VISUAL FLIGHT RULES FLIGHT INTO INSTRUMENT METEOROLOGICAL CONDITIONS (VFR into IMC)

A REVIEW OF ACCIDENTS INVOLVING ALASKAN AIR TAXI COMMERCIAL FLIGHT OPERATIONS 1983 TO 2000

BY

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APPENDIX

Executive Summary

The FAA Administrator has established some specific Alaskan goals, and that is to reduce the accident numbers by 20 percent by the year 2008. This study addressed one very specific type of accident, which is dependent on human factors, and according to many industry experts, is controllable. Flights involving continued visual flight rules (VFR) operations into instrument meteorological conditions (IMC) are the focus of this study.

The Capstone program is a technical attempt at solving continued flight into these conditions. However, a study released by Capstone has shown that although accident numbers have decreased, the technical application of this equipment has not yet had an effect on VFR into IMC crashes. Industry advocates applaud this technical advancement and future deployment may have a greater effect. The problem with any technical advancement is the difficulty with the human factors quotient involving the correct use of any new technology. As advanced as technology has become, technology has not been able to take the man out of the machine.

The information in this report corroborates many other previous studies and attempts to isolate other factors. The Bensyl and Thompson[1] report has already shown that controlled flight into terrain (CFIT) crashes, as they have termed those events, account for 50 percent of the total commercial accidents and are responsible for 79 percent of the commercial fatalities. This study's analysis used a slightly different data set and the results generally agree with the Bensyl and Thompson report.

This report has determined that the majority of VFR into IMC crashes occurred within 25 miles of the departure airport during the first leg of flight, during daylight hours on flat, snow-covered terrain. The majority of the pilots in these events had weather reporting capabilities and instrument approach facilities available. More startling is that the majority of these pilots were aware of the weather conditions at the time of departure. The report shows that a large number of these pilots were operating aircraft that were equipped for instrument flight but not certified.

The analysis of statewide statistics and the regional statistical distribution did not reveal any specific abnormalities. However, The Fairbanks region, as described in this study, appears to have an excellent record for the lack of VFR into IMC crashes.

This study was designed to become a baseline using as many factors as available. The lack of more detailed information is an entry and storage problem rather than a collection problem. This study should be used to identify future data needs and to develop a data entry and storage system so more meaningful analyses can be accomplished. More meaningful analyses will help allocate resources to more effectively target problem areas and reach the Administrator's goals.

[1] The Bensyl and Thompson study, published in 2000, was accomplished while these two epidemiologists were employed by the National Institute of Occupational Safety and Health (NIOSH) a branch of the CDC, Anchorage Field Office, Anchorage, Alaska.

Chronological Statistical Summary

Section A; General Statistics

1. The results from those previous studies have shown that over 54 percent of the FAR Part 135 accidents are associated with crashes termed as "controlled flight into terrain." These crashes have resulted in a 79 percent fatality rate of all occupational fatalities in the FAR Part 135 category. (Executive Summary, page 4)

2. The examination of the general statistical information in this study, derived from NTSB records, has shown that 75 percent of the 98 crashes reviewed were coded as an in-flight collision with terrain/water. (Section A, Charts 1 & 2)

3. The NTSB's probable cause for 61 percent of these cases was VFR into IMC of which 53 percent were caused by an active decision of the pilot-in-command to continue into IMC. (Section A, Chart 3)

4. The information reviewed in the NTSB accident reports showed that only 10 percent of the cases were considered to be the result of an inadvertent encounter with weather. (Section A, Chart 4)

5. The general statistics section of this study also showed that over 50 percent of the 98 crashes studied encountered weather during the cruise phase of flight, but only 24 percent had their crash during the cruise phase of flight. (Section A, Chart 5)

6. An overwhelming 31 percent were maneuvering when the crash occurred and only 16 percent had their crash while maneuvering to reverse direction. This means that the majority of the pilots who encountered weather made a decision to continue in the general direction of their destination. Only 16 percent were maneuvering to reverse direction thus appearing to make an attempt to exit the weather conditions. (Section A, Chart 6)

7. Approximately 82 percent of the crashes studied took place in reciprocating engine aircraft with the single engine land category claiming 59 percent of the crashes. (Section A, page 6a)

Section B; Detailed Analysis and Regional Distributions

8. There is no significance in the difference in the comparative ratio of VFR into IMC crashes based upon all the certificates used in this study (n=98) and the currently active certificates (n=55). The highest category involved in the VFR into IMC crash was the small FAR Part 135 commuter operator. (Section B, Charts 8,9, & 14)

9. An examination of the number and type of operator's certificates issued in the Alaska region show that 41 percent of the VFR into IMC events were by operations who held FAR Part 135 commuter operating authority. Of all the air carrier and operating certificates issued in the Alaska Region, only 10 percent of those certificates have FAR Part 135 commuter operating authority. However, over 50 percent of the crashes occurred while the carrier was operating under FAR Part 135 on-demand rules. (Section B, Chart 10)

10. The overall statistics show that the Y-K Delta Region has the highest number of VFR into IMC crashes but the regional distribution shows that the OTZ-OME region has the highest number of these crashes involving FAR Part 135 operators with commuter operating authority. (Section B, Chart 11)

11. Commuter operating authority has been issued to only 10 percent of the total Alaskan Air Carrier population. (Section B, Chart 14)

12. Commuter operators involved in VFR into IMC crashes account for a 50 percent fatality rate. (Section B)

13. A review of the pilot age groups involved in VFR into IMC events shows that the 25 to 29 year old age group has the highest involvement. This age group comprises only 8.23 percent of the total commercial pilot population in Alaska and is responsible for 20 percent of the VFR into IMC crashes. (Section B, Chart 15)

14. Although the 25 to 29 year old age group is only 8.23 percent of the Alaska commercial pilot population, they represent a VFR into IMC fatality rate of 21 percent among the pilots. They also have the highest survival rate of 19 percent. The worst group based on the fatality and survival comparison is the 40 to 44 year old age group. This is the largest commercial pilot population comprising 14.36 percent of the population. This group is responsible for 12.7 percent of the VFR into IMC crashes. This group also has a fatality rate of 21 percent but their survival rate is only 6 percent. This indicates that although the younger pilot may be more apt to have a VFR into IMC crash, they may have better a survival rate when compared to the 40 to 44 year old age group. (Section B, Figure 2)

15. The yearly distribution of VFR into IMC events has been on the increase since 1983. However, 1999 and 2000 show an approximately 45 percent decrease in these events. (Section B, Chart 17)

16. The monthly distribution of VFR into IMC events between all certificates and active certificates yields no significant difference except for the months of September and October. For the active certificate chart, April and September are the highest event months. However, both charts show an overall steady increase over the first part of the year through April. (Section B, Chart 19)

17. The daily distribution of VFR into IMC events shows they occur in the later part of the week for all certificates. Friday has the highest incidence of VFR into IMC events. (Section B, Chart 21)

18. The time of day distribution of VFR into IMC events, for the all certificates shows that the two time groups, 1201 – 1400 and 1401 – 1600 account for 40 percent of the VFR into IMC crashes. This needs to be compared to exposure times for the operators. This time frame may simply be a representation of the busiest times of the operational day. (Section B, Chart 22)

19. The terrain associated with the most VFR into IMC crashes was "flat snow covered" terrain. (Section B, Chart 23)

20. A review of the light conditions, which existed during the VFR into IMC crash, showed that approximately 75 percent of the cases occurred in daylight and/or daylight with whiteout conditions. (Section B, Chart 24)

21. The distance and direction of flight information showed that generally, 56 percent of the crashes occurred during the first leg of flight. Of that 56 percent, 67 percent of the VFR into IMC events occurred while outbound from the departure airport. (Section B, Chart 25 & 26)

22. The distance from the airport information showed that 53 percent of the crashes occurred within 25 miles of the airport. (Section B, Chart 27)

23. Approximately 47 percent of the VFR into IMC crashes had weather reporting facilities available within 25 miles of the crash site. (Section B, Chart 28)

24. There was insufficient data available to determine what percentage of pilots received a weather briefing. NTSB data confirms 28 percent of the pilots received a briefing and 67 percent of the pilots fell into the unknown category. (Section B, Chart 29 & Table 12)

25. Seventy-three percent of the pilots were found to be aware of the weather conditions either prior to departure, during the departure and flight, or just prior to the crash. (Section B, Chart 30)

26. Using the NTSB data it was determined that in 59 percent of the crashes the weather was as forecast. Only 7 percent of the cases had weather worse than forecast. (Section B, Chart 31)

27. The data was insufficient to determine what percentage of flights would have been able to receive an in-flight weather briefing or information during the crash flight. The chart shows only 16 percent of the flights were known to have been in a position to receive in-flight information. A total of 74 percent of the flights had missing data or it was undeterminable. Only 4 percent of the flights could be determined to be in a position where no information could be received during the flight. (Section B, Chart 32)

28. Instrument approach facilities were available to approximately 59 percent of the flights involved in VFR into IMC crashes. (Section B)

29. It was determined that 67 percent of the aircraft involved in VFR into IMC events, although not certified for IFR flight, had the necessary equipment installed to accomplish an instrument approach. In only 26 percent of the flights, the aircraft was equipped and certified for IFR flight. (Section B, Chart 34)

30. NTSB data showed that only 5 percent of the pilots involved in crashes for the active certificates were not certificated to operate in instrument meteorological conditions. Twenty-two percent were certified and current and 69 percent were certified but were arbitrarily deemed not current based on the type of operation being conducted. (Section B, Chart 35)

INTRODUCTION

Alaska, the 49th and largest State in the Union, has approximately 586,000 square miles and a road system with approximately 10,000 linear miles. As a result, transportation of people, goods, and mail rely a great deal on air transportation. The use of the airplane in Alaska has been equated to the use of a pickup truck on a farm.

The air transportation industry in Alaska has an extensive infrastructure using many makes and models of aircraft ranging from single engine reciprocating aircraft to jet aircraft operating on-demand, commuter, and scheduled service. Scheduled service, on many occasions, is accomplished in the remote and rural areas using commercially certificated pilots in single, reciprocating, engine aircraft. The airstrips into which these flights operate can range from lighted and paved, to unlit, unimproved, and unpaved.

The state has a number of mountain ranges, ranging in altitude from 4,000 feet to over 20,000 feet. As a result, these mountain ranges create numerous zones of differing weather with unique hazards.

A flight from Anchorage to Fairbanks would be similar in length and flight time as a flight from Atlanta, GA to Washington D.C. and a flight from Anchorage to Bethel would be similar in length and flight time as a flight from Washington D.C. to Chicago, IL. One can see that distances traveled in Alaska on a daily basis are considerable and normal for Alaskans and Alaskan Air Carriers.

Previous studies have compared FAR Part 135 Controlled Flight into Terrain accidents (CFIT), with general FAA Part 135 accidents. The information in the Bensyl and Thompson study showed that approximately 54 percent of FAR Part 135 accidents were attributed to VFR into IMC crashes between the years 1990 and 1998. These crashes were responsible for fatally injuring approximately 79 percent of the FAR Part 135 Fatalities.

The Bensyl and Thompson study reviewed this problem from an occupational point of view and addressed crashes only with occupational fatalities. As a result, only portions of the commercial aviation/air carrier VFR into IMC crashes were examined.

PURPOSE

The purpose of this study was to examine all the available data without re-investigating each accident. This was to determine whether or not existing databases provided by various Federal Agencies contained sufficient information to identify specific problem areas. The identification of these problem areas could then be used to develop interventions, and to direct available resources.

The information in the study also attempted to answer the following questions:

1. What was the most probable cause for these VFR into IMC crashes?
2. Did the NTSB determine who was responsible for the crash?
3. During what phase of flight did the pilot encounter the weather?
4. During what phase of flight did the actual crash occur?
5. What type of aircraft are primarily involved?
6. What are the differences in the regional distribution of VFR into IMC Crashes?
7. What type of operating certificate did the operators hold at the time of the crash?
8. Under what regulations was the flight conducted when the crash occurred?
9. Did pilot age play a factor in these VFR into IMC crashes or were the ages of the crew victims representative of the Alaska pilot population?
10. How did time of year, month, and day affect these crashes?
11. Is there a region in the State of Alaska with a higher number of VFR into IMC crashes? If so, could specific factors be identified for these regions?
12. Where did these VFR into IMC crashes take place in relationship to the following:
    a. Departure airport,
    b. Destination airport,
    c. Proximity to weather reporting facilities,
    d. Proximity to the IFR infrastructure,
    e. Leg of flight,
    f. Type of terrain,
    g. Type of lighting conditions.
13. How were the crashes distributed regionally based on the following:
    a. Type of Certificate held by the Air Carrier,
    b. Type of Operation being conducted at the time of the crash,
    c. Daily distribution of crashes by regions,
    d. Monthly distribution of crashes by regions,
    e. Yearly distribution of crashes by regions.
14. Could the location of required company management have an effect on the VFR into IMC crashes?
15. Did the type of cargo (by-pass mail) have an effect on the pilot's decision to operate in adverse or marginal weather?
16. Was there a difference in the data presented between active and non-active operators; operators who have since had their air carrier or operating certificate suspended, revoked, terminated, or surrendered?

SCOPE

This study reviewed all fatal and non-fatal, commercial air carrier/air operator crashes for the years 1983-2000 involving VFR into IMC where no mechanical irregularities were listed in the National Transportation Safety Board (NTSB) accident report. This included flights that resulted in controlled flight into terrain (CFIT), loss of control while maneuvering when associated with weather, spatial disorientation, and precautionary landings when associated with weather.

All of these types of crashes describe the end result of the flight. However, these crashes were analyzed because the decision making process used by the flight crews to continue into existing poor weather or deteriorating weather conditions was considered to be the same.

