilot," using the mode response for discrete choice data and open ended response data, and the median response for continuous data. The determination was made after subtracting the non-responsive answers. The description of the GA SPIFR pilot and his operational profile, therefore, represents a composite of the data, and although a description of a "typical" IFR single pilot is the result, the description may not, in fact, represent anyone in particular. The information is presented in the order in which the question appears on the questionnaire. Each numbered description below corresponds to the number of the question as it appears on the questionnaire.

1. He flies a single engine airplane (four places and over), having retractable gear and controllable propeller, manufactured since 1974 having a cruise speed of 140-149 knots, and an instrument approach speed of 100-109 knots.

2. His airplane is equipped with two communications transceivers, two VOR/LOC receivers, one glide slope receiver, an ADF and a marker beacon receiver, transponder with altitude encoder, and a DME receiver. It has an autopilot with roll and heading capability. It is also equipped with pitot heat and a headset boom microphone.

3. In his opinion, not planning ahead is the most common error made by IFR single pilots.

4. The <u>one</u> most serious problem which he has encountered in his experience as an IFR single pilot has been icing.

5. He handled the icing problem by obtaining an ATC clearance to a different altitude/heading.

6. Unforecast and unanticipated weather was the most frequent unanticipated thing which happened during his last three flights as an IFR single pilot.

7. Better, more up to date weather information/briefings is the one change in the system which would make his IFR single pilot flight operations easier.

8. Given a single engine airplane with one NAV/COM/LOC, and $7,500,

he would purchase the following additional equipment: transponder, second 360 or 720 channel transceiver, glideslope receiver, marker beacon receiver, second VOR/LOC receiver, pitot heat, ADF receiver and an altitude encoder.

9. He believes that instrument approach procedures should be included in his biennial flight review.

10. He has experienced no difficulties with instrument flight instruction, procedures, and techniques. (23% of respondents)

11. In obtaining preflight aviation weather information, he almost always makes a direct call to FSS (75%); often uses TV weather (35%); seldom visits FSS (49%), seldom uses PATWAS (38%) or TWEB (37%); and never uses the newspaper (43%) or "AM Weather" (38%).

12. In obtaining inflight aviation weather, he almost always uses ATIS (57%); often uses direct FSS communication (53%), EFAS (45%), or ARTCC (40%); seldom uses TWEB (40%).

13. He believes that ATC demands are a problem during instrument approaches, and that better controller awareness about the nature of the GA SPIFR operation would solve this problem.

14. He believes that inadequate lighting is a cockpit environment problem, and that better lighting would solve this problem.

15. He believes that there are no navigation type problems.

16. He believes that the Federal Aviation Regulations and ATC procedures are too complex and excessive, and that they should be simplified.

17. He believes that maintaining recency of experience is a problem, and that the use of more simulators would solve this problem.

18. He believes that poor stability is a problem in airplane stability and control and that the use of an autopilot would solve this problem.

19. He believes that the reliability of FSS weather information is a problem, but cannot recommend a solution to the problem.

20. He believes icing to be a weather problem, and that anticing/deicing equipment is the solution to this problem.

21. He believes that too many communications frequency changes is a problem, and that the system should be designed so as to require fewer frequency changes.

22. As a "normal" IFR flight becomes more difficult because of workload, ATC communications and clearance interpretation is the

aspect of his flying performance which is most likely to deteriorate. He attributes this deterioration to getting too busy with other tasks, having his attention divided, and not having enough time.

23. During an instrument approach in actual IFR conditions, he often encounters the "normal" IFR condition (39%) and has little difficulty with it (49%). He seldom encounters minimum ceiling and/or visibility (66%), light or moderate icing (63%), light or moderate turbulence (46%), or nonroutine ATC instructions (65%); when he does, he experiences little difficulty in handling the situation (44%, 32%, 41%, 39% respectively). He seldom encounters scattered or broken thunderstorms (55%), or strong winds (53%); when he does, he has some difficulty in handling the situation (38%, 43% respectively).

24. He flies from one of the higher aviation activity states, having a high percentage of the nation's more than 14,746 airports and 214,132 general aviation aircraft.

25. During the last twelve months, the most frequent approach he has flown was an ILS approach with radar assistance available.

26. He seldom has someone assist him in the airplane during a flight in actual IFR conditions. If he does, the person is a pilot but does not have an instrument rating, and is not a required copilot.

27. He would often prefer to have someone assist him in the airplane during flight in actual IFR conditions.

28. During the last twelve months, when he has had to cancel an IFR single pilot flight just before planned departure it was because of weather beyond his personal limitations.

29. During the daytime, he would go when light icing, light or moderate turbulence, heavy rain, scattered or broken thunderstorms, IFR over mountains, or IFR over water were reported to exist anywhere enroute. He would not go during the day if moderate icing, lines of thunderstorms, heavy ground fog or weather below minimums were reported. At night, he would go when light or moderate turbulence, scattered thunderstorms, or IFR over water were reported to exist anywhere enroute. He would not go at night if any of the other previously mentioned conditions were reported.

30. He uses the published minimums on instrument approach procedures as his personal minimums.

31. If the weather were reported to be below minimums at his destination airport, he would not fly the approach.

32. During the last twelve months, he has (a) filed IFR ten times, (b) had to hold once, (c) not had to execute a missed approach, (d)

been rerouted twice, (e) not had to divert to an alternate, (f) not had to ask for an altitude change due to icing, (g) asked for a route change due to thunderstorms once, (h) not had to declare an emergency, (i) not requested special handling.

33. He received his private pilot certificate in 1969 (12 years ago), his commercial certificate in 1971 (10 years ago), his multiengine rating in 1972 (9 years ago), and his instrument rating in 1973 (8 years ago). He is not an ATP and is not an instrument flight instructor.

34. During the last twelve months, all flying and single pilot IFR flying was for personal (pleasure) or business (not for hire) purposes.

35. During the last twelve months, he flew VFR and on an IFR flight plan more than four times per month, but in actual IFR conditions less that once per month.

36. On a scale of one (low) to six (high), he scores his skill and experience at four, his knowledge at five.

37. In the last twelve months, he has logged 190 hours total time, 190 as pilot in command, 9 single pilot actual instrument, 4 simulated instrument in an airplane, and none in a ground trainer. He has 1950 hours total time, 1750 pilot in command, 75 single pilot actual instrument, 65 simulated instrument in an airplane, and less than 10 in a ground trainer.

38. He is a 40 year old male.

PROBLEM IDENTIFICATION

Identifying those problems which the GA SPIFR pilot reports he is experiencing is an important step in gaining insights which may point to the identification of research tasks which will improve the safety and utility of the single pilot general aviation aircraft operating under instrument flight rules. An Advisory Group consisting of the two principal investigators and three other experienced general aviation researchers, individually reviewed the Statistical Summary Report, then met as a group to identify problem areas and suggest topics for research. The consensus of the Advisory Group's deliberations can be summarized as follows:

1. Important areas of concern to the GA SPIFR pilot appear in the data.

2. The data suggests that, on the whole, GA SPIFR pilots perceive a variety of operational problems.

3. Detailed analysis of the data will be required in order to identify smaller yet important operational problem areas experienced by specific GA SPIFR pilot categories.

Important Areas of Concern to the GA SPIFR Pilot

One way in which an insight can be gained into what areas trouble the GA SPIFR pilot and in what priority is to rank order Questions 13 through 21 by percentage of respondents supplying a usable problem answer. The results are shown in Table 1.

TABLE 1 - RESPONDENTS SUPPLYING USABLE PROBLEM ANSWER

Question	Problem Area	Percent of Respondents Supplying Usable Problem Answer
13	Instrument Approaches	51%
19	Weather Information	51
14	Cockpit Environment	48
21	Communications	44
20	Weather Encounters	38
17	Training and Proficiency	36
15	Navigation	31
16	Operations and Procedures	24
18	Airplane Stability and Control	18

Another approach to identifying GA SPIFR operational problems is to look at the top problem code responses appearing in Questions 13 through 21. Those reported by more than 5% of the respondents are shown in Table 2. The problem code shown in Table 2 and in other sections of this report corresponds to the code assigned to a specific response to a particular question on the SPIFR questionnaire. All codes are presented in NASA CR-165805. (7)

TABLE 2 - MOST FREQUENTLY REPORTED PROBLEM CODE RESPONSES

Question	Problem Code	Percent of Respondents	Problem Description
13	04	15%	ATC demands including during high workload conditions
14	01	14	Inadequate cabin/instrument panel lighting/approach chart lighting
19	05	12	Reliability of FSS weather information
14	02	11	High cabin noise level
18	04	9	Poor Stability
21	01	8	Too many communications frequency changes
21	09	7	Poor quality of airborne receivers/transmitters
16	03	7	FAR's/ATC procedures too complex/excessive
20	07	7	Icing
17	08	6	Maintaining recency of experience (including cost)
20	08	6	Thunderstorms
14	05	6	Instrument panel control arrangement/design
14	07	6	Standardization

A third approach is to inspect the most frequent responses within a question and aggregate them into another descriptive category. For example, the top three responses to Question 3 can be combined into a category of "Pilot Judgment and Decision Making," which accounts for 35% of the responses to the question "What is the most common error made by IFR single pilots?"

A fourth approach is to inspect the most frequent responses between questions and aggregate them into another descriptive category. For example, the two most frequent responses to Question 4, "What has been the one most serious problem which you have encountered in your experience as an IFR single pilot?" and Question 2Ø, "Weather Encounters" problems were icing and thunderstorms. Weather reporting information can be considered of concern to the GA SPIFR pilot when the responses are aggregated as shown in Table 3.

TABLE 3 - WEATHER REPORTING INFORMATION PROBLEMS

Question	Problem Code	Problem Rank	Percent of Respondents	Description
4	Ø9	3	7%	Unforecast/unanticipated weather
6	Ø8	2	18	Unforecast/unanticipated weather
7	4Ø	1	7	Better, more up to date weather information/ briefing
19	Ø5	1	12	Reliability of FSS weather information
19	Ø9	2	5	FSS briefer attempts to influence pilot's "GO-NO GO" decision
19	Ø3	3	5	Availability and reliability of FSS weather information
19	Ø6	4	5	Availability/timeliness of weather information
2Ø	15	3	4	Reliability of weather information

Question 13, Instrument Approach problems, had the highest percent of respondents supplying a usable problem answer. Question 9 indicates that instrument approach procedures should be included in the biennial flight review by a factor of three more than any other item.

Finally, analyst interpretation of the data is another way in which to gain insights into GA SPIFR operational problems. Workload begins to surface as a problem using this approach, as illustrated in Table 4.

TABLE 4 - WORKLOAD PROBLEMS

Question	Problem Code	Problem Rank	Percent of Respondents	Description
3	Ø2	1	16%	Not planning ahead
3	21	6	5	Allowing proficiency/ currency to deteriorate
4	Ø3	4	5	Workload
4	27	5	4	Lack of proficiency
6	1Ø	4	4	ATC operational demands
7	14	2	6	Use of flight director and/or autopilot
7	27	6	3	Minimize ATC frequency changes
13	Ø4	1	15	ATC demands including during high workload
13	Ø2	4	2	ATC requested approach speed too fast
16	21	2	1	Data management
18	Ø8	3	1	Workload
21	Ø1	1	8	Too many communications frequency changes
21	12	3	5	Misunderstanding clear-ances
21	Ø5	4	4	Excessive communications
21	11	5	4	Controllers/FSS briefers talk too fast

One limitation in aggregating the most frequent responses between questions in order arrive at a conclusion about a GA SPIFR operational problem is that the same respondents may be reporting the same problem in responding to different questions. This can be examined only by further detailed analysis.

GA SPIFR Pilots Perceive a Variety of Operational Problems

Overall, there were 418 problem code categories assigned to the responses to questions in the problem identification section, Questions 13 through 21. This large number of coding categories supports the observation that GA SPIFR pilots are reporting a variety of operational problems. The approach taken in assigning codes to the responses may have contributed to the resulting apparent large number of codes, however. It was decided early in the coding process that a coding category should be sufficiently detailed to be meaningfully descriptive. Thus, codes could be aggregated at a later date for particular analyses. From an analysis standpoint, aggregation of a large number of understandable coding categories is better than a fewer number of categories requiring a subsequent coding to achieve a more meaningful finer detail.

RECOMMENDED RESEARCH

Recommended research based upon the results of GA SPIFR survey falls into three categories:

1. Broad areas of research indicated by the problems which GA SPIFR pilots report they are experiencing.
2. Further, more detailed analysis of the GA SPIFR survey data.
3. Search for "unique" solutions to specific GA SPIFR problems.

Broad Areas of Research

The Problem Identification section and Appendix B of this report provide information from which the following broad areas of potential GA SPIFR research were deduced:

- Workload
- Pilot Judgment and Decision Making
- Instrument Approaches
- Weather Information
- Cockpit Environment
- Communications

Workload reduction will result in increasing the effectiveness and safety of the GA SPIFR operation. Documentation and analysis of actual pilot performance and workload during IFR flight using conventional cockpit displays and autopilots is required to provide baseline data against which to compare advanced control and display concepts.

Improving pilot judgment and decision making is another means of increasing the effectiveness and safety of the GA SPIFR operation. This requires that the GA SPIFR pilot's psychological state, nature and quality of information available and being used by him, be defined and characterized. Although The Federal Aviation Administration has recently begun to study the topic of pilot judgment, the research has not been focused on the GA SPIFR pilot. (4) (5)

The two problem areas troubling the greatest number of respondents were instrument approaches, with emphasis on workload, and weather information, with emphasis on improving its availability, reliability, and timeliness. Automatic flight control systems, advanced cockpit displays, and the development of GA SPIFR oriented ATC procedures are potential areas of research which can contribute to the reduction of workload during the approach phase of a GA SPIFR instrument flight. An investigation of improved preflight and inflight weather information dissemination methods for the GA SPIFR pilot also emerges as a recommended area of research.