This study's definition of commercial air carrier/air operator included all FAR Part 121, and 135 operators. It also included FAR Part 91 positioning flights. The NTSB defined these FAR Part 91 positioning flights as those flights operating under FAR Part 91 in conjunction with a FAR Part 135 operation. This meant that the flight had no revenue on board during the leg of flight when the crash occurred, but either the subsequent leg, or the succeeding leg was revenue producing. The reason these flights were included was based on the fact that the flight crews in these crashes still had to meet the requirements of FAR Part 135, such as training and currency. However, while operating under FAR part 91 rules, rules involving in-flight visibility requirements and flight and duty times are different. Most importantly, the decision process to penetrate weather and continue into deteriorating conditions was considered to be the same. One flight in the NTSB database was listed as a FAR Part 91 flight. This particular flight was a donated service by the air carrier in association with post Iditarod Race[2] support. The pilot and airplane met the requirements for a FAR Part 135 operation, but followed FAR Part 91 in-flight visibility rules, which required the pilot to have at least 1 mile of in-flight visibility. This crash was included in this analysis.

All flight crewmembers in this study were certificated at the Commercial or Air Transport Pilot level.

There was one foreign Air Carrier VFR into IMC crash, which was reviewed and excluded from this study.

No confidential or sensitive material was included in this study.

[2] Iditarod Race – Dogsled race from Anchorage Nome covering approximately 1100 miles. Many operators and private individuals offer or volunteer their services in support of the mushers and other personnel. Traditionally known as the Iditarod Air Force.

METHODOLOGY

Four different Data sets were used in constructing the database used in this study. These included, the Federal Aviation Administration's (FAA) Safety Performance Analysis System (SPAS) database, FAA Airman records, the downloaded NTSB database for the U.S., and the NTSB website database.

The NTSB database was not computerized until 1983. Records prior to 1983 exist in hardcopy only and would have to be ordered and hand searched. Therefore, only computerized records were reviewed, which included crashes from 1983 through 2000. Many crashes after the year 2000 did not yet have a probable cause assigned by the NTSB and were excluded.

The data was collected and entered into a statistical/graphical computer analysis program entitled SPSS for Windows. This resulted in 98 rows and 75 columns of data. During the data review, it was found that no single database contained sufficient information to populate the designed table. Furthermore, most of the information was not in a database format. Much of the detailed information used in this study was found in the long narrative of the NTSB report. Unfortunately, many of the earlier accident reports in the NTSB database, although it contained a long narrative, the long narrative was not entered into their database and was not retrievable.

As a result, crashes with some missing data blocks were included and are identified as such in this study because some information on these crashes was available and useful. This study used the 98 cases as the denominator in most percentage calculations except where noted. This study did not determine exposure[3] nor did it develop other denominator data.

Furthermore, the charts, graphs, and tables included all active, suspended, surrendered, terminated, and revoked certificates unless otherwise indicated. All of the crashes reviewed and analyzed in this study were active certificates at the time of the crash.

All of the categories depicted in bar charts, figures, tables, and frequency charts used in this study are mutually exclusive. This means that the percentage or count of any category is not included in another category within the same chart, graph, table, or frequency chart except were all the categories are totaled and labeled as such.

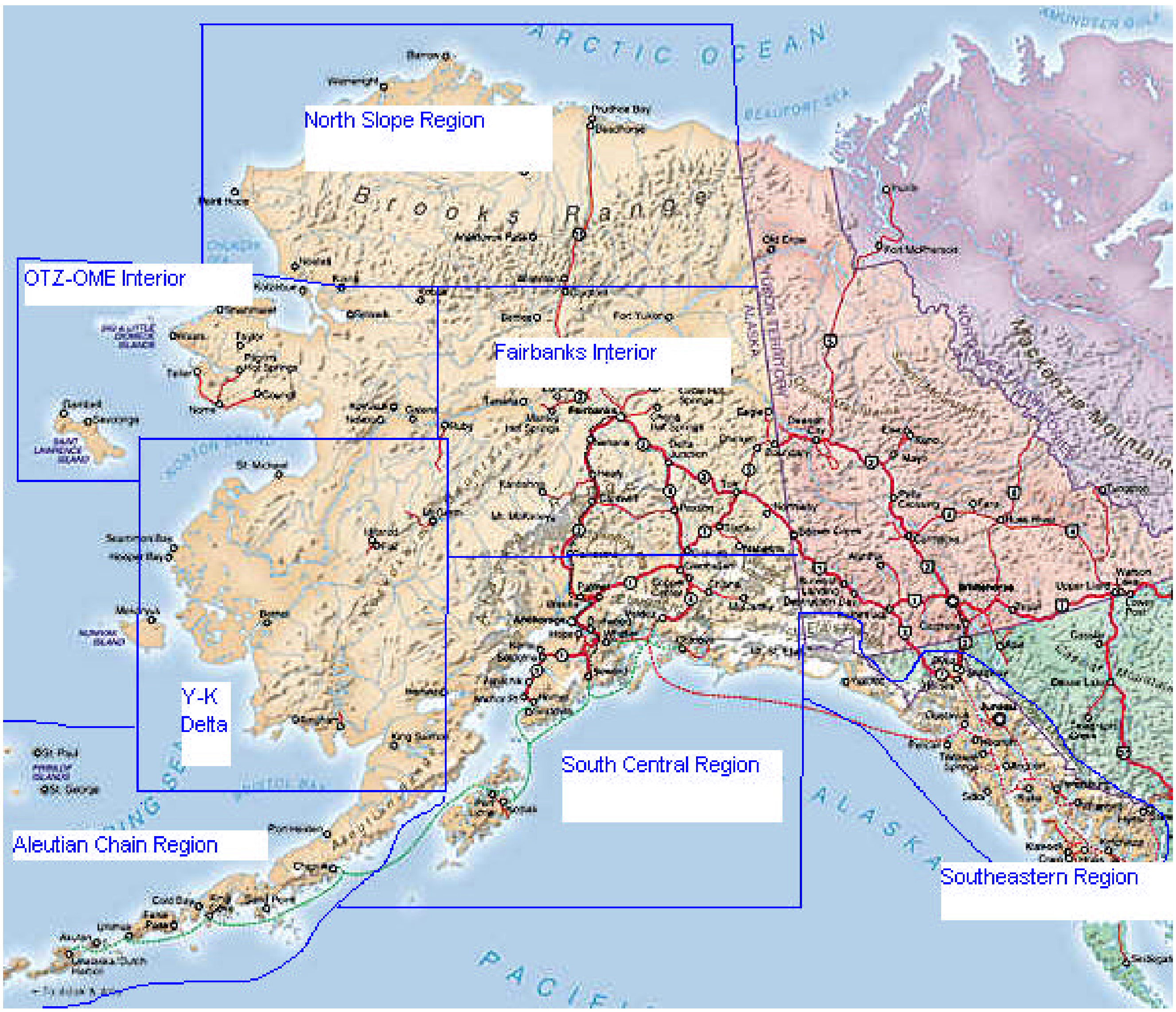
[3] Exposure Data – This is data that would indicate whether or not an operator is exposing the operation to more risk. This is usually determined by the number of hours flown. This data has been difficult to gather and many operators are not willing to divulge the information. Many times, the information presented to one agency differs with information presented to another. Therefore, it was believed that to develop arbitrary denominator data would create more discussion and reduce the credibility of this study.

Development of the Regions

This study deals with Statewide statistics immediately followed by regional distribution of VFR into IMC crashes. However, only one study has been completed that has defined a specific region. Therefore this study began by developing regions based on Capstone's definition of the Yukon-Kuskokwim Delta (Y-KD). Their definition of the Y-K Delta is the area from North Latitude 58 to 64 degrees, and from west longitude 155 to 167 degrees. This area included Bethel, Unalakleet, Dillingham, King Salmon, and McGrath to name a few. A pictorial display of the regions is shown in figure 1.

Regional development was important because of the number of mountain ranges within the State of Alaska. Each of these mountain ranges has a profound effect on localized and general weather conditions. The regions were divided to take these factors into account.

Figure 1



This map shows the approximate breakdown of the regional descriptions used in this report. The text descriptions are listed below.

SouthCentral Region – South of and including Cantwell, east of McGrath to the Alaska-Canadian border, west of and including Mt. St. Elias, and north of including the Chirikof Islands and Kodiak.

SouthEastern Region – East of Mt. St. Elias, south of the Alaska-Canadian border near Haines, north of the Southern Alaska-Canadian border.

Fairbanks Interior Region – The area north of the line established by the South Central Region at Cantwell to Atigun Pass, west of the Alaska-Canadian border to Galena.

OTZ-OME Interior Region – North of the Y-KD northern boundary to a line at Kivalina, west of Galena to the Alaska-Russia border including St. Lawrence Island.

North Slope Region – North of Atigun Pass, west of the Alaska-Canadian border, and east of the Alaska-Russia border.

Aleutian Chain Region – All territory south and west of the southern boundary of the Y-KD boundary.

The FAA does not maintain information on the distribution of air carrier/operating certificates issued by these described regions used in this study. The FAA does maintain records of certificate distribution by regional areas managed by the each of the Flight Standards District Offices.

Section A: General Statistics

1. NTSB Determination of Occurrence One

The coding system[4] used by the National Transportation Safety Board (NTSB) can be simple or complex depending on the type of accident investigated. In many cases, there is usually more than a single occurrence and phase of flight. To add to the complex nature of this coding system, investigators may or may not code a similar accident in the same manner. Although the NTSB has made an attempt to standardize the coding scheme, the end result is still based upon the objective information derived from the investigation, and the subjectivity of the Investigator-in-Charge. Consequently, when reviewing the occurrences and phases of flight in the NTSB reports, particular attention had to be given to the first occurrence and succeeding occurrences, as well as the sequence of events.

An example of the possibility of non-standardized coding schemes could involve an engine failure during cruise flight. The engine failure itself did not necessarily cause the accident and an investigator may elect to not code the engine failure during cruise flight. His or her report might simply show the code for a forced landing and nose over with no mention of engine failure during cruise flight in the coding scheme. The engine failure information might then be contained only in the long narrative. As a result, a simple search based upon the NTSB coding information might not show all accidents in the desired search criteria.

In this study, visual flight rules into instrument meteorological conditions (VFR into IMC), could have been coded a number of ways. These type of crashes could have been coded either as in-flight encounter with weather as the first occurrence followed by in-flight collision with terrain, object, or water, or loss of control in flight. This is important because some investigators coded the in-flight encounter with weather as the first occurrence where other investigators coded the in-flight collision with terrain/water as the first occurrence. If this study looked only at the first occurrences for information, approximately 50 percent of the cases would have been missed and excluded from this study.

This study was designed to review crashes where the pilot of an aircraft encountered weather and elected to continue in those conditions. It was assumed that there was an in-flight encounter with weather when the first occurrence was coded as an in-flight collision with terrain/water/object, and the NTSB accident report narrative showed weather involvement. As mentioned earlier in the methodology, the mental processes used by the flight crews in any of these cases would have been the same; the pilot encountered the weather, elected to continue, and either lost control of the aircraft, collided with terrain/water/object, or executed a precautionary landing. The important issue is the pilot/flight crew's decision to continue in deteriorating weather.

The information in Chart 1 shows the NTSB's breakdown of occurrences[5] for crashes[6] selected for this study. The categorization of occurrences and labels used on Charts 1 and 2 are as follows:

Missing data
In flight encounter with weather
In flight collision with terrain/water
Loss of control in flight
In flight collision with object
Missing aircraft

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[4] Coding System – a method developed and used by the NTSB to objectively describe what occurred during what phase of flight, the individual responsible, and the action taken. The coding system also includes a sequence of events schema, which clearly delineates the causes and factors associated with an event.

[5] The NTSB investigator will usually list the occurrence during which the sequence of events began leading to the accident. Often, investigators will list more than one occurrence for an accident.

[6] The term crash is used throughout this report instead of accident. The term accident denotes the circumstances of the occurrence were beyond the control of human intervention. No matter what action the occupants had taken, the event would have occurred. Therefore, the term crash is used.

Data not issued

A limitation of the SPSS program would not allow length labels and as a result, many of the long names were truncated.

Chart 1 shows that 46 percent of the 98 crashes reviewed were coded as an “in flight encounter with weather.” The next highest column showed that 35 percent of the crashes were coded as an “in flight collisions with terrain/water” as the first and only occurrence.

Chart 1

NTSB Determination of Occurrence One

n=98

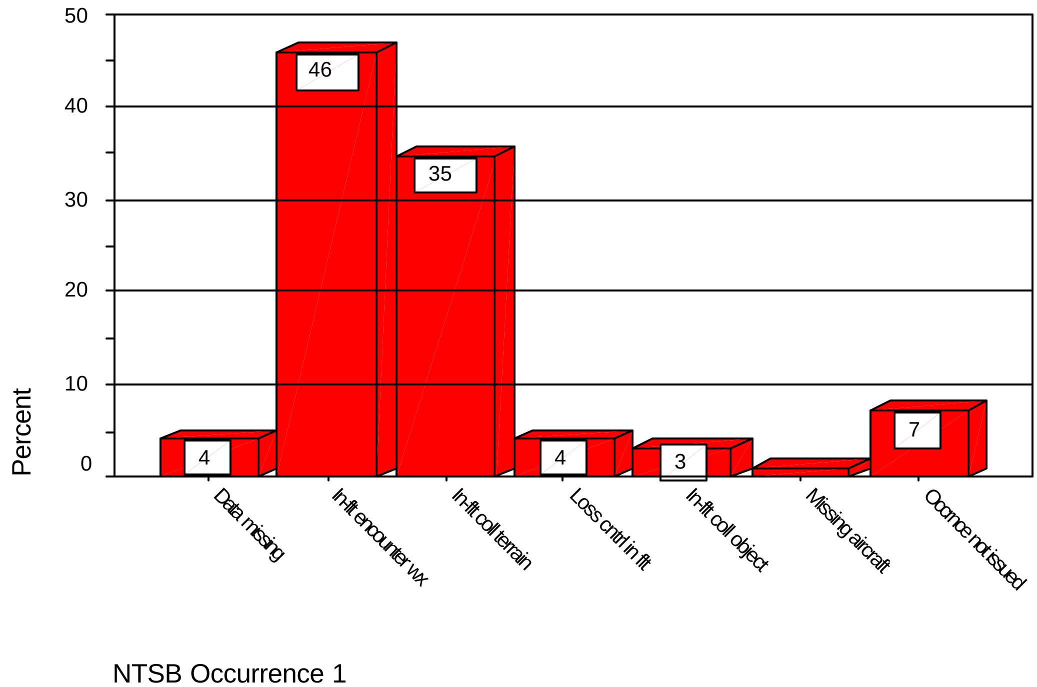
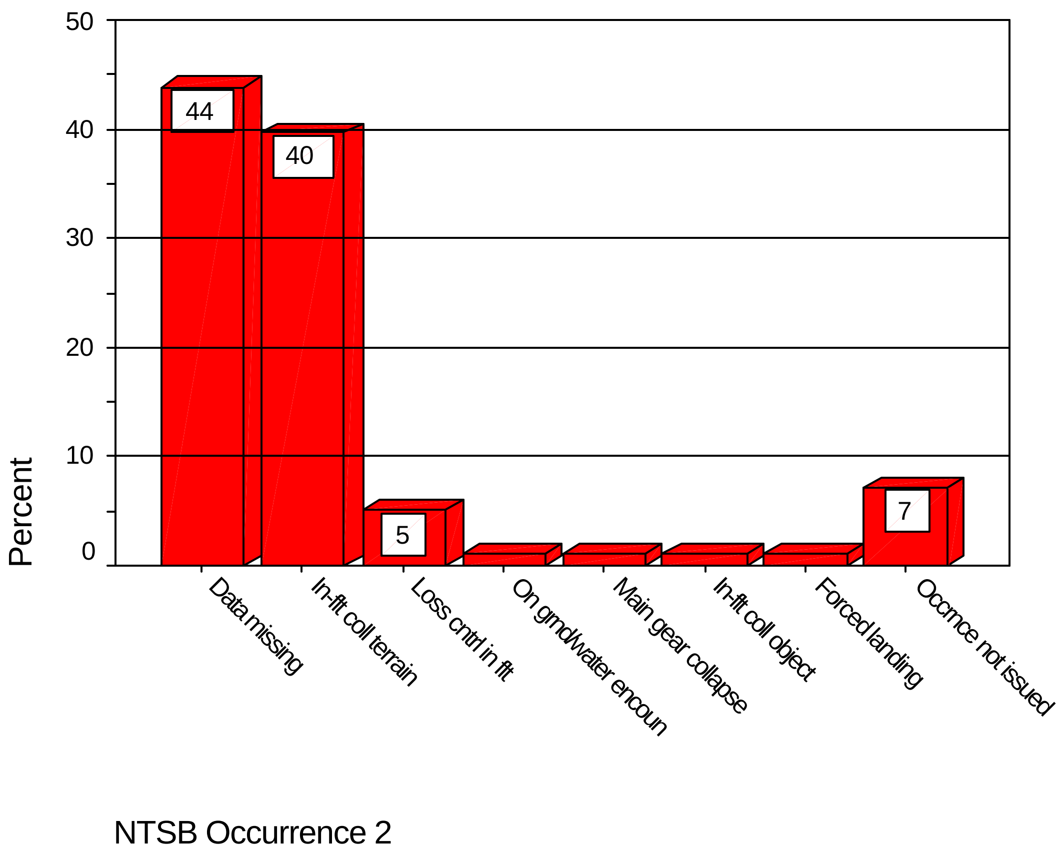


Chart 2 shows the NTSB's second listed occurrence in the crash sequence. Notice that the missing column shows 44 percent. This is because 44 percent of the crashes reviewed did not have a second occurrence listed. The significant number on this chart is the 40 percent column associated with the occurrence of "in-flight collision with terrain/water." When this number is added to Chart 1's column of in-flight collision with terrain/water, 75 percent of the crashes in this study were coded as an in-flight collision with terrain/water. However, all flights and crashes reviewed in this study were associated with an encounter with weather. The "data missing" column is a result of the NTSB Investigator's decision not to code in-flight encounter with weather as the first occurrence. Instead, the investigator coded in-flight collision with terrain as the first cause. This is merely a difference of coding preferences driven by the NTSB Investigator's experience or knowledge. This strengthens the hypothesis that the decision-making used by the pilots involved in these crashes is similar when encountering or continuing in marginal or adverse weather.

Chart 2

NTSB Determination of Occurrence Two
n=98



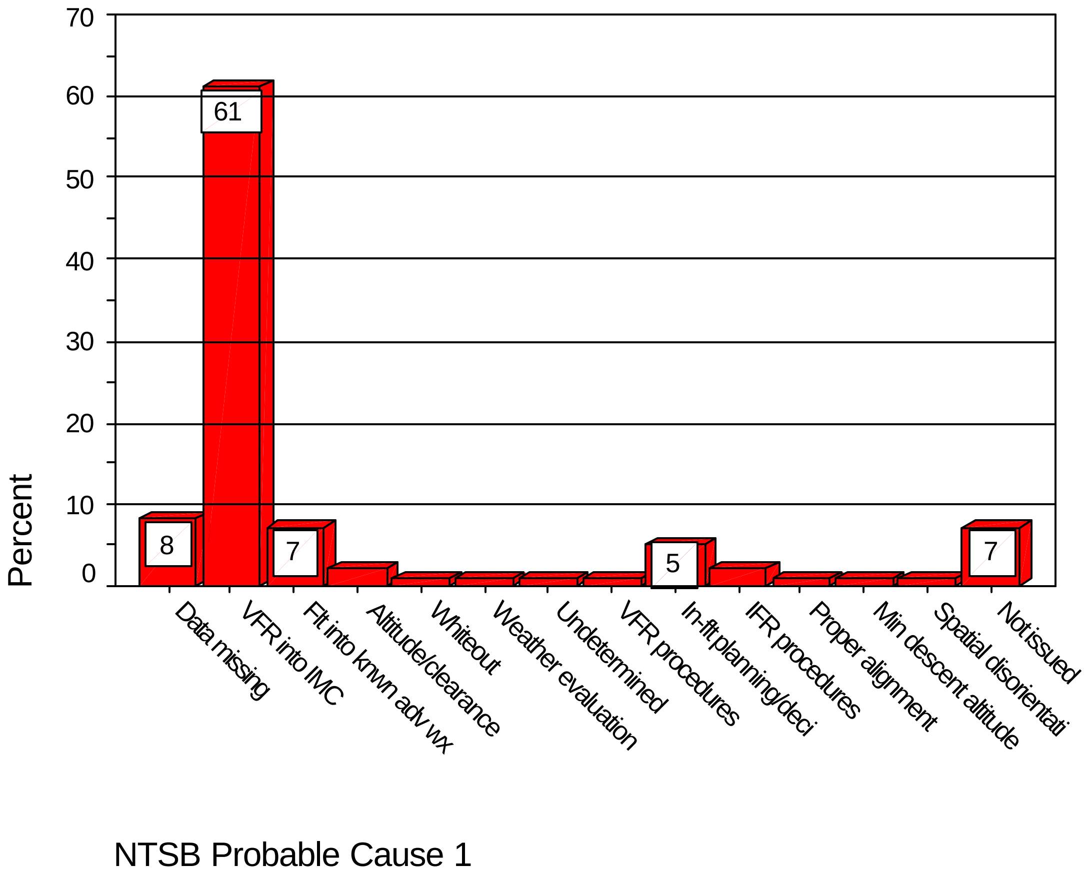
2. NTSB Determination of Probable Cause

A review of the NTSB data in Chart 3 showed that 61 percent of the cases reviewed, that had a first occurrence listed, the NTSB determined the probable cause as VFR into IMC. Another 7 percent of the crashes had a probable cause of "flight into known adverse weather." In Section 1, an analysis of Charts 1 and 2 revealed that at least 75 percent of the occurrences listed involved an in-flight collision crash. The 7 percent disparity between the probable cause percentage and the occurrence percentage can be attributed to the subjective coding of the NTSB Investigator. A more detailed analysis of the coding could reconcile the 7 percent difference. This 7 percent difference is considered to be minimal.

Chart 3

NTSB First Probable Cause

n=98

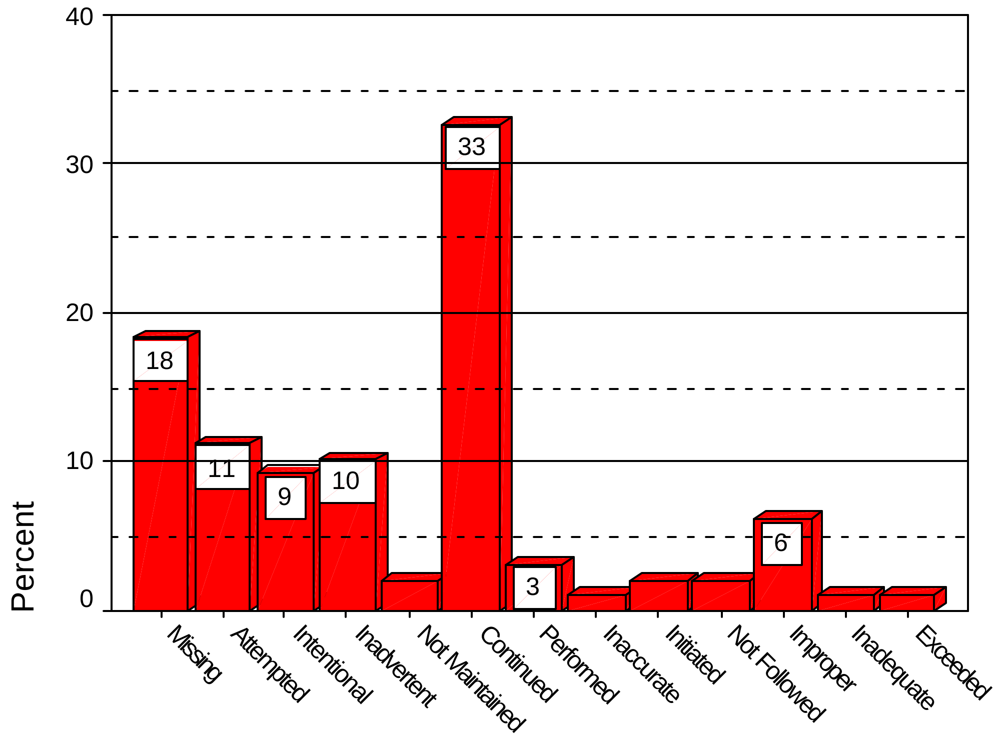


3. NTSB Description of Pilot Action

Chart 4 shows the percentages of the "action taken"[7] by the pilot-in–command during the first occurrence. The probable cause of the first occurrence, as depicted in Chart 3, is VFR into IMC and Chart 4 shows that 33 percent of these cases, the pilot "continued" VFR into IMC. If the "continued", "intentional", and "attempted", action columns, are added, 53 percent of the VFR into IMC crashes were a result of an active decision by the pilot-in-command to continue into IMC weather conditions. Only 10 percent of the cases were considered by the NTSB to be inadvertent VFR into IMC flight.

Chart 4

Action on NTSB Probable Cause
n=98



NTSB Action on Probable Cause 1

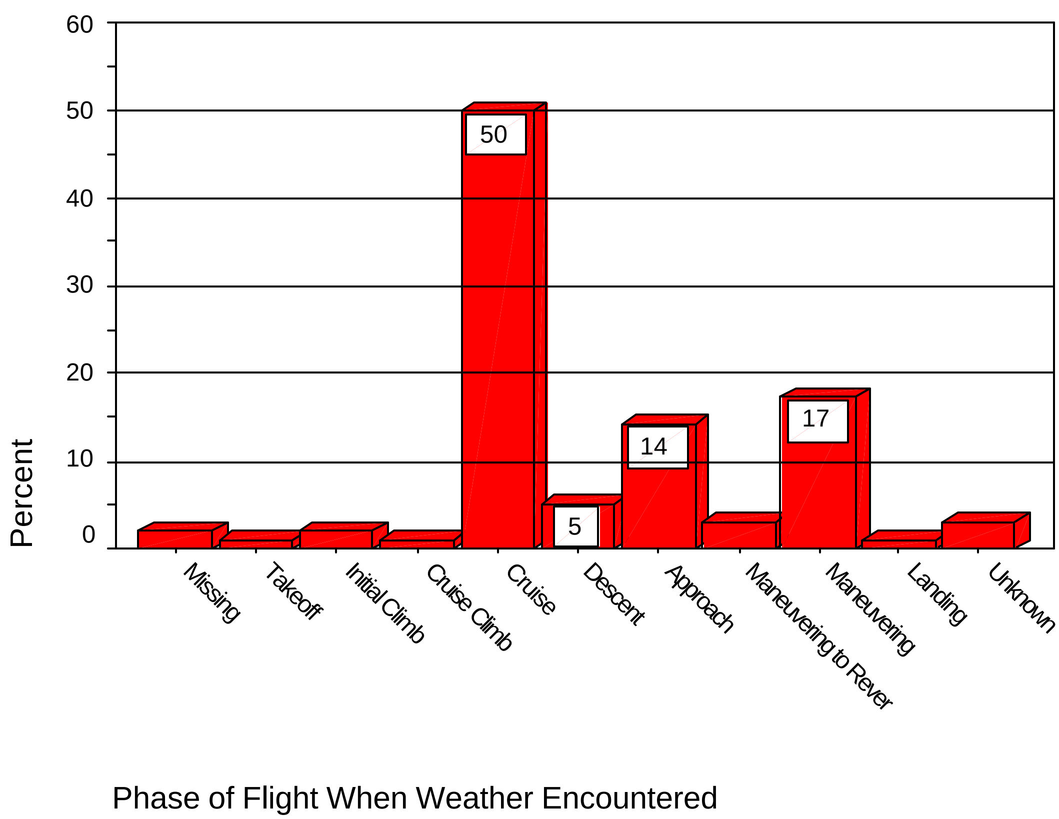
[7] The term "action taken" is identified in the NTSB coding scheme for the operational elements. These coding schemes have 3 columns were the first column identifies a factor or cause such as "VFR into IMC". The second column will describe an "action taken" such as "attempted", and the third column will list the person responsible for taking the action such as "pilot-in-command".