Improving the cockpit environment is of considerable interest to the GA SPIFR pilot. It seems that a modest research effort could produce information useful in improving the cockpit environment with respect to improved lighting and noise reduction.

The GA SPIFR pilot also has a high interest in reducing the radio communications workload, both in terms of too many frequency charges and excessive communications. Research into more efficient frequency assignment methods, automatic frequency switching, and improved information transfer methods have the potential for alleviating this concern of the GA SPIFR pilot.

Further Detailed Analysis

Further detailed analysis of the survey data can provide additional insight into the nature of the GA SPIFR pilot and his operational problems in the following ways:

1. Providing answers to specific questions about the GA SPIFR operation as is illustrated in Appendix C, Selected Data Analysis Examples.

2. Allowing a further test of the hypothesis that the operational problems experienced by the GA SPIFR pilot are independent of experience. (Refer to QUERY 7 in Appendix C.)

3. Determining whether a change in design, training, regulations, or procedures, or a combination thereof, is the most appropriate solution to a particular problem or class of problems.

It is suggested that an analysis of the response codes to Questions 3 through 7, 9, 10, and 13 through 22 be performed to aggregate them into a fewer number. The aggregation scheme used should combine response codes having similar characteristics, thereby permitting more meaningful detailed analysis. Care should be exercised during the aggregation process so that useful detail is not lost.

As a next step in further detailed analysis, it is suggested that cross tabulations (or matrices) be developed for the responses to Questions 3 through 7, 9, 10, 13 through 22, 28, and 29 and the following variables:

Pilot Certification (private, commercial, ATP) (Q.33)
Type of Airplane (Q.1, CC21)
Level of Avionics (minimum, medium, maximum) (Q.2)
Autopilot vs. No Autopilot (Q.2)
No Autopilot (copilot, no copilot) (Q.2, Q.26)
Recent Experience with SPIFR flying (high, medium, low) (Q.32, Q.37, CC31-33)
Type of Flying (Q.34, CC66)

Based upon the insights gained in the cross tabulations, a multi-level set of GA SPIFR operational profiles could then be developed and run against the same set of questions as the above variables. For example, a set of profiles could be researched in order to determine if there are problems peculiar to a particular profile, as illustrated in Table 5.

TABLE 5 - SUGGESTED GA SPIFR OPERATIONAL PROFILES FOR ANALYSIS

Variable	Operational Profile Level					
	1	2	3	4	5	6
Pilot certification	ATP	ATP	COM	COM	PVT	PVT
Airplane	TBP	MEP	MEP	SEP	MEP	SEP
Avionics	MAX	MED	MAX	MED	MED	MIN
Autopilot	YES	YES	YES	NO	YES	NO
Copilot	YES	NO	YES	NO	NO	NO
Recency of SPIFR	HI	MED	HI	MED	MED	LOW
Type of Flying	CORP or ATX	BUS	CORP or ATX	BUS	BUS	PER

An analysis of the confidence level in the responses to each question could be performed. This analysis would reveal questions which were often not answered, or were too sensitive or non relevant to the respondent. As a variation of this analysis, certain respondents could be removed from the GA SPIFR data set (N = 1619) because they did not answer a sufficient number of questions, perhaps leaving a more meaningful data set for analysis.

Finally, Question 7 appears to have a high potential for assigning priorities to desirable changes in the GA SPIFR operation. Aggregated responses to this question, in particular, should be examined in relation to other findings developed as a result of a more detailed analysis of the GA SPIFR survey data.

Search for "Unique" Solutions

There is an intuitive feeling among certain researchers that the GA SPIFR survey data should contain truly novel and effective suggestions provided by the respondents as solutions to certain GA SPIFR problems. An analysis of the most frequently reported problem/solution codes for Questions 13 through 21 suggests that there are no revelations in the data, as far as the researcher experienced in this area is concerned. If there are unique solutions in the data, then they are well hidden and special analyses will be required to identify them.

On the other hand, perhaps the unique solutions are disguised in common aeronautical terms, and analyst judgment and insight in interpreting the data is all that is required to identify them. For example, improving the availability, reliability, and timeliness of weather information has been identified as an area for further research. An examination of the most frequently mentioned problem codes for Questions 19 and 20, with the associated solution codes, reveals that a more well developed PIREP system might, in the GA SPIFR pilot's view, reduce the severity of the weather information problem.

In any event, if a search for unique solutions is conducted, it should be done only for those problems which are deemed to be significant in the first place. Further, the solutions suggested are from the viewpoint of a pilot respondent, and the worth of a suggested solution must be tested against its feasibility.

CONCLUDING REMARKS

This document presents the final report of a study of the general aviation single pilot operating under instrument flight rules (GA SPIFR). The objectives of the study were to (1) develop a GA SPIFR operational profile, (2) identify problems experienced by the GA SPIFR pilot, and (3) identify research tasks which have the potential for eliminating or reducing the severity of the problems.

To obtain the information necessary to accomplish these objectives, a mail questionnaire survey of instrument rated pilots was conducted. The questionnaire elicited information about the GA SPIFR pilot's airplane and equipment characteristics; personal observations, experiences, and opinions; personal recommendations concerning his most common problems and recommended solutions; difficulty of IFR single pilot flight; typical IFR single pilot flight characteristics; and flying experience. Complete questionnaire data is reported in NASA CR-165805 (7).

Based upon the results of the GA SPIFR survey, this final report presents the general aviation IFR single pilot operational profile, illustrates selected data analysis examples, identifies the problems which he is experiencing, and recommends further research in the following areas: workload, pilot judgment and decision making, instrument approaches, weather information, cockpit environment, and communications.

As illustrated by the "Selected Data Analysis Examples" section of this report, the GA SPIFR survey information provides a data base which can be manipulated to supply specific answers to specific questions about the nature of the GA SPIFR operation. It is this capability which may provide an important and unexpected peripheral benefit to future GA SPIFR research.

REFERENCES

1. Federal Aviation Administration: "FAA Statistical Handbook of Aviation, Calendar Year 1980."

2. Federal Aviation Administration: "FAA Aviation Forecasts, Fiscal Years 1981-1992."

3. Forsyth, D.L.; and Shaughnessy, J.D.: "Single Pilot IFR Operating Problems Determined From Accident Data Analysis," NASA TM-78773, 1978.

4. Jensen, R.S.; and Benel, R.A.: "Judgment Evaluation and Instruction in Civil Pilot Training," FAA-RD-78-24.

5. Berlin, J.I.; et al.: "Pilot Judgment Training and Evaluation, Volume I, Technical Summary," DOT/FAA/CT-82/56-I.

6. Weislogel, G.S.; and Miller, J.M.: "Study to Determine the Operational Profile and Mission of the Certificated Instrument Rated Private and Commercial Pilot," FAA-RD-70-51.

7. Weislogel, G.S.; and Chapman, G.C.: "Statistical Summary: Study to Determine the IFR Operational Profile of the General Aviation Single Pilot," NASA CR-165805, 1982.

The Ohio State University
Department of Aviation

APPENDIX A

Form Approved
O.M.B. No. 0104-S80001

IFR SINGLE PILOT SURVEY
Questionnaire

INSTRUCTIONS FOR FILLING OUT THE QUESTIONNAIRE

A. Unless otherwise indicated, answer the questions in terms of how you use your instrument rating in the type of airplane you most often fly as an IFR single pilot on a flight in actual IFR conditions.

B. An IFR single pilot operation is defined as: "A general aviation IFR flight operation which requires, by Federal Aviation Regulation or company policy, that only one instrument rated pilot perform all of the piloting functions. If another person is on board (instrument rated pilot or not) and assisting (with communications and navigation, for example), it is still considered a single pilot IFR operation."

C. Use a pencil.

D. On narrative answer questions, briefly outline your answer rather than providing a detailed explanation. However, if you need more space in answering a particular question, use the space provided at the end of the questionnaire.

E. In all cases, when you do not have an exact answer, your best estimate is acceptable.

F. Check ☑ to indicate your response or fill in as indicated.

SECTION 1 · AIRPLANE AND EQUIPMENT CHARACTERISTICS

CARD 1

1. What type of airplane do you now fly as an IFR single pilot most often?

make and model: ____________ 5-10 ______

11 retractable gear: [1] yes [2] no
12 controllable propeller: [1] yes [2] no
13-14 year of manufacture: 19______
15-17 average cruise speed: ______knots
18-20 average instrument approach speed: ______knots
21 check one:
[1] single-engine, 1-3 places
[2] single-engine, 4 places and over
[3] multiengine piston
[4] turboprop
[5] turbojet

2. What kind of equipment does the airplane have?
(check as applicable)

22 communication transceiver [1] one [2] two

navigation
23 VOR/LOC receiver [1] one [2] two
24 glide slope receiver [1] one [2] two
25 ☐ ADF
26 ☐ RMI
27 ☐ marker beacon
28 ☐ transponder
29 ☐ altitude encoder
30 ☐ DME
31 ☐ RNAV

autopilot
32 ☐ roll 33 ☐ heading 34 ☐ pitch 35 ☐ altitude
36 ☐ nav coupler

special
37 ☐ pitot heat
38 ☐ HSI
39 ☐ flight director
40 ☐ headset boom microphone
41 ☐ oxygen
42 ☐ cabin pressurization
44 ☐ control surface anti-icing or de-icing
45 ☐ propeller anti-icing
46 ☐ windshield anti-icing
47 ☐ weather radar
48 ☐ non-radar thunderstorm display

43 ☐ other (please specify) ____________

SECTION 2 · PERSONAL OBSERVATIONS, EXPERIENCES, AND OPINIONS (use last page for additional space)

3. In your opinion, what is the most common error made by IFR single pilots?

49,50______

4. What has been the one most serious problem which you have encountered in your experience as an IFR single pilot?

51,52______

5. How did you handle the problem mentioned in the previous question?

53,54______

6. Consider your last three flights as an IFR single pilot. Please note anything unanticipated which happened during those flights.

55,56______

7. What one change in the system (e.g., ATC, regulations, procedures, weather dissemination) your airplane and equipment, or flight training, would make your IFR single pilot flight operations easier?

57,58______

8. **Suppose that you have just purchased a single engine airplane that you plan to use for single pilot IFR flight, equipped with a single NAV/COM with LOC. You have $7,500 to spend on additional equipment. Check the equipment you would purchase.**

communication

- 59 ☐ 720 channel transceiver ($1500)
- 60 ☐ 360 channel transceiver ($1000)

navigation

- 61 ☐ VOR/LOC ($1500)
- 62 ☐ glide slope ($700)
- 63 ☐ ADF ($1700)
- 64 ☐ marker ($350)
- 65 ☐ transponder ($800)
- 66 ☐ altitude encoder ($800)
- 67 ☐ DME ($3500)
- 68 ☐ RNAV (also requires DME) ($3500)

autopilot

- 69 ☐ roll (wing leveler) ($1100)
- 70 ☐ roll/heading ($1500)
- 71 ☐ roll/heading/pitch ($3500)
- 72 ☐ roll/heading/pitch/altitude ($5500)
- 73 ☐ nav coupler ($600)

special

- 74 ☐ pitot heat ($75)
- 75 ☐ HSI ($2800)
- 76 ☐ headset boom microphone ($150)
- 77 ☐ other (please specify item and cost) ______________
- 78 ☐ weather radar ($7000)
- 79 ☐ non-radar thunderstorm display ($5500)

CARD 2

9. **What items do you think should be included in the biennial flight review concerning instrument proficiency?** 6,7____

10. **What difficulties have you experienced with instrument flight instruction (including proficiency), procedures, and techniques?** 8,9____

11. **How often have you used the following preflight sources of aviation weather information?**

		never	seldom	often	almost always
Direct call to FSS	10	☐1	☐2	☐3	☐4
Direct visit to FSS	11	☐	☐	☐	☐
PATWAS (telephone transcribed weather)	12	☐	☐	☐	☐
TWEB (radio transcribed weather)	13	☐	☐	☐	☐
"AM Weather" PBS TV	14	☐	☐	☐	☐
TV Weather	15	☐	☐	☐	☐
Newspaper	16	☐	☐	☐	☐
Other (please specify)	17	☐1	☐2	☐3	☐4

12. **How often have you used the following inflight sources of aviation weather information?**

		never	seldom	often	almost always
Direct FSS communication	18	☐1	☐2	☐3	☐4
EFAS (Flight Watch)	19	☐	☐	☐	☐
ARTCC (Center)	20	☐	☐	☐	☐
TWEB (radio transcribed weather)	21	☐	☐	☐	☐
ATIS	22	☐	☐	☐	☐
Other (please specify)	23	☐1	☐2	☐3	☐4

SECTION 3 - PERSONAL RECOMMENDATIONS

These questions are important because your answers will contribute to the design of future systems which will enhance the utility and safety of the IFR single pilot operation. Considering your experience as an IFR single pilot, indicate the most common problem which you have encountered in each of the following areas and your recommended solution. If you have not encountered a problem in a particular area, leave blank.

13. **Instrument Approaches (e.g., approach charts, non-standard approach procedures, ATC demands)**
    Problem: 24,25____
    Solution: 26,27____

14. **Cockpit Environment (e.g., instrument panel/controls, noise level, warning systems, lighting)**
    Problem: 28,29____
    Solution: 30,31____

15. **Navigation (e.g., enroute charts, enroute procedures, radar vectors, ADF, VOR, RNAV, DME, displays/indicators)**
    Problem: 32,33____
    Solution: 34,35____

16. **Operations and Procedures (e.g., aircraft systems, ATC, regulations, inflight data management)**
    Problem: 36,37____
    Solution: 38,39____

17. **Training and Proficiency (e.g., adequacy, standardization, desk top and aircraft simulators)**
    Problem: 40,41____
    Solution: 42,43____

18. Airplane Stability and Control (e.g., hands off stability, use of autopilots, stall/spin, limitations of conventional control wheel)

Problem: 44,45 ______

Solution: 46,47 ______

19. Weather Information (e.g., availability, reliability, content, presentation)

Problem: 48,49 ______

Solution: 50,51 ______

20. Weather Encounters (e.g., precipitation, icing, thunderstorms, hail, low ceiling, low visibility, turbulence, wind shear)

Problem: 52,53 ______

Solution: 54,55 ______

21. Communications (e.g., excessive communication/frequency changes, misunderstandings, radio noise/static, audio quality, information content)

Problem: 56,57 ______

Solution: 58,59 ______

SECTION 4 - DIFFICULTY OF IFR SINGLE PILOT FLIGHT

22. As a "normal" IFR flight becomes more difficult because of work load, which aspect of your flying performance is most likely to deteriorate? (check one)

60 [1] remembering ATC instructions
[2] accurate interpretation of instruments
[3] heading control
[4] use of enroute charts, approach charts, and manuals
[5] ATC communications and clearance interpretation
[6] maintaining positional awareness
[7] altitude control
[8] no problems
[9] other (please specify) ______

61,62 To what do you attribute this deterioration? ______

23. During an instrument approach in actual IFR conditions, how frequently have you encountered the IFR condition indicated, and how difficult is the condition for you to handle?

	FREQUENCY OF ENCOUNTER (check one box on each line)				DIFFICULTY (check one box on each line except when frequency is never)			
IFR condition	never	seldom	often	almost always	little	some	much	extreme
normal (does not include any of the conditions which follow)	63 [1]	[2]	[3]	[4]	64 [1]	[2]	[3]	[4]
minimum ceiling and/or visibility	65 ☐	☐	☐	☐	66 ☐	☐	☐	☐
light or moderate icing	67 ☐	☐	☐	☐	68 ☐	☐	☐	☐
light or moderate turbulence	69 ☐	☐	☐	☐	70 ☐	☐	☐	☐
scattered or broken thunderstorms	71 ☐	☐	☐	☐	72 ☐	☐	☐	☐
strong winds	73 ☐	☐	☐	☐	74 ☐	☐	☐	☐
nonroutine ATC instructions	75 [1]	[2]	[3]	[4]	76 [1]	[2]	[3]	[4]

CARD 3

SECTION 5 - TYPICAL IFR SINGLE PILOT FLIGHT CHARACTERISTICS

24. Where do you originate most of your IFR flights?

airport name ______ 6-8 ______
city ______ state ______ 9,10 ______

25. What instrument approach have you most often made during the last 12 months? (check one)

11 [1] ILS [4] VOR/DME [7] LDA
[2] LOC [5] ADF [8] SDF
[3] VOR [6] RNAV [9] radar vectors

12 Is radar assistance available during this approach?
[1] yes [2] no

26. How frequently do you have someone assist you in the airplane during flight in actual IFR conditions?

13 [1] never [2] seldom [3] often [4] almost always
14 is this person a pilot? .... [1] yes [2] no
15 does he have an instrument rating?...... [1] yes [2] no
16 is he a required copilot? .... [1] yes [2] no
17 ☐ required by Federal Aviation Regulation
18 ☐ required by company policy

27. If a copilot is not required, how often would you prefer to have someone assist you in the airplane during flight in actual IFR conditions?

19 [1] never [2] seldom [3] often [4] almost always

28. What single factor has caused you most often to cancel an IFR single pilot flight just before planned departure during the last 12 months?

20 [1] I have not had to cancel a proposed IFR flight
[2] weather worse than published minimums
[3] weather beyond my personal limitations
[4] weather beyond aircraft/equipment capability
[5] equipment malfunction
[6] lack of adequate weather information
[7] lack of adequate flight publications
[8] other (please specify) ______

29. If the following weather conditions were reported to exist anywhere enroute, what would you do?

		DAY			NIGHT	
		go	not go		go	not go
light icing	21	[1]	[2]	22	[1]	[2]
moderate icing	23	☐	☐	24	☐	☐
light turbulence	25	☐	☐	26	☐	☐
moderate turbulence	27	☐	☐	28	☐	☐
heavy rain	29	☐	☐	30	☐	☐
scattered thunderstorms	31	☐	☐	32	☐	☐
broken thunderstorms	33	☐	☐	34	☐	☐
lines of thunderstorms	35	☐	☐	36	☐	☐
heavy ground fog	37	☐	☐	38	☐	☐
weather below minimums	39	☐	☐	40	☐	☐
IFR over mountains	41	☐	☐	42	☐	☐
IFR over water	43	[1]	[2]	44	[1]	[2]

30. At the destination airport, what are your personal minimums for making each of the following types of approaches?

DAY

	ceiling (in feet)	visibility (in miles)		I use published minimums
ILS	45-48 ______	49,50 ______	or	51 ☐
LOC	52-55 ______	56,57 ______	or	58 ☐
VOR	59-62 ______	63,64 ______	or	65 ☐
ADF	66-69 ______	70,71 ______	or	72 ☐

CARD 4

NIGHT

	ceiling (in feet)	visibility (in miles)		I use published minimums
ILS	6-9 ______	10,11 ______	or	12 ☐
LOC	13-16 ______	17,18 ______	or	19 ☐
VOR	20-23 ______	24,25 ______	or	26 ☐
ADF	27-30 ______	31,32 ______	or	33 ☐

31. If the weather were reported to be below minimums at your destination airport, would you fly the approach?

34 [1] yes [2] no

32. Excluding proficiency flights, during the last 12 months, how many times have you:

- filed IFR? .... 35,36 ______
- had to hold? .... 37,38 ______
- executed a missed approach? .... 39,40 ______
- been rerouted? .... 41,42 ______
- diverted to an alternate? .... 43,44 ______
- asked for an altitude change due to icing? .... 45,46 ______
- asked for a route change due to thunderstorms? .... 47,48 ______
- declared an emergency? .... 49,50 ______
- requested special handling? .... 51,52 ______

SECTION 6 - FLYING EXPERIENCE

33. In what year did you originally receive the following certificates and/or ratings?

private: 53,54 19______	multiengine: 59,60 19______
commercial: 55,56 19______	ATP: 61,62 19______
instrument: 57,58 19______	flight instructor/instrument: 63,64 19______

34. In what type of flying were you most often engaged during the last 12 months?

	all flying (check one)	single pilot IFR flying (check one)
	65	66
general aviation		
business (not for hire)	[1]	[1]
business (corporate pilot)	[2]	[2]
air taxi or charter	[3]	[3]
giving instruction	[4]	[4]
other commercial	[5]	[5]
personal (pleasure)	[6]	[6]
airline	[7]	[7]
military	[8]	[8]

35. During the last 12 months, how often, on the average, did you fly?

	VFR (check one)	on an IFR flight plan (check one)	in actual IFR conditions (check one)
	67	68	69
less than once per month	[1]	[1]	[1]
about monthly	[2]	[2]	[2]
about twice per month	[3]	[3]	[3]
about four times per month	[4]	[4]	[4]
more than four times per month	[5]	[5]	[5]

36. Place yourself on a scale of all instrument pilots in terms of your opinion of your present skill, knowledge, and experience:

		low					high
skill	70	[1]	[2]	[3]	[4]	[5]	[6]
knowledge	71	☐	☐	☐	☐	☐	☐
experience	72	[1]	[2]	[3]	[4]	[5]	[6]

CARD 5

37. What is your approximate flight time in hours?

	in last 12 mos.	total
total time	6-9 ______	10-14 ______
total pilot in command	15-18 ______	19-23 ______
actual instrument	24-26 ______	27-30 ______
single pilot actual instrument	31-33 ______	34-37 ______
simulated instrument in an airplane	38,39 ______	40-43 ______
ground trainer	44,45 ______	46-49 ______

38. 50,51 **Age:**______ 52 [1] **male** [2] **female**

39. Are there any general comments you wish to make about IFR single pilot flying which you think might be useful for us to know?

53,54______

40. ADDITIONAL SPACE FOR ANSWERS TO NARRATIVE QUESTIONS (specify question number)

APPENDIX B
CONDENSED SUMMARY OF IFR SINGLE PILOT SURVEY QUESTIONNAIRE DATA
(Table numbers correspond to same table numbers in NASA CR 165805)

TABLE B1 - WHAT TYPE OF AIRPLANE DO YOU NOW FLY AS AN IFR SINGLE PILOT MOST OFTEN? (Q.1)

Make and Model: (Top 15)

Cessna 172	15%	Bonanza 35	04%	Cessna 177	03%
Piper Cherokee	13	Piper Cherokee 6	04	Beech King Air	03
Cessna 182	08	Beech Baron	04	Piper Apache/Aztec	03
Cessna 210	05	Piper Navajo	03	Beech Bonanza 36	02
Mooney	05	Cessna 310	03	Piper Seneca	02

retractable gear 64%, controllable propeller 76%

	MEDIAN	MODE
year of manufacture	1974	1979
average cruise speed (knots)	140-149	130-139
average instrument approach speed (knots)	100-109	090-099

single-engine, 1-3 places	07%	turboprop	06%
single-engine, 4 places and over	63	turbojet	01
multiengine piston	22		

TABLE B2 - WHAT TYPE OF EQUIPMENT DOES THE AIRPLANE HAVE? (Q.2)

COMMUNICATION

one communications transceiver	05%
two communications transceivers	94%

NAVIGATION

one VOR/LOC receiver	11%	marker beacon	95%
two VOR/LOC receivers	88	transponder	98
one glideslope receiver	71	altitude encoder	66
two glideslope receivers	21	DME	63
ADF	94	RNAV	21
RMI	22		

AUTOPILOT

roll	64%	altitude	36%
heading	62	nav coupler	50
pitch	40		

SPECIAL

pitot heat	94%	control surface anti-icing or de-icing	20%
HSI	28	propeller anti-icing	25
flight director	16	windshield anti-icing	21
headset boom microphone	56	weather radar	19
oxygen	30	non-radar thunderstorm display	02
cabin pressurization	11		

TABLE B3 - IN YOUR OPINION, WHAT IS THE MOST COMMON ERROR MADE BY IFR SINGLE PILOTS? (Q.3)

Code	Response	No.	%
(Ø2)	Not planning ahead	266	16%
(Ø6)	Over confidence/ignorance in being able to handle weather/limitations/capabilities	185	11
(Ø1)	Exceeding/inaccurate assessment of personal limitations/capabilities	133	Ø8
(Ø4)	Misunderstanding/failure to understand ATC instructions/procedures	92	Ø7
(2Ø)	Violating minimums	9Ø	Ø6
(21)	Allowing proficiency/currency to deteriorate	83	Ø5

Explanatory notes applying to Tables B3 through B7, B1Ø, B13 through B22, and B39:

1. The numbers which appear in parentheses in the left column of these Appendix B tables are the response codes which were assigned to respondents' answers to questions on the returned questionnaires. All response codes in the GA SPIFR data are defined in NASA CR 1658Ø5, "Statistical Summary: Study to Determine the IFR Operational Profile and Problems of The General Aviation Single Pilot." For example, in Table B3, (Ø2) is the code assigned to responses to Question 3 which indicated that "not planning ahead" is the most common error made by IFR single pilots. In Table B5, (Ø5) is the problem code assigned to the problem "thunderstorms", with (17) the code assigned to the "requested ATC assistance/cooperation" solution to the "thunderstorms" problem answer to Question 4.

2. The numbers which appear in parentheses in the two far right columns of these Appendix B tables indicate the number and percentage of solution responses within the particular problem response shown. For example, in Table B5, 116 respondents (7% of the 1619 total respondents) replied that "thunderstorms" are the most serious problem. Of the 116, (15) (13%) responded that they solved the problem by "requested ATC assistance/cooperation."