4. Phase of Flight when Weather was Encountered

Chart 5 depicts the phase of flight during which the weather was encountered. Fifty percent of the crashes examined showed the flight encountered weather during the cruise phase of flight. Subsequently, the flight may have crashed during a different phase flight. This data was developed to compare when the flight encountered the weather to when the flight crashed. The next highest column shown in the chart is the “maneuvering” column with 17 percent of the crashes coded as maneuvering at the time of the crash. The “maneuvering” column is considered differently than the column labeled “maneuvering to reverse direction”. As a former NTSB Investigator, it was common practice to code a crash as “maneuvering to reverse direction” when the pilot was attempting to exit the weather conditions. All other circumstances involving maneuvering of the airplane in an attempt to continue in the general direction of the destination were coded as “maneuvering”.

If the cruise, cruise climb, and maneuvering columns are added, over 67 percent of the flights encountered weather and attempted to continue to their destination.

Chart 5
Phase of Flight When Weather was Encountered
n=98

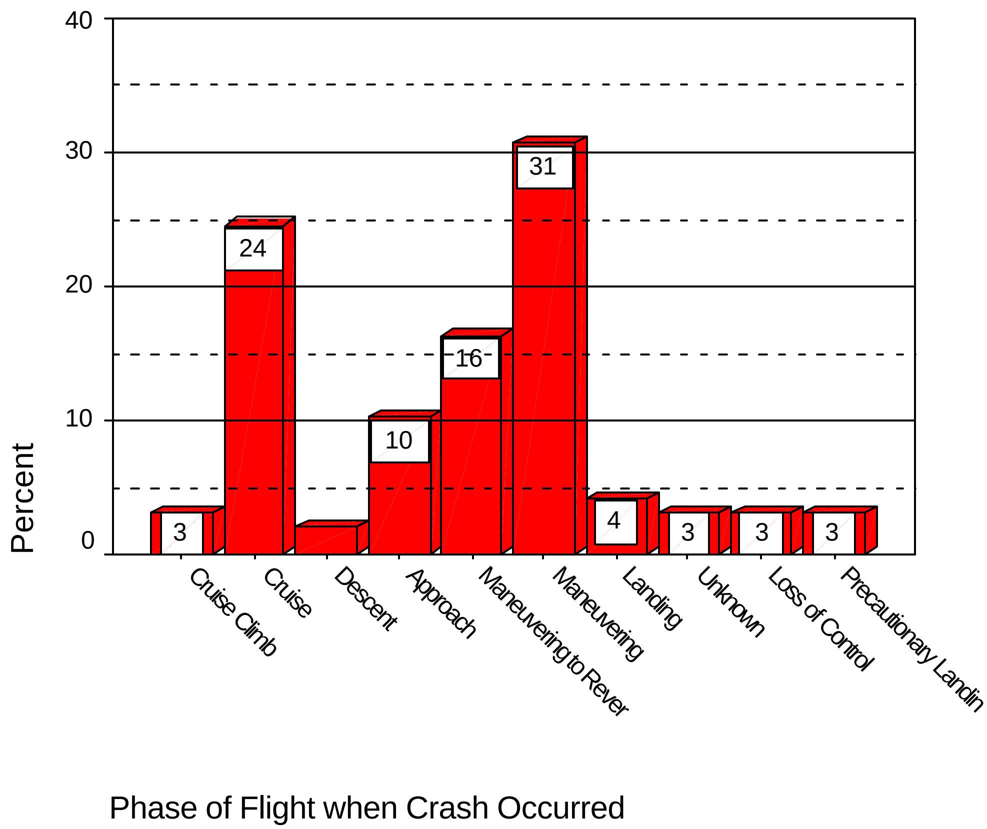


5. Phase of Flight when Crash Occurred

The information in Chart 6 is different than Chart 5 because Chart 6 shows the phase of flight during which the crash took place. This chart shows that only 24 percent of the cases had their crash during cruise flight compared to Chart 5, which shows that 50 percent of the crashes encountered the weather during the same phase of flight. Another 31 percent of the pilots studied had their crash while maneuvering, which, as explained earlier, is a good indication of the pilot's attempt to posture for better weather conditions while continuing toward the destination. This means that approximately 55 percent of the pilots had their crash either during cruise or maneuvering flight while continuing toward their destination.

The last significant number was the column labeled "maneuvering to reverse direction. This column shows that 16 percent of the crashes occurred during maneuvering to reverse direction of flight. In these cases, the NTSB Investigator would have used this coding if the pilot was attempting to exit the weather conditions by executing a reversal of direction to retrace his flight path. This technique is a recommended procedure for exiting weather conditions.

Chart 6
Phase of Flight When Crash Occurred
n=98

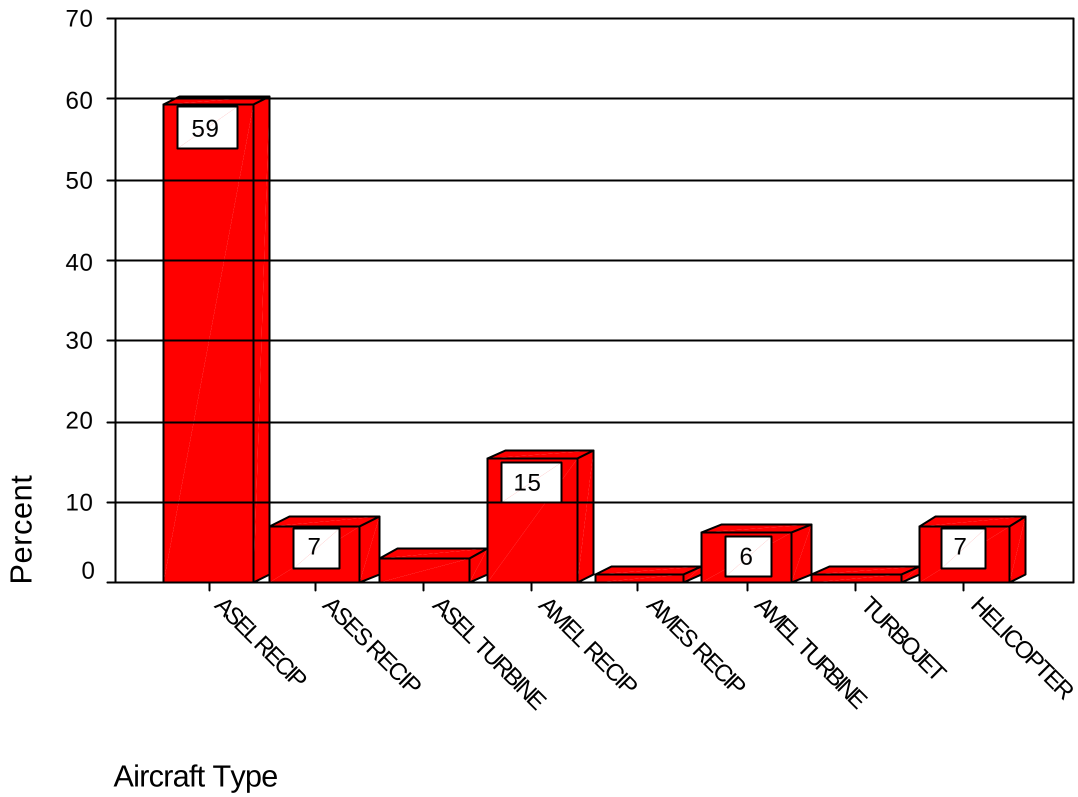


6. Type of Aircraft

This study did not identify the make and model of aircraft involved in these VFR into IMC crashes. Instead, the categories used for this study were broad and differentiated between number of engines, type of engines, and helicopters. The data in Chart 6a shows that 59 percent of the aircraft crashes in this study occurred in single, reciprocating engine, land aircraft. This category, however, is considered to be representative of the population of aircraft in use throughout the state of Alaska. What is interesting to note is that three of the highest columns in this chart are reciprocating engine aircraft. The helicopter column is a mix of turbine and reciprocating engine helicopters.

This generalized view of the types of aircraft involved in VFR into IMC crashes, although it may be representative of the aircraft population, may also indicate a limitation problem concerning aircraft performance and use of the instrument flight rules infrastructure[8].

Chart 6a
Type of Aircraft
n=98



[8] Instrument Flight Rules Infrastructure for the purposes of this report mean the availability of weather reporting facilities, instrument approach facilities, aircraft IFR certification, and pilot IFR certification.

Section B: Detailed Analysis and Regional Distributions

This next section will attempt to answer the remaining questions listed in the purpose section of this study. Because Alaska has at least five mountain ranges with varying and fast moving weather, comparing the regional distribution to the statewide statistics was imperative and could help identify potential problem areas.

1. Regional Distribution of VFR into IMC Crashes

One of the questions posed in the purpose section of this study was to determine which regions, as defined by this study, had the most VFR into IMC crashes. Chart 7, on the next page, shows the regional distribution of VFR into IMC crashes reviewed in this study. Of the seven regions described in this study, four of those regions have distinctly larger numbers of VFR into IMC crashes. The highest region is the Y-K Delta region followed by the SouthCentral region, SouthEastern region, and finally the Nome-Kotzebue region. The three latter regions are numerically close concerning crashes. However, the Y-K Delta region has seven more VFR into IMC crashes higher than the next closest region. It showed clearly that the Y-K Delta had the highest number of these crashes for the time period studied. The next highest regions were the SouthCentral region, followed by the SouthEastern region, and finally by the Kotzebue-Nome region.

There was not enough data to determine if this distribution was representative of the amount of exposure in each region. The exposure in each region depends largely on the season, the number of operators, and number of aircraft. These are only some examples of the factors affecting exposure. The use of proxies may not be valid because many takeoff and landings within these regions are from non-towered, uncontrolled airports. This particular proxy based exposure determination upon the number of takeoffs and landings and then calculated a number for flying hours. The number of takeoffs and landings was usually generated by information from tower-controlled airports. Alaska has only five tower-controlled airports.

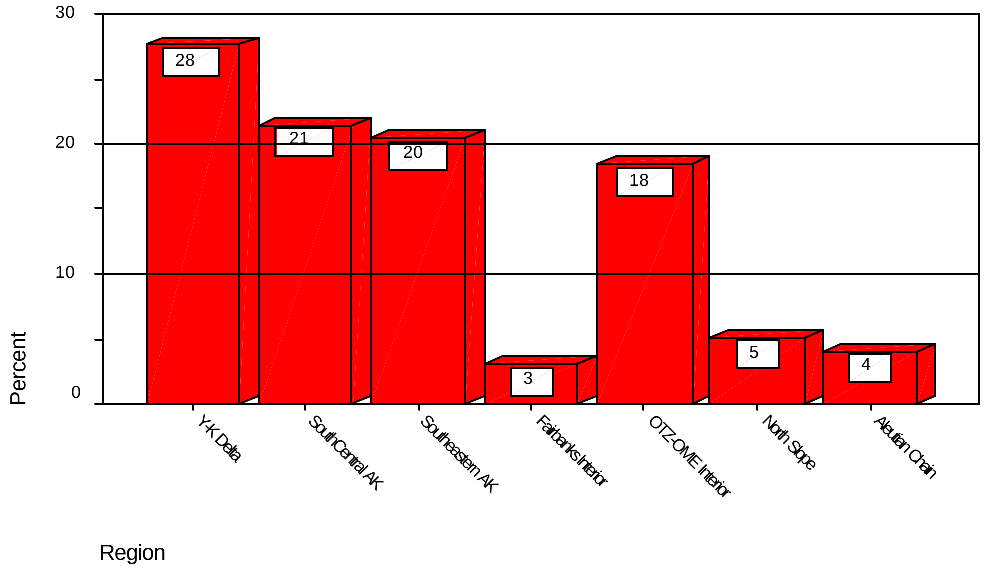
Another proxy that has been proposed but not validated determines the number of aircraft an operator uses in his/her operation, then determines the number of hours flown using an industry cognitive approach that the operator will use the airplane to earn revenue. Therefore the aircraft must be used a given number of hours monthly or annually. This proxy has promise but has not been validated.

Chart 7, on the next page, shows the regional distribution of VFR into IMC crashes reviewed in this study. Of the seven regions described in this study, four of those regions have distinctly larger numbers of VFR into IMC crashes. The highest region is the Y-K Delta region followed by the SouthCentral region, SouthEastern region, and finally the Nome-Kotzebue region. The three latter regions are numerically close concerning crashes. However, the Y-K Delta region is 7 VFR into IMC crashes higher than the next closest region.

The remaining three regions have a low number of VFR into IMC crashes. Again, these regions would need to be examined to determine the exposure and that exposure rate compared to the other regions. Common "tribal"[9] knowledge of the Aleutian Chain and the North Slope regions indicates long periods of inclement weather, which may account for the low number of VFR into IMC crashes. However, the Fairbanks region, with only three VFR into IMC crashes, does not have any worse weather condition phenomenon than the SouthCentral region. A study of operator exposure and actual periods of inclement weather conditions should be done to either confirm or dispel the "tribal" knowledge.