TABLE B4 - WHAT HAS BEEN THE ONE MOST SERIOUS PROBLEM WHICH YOU HAVE ENCOUNTERED IN YOUR EXPERIENCE AS AN IFR SINGLE PILOT? (NOTE: RESPONSES TO QUESTIONS 4 AND 5 ARE COUPLED AND PRESENTED UNDER QUESTION 5 DATA.)(Q.4)

TABLE B5 - HOW DID YOU HANDLE THE PROBLEM MENTIONED IN THE PREVIOUS QUESTION? (Q.5)

Problem Code	Solution Code	Response	No.	%
(Ø2)		Icing (structural or induction system)	26Ø	16%
	(Ø2)	Obtained ATC clearance to different altitude/heading	(161)	(62%)
	(11)	Cancelled/terminated flight	(39)	(15)
	(Ø3)	Worked harder/smarter (planning ahead)	(19)	(Ø7)
(Ø5)		Thunderstorms	116	Ø7%
	(Ø2)	Obtained ATC clearance to different altitude/heading	(27)	(23%)
	(Ø3)	Worked harder/smarter (planning ahead)	(2Ø)	(17)
	(17)	Requested ATC assistance/cooperation	(15)	(13)
(Ø9)		Unforecast/unanticipated weather	1Ø8	Ø7%
	(Ø8)	Diverted to alternate	(22)	(2Ø%)
	(11)	Cancelled/terminated flight	(19)	(18)
	(Ø2)	Obtained ATC clearance to different altitude/heading	(14)	(13)
(Ø3)		Workload	76	Ø5%
	(Ø3)	Worked harder/smarter (planning ahead)	(46)	(61%)
	(17)	Requested ATC assistance/cooperation	(Ø7)	(Ø9)
	(1Ø)	Obtained instrument recency of experience/ refresher training	(Ø4)	(Ø5)
(27)		Lack of proficiency	65	Ø4%
	(1Ø)	Obtained instrument recency of experience/ refresher training	(33)	(43%)
	(Ø3)	Worked harder/smarter (planning ahead)	(Ø8)	(11)
	(Ø5)	Selected no action	(Ø6)	(Ø8)
(13)		Airplane communications equipment failure/ malfunction	62	Ø4%
	(21)	Took routine action/followed standard procedure	(31)	(Ø2%)

TABLE B6 - CONSIDER YOUR LAST THREE FLIGHTS AS AN IFR SINGLE PILOT. PLEASE NOTE ANYTHING UNANTICIPATED WHICH HAPPENED DURING THOSE FLIGHTS. (Q.6)

Code	Response	No.	%
(Ø1)	Nothing unanticipated happened	543	34%
(Ø8)	Unforecast/unanticipated weather	285	18
(Ø7)	ATC clearance changes/routing different than filed	79	Ø5
(1Ø)	ATC operational demands (pilot asked to do something he didn't feel comfortable with)	63	Ø4
(12)	Nav/transponder equipment malfunction/failure	57	Ø4
(16)	Airplane communications equipment failure/ malfunction	48	Ø3

TABLE B7 - WHAT ONE CHANGE IN THE SYSTEM (E.G., ATC, REGULATIONS, PROCEDURES, WEATHER DISSEMINATION) YOUR AIRPLANE AND EQUIPMENT, OR FLIGHT TRAINING, WOULD MAKE YOUR IFR SINGLE PILOT FLIGHT OPERATIONS EASIER? (Q.7)

Code	Response	No.	%
(4Ø)	Better, more up to date weather information/ briefing	119	Ø7%
(14)	Use of flight director and/or autopilot	1Ø2	Ø6
(52)	More stringent requirements to receive and maintain instrument rating	73	Ø5
(16)	Weather dissemination through ATC	66	Ø4
(Ø8)	Require actual IFR experience during flight training	52	Ø3
(27)	Minimize ATC frequency changes	52	Ø3

TABLE B8 - SUPPOSE THAT YOU HAVE JUST PURCHASED A SINGLE ENGINE AIRPLANE THAT YOU PLAN TO USE FOR SINGLE PILOT IFR FLIGHT, EQUIPPED WITH A SINGLE NAV/COM WITH LOC. YOU HAVE $7,500 TO SPEND ON ADDITIONAL EQUIPMENT. WHAT EQUIPMENT WOULD YOU PURCHASE? (Q.8)

COMMUNICATION			
720 channel transceiver($1500)	49%		
360 channel transceiver($1000)	43%		
NAVIGATION			
VOR/LOC($1500)	78%	transponder($800)	94%
glideslope($700)	84	altitude encoder($800)	55
ADF($1700)	64	DME($3500)	21
marker($350)	82	RNAV($3500)(requres DME)	01
AUTOPILOT			
roll (wing leveler) ($1100)	13%		
roll/heading($1500)	27		
roll/heading/pitch($3500)	04		
roll/heading/pitch/altitude($5500)	02		
nav coupler($600)	12		
SPECIAL			
pitot heat($75)	77%		
HSI($2800)	03		
headset boom microphone($150)	53		
weather radar($7000)	05		
non-radar thunderstorm display($5500)	00		

TABLE B9 - WHAT ITEMS DO YOU THINK SHOULD BE INCLUDED IN THE BIENNIAL FLIGHT REVIEW CONCERNING INSTRUMENT PROFICIENCY? (Q.9)

Code	Response	No.	%
(12)	Instrument approach procedures	331	20%
(20)	Basic instrument flying skills	96	06
(02)	Partial panel	95	06
(07)	Federal Aviation Regulations	94	06
(05)	Unusual attitudes	84	05
(09)	Nonprecision instrument approach(es)	66	04

TABLE B1Ø - WHAT DIFFICULTIES HAVE YOU EXPERIENCED WITH INSTRUMENT FLIGHT INSTRUCTION (INCLUDING PROFICIENCY), PROCEDURES, AND TECHNIQUES? (Q.1Ø)

Code	Response	No.	%
(Ø1)	No difficulties (None)	37Ø	23%
(19)	Lack of instructor standardization	69	Ø4
(27)	ADF procedures/techniques	68	Ø4
(15)	Insufficient actual IFR training (in IMC)	66	Ø4
(38)	Keeping current, maintaining proficiency	58	Ø4
(22)	Inefficient/insufficient/ill prepared flight instruction	57	Ø4

TABLE B11 - HOW OFTEN HAVE YOU USED THE FOLLOWING PREFLIGHT SOURCES OF AVIATION WEATHER INFORMATION? (Q.11)

Preflight Weather Information	never	seldom	often	almost always
Direct call to FSS	ØØ%	Ø2%	21%	75%
Direct visit to FSS	Ø4	49	34	Ø7
PATWAS (telephone transcribed weather)	26	39	17	Ø7
TWEB (radio transcribed weather) . .	27	37	19	Ø4
"AM Weather" PBS TV.	38	28	18	Ø5
TV Weather	18	23	35	16
Newspaper.	43	24	16	Ø5
Other.	Ø9	Ø2	Ø5	Ø4

TABLE B12 - HOW OFTEN HAVE YOU USED THE FOLLOWING INFLIGHT SOURCES OF AVIATION WEATHER INFORMATION? (Q.12)

Inflight Weather Information	never	seldom	often	almost always
Direct FSS communication	ØØ%	15%	53%	27%
EFAS (Flight Watch).	Ø7	23	45	17
ARTCC (Center)	Ø4	32	4Ø	15
TWEB (radio transcribed weather) . .	18	4Ø	23	Ø4
ATIS	Ø1	Ø6	33	57
Other.	Ø6	Ø1	Ø3	Ø2

NOTE: Tables B13 through B21 present the most common problem the SPIFR pilot has encountered in each of the areas indicated, with a recommended solution. The top six problems are listed for each area, with the top three solutions accounting for more than one percent of the solutions to the problem.

TABLE B13 - INSTRUMENT APPROACHES (E.G., APPROACH CHARTS, NON-STANDARD APPROACH PROCEDURES, ATC DEMANDS)(Q.13)

Problem Code	Solution Code	Response	No.	%
(Ø4)		ATC demands including during high workload conditions (e.g., communications, vectoring, clearance changes, rapid descents)	243	15%
	(Ø3)	Better controller awareness	(5Ø)	(21%)
	(13)	Request ATC assistance/cooperation	(48)	(2Ø)
	(Ø5)	Minimize ATC communications demands/ clearance changes	(19)	(Ø8)
(Ø1)		Chart format/content	79	Ø5%
	(Ø7)	Standardize NOS and commercial approach charts	(2Ø)	(25%)
	(11)	Change chart format/content	(14)	(18)
	(Ø6)	Add color to approach charts	(Ø8)	(1Ø)
(5Ø)		Charts too cluttered/too busy to read easily	64	Ø4%
	(53)	Unclutter, simplify charts	(36)	(56%)
	(56)	Important information highlighted and/or depicted in an orderly manner	(Ø9)	(14)
	(11)	Change chart format/content	(Ø2)	(Ø3)
(Ø2)		ATC requested approach speed too fast	4Ø	Ø2%
	(Ø3)	Better controller awareness	(Ø8)	(2Ø%)
	(32)	Better or corrective spacing of aircraft having different speeds	(Ø8)	(2Ø)
	(15)	Provide different approaches for airplanes of different speeds	(Ø5)	(13)
(16)		Understanding ATC clearance and instructions/ too fast	34	Ø2%
	(1Ø)	Request ATC clarification	(1Ø)	(29%)
	(13)	Request ATC assistance/cooperation	(Ø8)	(24)
	(Ø3)	Better controller awareness	(Ø5)	(15)
(Ø6)		Approach procedures too complicated/unfamiliar	33	Ø2%
	(Ø4)	More thorough flight instruction/proficiency	(Ø6)	(18%)
	(42)	Familiarize oneself, study	(Ø4)	(12)
	(13)	Request ATC assistance/cooperation	(Ø3)	(Ø9)

TABLE B14 - COCKPIT ENVIRONMENT (E.G., INSTRUMENT PANEL/CONTROLS, NOISE LEVEL, WARNING SYSTEMS, LIGHTING) (Q.14)

Problem Code	Solution Code	Response	No.	%
(Ø1)		Inadequate cabin/instrument panel/ approach chart lighting	22Ø	14%
	(11)	More lighting sources/various color and brighter lighting	(92)	(42%)
	(Ø3)	Redesign (including standardization) more research information	(68)	(31)
	(Ø6)	Integral instrument lighting	(27)	(12)
(Ø2)		High cabin noise level	178	11%
	(Ø1)	More noise insulation (soundproofing)	(73)	(41%)
	(Ø7)	Use ear plugs/headset/hands off COM	(47)	(26)
	(Ø3)	Redesign (including standardization)/more research/information	(28)	(16)
(Ø5)		Instrument panel control arrangement/design	94	Ø6%
	(Ø3)	Redesign (including standardization)/more research/information	(7Ø)	(74%)
	(17)	Use of integrated displays (HSI, FD)	(1Ø)	(11)
	(Ø9)	Digital display	(Ø2)	(Ø2)
(Ø7)		Standardization	9Ø	Ø6%
	(Ø3)	Redesign (including standardization)/more research/information	(76)	(84%)
	(Ø5)	Voluntary manufacturer compliance	(Ø1)	(Ø1)
	(13)	Adequate familiarization with instrument layout	(Ø1)	(Ø1)
(Ø4)		Warning lights	28	Ø2%
	(Ø4)	Annunciator panel/warning system	(13)	(46%)
	(Ø3)	Redesign (including standardization)/more research/information	(Ø7)	(25)
	(1Ø)	Use of audio warning	(Ø3)	(11)
(Ø3)		Organizing charts, flight logs, etc., for ease of use	19	Ø1%
	(21)	Yoke clamp fixture	(Ø6)	(32%)
	(Ø3)	Redesign (including standardization)/more research/information	(Ø2)	(11)
	(23)	Lighted chart holder	(Ø2)	(11%)

TABLE B15 - NAVIGATION (E.G., ENROUTE CHARTS, ENROUTE PROCEDURES, RADAR VECTORS, ADF, VOR, RNAV, DME, DISPLAYS/INDICATORS) (Q.15)

Problem Code	Solution Code	Response	No.	%
(2Ø)		Chart design	64	Ø4%
	(Ø2)	Redesign charts	(32)	(5Ø%)
	(16)	Use color graphics	(1Ø)	(16)
	(Ø4)	Redesign (including standardization)	(Ø4)	(Ø6)
(Ø2)		Radar vectors	62	Ø4%
	(Ø6)	Require ATC to state point at which radar vectoring terminates	(11)	(18%)
	(34)	Inform pilot of nature and extent of radar vector for more efficient vectoring	(1Ø)	(16)
	(Ø8)	More ATC awareness of single pilot workload limititations	(Ø7)	(11)
(Ø6)		Chart clutter	44	Ø3%
	(Ø2)	Redesign charts	(29)	(66%)
	(16)	Use color graphics	(Ø7)	(16)
	(Ø3)	Establish RNAV/direct routes	(Ø1)	(Ø2)
(24)		Inadequate VOR-ADF system/transmitter and receiver/poor, inaccurate signals	31	Ø2%
	(24)	Upgrade maintenance of ground facilities by FAA	(15)	(47%)
	(47)	Stronger transmitters/receivers	(Ø4)	(13)
	(Ø4)	Redesign (including standardization)	(Ø3)	(Ø9)
(Ø7)		NAV display design	3Ø	Ø2%
	(Ø4)	Redesign (including standardization)	(26)	(87%)
	(11)	Reduce cost	(Ø2)	(Ø7)
	(32)	Redesign panel/combine instrument/ alleviate scan	(Ø1)	(Ø3)
(Ø5)		Inflexibility of ATC in approving RNAV routes/ direct routes	25	Ø2%
	(Ø3)	Establish RNAV/direct routes	(19)	(76%)
	(Ø7)	More use of RNAV	(Ø1)	(Ø4)

TABLE B16 - OPERATIONS AND PROCEDURES (E.G., AIRCRAFT SYSTEMS, ATC, REGULATIONS, INFLIGHT DATA MANAGEMENT) (Q.16)

Problem Code	Solution Code	Response	No.	%
(03)		FAR's/ATC procedures too complex/excessive	107	07%
	(03)	Simplify regulations/procedures	(81)	(76%)
	(02)	Eliminate	(01)	(01)
	(05)	Better coordination	(01)	(01)
(21)		Data Management (charts, etc.)	21	01%
	(19)	Better cockpit design for managing paperwork	(06)	(29%)
	(08)	Use advanced technology	(03)	(14)
	(46)	Use a copilot	(02)	(10)
(01)		Nonstandard location of controls	15	01%
	(01)	Redesign (including standardization)	(12)	(80%)
	(17)	Require emergency systems	(01)	(07)
(09)		ATC talks too much and too fast	14	01%
	(07)	Talk slower	(06)	(43%)
	(04)	Simplify ATC communications	(02)	(14)
	(14)	More ATC awareness of single pilot workload limitations	(02)	(14)
(14)		Excessive radar vectoring	14	01%
	(10)	Permit more direct routing through terminal areas	(02)	(14%)
	(21)	Publications of preferred routes through congested areas	(02)	(14)
	(30)	ATC cooperation with general aviation aircraft	(01)	(07)
(22)		Lack of aircraft emergency systems	14	01%
	(17)	Require emergency systems	(09)	(64%)
	(02)	Eliminate	(01)	(07)

TABLE B17 - TRAINING AND PROFICIENCY (E.G, ADEQUACY, STANDARDIZATION, DESK TOP AND AIRCRAFT SIMULATORS) (Q.17)

Problem Code	Solution Code	Response	No.	%
(Ø8)	Maintaining recency of experience (including cost)		99	Ø6%
	(Ø7)	More use of simulators	(36)	(36%)
	(Ø5)	Continued proficiency practice	(1Ø)	(1Ø)
	(Ø4)	Design low cost motion simulator	(Ø5)	(Ø5)
(25)	Inadequate proficiency		72	Ø4%
	(3Ø)	Higher requirements to remain proficient (more than 6 hrs. in 6 mos.)	(2Ø)	(28%)
	(11)	Periodic instrument checkride	(14)	(19)
	(Ø5)	Continued proficiency practice	(Ø7)	(1Ø)
(Ø3)	Insufficient training in IMC and weather hazards		66	Ø4%
	(Ø3)	Spend more time training in IMC	(47)	(71%)
	(Ø1)	More training	(Ø6)	(Ø9)
	(17)	Emphasize teaching techniques	(Ø3)	(Ø5)
(Ø7)	Lack of standardized training		51	Ø3%
	(Ø6)	Standardize training	(35)	(69%)
	(41)	Better enforcement by FAA	(Ø2)	(Ø4)
	(Ø3)	Spend more time training in IMC	(Ø2)	(Ø4)
(1Ø)	Ineffective use of/lack of simulators		51	Ø3%
	(Ø7)	More use of simulators	(2Ø)	(39%)
	(1Ø)	FAA provide low cost simulator time	(Ø8)	(16)
	(46)	More availability of simulators (location)	(Ø6)	(12)
(12)	Inadequate training quality		49	Ø3%
	(27)	Higher actual instrument experience for CFII's	(12)	(24%)
	(17)	Emphasize teaching techniques	(Ø8)	(16)
	(Ø7)	More use of simulators	(Ø4)	(Ø8)

TABLE B18 - AIRPLANE STABILITY AND CONTROL (E.G., HANDS OFF STABILITY, USE OF AUTOPILOTS, STALL/SPIN, LIMITATIONS OF CONVENTIONAL CONTROL WHEEL) (Q.18)

Problem Code	Solution Code	Response	No.	%
(Ø4)		Poor stability	153	Ø9%
	(Ø6)	Use autopilot	(37)	(24%)
	(Ø1)	Require wing levelers	(32)	(21)
	(Ø7)	Better design	(19)	(12)
(Ø2)		Autopilot	68	Ø4%
	(Ø4)	More emphasis on hand flying	(1Ø)	(15%)
	(Ø6)	Use autopilot	(1Ø)	(15)
	(21)	A cheaper, more efficient autopilot	(Ø8)	(12)
(Ø8)		Workload	17	Ø1%
	(Ø6)	Use autopilot	(11)	(65%)
	(21)	A cheaper, more efficient autopilot	(Ø2)	(12)
	(Ø7)	Better design	(Ø1)	(Ø6)
(Ø3)		Control wheel	11	Ø1%
	(16)	Control stick instead of control wheel	(Ø4)	(36%)
	(Ø7)	Better design	(Ø2)	(18)
	(Ø2)	Limit travel	(Ø1)	(Ø9)
(1Ø)		Trim	1Ø	Ø1%
	(Ø7)	Better design	(Ø3)	(3Ø%)
	(12)	Require 3 axis trim	(Ø3)	(3Ø)
	(Ø6)	Use autopilot	(Ø1)	(1Ø)
(13)		Stall/spin handling	Ø9	Ø1%
	(Ø5)	More training	(Ø2)	(22%)
	(Ø7)	Better design	(Ø2)	(22)
	(23)	Require stall/spin training for private pilots	(Ø1)	(11)

TABLE B19 - WEATHER INFORMATION (E.G., AVAILABILITY, RELIABILITY, CONTENT, PRESENTATION) (Q.19)

Problem Code	Solution Code	Response	No.	%
(Ø5)		Reliability of FSS weather information	199	12%
	(15)	More emphasis on PIREP's	(24)	(12%)
	(Ø6)	More frequent update	(17)	(Ø9)
	(Ø8)	Better interpretation of weather information by briefer for pilots	(16)	(Ø8)
(Ø9)		FSS briefer attempts to influence pilot's "GO-NO GO" decision	79	Ø5%
	(Ø8)	Better interpretation of weather information by briefer for pilots	(23)	(29%)
	(16)	More training for FSS briefers	(Ø9)	(11)
	(15)	More emphasis on PIREP's	(Ø6)	(Ø8)
(Ø3)		Availability and reliability of FSS weather information	75	Ø5%
	(1Ø)	Offer aviation weather on commercial broadcast station/cable TV	(Ø6)	(Ø8%)
	(2Ø)	More PATWAS availability	(Ø5)	(Ø7)
	(28)	8ØØ phone number for aviation weather	(Ø5)	(Ø7)
(Ø6)		Availability/timeliness of weather information	73	Ø5%
	(Ø6)	More frequent update	(23)	(32%)
	(15)	More emphasis on PIREP's	(Ø9)	(12)
	(Ø7)	Automation	(Ø7)	(1Ø)
(2Ø)		Long delays in reaching FSS during poor weather	62	Ø4%
	(17)	More briefers during peak hours and poor weather	(34)	(55%)
	(1Ø)	Offer aviation weather on commercial broadcast station/cable TV	(Ø5)	(Ø8)
	(15)	More emphasis cn PIREP's	(Ø3)	(Ø5)
(Ø8)		Inconsistent quality of weather briefings	6Ø	Ø4%
	(16)	More training for FSS briefers	(12)	(2Ø%)
	(21)	Establish standard format for briefer to report to pilot	(1Ø)	(17)
	(Ø8)	Better interpretation of weather information by briefer for pilots	(Ø9)	(15)

TABLE B2Ø - WEATHER ENCOUNTERS (E.G., PRECIPITATION, ICING, THUNDERSTORMS, HAIL, LOW CEILING, LOW VISIBILITY, TURBULENCE, WIND SHEAR) (Q.2Ø)

Problem Code	Solution Code	Response	No.	%
(Ø7)		Icing	1Ø6	Ø7%
	(22)	Anticing/deicing equipment	(23)	(22%)
	(Ø1)	More emphasis on PIREP's	(16)	(15)
	(12)	Use caution/avoid/treat with respect	(11)	(1Ø)
(Ø8)		Thunderstorms	95	Ø6%
	(Ø2)	More ground based weather radar	(19)	(2Ø%)
	(Ø8)	ATC radar avoidance vector	(13)	(14)
	(16)	Airborne weather radar	(13)	(14)
(15)		Reliability of weather information	68	Ø4%
	(21)	Update forecasting methods/personnel	(19)	(28%)
	(Ø1)	More emphasis on PIREP's	(12)	(18)
	(Ø6)	More frequent/more timely update	(Ø8)	(12)
(Ø5)		All are problems	55	Ø3%
	(12)	Use caution/avoid/treat with respect	(14)	(25%)
	(Ø4)	Knowledge of equipment/personal limitations	(12)	(22)
	(17)	Pilot training	(Ø8)	(15)
(14)		Windshear	4Ø	Ø2%
	(18)	Develop better/more accurate windshear detection equipment	(21)	(53%)
	(Ø1)	More emphasis on PIREP's	(Ø4)	(1Ø)
	(19)	Greater pilot attentiveness on approaches	(Ø3)	(Ø8)
(1Ø)		Icing and thunderstorms	36	Ø2%
	(12)	Use caution/avoid/treat with respect	(Ø8)	(22%)
	(Ø1)	More emphasis on PIREP's	(Ø4)	(11)
	(Ø2)	More ground based weather radar	(Ø4)	(11)

TABLE B21 - COMMUNICATIONS (E.G., EXCESSIVE COMMUNICATION/FREQUENCY CHANGES, MISUNDERSTANDINGS, RADIO NOISE/STATIC, AUDIO QUALITY, INFORMATION CONTENT) (Q.21)

Problem Code	Solution Code	Response	No.	%
(Ø1)		Too many communications frequency changes	126	Ø8%
	(Ø9)	Fewer frequency changes	(6Ø)	(48%)
	(Ø2)	Simplify communications	(Ø3)	(Ø2)
	(Ø5)	Better equipment	(Ø3)	(Ø2)
(Ø9)		Poor audio quality of airborne receivers/ transmitters	116	Ø7%
	(Ø5)	Better equipment	(59)	(51%)
	(Ø1)	Use boom microphone/with headset	(14)	(12)
	(Ø7)	Talk more slowly/distinctly	(Ø3)	(Ø3)
(12)		Misunderstanding clearances	78	Ø5%
	(Ø7)	Talk more slowly/distinctly	(22)	(28%)
	(11)	Keep trying	(Ø8)	(1Ø)
	(24)	ATC awareness of readback	(Ø7)	(Ø9)
(Ø5)		Excessive communications	7Ø	Ø4%
	(13)	Pilot training	(19)	(27%)
	(Ø2)	Simplify communications	(1Ø)	(14)
	(Ø6)	More frequencies/controllers	(Ø5)	(Ø7)
(11)		Controllers/FSS briefers talk too fast	58	Ø4%
	(Ø7)	Talk more slowly/distinctly	(32)	(55%)
	(Ø1)	Use boom microphone/with headset	(Ø3)	(Ø5)
	(17)	ATC sensitivity to SPIFR problems	(Ø2)	(Ø3)
(13)		Noise	34	Ø2%
	(Ø5)	Better equipment	(Ø8)	(24%)
	(Ø1)	Use boom microphone/with headset	(Ø7)	(21)
	(1Ø)	Quiet cabin interior	(Ø4)	(12)

TABLE B22 - AS A "NORMAL" IFR FLIGHT BECOMES MORE DIFFICULT BECAUSE OF WORKLOAD, WHICH ASPECT OF YOUR FLYING PERFORMANCE IS MOST LIKELY TO DETERIORATE? (Q.22)

Aspect of Flying Performance Most Likely to Deteriorate	%
Remembering ATC instructions	15%
Accurate interpretation of instruments	Ø3
Heading control	14
Use of enroute charts, approach charts, and manuals	15
ATC communications and clearance interpretation	17
Maintaining positional awareness	16
Altitude control	Ø3
No problems	13
Other (please specify)	Ø2

Code	Deterioration Attributed To	No.	%
(Ø3)	Get too busy with other tasks/divided attention/not enough time	335	21%
(Ø5)	Too busy flying the airplane	1Ø5	Ø6
(Ø7)	Lack of proficiency (currency)	62	Ø4
(12)	Radar vectors	52	Ø3
(Ø8)	Fatigue	46	Ø3
(Ø1)	ATC talks too fast	41	Ø3

TABLE B23 - DURING AN INSTRUMENT APPROACH IN ACTUAL IFR CONDITIONS, HOW FREQUENTLY HAVE YOU ENCOUNTERED THE IFR CONDITION INDICATED, AND HOW DIFFICULT IS THE CONDITION FOR YOU TO HANDLE? (Q.23)

	FREQUENCY OF ENCOUNTER				DIFFICULTY			
IFR condition	never	seldom	often	almost always	little	some	much	extreme
normal (does not include any of the conditions which follow).	02%	08%	39%	14%	49%	05%	00%	00%
minimum ceiling and/ or visibility . . .	05	66	23	01	44	36	05	00
light or moderate icing	20	63	10	00	32	31	09	02
light or moderate turbulence.	01	46	46	01	41	41	05	00
scattered or broken thunderstorms . . .	11	55	26	01	25	38	14	02
strong winds. . . .	03	53	35	01	35	43	08	00
unonroutine ATC instructions. . . .	07	65	18	02	39	34	09	01

TABLE B24 - WHERE DO YOU ORIGINATE MOST OF YOUR IFR FLIGHTS? (Q.24)

Airports Having Ten or More Reports (Frequency)				Top Ten States	
IDENT	Airport	Location	Freq	States	Percent
FRG	Republic Field	Farmingdale, NY	16	CA	14%
VNY	Van Nuys Airport	Van Nuys, CA	15	TX	08
TEB	Teterboro	Teterboro, NJ	14	FL	06
LGB	Long Beach Airport	Long Beach, CA	13	IL	04
PDK	DeKalb-Peachtree	Atlanta, GA	13	NY	04
HOU	Hobby	Houston, TX	12	OH	04
SJC	San Jose Municipal	San Jose, CA	12	MI	03
TOA	Torrance	Torrance, CA	12	WA	03
BFI	Boeing Field	Seattle, WA	10	GA	03
DAL	Love Field	Dallas, TX	10	PA	03
FTY	Fulton County	Atlanta, GA	10		
OAK	Oakland	Oakland, CA	10		

TABLE B25 - WHAT INSTRUMENT APPROACH HAVE YOU MOST OFTEN MADE DURING THE LAST 12 MONTHS? (Q.25)

ILS	69%	VOR/DME	04%	LDA	00%
LOC	07	ADF	03	SDF	00
VOR	13	RNAV	00	radar vectors	02

Is radar assistance available during this approach?

yes 71% no 16%

TABLE B26 - HOW FREQUENTLY DO YOU HAVE SOMEONE ASSIST YOU IN THE AIRPLANE DURING FLIGHT IN ACTUAL IFR CONDITIONS? (Q.26)

never 19% seldom 49% often 21% almost always 09%

is this person a pilot?	yes 57%	no 22%
does he have an instrument rating	yes 38	no 40
is he a required copilot?	yes 07	no 71
required by Federal Aviation Regulation	04%	
required by company policy	07%	