[9] "Tribal" knowledge is considered to be local knowledge of a particular subject. There is usually no written information or statistical analysis to support the tribal knowledge.

Chart 7
Regional Distribution of VFR into IMC Crashes
n=98



2. Type of Operating Certificate

Responses from various aviation groups to previous studies have stated that most of the VFR into IMC crashes was a result of small[10] operators. A review of the data involving these 98 crashes showed that 40 percent of the VFR into IMC crashes was actually incurred by operators who held FAR Part 135 commuter operating authority. Chart 8, shown on the next page, gives a detailed breakdown of the types of certificates held by operators in this study.

Another response from some aviation groups to previous studies has been that operators who no longer are in business caused most of these crashes. This study has determined that of the 98 crashes used in this study, 55 of the crashes were by operators who are still in business today. That means approximately 56 percent of the operators are still in business.

Furthermore, by comparing the distributions between Chart 8, the all-inclusive distribution, against Chart 9, the distribution for active certificates only, there is no appreciably difference in the distribution of these crashes.

There is a small change between active and inactive certificates occurring in the small on demand 9-passenger or less certificate holders, the small on demand 10-passenger or more, and the large 135 certificate holder categories. The significant information derived from these two charts, however, still shows no appreciable change in the bell curve distribution as depicted in Charts 8 and 9. Operators holding small 135 commuter operating authority are still the largest category involved in VFR into IMC crashes in both groups.

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[10] For purposes of this study, small operators are considered to be those operators holding either an air carrier certificate or an operating certificate with authorizations to operate 9 passengers on demand and 10 passengers on demand. This category includes single pilot operators and basic operators.

Chart 8
Type of Certificate Issued
Includes all Active, Suspended, Surrendered, Revoked, and Terminated Certificates
n=98

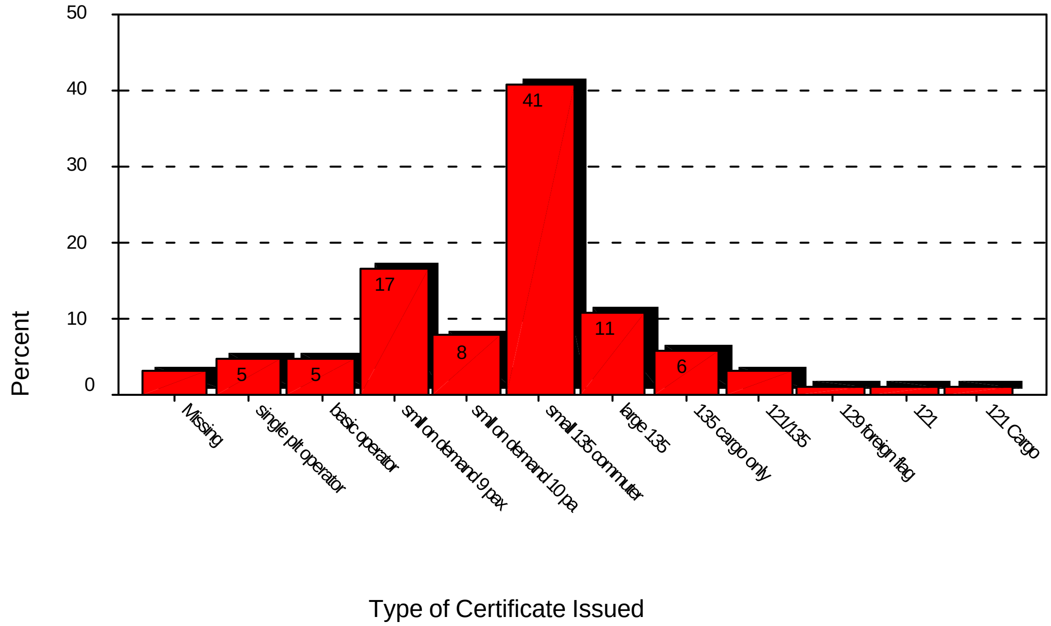
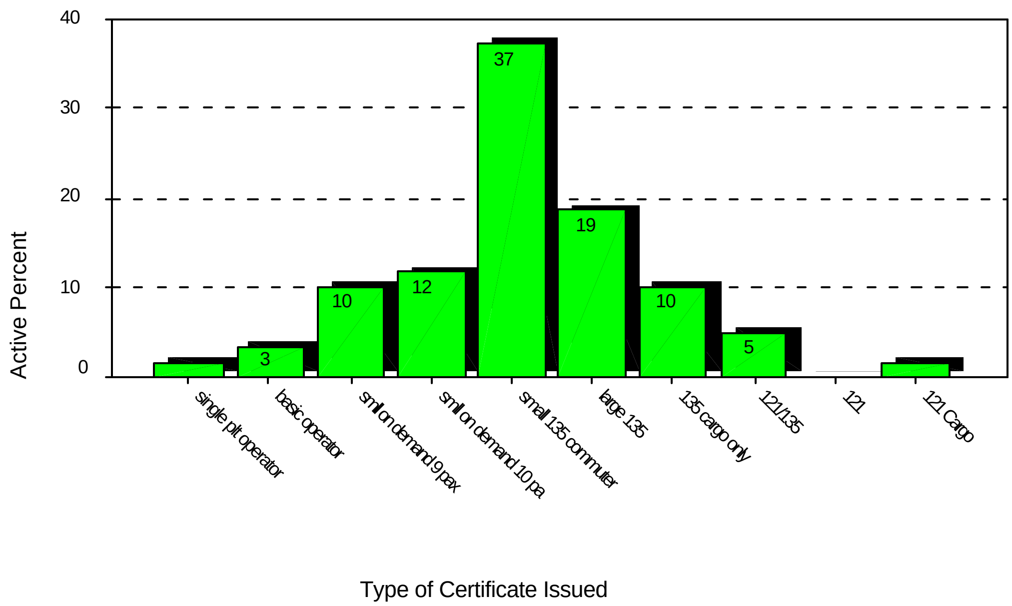


Chart 9
Type of Certificate Issued
Includes Active Certificates Only
n=55



a. Type of Certificate Held versus Regional Distribution

The significance of determining the type of certificate held by the operator was to see if certain operators, although operating under varying rules, generally operated at a higher standard based on the type of certificate held. The data reviewed showed that operators who have certificates, which would normally require them to operate at a higher standard, are actually the operators having the greatest number of the VFR into IMC crashes

The information in Table 1, shown below, is a regional distribution of the type of operating certificate held by the air carrier at the time of the crash. The category descriptions of the type of certificates held are based on the Federal Aviation Administration's current certificate management system[11].

Table 1
Type of Certificate Held versus Regional Distribution

Type of Certificate held		Region	Frequency	Percent	Valid Percent	Cumulative Percent
Missing data.	Valid	Y-K Delta	1	33.3	33.3	33.3
Missing data		SouthCentral AK	1	33.3	33.3	66.7
Missing data		OTZ-OME Interior	1	33.3	33.3	100.0
		Total	3	100.0	100.0	
single pilot operator	Valid	Y-K Delta	2	40.0	40.0	40.0
		SouthCentral AK	1	20.0	20.0	60.0
		Southeastern AK	1	20.0	20.0	80.0
		North Slope	1	20.0	20.0	100.0
		Total	5	100.0	100.0	
basic operator	Valid	SouthCentral AK	3	60.0	60.0	60.0
		Southeastern AK	2	40.0	40.0	100.0
		Total	5	100.0	100.0	
small on demand 9 pax	Valid	Y-K Delta	6	37.5	37.5	37.5
		SouthCentral AK	7	43.8	43.8	81.3
		Southeastern AK	2	12.5	12.5	93.8
		Aleutian Chain	1	6.3	6.3	100.0
		Total	16	100.0	100.0	
small on demand 10 pax	Valid	Y-K Delta	4	50.0	50.0	50.0
		SouthCentral AK	3	37.5	37.5	87.5
		OTZ-OME Interior	1	12.5	12.5	100.0
		Total	8	100.0	100.0	
small 135 commuter	Valid	Y-K Delta	10	25.0	25.0	25.0
		SouthCentral AK	5	12.5	12.5	37.5
		Southeastern AK	8	20.0	20.0	57.5
		OTZ-OME Interior	14	35.0	35.0	92.5
		North Slope	2	5.0	5.0	97.5
		Aleutian Chain	1	2.5	2.5	100.0
		Total	40	100.0	100.0	
large 135	Valid	Y-K Delta	1	10.0	10.0	10.0
		Southeastern AK	7	70.0	70.0	80.0
		OTZ-OME Interior	1	10.0	10.0	90.0
		North Slope	1	10.0	10.0	100.0
		Total	10	100.0	100.0	
135 cargo only	Valid	Y-K Delta	2	33.3	33.3	33.3
		SouthCentral AK	1	16.7	16.7	50.0
		Fairbanks Interior	3	50.0	50.0	100.0
		Total	6	100.0	100.0	
121/135	Valid	OTZ-OME Interior	1	33.3	33.3	33.3
		Aleutian Chain	2	66.7	66.7	100.0
		Total	3	100.0	100.0	
121	Valid	Y-K Delta	1	100.0	100.0	100.0
121 CARGO	Valid	North Slope	1	100.0	100.0	100.0

[11] Operation Specification System – This is a series of paragraphs that give the operator certain authorizations. As an example, an operator holding an Air Carrier certificate may or may not operate a scheduled commuter service. The operation specifications, among other requirements, would give the operator the authority. The system is complex and is computer generated with many standardized paragraphs.

The most significant category in Table 1 is the small 135-commuter category showing a total of 40 VFR into IMC crashes. The information from the general statistics section showed that the Y-K Delta area had the highest number of total VFR into IMC crashes. However, Table 1 shows that the Kotzebue-Nome area, when looking at the small 135 commuter operators, had the highest number (14) of VFR into IMC crashes compared to the Y-K Delta with 10 crashes.

The information above shows that the category of single pilot operators and the basic operators each had only 5 VFR into IMC crashes during the time frame 1983 to 2000.

Further research is needed to determine if the regional distribution of VFR into IMC crashes is commensurate with the regional distribution of the type of certificates issued.

3. FAR Rules under which Operation and Crash took place

Although the operator may have held commuter-operating authority, the flight rules under which the flight crashed may have been different. This next section looks at the rules under which the flight was operating when the VFR into IMC crash occurred.

Even though operators may have the authority to operate as a FAR Part 135 commuter, the VFR into IMC crash may have occurred while the carrier was operating under different operating rules, such as on-demand air taxi. These types of operations are allowable and within the purview of the regulations and operation specifications. Chart 10, page 28, shows the rules under which the air carrier's flight was operating at the time of the crash.

A comparison of Chart 8, page 24, and Chart 10, page 28, shows that although 41 percent of the crashes were by carriers holding commuter-operating authority, over 50 percent of the crashes occurred while the carrier was operating under FAR Part 135 on-demand rules. However, Chart 10 also shows that crashes during commuter operations accounted for approximately 30 percent, the second highest column, of the VFR into IMC crashes. Only 11 percent of the operators who held commuter-operating authority had a VFR into IMC crash during FAR Part 135 on-demand operations.

Chart 10
Type of Operating Rules During which Crash Occurred
Includes All Certificates
n=98

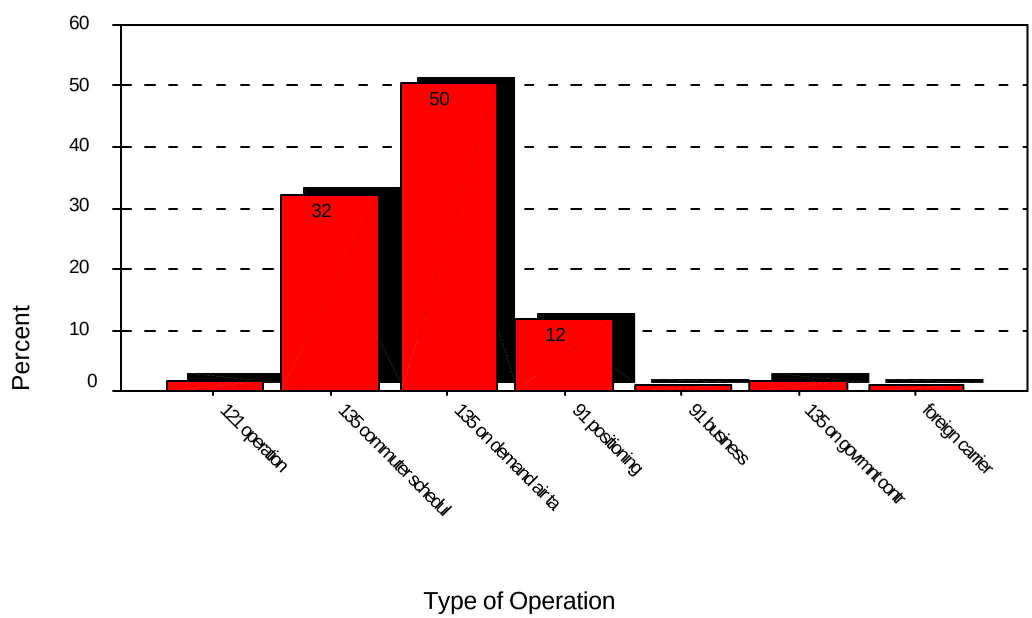


Table 2 is a comparison of the total number of fatalities and fatal crashes involved in the VFR into IMC crashes categorized by the type of operating certificate issued. The top row indicates the number of fatalities on board. The left hand column shows the type of certificate the operator was issued. The numbers in the table show the number of crashes for that certificate. In the case of the small 135-commuter category, the total column shows a raw number of 40 crashes. To find the number of fatalities for each certificate, you must multiply the number in the column associated with the type of certificate by the number at the top of the column. As a result, Table 2 shows 40 VFR into IMC crashes for small 135 commuter operations and the number of fatalities is calculated to be 65 because the "0" column had 16 crashes listed with no fatalities.

The calculations from Table 2 reveal there were 130 total fatalities involved in all VFR into IMC crashes reviewed in this study. Of these 130 fatalities, 65 were attributed to the small 135 commuter operators.

This equates to a crash rate of 41 percent for small 135 commuter operations with a fatality rate of 50 percent. Comparing the information from chart 14, page 32, it shows that only 10 percent of the total operating certificates issued in the Alaskan Region have commuter-operating authority.

This means that 10 percent of the certificate holders, those with commuter operating authority, have had 41 percent of the VFR into IMC crashes resulting in a 50 percent fatality rate for this group.

Table 2

Type of Certificate * Fatalities on Board Crosstabulation

Count

		Fatalities on Board									Total
		0	1	2	3	4	5	6	7	9	
Type of Certificate	single pilot operator	0	3	1	1	0	0	0	0	0	5
	basic operator	3	0	1	0	0	0	1	0	0	5
	small on demand 9 pax	7	4	0	0	3	0	1	1	0	16
	small on demand 10 pax	4	4	0	0	0	0	0	0	0	8
	small 135 commuter	16	10	7	1	1	1	2	1	1	40
	large 135	6	0	2	0	1	1	0	0	0	10
	135 cargo only	3	3	0	0	0	0	0	0	0	6
	121/135	2	1	0	0	0	0	0	0	0	3
	121	1	0	0	0	0	0	0	0	0	1
	121 CARGO	1	0	0	0	0	0	0	0	0	1
Total		43	25	11	2	5	2	4	2	1	95

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Type of Certificate Fatalities on Board	95	96.9%	3	3.1%	98	100.0%

a. Type of Operation Conducted versus Regional Distribution

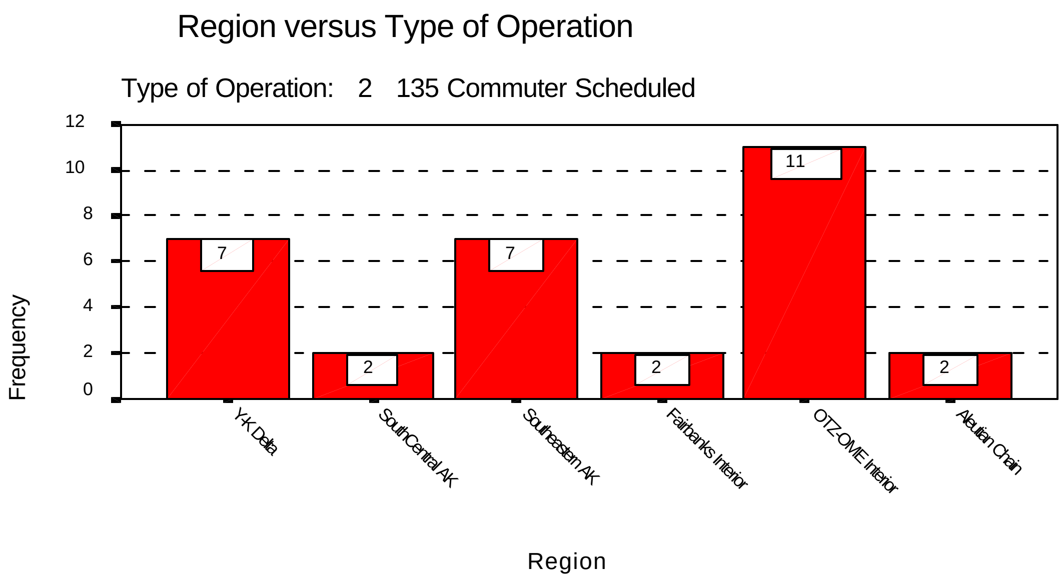
This section shows the regional distribution of the VFR into IMC crashes based upon the rules under which the flight was being conducted at the time of the crash. This is important, as mentioned earlier, because an air carrier may hold authority to operate as a scheduled commuter as well as the authority to operate aircraft on-demand. Often times, the same flight crews and the same aircraft used in scheduled service are used in on-demand service.

i. FAR Part 135 Scheduled Commuter Operations

Chart 11 shows the regional distribution based on the type of operation being conducted. The OTZ-OME (Kotzebue- Nome) Interior region has had the most crashes while operating under the rules of FAR Part 135 commuter scheduled service. It is not known if this distribution of crashes is representative of the distribution of air carrier/operating certificates. The distribution depicted in this analysis may be representative of the total air carrier population. More review would be necessary.

Chart 11

All Certificates, n=98

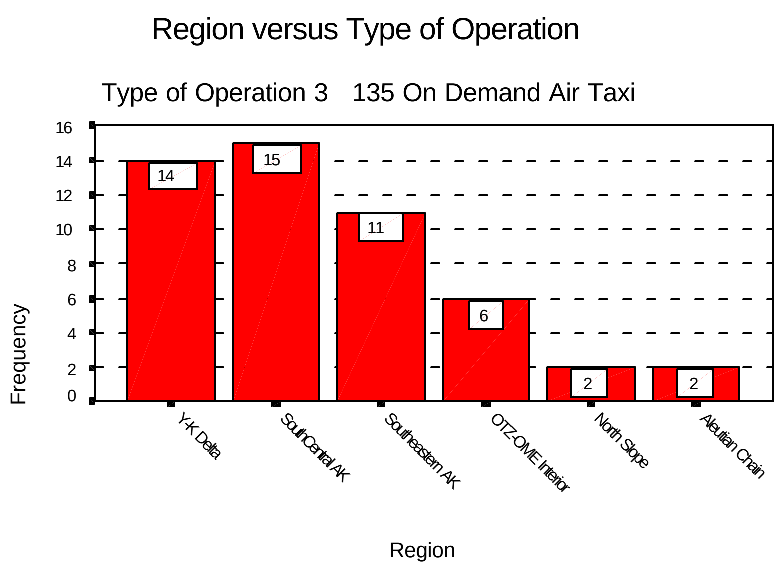


ii. FAR Part 135 On Demand Air Taxi

Chart 12 depicted below shows the relationship of the type of operation being conducted under FAR Part 135 on-demand operations versus regional distribution. This chart looks only at the rules under which the VFR into IMC crash took place regardless of the type of operating authority issued.

Chart 12

All Certificates, n=98



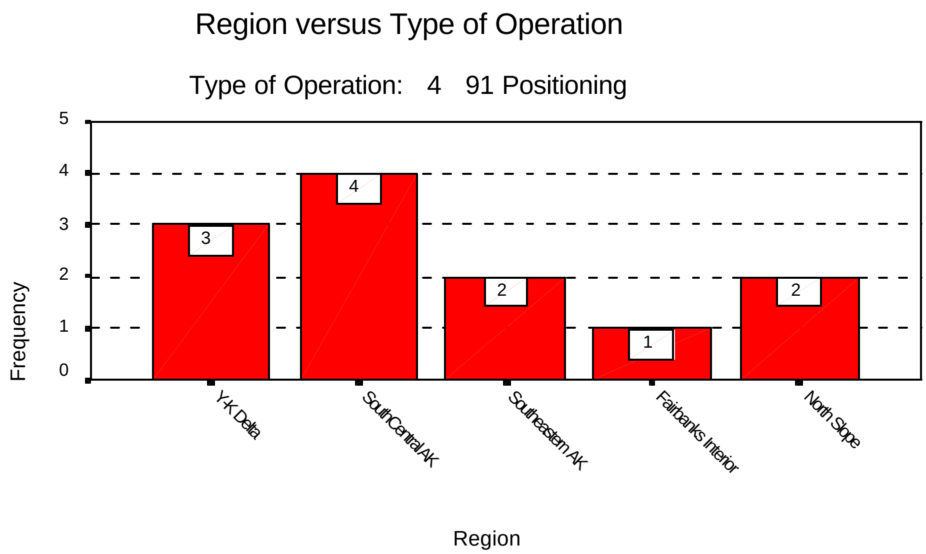
This means that an operator holding commuter operations specifications, who is conducting on-demand operations, is included in this category. Here we see that the SouthCentral Region of Alaska has the highest incidence of VFR into IMC crashes and the Y-K Delta is second. Again, it is not known if these types of operations are representative of the population distribution of certificates held in each of the regions as described in this study.

iii. FAR Part 91 Positioning

This category is necessary because operators, although they have operating authority, may operate with lesser in-flight visibility requirements when operating aircraft with no revenue on board. This accident category was defined in the NTSB reports as FAR Part 91 positioning flights with a corroborating statement in the narrative section of the report, which stated, “This was a FAR Part 91 positioning flight operating in conjunction with FAR Part 135.” This meant that at least one of the legs of the flight had revenue on board, but the accident took place during a leg that was non-revenue producing.

Chart 13 below shows that the SouthCentral region has had the most crashes involving FAR Part 91 positioning VFR into IMC crashes.

Chart 13
All Certificates



4. Certificate Status

a. Total Number of Operating Certificates Issued

The following was developed from information retrieved from Federal Aviation Administration's (FAA) Safety Performance Analysis System (SPAS). It shows the distribution of the total number of types of certificates issued in the Alaskan Region. Information from Chart 7 showed that 41 percent of VFR into IMC crashes were by operators who held 135 commuter operating authority. Chart 14 on the next page shows that only 10 percent of the total air carrier/operating certificates issued in Alaska had commuter-operating authority. When this information is distributed it equates to an approximate ratio of 4 VFR into IMC crashes per operator holding commuter-operating authority for the period covering1983 to 2000.

The information in the NTSB database categorizes operators differently than the FAA SPAS database. The NTSB database shows only 3 categories associated with FAR Part 135 operations. Their 3 categories consist of the following:

1. 135 commuter scheduled operations,
2. 135 on demand operations, and
3. 135 on government contract operations.

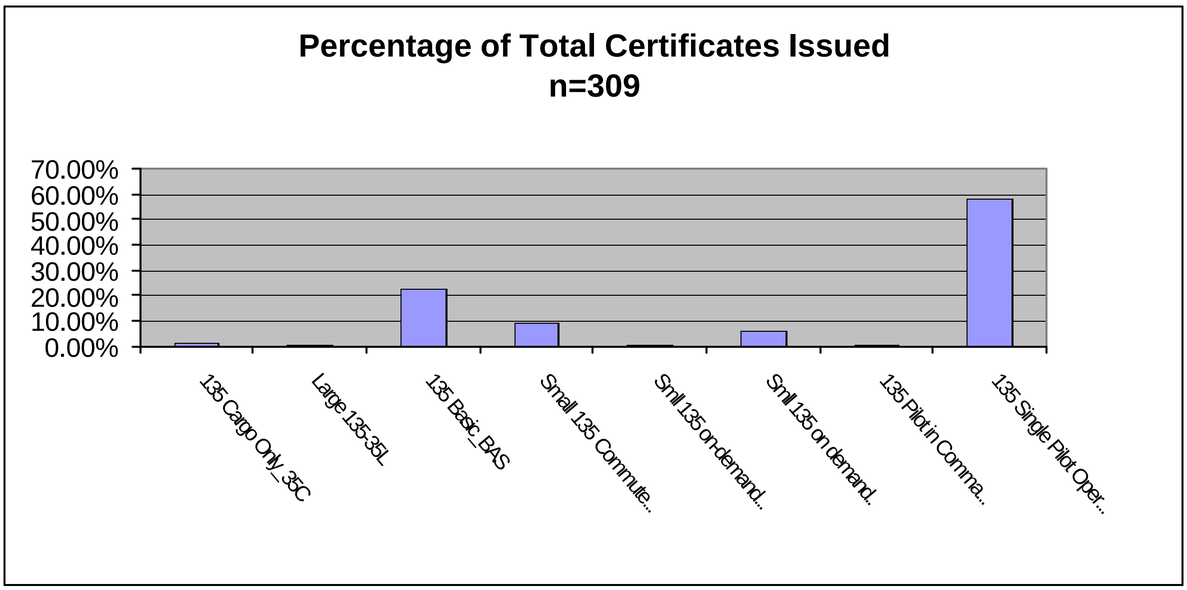
The FAA SPAS database has 8 separate categories for FAR Part 135 operations. These categories are listed below along with their respective SPAS designator code.

1. 135 basic	BAS
2. 135 cargo only	35C
3. 135 PIC	PIC
4. 135 single pilot	SPO
5. Large 135	35L
6. Small 135 commuter	CMA
7. Small on demand 10 pax	O10
8. Small on demand 9 pax	09X

This information shows that the NTSB report categorization system combines 7 of the 8 FAA SPAS categories into a single category. This makes it very difficult to use only the NTSB database to determine any statistical significance among FAR Part 135 operators.

Further review of the charts shows that Chart 9 described the type of rules under which the flight was operating when the crash occurred. This showed that 50 percent of VFR into IMC crashes occurred during operations under 135 on-demand air taxi rules. By using this information and the information from Chart 14 on the next page, and excluding the 135 commuter operators, 58 percent of the certificates issued in the Alaskan Region were for FAR Part 135 on-demand operating authority. This gives a ratio of 1 VFR into IMC crash per FAR Part 135 on-demand certificate for the time frame 1983 to 2000. This comparison shows a significant difference for 135 commuter operators, which average 4 crashes per commuter certificate.

Chart 14



b. Certificate Status versus Regional Distribution

One of the questions asked in the purpose section of this study was if any of the defined regions in the State of Alaska had a higher number of VFR into IMC crashes and what factors might be associated with those regions.

The frequency table below shows the distribution of all VFR into IMC crashes by region and the status of the operator's operating certificate. This table is not a representation of the distribution of all air carrier and/or operating certificates issued in the Alaskan Region. It depicts only of those involved in VFR into IMC crashes.