TABLE B27 - IF A COPILOT IS NOT REQUIRED, HOW OFTEN WOULD YOU PREFER TO HAVE SOMEONE ASSIST YOU IN THE AIRPLANE DURING FLIGHT IN ACTUAL IFR CONDITIONS? (Q.27)

never 05% seldom 32% often 34% almost always 27%

TABLE B28 - WHAT SINGLE FACTOR HAS CAUSED YOU MOST OFTEN TO CANCEL AN IFR SINGLE PILOT FLIGHT JUST BEFORE PLANNED DEPARTURE DURING THE LAST 12 MONTHS? (Q.28)

Factor Causing Cancellation of SPIFR Flight	%
I have not had to cancel a proposed IFR flight	20%
weather worse than published minimums	14
weather beyond my personal limitations	33
weather beyond aircraft/equipment capability	23
equipment malfunction	03
lack of adequate weather information	01
lack of adequate flight publications	00
other (please specify)	02

TABLE B29 - IF THE FOLLOWING WEATHER CONDITIONS WERE REPORTED TO EXIST ANYWHERE ENROUTE, WHAT WOULD YOU DO? (Q.29)

Weather Condition	DAY		NIGHT	
	go	not go	go	not go
light icing	68%	29%	36%	61%
moderate icing.	22	74	11	84
light turbulence.	98	ØØ	92	Ø5
moderate turbulence	82	15	59	37
heavy rain.	7Ø	28	42	55
scattered thunderstorms . . .	88	11	49	47
broken thunderstorms.	52	46	21	76
lines of thunderstorms. . . .	11	88	Ø4	93
heavy ground fog.	4Ø	58	21	75
weather below minimums. . . .	2Ø	78	1Ø	87
IFR over mountains.	7Ø	28	45	51
IFR over water.	76	21	55	41

TABLE B3Ø - AT THE DESTINATION AIRPORT, WHAT ARE YOUR PERSONAL MINIMUMS FOR MAKING EACH OF THE FOLLOWING TYPES OF APPROACHES? (Q.3Ø)

I use published minimums:	DAY	NIGHT
ILS	74%	7Ø%
LOC	79	73
VOR	79	73
ADF	75	69

TABLE B31 - IF THE WEATHER WERE REPORTED TO BE BELOW MINIMUMS AT YOUR DESTINATION AIRPORT, WOULD YOU FLY THE APPROACH? (Q. 31)

yes 45%	no 52%

TABLE B32 - EXCLUDING PROFICIENCY FLIGHTS, DURING THE LAST 12 MONTHS, HOW MANY TIMES HAVE YOU: (Q.32)

Experience	Percent Zero Reports	Number of Times Reported at Cumulative Percentage Indicated			
		25%	50%	75%	99%
filed IFR?	13%	4	10	30	400
had to hold?	47	0	0	2	20
executed a missed approach?.	62	0	0	1	10
been rerouted?	30	0	2	6	90
diverted to an alternate?.	74	0	0	0	8
asked for an altitude change due to icing?	52	0	0	2	20
asked for a route change due to thunderstorms?	42	0	1	4	30
declared an emergency?	96	0	0	0	1
requested special handling?.	87	0	0	0	3

TABLE B33 - IN WHAT YEAR DID YOU ORIGINALLY RECEIVE THE FOLLOWING CERTIFICATES AND/OR RATINGS? (Q.33)

Certificate or Rating	QUARTILE				No Response
	1st	2nd	3rd	4th	
private.	1929-61	1962-68	1969-73	1974-81	09%
commercial	1931-64	1965-70	1971-75	1976-81	23
instrument	1939-67	1968-72	1973-76	1977-81	03
multiengine.	1940-65	1966-71	1972-76	1977-81	33
ATP.	1941-68	1969-75	1976-78	1979-81	77
flight instructor/instrument	1940-67	1968-74	1975-78	1979-81	61

TABLE B34 - IN WHAT TYPE OF FLYING WERE YOU MOST OFTEN ENGAGED DURING THE LAST 12 MONTHS? (Q.34)

Type of Flying	all flying	single pilot IFR flying
general aviation		
business (not for hire).	28%	29%
business (corporate pilot) . . .	09	09
air taxi or charter.	06	08
giving instruction	13	05
other commercial	03	02
personal (pleasure).	28	32
airline.	05	00
military	03	00
no response.	05	16

TABLE B35 - DURING THE LAST 12 MONTHS, HOW OFTEN, ON THE AVERAGE, DID YOU FLY? (Q.35)

Frequency of Flying	VFR	on an IFR flight plan	in actual IFR conditions
less than once per month	Ø9%	22%	4Ø%
about monthly.	Ø8	16	14
about twice per month.	14	16	13
about four times per month . . .	16	11	Ø8
more than four times per month .	45	29	18
no response.	Ø8	Ø6	Ø7

TABLE B36 - PLACE YOURSELF ON A SCALE OF ALL INSTRUMENT PILOTS IN TERMS OF YOUR OPINION OF YOUR PRESENT SKILL, KNOWLEDGE, AND EXPERIENCE: (Q.36)

Item	low(1)	(2)	(3)	(4)	(5)	high(6)	no response
skill. . . .	Ø2%	Ø6	18	3Ø	28	13	Ø2
knowledge. .	Ø1	Ø3	12	31	34	17	Ø2
experience .	Ø7	14	19	21	19	17	Ø2

TABLE B37 - WHAT IS YOUR APPROXIMATE FLIGHT TIME IN HOURS? (Q.37) (Refer to Figures 1 and 2)

TABLE B38 - AGE AND SEX (Q.38)

Age: 18-19(Ø3%), 2Ø-29(14%), 3Ø-39(3Ø%), 4Ø-49(22%) 5Ø-59(26%), 6Ø-69(Ø5%), 7Ø-79(ØØ%)		
male 95%	female Ø3%	no response Ø2%

TABLE B39 - ARE THERE ANY GENERAL COMMENTS YOU WISH TO MAKE ABOUT IFR SINGLE PILOT FLYING WHICH YOU THINK MIGHT BE USEFUL FOR US TO KNOW? (Q.39)

Code	Response	No.	%
(Ø4)	SPIFR requires training and currency	31	Ø2%
(21)	Use autopilot	29	Ø2
(23)	SPIFR is safe if aircraft/personal limitations are observed	29	Ø2
(Ø7)	SPIFR is not safe	27	Ø2
(19)	Workload on SPIFR is too high	27	Ø2
(27)	All IFR operations should require two pilots	21	Ø1

FIGURE I

TIME IN LAST TWELVE MONTHS (HOURS)

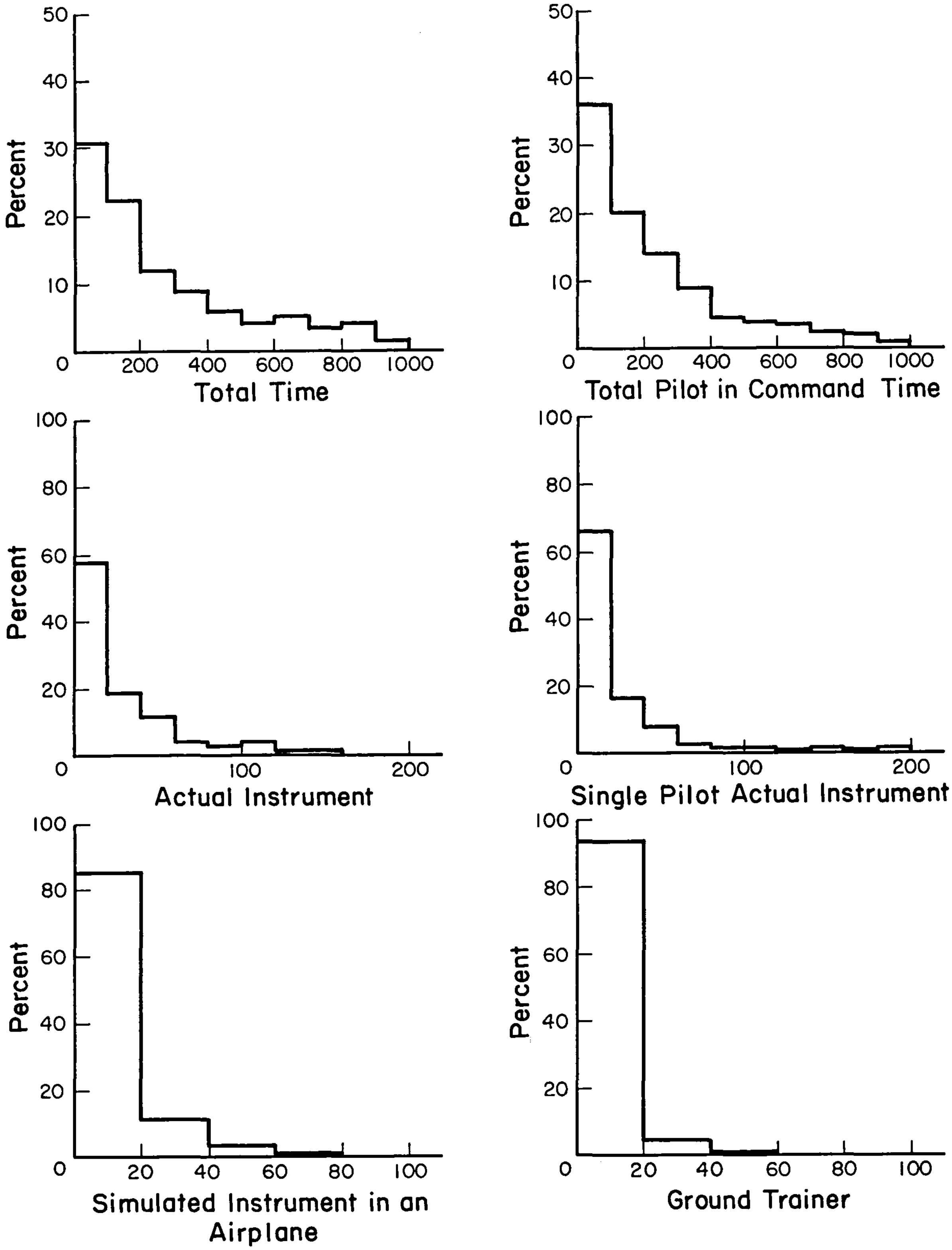
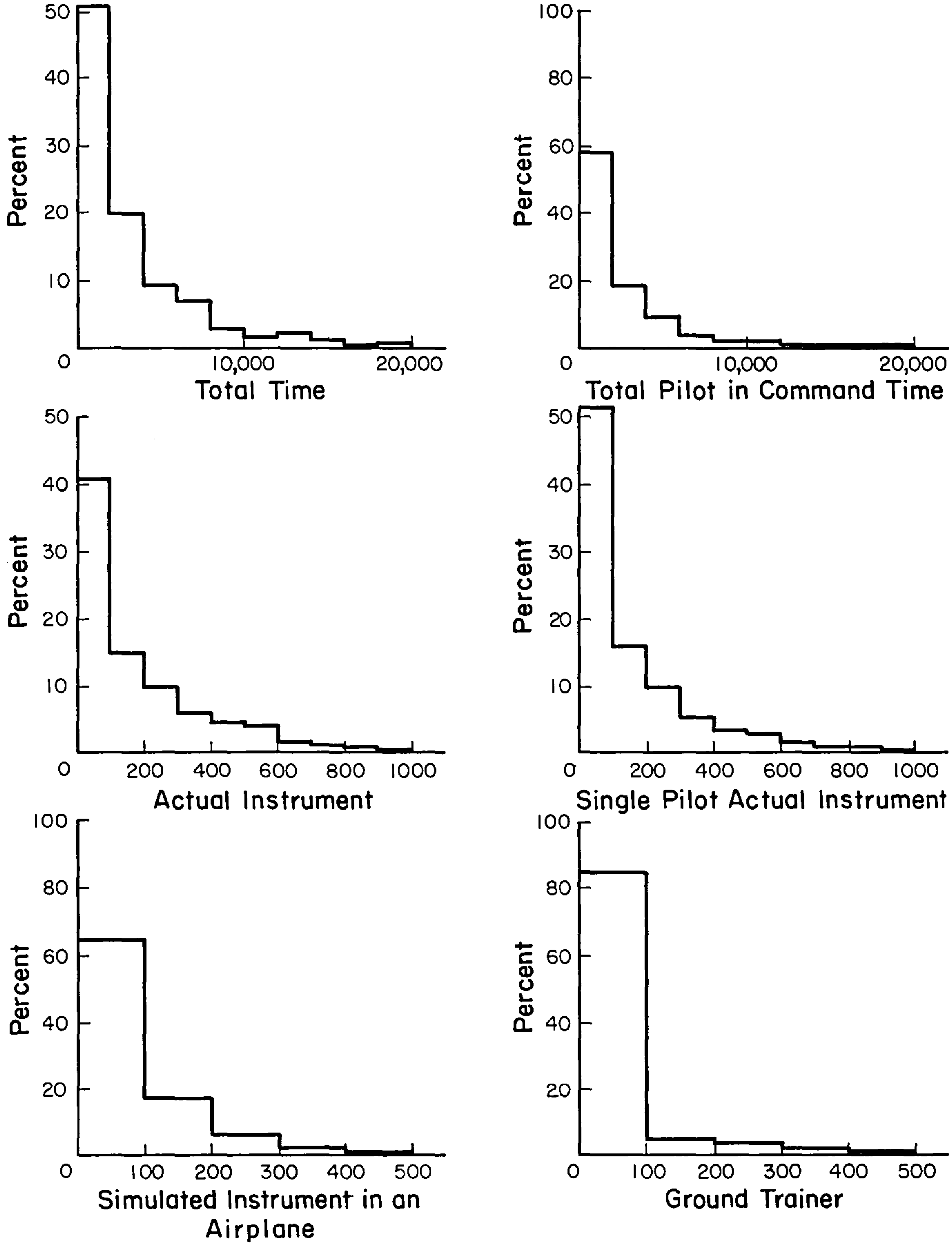


FIGURE 2
TOTAL TIME (HOURS)



APPENDIX C
SELECTED DATA ANALYSIS EXAMPLES

The GA SPIFR data set has considerable potential for answering questions about the nature of the GA SPIFR flight operation in terms of his airplane and equipment characteristics; his personal observations, experiences, and opinions; his personal recommendations considering the problems he is experiencing and possible solutions; the difficulty he experiences with IFR single pilot flight; the typical characteristics of his IFR single pilot flight; and his flying experience. In order to use this potential properly, however, first an appropriate and relevant question must be formulated. Then, the right combination of data must be analyzed with the correct statistical analysis techniques in order to develop a reasonable answer.