Table 3

Certificate Status versus Regional Distribution

Region	Computer validation	Certificate Status	Frequency	Percent	Valid Percent	Cumulative Percent
Y-K Delta	Valid	Active	13	48.1	50.0	50.0
		Revoked	2	7.4	7.7	57.7
		Surrendered	6	22.2	23.1	80.8
		Terminated	5	18.5	19.2	100.0
		Total	26	96.3	100.0	
	Missing	System	1	3.7		
	Total		27	100.0		
SouthCentral AK	Valid	Active	7	33.3	35.0	35.0
		Revoked	3	14.3	15.0	50.0
		Surrendered	8	38.1	40.0	90.0
		Terminated	2	9.5	10.0	100.0
		Total	20	95.2	100.0	
	Missing	System	1	4.8		
	Total		21	100.0		
Southeastern AK	Valid	Active	15	75.0	75.0	75.0
		Suspended	1	5.0	5.0	80.0
		Revoked	1	5.0	5.0	85.0
		Surrendered	1	5.0	5.0	90.0
		Terminated	2	10.0	10.0	100.0
		Total	20	100.0	100.0	
Fairbanks Interior	Valid	Active	3	100.0	100.0	100.0
OTZ-OME Interior	Valid	Active	11	61.1	64.7	64.7
		Surrendered	2	11.1	11.8	76.5
		Terminated	4	22.2	23.5	100.0
		Total	17	94.4	100.0	
	Missing	System	1	5.6		
	Total		18	100.0		
North Slope	Valid	Active	4	80.0	80.0	80.0
		Terminated	1	20.0	20.0	100.0
		Total	5	100.0	100.0	
Aleutian Chain	Valid	Active	2	50.0	50.0	50.0
		Surrendered	2	50.0	50.0	100.0
		Total	4	100.0	100.0	

Table 3 clearly shows that when all certificates are included, the Y-K Delta has had the largest number of VFR into IMC crashes, followed by the SouthCentral Region, and then the SouthEastern Region. However, the argument used by industry advocates has been that most of these crashes were the fault of operator's whose certificates have long been revoked, suspended, surrendered, or terminated. With the exception of the SouthCentral Region, all regions have a higher number of active certificates compared to the other categories. The percentage rates in the last 3 columns are applicable to the respective regions.

This analysis confirms the long held assumption that the Y-K Delta region has been the largest culprit in VFR into IMC crashes. However, the SouthEastern region has more active certificates involved in these same types of crashes. There is no great disparity of ratios between active certificates and non-active certificates; thereby dispelling the industry advocates argument.

5. Pilot Age Groups

The pilot age groupings used in this study followed the same age group breakdown as the FAA's Civil Airman Statistics Branch. It is not known whether there were specific physiological determinants that were factored into this age grouping methodology. For the sake of standardization, this study used the same grouping.

Chart 15, on page 34, shows the distribution in percentages of the age groups involved in VFR into IMC crashes (n=98). The highest percentage age group is the 25 through 29-year-old group. However, the next 3 older age groups are also significantly elevated.

Further analysis was done to determine the distribution of the total pilot population by age groups. This pilot and certificate information was provided by FAA Civil Airman Statistics and used to estimate the total pilot population in the State of Alaska distributed by the age groups used in this study. According to FAA Civil Airman Statistics, there are approximately 4014 active pilots as of the year 2000, with a certificate level of commercial and/or Airline Transport Pilot. By performing a simple interpolation the following comparison was derived comparing the percentages listed in Chart 15 and the total pilot population for the age groups listed in figure 2, page 34.

This shows that the 24-29 year old age group is only 8.23 percent of the total pilot population in Alaska, yet they are having 20 percent of the VFR into IMC crashes. This means the frequency of VFR into IMC crashes based on age distribution of the study group is not commensurate with the distribution of the total Alaskan pilot population.

Chart 15

All Certificates
Pilot Age Groups

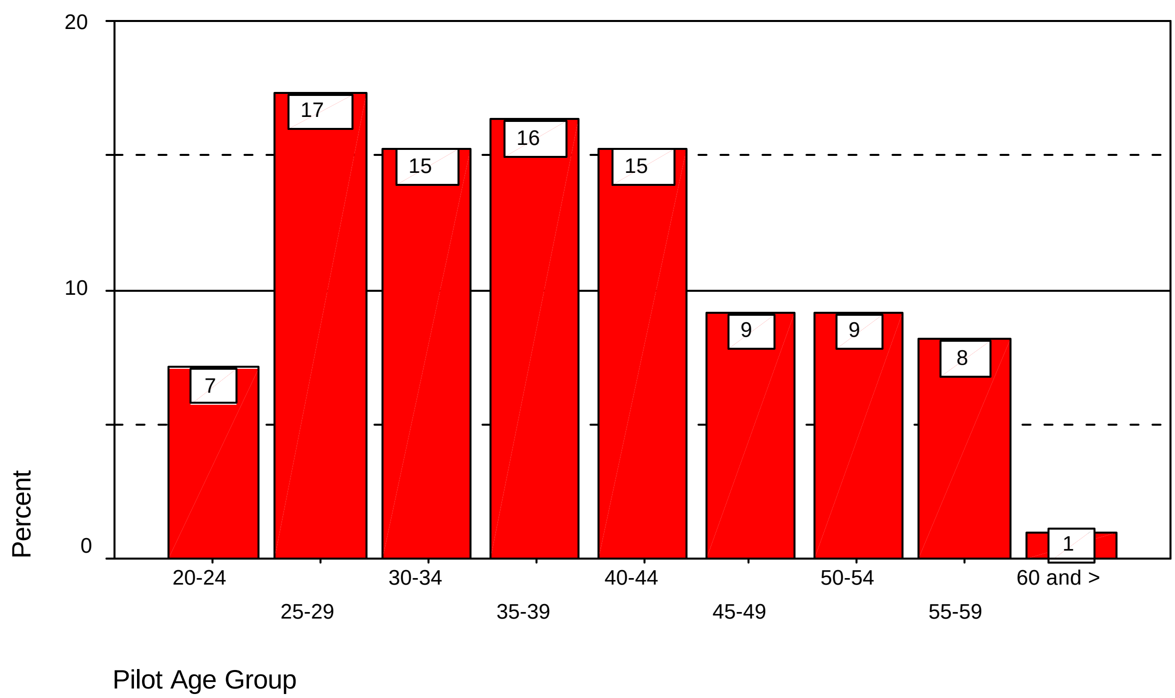


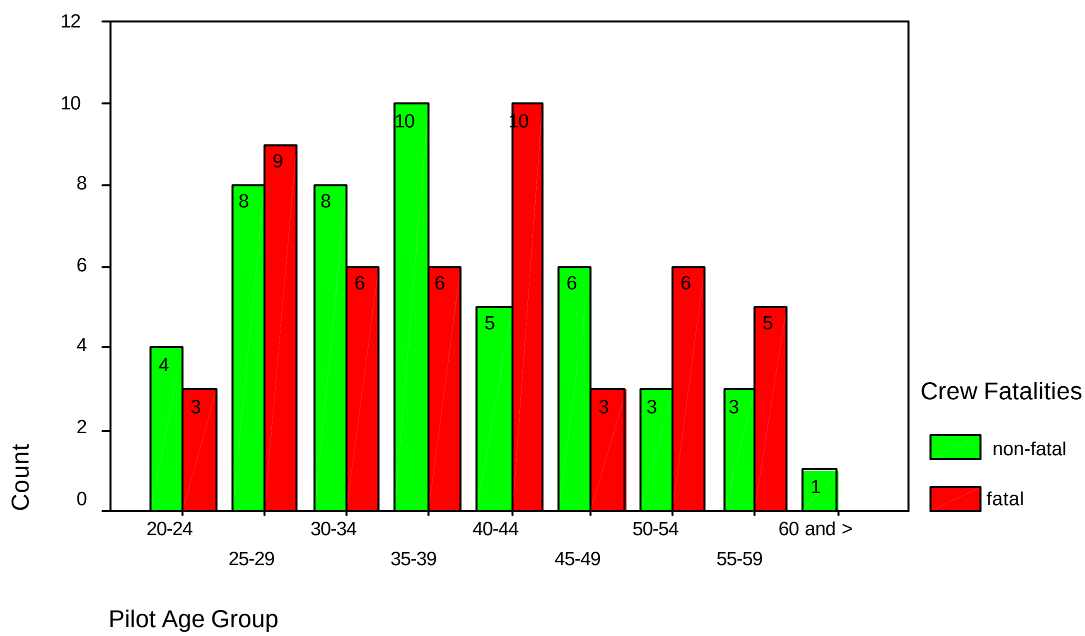
Figure 2

Pilot Age Groups	Percent of pilot age group of AK pilot population	Percentage of pilot age group of AK pilots involved in VFR into IMC crashes
20-24	3.28%	9.10%
24-29	8.23%	20.00%
30-34	11.91%	9.10%
35-39	14.15%	14.50%
40-44	14.36%	12.70%
45-49	12.98%	14.50%
50-54	14.15%	10.90%
55-59	10.60%	7.30%
60-64	6.44%	0.00%
65-69	3.90%	0.00%
missing	0.00%	1.80%
	100	99.90%

A look at Chart 16 below shows crew fatalities based on age groups. It depicts no significant disparity between the fatal and non-fatal categories in the 24-29 year old age group. What is disturbing about this information is that for the 24-29 year old age group, approximately 47 percent of the pilots in this age group, who are involved in VFR into IMC crashes, survive. When you compare this to the 40 to 44 and 50 to 54 year old age group, both of these groups have only a 33 percent survival rate within their age groups. This may have some significance concerning pilot experience, confidence, and/or complacency.

Chart 16

Pilot Age Group Fatalities



a. Regional Distribution by Pilot Age Groups

The data sampling size made it difficult to make any determination of the regional distribution of pilot age. Table 4 shows the regional distribution of the pilot age groups involved in the VFR into IMC crashes. The regional distribution of the general working pilot population could not be determined. Further research would be needed to determine if pilot age was a significant factor regionally. An example of the significance could be gleaned by viewing the 20 to 24 year old age group and the lack of numbers in the northern most regions as well as the Aleutian region.

One case in the NTSB database did not have a pilot's age and was omitted from the Table 4 shown on the next page.

Table 4
All Certificates, n=97

Pilot Age Group * Region Crosstabulation

Count

		Region							
		Y-K Delta	SouthCentral AK	Southeastern AK	Fairbanks Interior	OTZ-OME Interior	North Slope	Aleutian Chain	Total
Pilot Age Group	20-24	3	2	2	0	0	0	0	7
	25-29	2	2	6	1	6	0	0	17
	30-34	3	7	2	0	2	0	1	15
	35-39	7	3	1	0	3	2	0	16
	40-44	4	3	1	1	3	1	2	15
	45-49	3	1	3	1	1	0	0	9
	50-54	1	2	4	0	1	0	1	9
	55-59	3	1	1	0	2	1	0	8
	60 and >	1	0	0	0	0	0	0	1
Total		27	21	20	3	18	4	4	97

6. Yearly Distribution

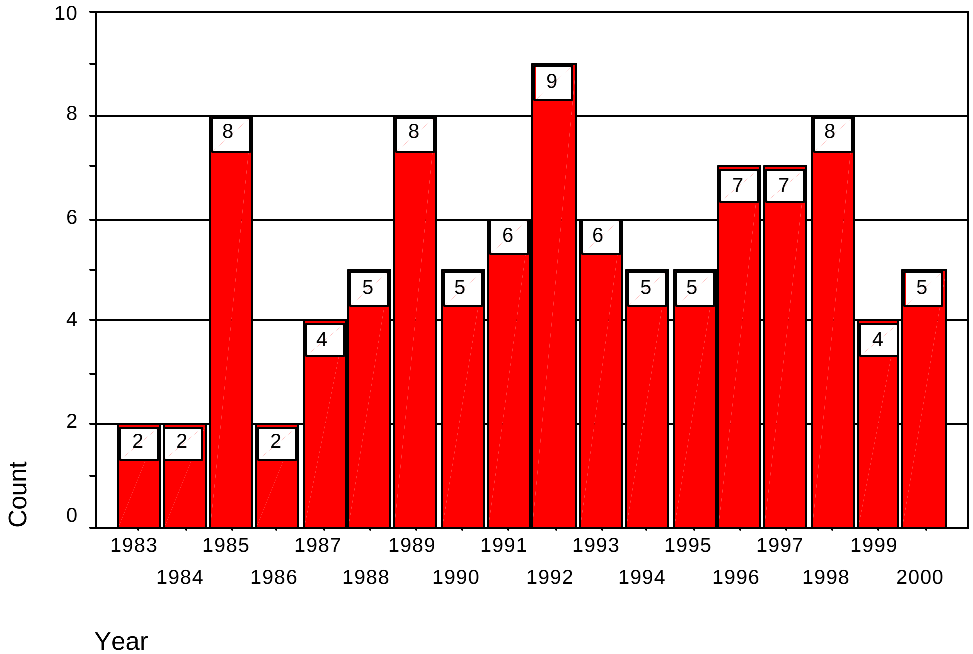
Chart 17 shown on the next page displays the frequency of VFR into IMC crashes based on the years. Notice that from 1983 through 1992, the distribution, with the exception of the spikes, has steadily increased. Between 1993 and 1998, there was a drop and subsequent increase in the frequency. The decrease in 1999 and 2000 appears to be significant and further research needs to be accomplished to determine what changes within the FAA or the Civil Aviation Industry might have affected this reduction.

There is speculation that the introduction of the Capstone 1[14] project into the Yukon Kuskokwim Delta (Y-K Delta) was responsible for this reduction. However, approximately 148 aircraft were equipped with Capstone 1 equipment. Six accidents have involved aircraft with Capstone 1 equipment on board, and 2 of those accidents were weather related. This gives the Capstone equipped aircraft a weather related accident rate of 1.3 percent and a total accident rate of approximately 4 percent of the 148 equipped aircraft. Further research needs to be accomplished to determine if the accident rate for weather related accidents of Capstone equipped aircraft is commensurate with the total aircraft population of the Y-K Delta.