As an illustration that the survey data can be used to answer questions about the nature of the GA SPIFR pilot, twelve relatively simple questions are presented in the pages which follow, and the answer is developed using data from the GA SPIFR survey. No sophisticated statistical analysis techniques were used in these examples. However, the data lends itself to analyses using routine statistical tools to test the significance of the differences in data, such as the "Chi-square" and "t" tests. Further, more sophisticated statistical tools may be applied to certain types of data in order to derive further insights into the GA SPIFR operation. Detailed data analysis, however, was beyond both the scope and intent of this particular study effort.

QUERY

1. Is the task of tuning communications and navigation radios a major problem or distraction?

2. What instrument training solutions were suggested to alleviate reported problems?

3. How many respondents have not encountered a problem in a particular area?

4. What is the relationship between the different types of airplanes being flown SPIFR and the single pilot actual instrument time flown in the last 12 months?

5. What is the relationship between the type of SPIFR flying and the type of airplane most often flown SPIFR?

6. What is the relationship between the type of SPIFR flying and the equipment aboard the airplane most often flown SPIFR?

7. Are the operational problems experienced by the SPIFR pilot independent of experience?

8. Given that the airplane flown by the SPIFR pilot has a certain piece of equipment, what other equipment is it likely to have?

9. Given that the SPIFR pilot purchases a specific piece of equipment, what other equipment is he likely to purchase?

10. What information can be gleaned from the 231 respondents who returned unusable questionnaires?

11. What is the comparison between the certificates held by the respondents in the GA SPIFR data set to the total sample?

12. Can the results of this survey be compared to any earlier surveys?

QUERY 1: Is the task of tuning communications and navigation radios a major problem or distraction?

CONCLUSION: The task of tuning communications and navigation radios is clearly identifiable as a problem in the responses, although on the basis of specific responses (rather than a general problem response like "workload"), it does not appear to be a major problem or distraction.

Questions Analyzed: 4, 7, 15, 21

TABLE C1 - RADIO TUNING PROBLEM

Question Analyzed	Problem Code	Problem Rank	Number of Responses	Responses
4	Ø4	11	43	ATC clearance/frequency changes
7	27	7	52	Minimize ATC frequency changes
	Ø4	26	9	Minimize communications contact
15	23	21	3	Lack of COM frequency information for pretuning
	59	22	2	Excessive frequency changes during an approach
	25	23	1	Changing NAV frequencies at halfway point
21	Ø1	2	126	Too many communications frequency changes
	Ø2	16	1Ø	Too many transponder code changes
	34	24	1	Next assigned frequency too far apart

Explanatory Note: The problem codes referred to in Tables C1, C2, and C7 are the response codes which were assigned to respondents' answers to questions on the returned questionnaires. All response codes in the GA SPIFR data are defined in NASA CR 1658Ø5, "Statistical Summary: Study to Determine The IFR Operational Profile and Problems of The General Aviation Single Pilot."

QUERY 2: What instrument training solutions were suggested to alleviate reported problems?

CONCLUSION: Except for the question dealing specifically with training and proficiency problems in Section 3 of the SPIFR Questionnaire, few reported problems contained a suggested solution involving instrument training.

Questions Analyzed: Top six problem codes in Questions 13 through 21. If one of the top three suggested solutions within each problem code involved training, the problem was counted as having an instrument training remedy. (Refer to question responses in Appendix B.)

TABLE C2 - INSTRUMENT TRAINING CITED AS A PROBLEM SOLUTION

Question Analyzed	Top Six Problem Codes (Solution Codes)
13	Ø6 (Ø4, 42)
14	None
15	None
16	None
17	Ø8 (Ø7, Ø5, Ø4) 25 (3Ø, 11, Ø5) Ø3 (Ø3, Ø1, 17) Ø7 (Ø6, 41, Ø3) 1Ø (Ø7, 1Ø, 46) 12 (27, 17, Ø7)
18	13 (Ø5, 23)
19	None
2Ø	Ø5 (17)
21	Ø5 (13)

Question 17 is the Training and Proficiency question. Excluding Question 17, there were 48 (6 times 8) top six problem codes in the Question 13 through 21 series. Only four of these problem codes contained a suggested training solution.

QUERY 3: How many respondents have not encountered a problem in a particular area?

CONCLUSION: A high percentage of SPIFR pilots are not experiencing any problems with the various activities, systems, and environments to which they are exposed during the conduct of a SPIFR flight.

Questions Analyzed: 13 through 21. If respondent had not encountered a problem in a particular area, he was to leave his response blank.

TABLE C3 - NO PROBLEMS REPORTED

Question Analyzed	Percentage Responses		
	Blank	None	Total
13	45%	03%	48%
14	46	04	50
15	59	06	65
16	63	05	68
17	54	04	58
18	70	08	78
19	43	05	48
20	57	03	60
21	46	04	50
Average	54%	05%	58%

QUERY 4: What is the relationship between the different types of airplanes being flown SPIFR and the single pilot actual instrument flight time flown in the last 12 months?

CONCLUSION: More total SPIFR hours are being flown in airplanes appearing with greater frequency. The more complex the airplane, the greater the average hours flown. The turbojet sample is too small for meaningful results.

Questions Analyzed: 1, 37

TABLE C4 - RELATIONSHIP BETWEEN AIRPLANE FLOWN AND ACTUAL INSTRUMENT FLIGHT TIME

Type of Airplane	Airplanes		Single Pilot Actual Instrument Hours Flown in last 12 months		
	Number	Percent	Total	Percent	Mean
Single-engine, 1-3 places	120	07%	1319	04%	11
Single-engine, 4 places & over	1022	63	15917	45	16
Multiengine piston	354	22	13156	37	37
Turboprop	90	06	4475	13	50
Turbojet	20	01	197	01	10
No response	13	01	98	00	8

QUERY 5: What is the relationship between the type of SPIFR flying and the type of airplane most often flown SPIFR?

CONCLUSION: The more sophisticated the airplane, the more likely it is to be used in a business or air transportation for hire function.

Questions Analyzed: 1, 34

TABLE C5 - RELATIONSHIP BETWEEN TYPE OF FLYING AND AIRPLANE FLOWN

Type of GA SPIFR Flying	Type of Airplane						
	S.E. 1-3	S.E. ≥ 4	M.E. Piston	Turbo-prop	Turbo-jet	No Answer	Total
Business (not for hire)	29	3Ø9	115	12	Ø	1	466
Business (corporate pilot)	1	24	61	45	9	Ø	14Ø
Air taxi or charter	2	32	73	12	2	1	122
Giving instruction	9	66	1Ø	3	Ø	1	89
Other commercial	5	2Ø	8	4	Ø	1	38
Personal (pleasure)	5Ø	4Ø6	46	4	2	5	513
No answer	24	165	41	1Ø	7	4	251
Total	12Ø	1Ø22	354	9Ø	2Ø	13	1619

QUERY 6: What is the relationship between the type of SPIFR flying and the equipment aboard the airplane most often flown SPIFR?

CONCLUSION: Aircraft used for business or air transportation functions are likely to be better equipped.

Questions Analyzed: 2, 34

TABLE C6 - RELATIONSHIP BETWEEN AIRPLANE EQUIPMENT AND TYPE OF FLYING

Equip ment Code	Airplane Equipment	No Ans	Percent of Type of GA SPIFR Flying Having Equip.: Business, Not For Hire	Business, Corp. Pilot	Air Taxi or Charter	Giving Instr.	Other Comm.	Pers. (Pleas.)
22(1)	One COM	Ø6%	Ø4%	Ø1%	Ø2%	Ø3%	11%	Ø7%
22(2)	Two COM	92	95	96	98	96	89	92
23(1)	One VOR/LOC	2Ø	Ø9	ØØ	Ø4	12	11	13
23(2)	Two VOR/LOC	78	9Ø	99	96	88	87	87
24(1)	One GS	69	72	42	61	84	79	79
24(2)	Two GS	19	2Ø	56	39	12	18	11
25	ADF	91	94	98	98	98	95	92
26	RMI	21	2Ø	62	33	12	34	11
27	Marker Beacon	91	96	99	99	99	1ØØ	93
28	Transponder	96	99	98	98	99	1ØØ	98
29	Altitude Encoder	56	71	94	85	66	79	54
3Ø	DME	53	69	98	84	47	61	5Ø
31	RNAV	19	21	64	43	11	16	Ø8
	Autopilot							
32	-Roll	48	73	95	84	45	61	55
33	-Heading	5Ø	68	96	85	44	53	51
34	-Pitch	32	43	9Ø	74	26	42	22
35	-Altitude	27	41	9Ø	71	26	37	16
36	-Nav	38	58	9Ø	7Ø	35	47	35
37	Pitot Heat	91	96	1ØØ	1ØØ	92	95	91
38	HSI	21	3Ø	79	52	16	24	15
39	Flight Dir.	14	15	59	35	Ø6	16	Ø4
4Ø	Headset Mic.	5Ø	65	71	58	34	45	52
41	Oxygen	26	33	79	38	18	24	15
42	Cabin Press.	11	Ø8	59	18	Ø3	11	Ø2
43	Other	Ø4	Ø5	1Ø	Ø4	ØØ	Ø5	Ø3
44	Control Surface Anti-icing or De-icing	18	16	77	52	Ø8	21	Ø5
45	Propeller Anti-icing	19	24	84	6Ø	12	32	Ø7
46	Windshield Anti-icing	17	16	76	57	1Ø	21	Ø5
47	Weather Radar	15	15	75	47	Ø6	13	Ø4
48	Non-radar Thunderstorm Display	Ø3	Ø3	ØØ	Ø2	ØØ	Ø3	Ø1

QUERY 7: Are the operational problems experienced by the SPIFR pilot independent of experience?

CONCLUSION: Based upon this analysis, which reveals the relatively high commonality of response codes reported between categories of pilots of different experience levels, it appears that the operational problems experienced by the SPIFR pilot are independent of experience. If this hypothesis is valid, then it is suggested that remedies to SPIFR operational problems do not lie in improving SPIFR capabilities through more training and experience. Rather, the nature of the SPIFR task should be changed through the redesign of cockpit systems and ATC procedures in handling the SPIFR pilot.

Categories of pilots for analysis:

A - Less than 10 hours single pilot actual instrument in last 12 months (n=726) (Question 37)

B - 60 hours or more single pilot actual instrument in last 12 months (n=130) (Question 37)

C - 30 hours or more single pilot actual instrument in last 12 months and has been a flight instructor/instrument (n=168) (Questions 33 and 37)

Questions analyzed: 3, 4, 7

TABLE C7 - TOP TEN RESPONSE CODES BY CATEGORY OF PILOT

Question	A		B		C	
	Code	Percent	Code	Percent	Code	Percent
Question 3 In your opinion, what is the most common error made by IFR single pilots? (Total codes = 38)						
	02	15%	02	21%	02	22%
	06	13	06	08	04	09
	01	10	13	06	06	08
	20	06	01	05	11	05
	04	05	05	05	13	05
	21	04	03	04	15	05
	03	04	20	04	20	05
	08	03	21	04	01	05
	05	03	04	03	18	04
	15	03	08	03	21	04

TABLE C7 - TOP TEN RESPONSE CODES BY CATEGORY OF PILOT (CONTINUED)

Question	A		B		C	
	Code	Percent	Code	Percent	Code	Percent
Question 4 What has been the one most serious problem which you have encountered in your experience as an IFR single pilot? (Total codes = 53)						
	02	14%	02	13%	02	17%
	09	07	05	09	09	07
	05	06	03	07	03	07
	27	05	07	06	05	07
	03	05	09	06	07	05
	13	04	06	05	10	05
	24	04	10	05	06	04
	28	04	27	04	33	04
	10	03	33	04	27	04
	33	03	04	03	13	03
Question 7 What one change in the system, your airplane and equipment, or flight training, would make your IFR single pilot flight operations easier? (Total codes = 121)						
	40	07%	40	10%	40	06%
	14	06	52	08	14	05
	52	05	14	06	52	05
	38	04	16	06	08	04
	27	04	54	04	16	04
	08	03	08	03	18	04
	54	03	17	03	27	03
	16	03	28	03	28	03
	22	02	23	02	54	03
	31	02	38	02	07	02

TABLE C8 - COMMONALITY OF RESPONSE CODES

Question and Pilot Categories	Percent Commonality		
	Top 3	Top 5	All 10
Question 3			
A and B	66	60	90
A and B and C	66	40	60
Question 4			
A and B	66	80	70
A and B and C	33	60	70
Question 7			
A and B	100	60	70
A and B and C	100	60	60

QUERY 8: Given that the airplane flown by the SPIFR pilot has a certain piece of equipment, what other equipment is it likely to have?

CONCLUSION: The GA SPIFR data set permits an estimate of the probability that an airplane flown SPIFR will have a certain piece of equipment, given that it has certain other equipment.

Question Analyzed: Question 2.

Discussion:

The entries in the matrix represent the joint relative frequencies of all possible doublets of equipment listed in Question 2. For example, the number 86 appearing at the intersection of row 27 and column 23(2) indicates that 86 percent of the airplanes most often flown SPIFR by the respondents had both two VOR receivers (23(2)) and a marker beacon receiver (27). The numbers to the right of the main diagonal represent the simple relative frequencies for each equipment class taken separately. For example, the number 95 appearing opposite row 27 indicates that 95 percent of the airplanes were equipped with marker beacon receivers (27), regardless of what other equipment, was on board.

If one interprets these relative frequencies as probabilities it is then a simple matter to calculate the probability that a certain piece of equipment will be on board, given that an airplane has certain other equipment. For example, the probability that an airplane will have a marker beacon receiver, given that it has 2 VOR receivers can be estimated from :

$$\Pr(\text{Marker}/2\ \text{VOR}) = \frac{\Pr(\text{Marker and } 2\ \text{VOR})}{\Pr\ (2\ \text{VOR})} = \frac{.86}{.88} = 0.98$$

Calculation of such conditional probabilities can reveal some interesting and somewhat non-intuitive observations. For example, from row 40 (boom microphone) and column 28 (transponder) we find that even though only 56 percent of the airplanes were equipped with both transponder and boom microphone, given that an airplane had a boom microphone, the probability that it had a transponder was nearly 1.0.

TABLE C9 - AIRPLANE EQUIPMENT MATRIX

(Refer to discussion in QUERY 8)

(1) = one unit
(2) = two units

All numbers within matrix are percentages

	22 (1)	22 (2)	23 (1)	23 (2)	24 (1)	24 (2)	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
22(1)	5																													
22(2)	-	94																												
23(1)	04	08	11																											
23(2)	01	86	-	88																										
24(1)	03	67	09	62	71																									
24(2)	00	20	00	21	-	21																								
25	04	89	10	84	68	21	94																							
26	01	20	01	20	09	12	21	22																						
27	03	91	09	86	69	21	91	21	95																					
28	04	92	10	87	70	21	93	21	94	98																				
29	02	64	05	61	45	19	65	19	66	66	66																			
30	02	60	04	58	41	20	61	19	62	62	52	63																		
31	00	20	01	20	09	12	21	11	21	21	20	21	21																	
32	01	63	04	60	44	18	63	18	64	64	52	52	20	64																
33	01	60	04	57	42	18	60	18	61	61	51	51	20	58	62															
34	00	39	02	38	23	17	40	17	40	40	36	38	19	39	40	40														
35	00	35	01	35	19	17	36	16	36	36	34	35	18	36	36	35	37													
36	00	49	02	48	32	17	49	16	49	50	43	43	19	47	47	34	33	50												
37	04	89	10	84	67	21	89	21	91	93	64	61	21	63	61	40	36	49	94											
38	00	28	01	27	13	15	28	15	29	29	27	28	17	26	26	24	23	25	29	29										
39	00	16	04	16	05	11	16	11	16	16	16	16	11	15	16	15	15	15	16	15	16									
40	02	53	05	51	38	14	54	14	55	56	41	41	15	41	39	27	25	33	54	20	11	56								
41	00	28	01	28	16	13	29	13	29	29	27	28	15	27	27	23	23	24	29	19	13	22	30							
42	00	11	00	11	02	09	11	09	11	11	11	11	08	11	11	11	11	11	11	11	09	08	11	11						
43	00	04	00	04	02	02	04	02	04	04	04	04	02	04	03	03	03	03	04	02	02	03	03	01	04					
44	00	20	00	20	07	13	20	13	20	20	20	20	13	18	19	18	19	18	20	16	12	14	16	11	02	20				
45	00	24	01	24	11	14	25	13	25	25	24	24	14	22	23	22	23	22	25	18	13	18	18	10	02	19	25			
46	00	20	00	20	07	13	20	12	21	21	20	20	13	19	19	19	19	18	21	16	12	14	15	10	02	17	18	21		
47	00	18	00	18	06	13	18	12	18	18	18	18	13	17	18	17	18	17	18	16	12	13	14	11	02	15	16	15	19	
48	00	02	00	02	01	00	02	00	02	02	02	02	01	02	02	01	01	02	02	01	00	02	01	00	00	01	01	00	00	02

CARD 1 CARD COLUMNS 22-48 (rows)

CARD 1 CARD COLUMNS 22-48 (columns)

QUERY 9: Given that the SPIFR pilot purchases a specific piece of equipment, what other equipment is he likely to purchase?

CONCLUSION: The GA SPIFR data set permits an estimate of the probability that a SPIFR will purchase a certain piece of equipment, given that he has already purchased another piece of equipment.

Question Analyzed: Question 8.

Discussion:

The entries in the matrix represent the joint relative frequencies of all possible doublets of desired equipment purchases specified by the SPIFR. The numbers to the right of the main diagonal represent simple relative frequencies for each equipment class. For example 81 percent would purchase both a glideslope (column 62) and a transponder (row 65). The most popular choice of equipment is the transponder (row 65) specified by 94 percent of the respondents. However, given that a transponder is purchased, the probability that a glide slope will be purchased is 0.86:

$$\Pr(\text{glideslope/transponder}) = \frac{\Pr(\text{glideslope and transponder})}{\Pr(\text{Transponder})} = \frac{.81}{.94} = 0.86$$

TABLE C10 - AIRPLANE EQUIPMENT MATRIX

All numbers within matrix are percentages

CARD 1 CARD COLUMNS 59-79	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
59	49																				
60	01	43																			
61	40	34	78																		
62	43	36	68	84																	
63	34	27	54	57	64																
64	42	36	67	74	57	82															
65	47	41	75	81	62	80	94														
66	31	20	44	49	36	49	53	55													
67	07	10	10	15	06	13	18	08	21												
68	00	00	00	01	00	01	00	00	00	01											
69	04	08	11	11	09	11	13	04	02	00	13										
70	12	13	21	23	14	23	26	15	03	00	00	27									
71	01	02	02	03	01	02	04	01	00	00	00	00	04								
72	01	00	01	01	01	01	01	01	01	00	00	00	00	02							
73	05	06	09	10	05	10	11	06	01	00	02	07	01	01	12						
74	38	34	62	67	52	67	75	44	13	01	11	24	03	01	10	77					
75	02	01	01	02	02	02	03	02	01	00	00	00	00	00	00	02	03				
76	25	25	42	46	34	47	52	29	09	00	09	17	02	01	08	47	02	53			
77	02	02	04	04	03	04	05	03	01	00	01	01	00	00	01	04	00	03	05		
78	01	00	00	01	00	00	01	00	00	00	00	00	00	00	00	01	00	00	00	01	
79	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

CARD 1 CARD COLUMNS 59-79

QUERY 1Ø: What information can be gleaned from the 231 respondents who returned unusable questionnaires?

CONCLUSION: An analysis of the 231 unusable returns revealed the following breakdown of responses:

TABLE C11 - ANALYSIS OF UNUSABLE RETURNS

Response	Number	Percent
I never fly SPIFR (it's unsafe)	83	36%
All my flying is military	53	23
All my flying is airline	4Ø	17
I have not flown IFR for some time	16	Ø7
Unusable response	14	Ø6
I am retired and do not fly	13	Ø6
All other	12	Ø5
Total	231	1ØØ%

QUERY 11: What is the comparison between the certificates held by the respondents in the GA SPIFR data set to the total sample?

CONCLUSION: An analysis of the certificate composition of both the GA SPIFR data set and the total sample disclosed the following distribution:

Question Analyzed: 33

TABLE C12 - COMPARISON BETWEEN GA SPIFR DATA SET AND TOTAL SAMPLE

Certificate	GA SPIFR Data Set		Total Sample	
	Number	Percent	Number	Percent
Private	368	23%	75Ø	15%
Commercial	878	54	2889	58
ATP	373	23	13Ø4	26
Total	1619		4943	

QUERY 12: Can the results of this survey be compared to any earlier surveys?

CONCLUSION: Yes, a similar survey was conducted by the Federal Aviation Administration in 1970. (6) Of particular interest are the following comparisons:

Questions Analyzed: Refer to Tables C13 and C14 below.

TABLE C13 - MOST COMMON ERROR MADE BY INSTRUMENT RATED PILOTS

1970 Survey (Q.40)	
Not knowing personal limitations	16%
Not planning ahead	16
Confidence in being able to handle weather	06
1981 Survey (Q.3)	
Not planning ahead	16%
Overconfidence/ignorance in being able to handle weather/limitations/capabilities	11
Exceeding/inaccurate assessment of personal limitations/capabilities	08

TABLE C14 - MOST UNCOMFORTABLE OR THREATENING EXPERIENCE/ONE MOST SERIOUS PROBLEM ENCOUNTERED

1970 Survey (Q.42)	
Structural icing	29%
Thunderstorms	12
1981 Survey (Q.4)	
Icing (structural or induction system)	16%
Thunderstorms	07

APPENDIX D
STUDY ADVISORY GROUP

G. Courtney Chapman is an Associate Professor of Aviation. His research interests include pilot training and operations, and aircraft crashworthiness. During 1977-78, Prof. Chapman was on a leave of absence as a consultant to the FAA/NASA Aviation Safety Reporting Program at NASA Ames. He has been a pilot for 28 years, and has had experience as a Naval Aviator, Senior Army Aviator, and FAA Designated Pilot Examiner. He holds the following airman certificates: ATP (AMEL), Commercial (ASEL, AMEL & S, Helicopter, Instrument), Private (Glider), Flight Instructor (ASEL, AMEL, Instrument, Helicopter), Ground Instructor (Advanced, Instrument).

Walter C. Giffin is a Professor of Industrial and Systems Engineering. He has authored three textbooks in the area of quantitative methods for industrial engineering and operations research. Prof. Giffin has directed research for several M.S. theses and Ph.D. dissertations on air traffic control systems analysis and design. He is a co-principal investigator on the NASA sponsored research project "An Investigation into Pilot and System Response to Critical In-Flight Events", Contract No. NASA-10047, and Grant No. NAG 2-75. An active pilot for 27 years, he holds the following airman certificates: Commercial (ASEL, Instrument), Flight Instructor (ASEL).

Thomas H. Rockwell is a Professor of Industrial and Systems Engineering. His principal interests lie in human factors engineering with specific emphasis on human performance. He has done extensive work on (a) visual search using eye-movement techniques--one of which was done in IFR approaches, (b) performance under stress, and (c) personal risk acceptance. He is a co-principal investigator on the NASA sponsored research project "An Investigation into Pilot and System Response to Critical In-Flight Events", Contract No. NASA-10047, and Grant No. NAG 2-75. He holds the following airman certificates: Private (ASEL, AMEL, Instrument).

Richard L. Taylor is an Associate Professor of Aviation. His research interests relate to instrument and ATP pilot training and operations. A writer and author, Prof. Taylor wrote the best seller "Instrument Flying." He has also authored "Fair Weather Flying," "Understanding Flying," and "Positive Flying." He writes regular columns for aviation publications. A pilot for 25 years, Prof. Taylor has had experience as a U.S. Army Aviator and as a USAF Command Pilot. He holds the following airman certificates: ATP (AMEL), Commercial (ASEL & S, AMEL & S, Helicopter, Glider, Instrument; Type Ratings: DC3, DC4, B377, SA16, Citation), Flight Instructor (ASEL, AMEL, Instrument, Helicopters, Gliders), Ground Instructor (Advanced, Instrument).

Stacy Weislogel is a Professor of Aviation. He teaches courses in aviation law, the use and operation of aircraft in the system, flight instruction methodology, aircraft performance and flight test engineering. His research interests are related to the areas in which he teaches. He has been principal investigator on two previous surveys of the operational profiles of general aviation airmen. A pilot for 22 years, he holds the following airman certificates: ATP (AMEL), Commercial (ASEL, AMEL, Instrument), Flight Instructor (ASEL, AMEL, Instrument), Ground Instructor (Advanced, Instrument). He is an active pilot and frequent lecturer in the AOPA Instrument,Flight Instructor, and Updater courses.

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA CR-3576		

4. Title and Subtitle	5. Report Date
STUDY TO DETERMINE THE IFR OPERATIONAL PROFILE AND PROBLEMS OF THE GENERAL AVIATION SINGLE PILOT	February 1983
	6. Performing Organization Code
7. Author(s) G. S. Weislogel	8. Performing Organization Report No.
9. Performing Organization Name and Address The Ohio State University Department of Aviation Columbus, Ohio 43210	10. Work Unit No.
	11. Contract or Grant No. NAS1-15969
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, DC 20546	13. Type of Report and Period Covered Contractor Report
	14. Sponsoring Agency Code

15. Supplementary Notes

Langley Technical Monitor - Hugh P. Bergeron

16. Abstract

This document presents the final report of a study of the general aviation single pilot operating under instrument flight rules (GA SPIFR). The objectives of the study were to (1) develop a GA SPIFR operational profile, (2) identify problems experienced by the GA SPIFR pilot, and (3) identify research tasks which have the potential for eliminating or reducing the severity of the problems. To obtain the information necessary to accomplish these objectives, a mail questionnaire survey of instrument rated pilots was conducted. Complete questionnaire data are reported in NASA CR-165805, "Statistical Summary: Study to Determine the IFR Operational Profile of the General Aviation Single Pilot." Based upon the results of the GA SPIFR survey, this final report presents the general aviation IFR single pilot operational profile, illustrates selected data analysis examples, identifies the problems which he is experiencing, and recommends further research.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Airman, General Aviation, Instrument Flying, Pilots, Questionnaire, Survey	Unclassified - Unlimited Subject Category 03

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified	68	A04

* For sale by the National Technical Information Service, Springfield, Virginia 22161

End of Document