[14] The term Capstone 1 is used in this report to signify the first phase of the Capstone project, which involved the installation of equipment in aircraft in the Yukon-Kuskokwim Delta. The Capstone project has a phase 2 program that involves different equipment and is being implemented in the Alaska Southeastern Region.

Chart 17

Yearly Distribution



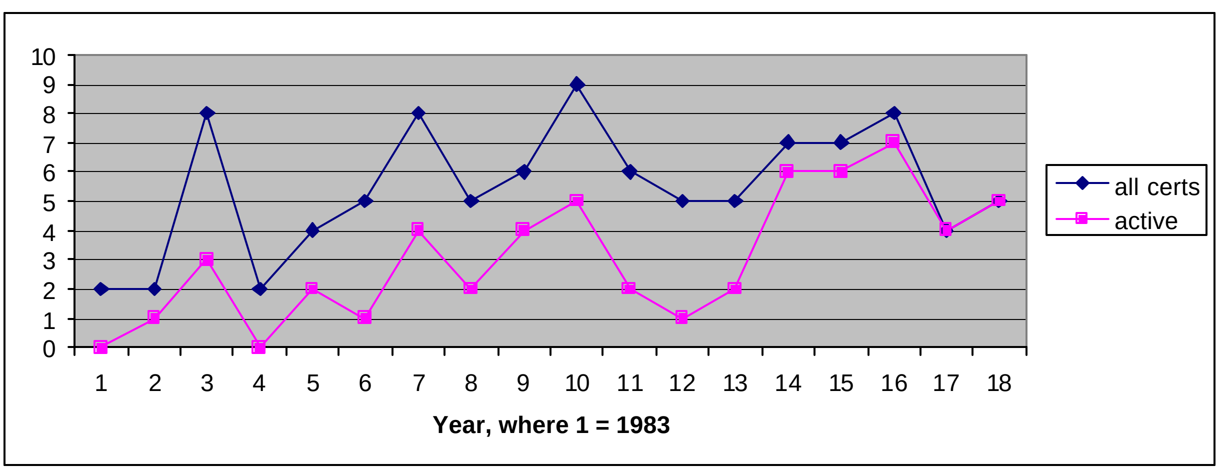
a. Regional Distribution versus Year

The regional distribution of VFR into IMC crashes by year did not show any significant difference in the crash distribution. The information did validate that the Y-K Delta has had the highest number of VFR into IMC crashes for the time frame used in this study.

The line chart depicted on Chart 18, shows two lines. The blue line or series 1 line represents the VFR into IMC crashes involving all certificates. The purple line or series 2 line represents only the active certificates. The trend of each line is respective of the other line until the later years where the lines begin to merge.

Chart 18

Comparison of All certificates versus Active Certificates



There is nothing unusual about this comparison because it is reasonable for time to have an effect on certificate status. The important information this chart provides is that a baseline can be established where the two lines meet in the year 1999 and 2000. Future studies covering similar information should begin with the year 2000 and compared against the information in this study.

Table 5 is a cross tabulation of the SPSS data involving the distribution of the type of certificates versus the regions. The table corroborates all the previous evidence and analyses of this data that the Y-K Delta has had the highest number of VFR into IMC crashes.

One bit of information that should not be overlooked is the low crash numbers in the Fairbanks region. Throughout this study, the Fairbanks region has shown a low number of VFR into IMC crashes.

Table 5
All Certificates, n=98

Year * Region Crosstabulation

Count

		Region							
		Y-K Delta	SouthCentral AK	Southeastern AK	Fairbanks Interior	OTZ-OME Interior	North Slope	Aleutian Chain	Total
Year	1983	0	0	0	0	1	1	0	2
	1984	0	1	0	0	0	1	0	2
	1985	4	1	1	0	2	0	0	8
	1986	0	0	0	0	1	0	1	2
	1987	2	1	0	0	1	0	0	4
	1988	1	1	2	0	0	0	1	5
	1989	0	4	3	0	1	0	0	8
	1990	2	1	0	0	0	0	2	5
	1991	1	2	2	0	1	0	0	6
	1992	2	2	3	0	2	0	0	9
	1993	2	1	1	1	1	0	0	6
	1994	1	2	1	0	1	0	0	5
	1995	1	3	1	0	0	0	0	5
	1996	0	2	3	0	2	0	0	7
	1997	4	0	1	0	1	1	0	7
	1998	4	0	0	0	3	1	0	8
	1999	1	0	2	1	0	0	0	4
	2000	2	0	0	1	1	1	0	5
Total		27	21	20	3	18	5	4	98

7. Monthly Distribution

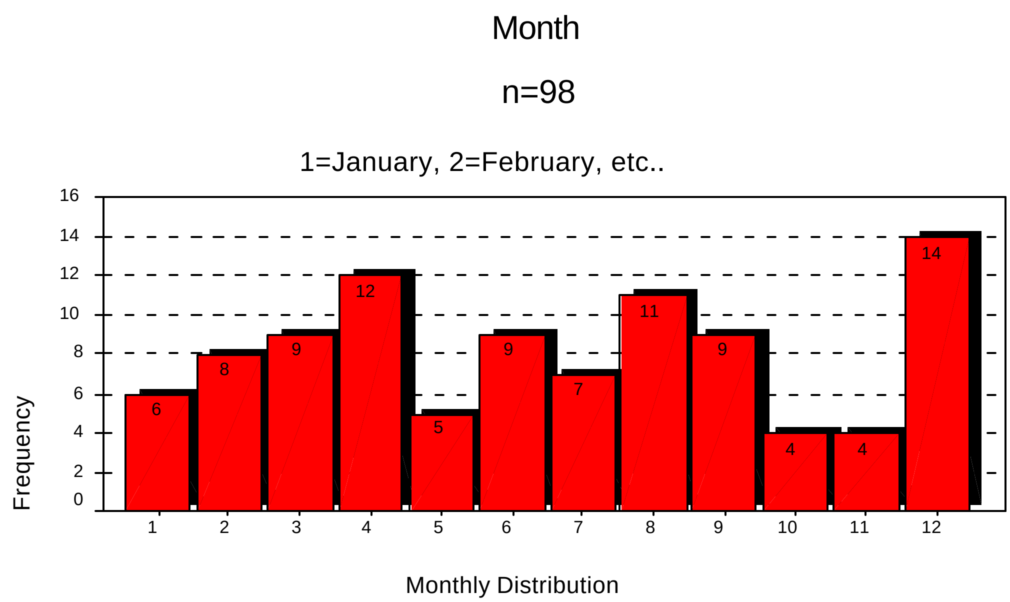
Many air carrier operations are conducted on a seasonal basis. Some operators continue operations year round, but the bulk of their business may be conducted during the summer tourist season. Since there is no denominator data to determine actual exposures for these air carriers, the number of VFR into IMC crashes may be representative of the carrier's exposure. Exposure does not justify an increase in these types of crashes, but may help in determining the type of resources needed to prevent future similar crashes.

A review of the monthly distribution of these crashes in Chart 19 shows a steady increase of crashes with a spike in April, which is traditionally the beginning of the flying season in Alaska.

The next significant spike in chart 19 occurs in the month of December. This spike cannot be associated with the normal tourist flying season. However, The month of December is a major holiday season and can be associated with the lowest light conditions of the year.

Practical operating experience has shown that during the month of December, many villagers travel to and from population centers and other villages for numerous reasons. However, this possible increase in operating exposure has not been documented. Further research or additional data would be needed to make a determination.

Chart 19
All Certificates

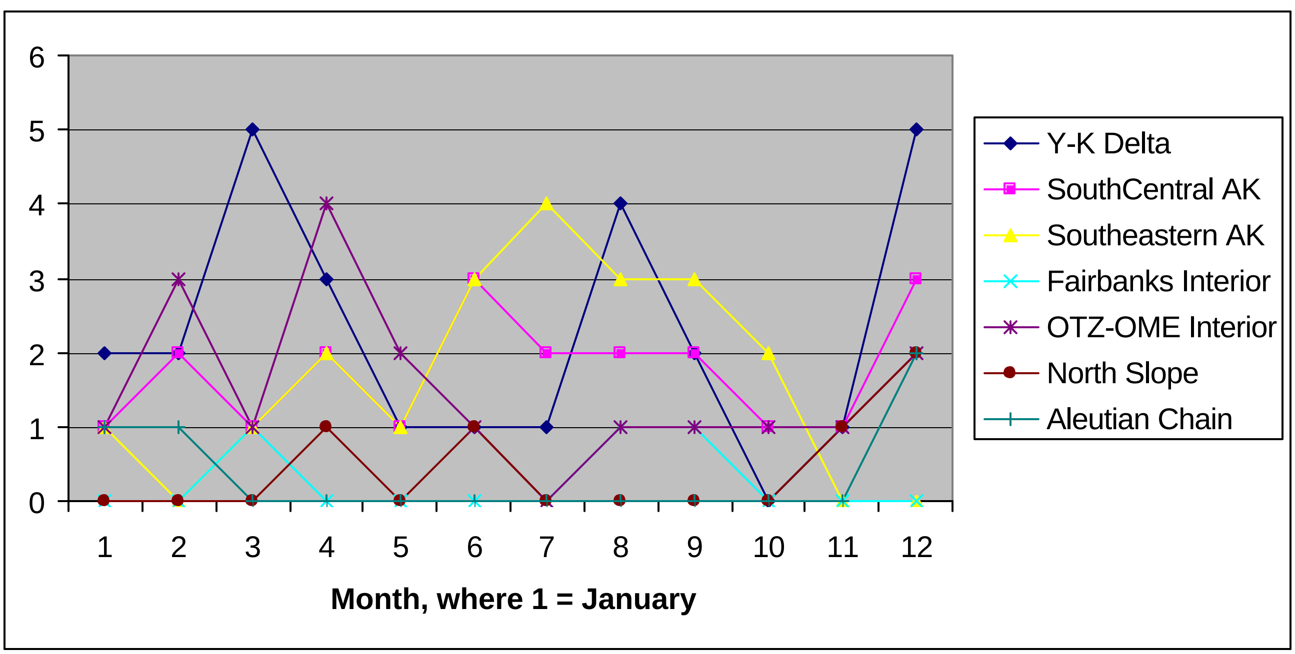


a. Regional Distribution versus Month

Examination of chart 20, the regional distribution of VFR into IMC crashes based upon months showed that the Y-K Delta had 3 significant spikes (March, August, December). The Kotzebue-Nome region had a single spike (April), and the SouthEastern region had a single spike in July.

The data available for this study was insufficient to develop any analyses based on regional climactic conditions. Undeterminable exposure data may also have an effect on the regional distribution of these VFR into IMC crashes. The beginning and end of the flying/tourist season and seasonal recurrent training may all be factors in this distribution.

Chart 20
All Certificates, n=98

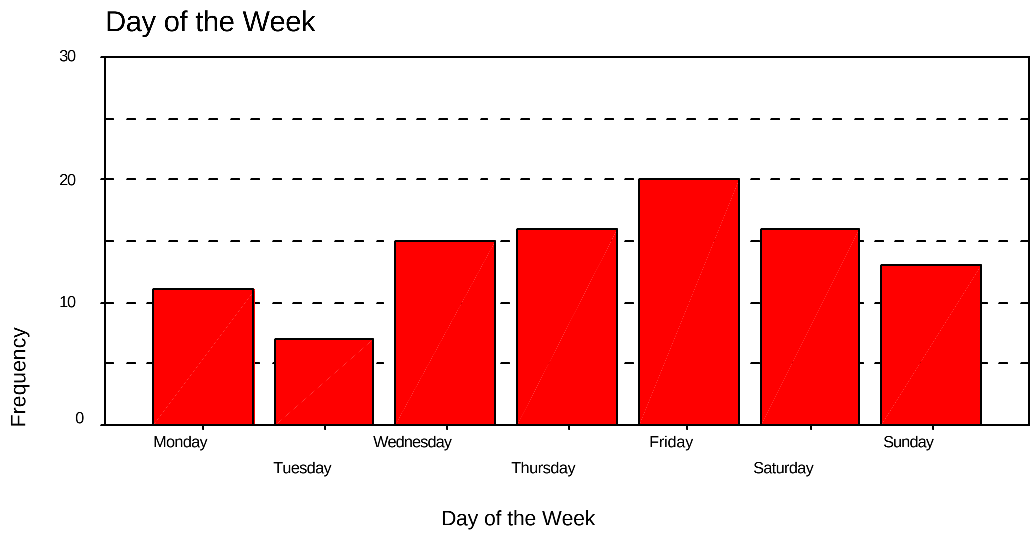


8. Daily Distribution

The daily distribution of VFR into IMC crashes may be considered important in answering questions such as whether or not management's location in relationship to the air carrier's main base of operations has an effect on pilot's decision-making processes; and could there be more exposure during a particular day; or can this daily distribution be attributed to predictable weather cycles.

The data available from NTSB reports and the FAA database systems used in this study contained insufficient information to answer these questions. Therefore the distribution in chart 21 is presented.

Chart 21
All Certificates (n=98)



This distribution shows that the latter part of the week, specifically Thursday, Friday, and Saturday has had the highest frequency of crashes. Some operators do not have the FAR required management co-located with many of their bases of operations. When the required management is not co-located, it would be important for the air carrier to have a good operational control system during air carrier operations. If the required management maintains operational control, and they leave the base of operations during the latter part of the week, this could indicate an inadequate operational control system. Other interesting questions, which might address the higher number of crashes in the latter part of the week, are whether or not pilots are on a rotating schedule? Are the pilot's families located near their base of operations or do the pilots travel to and from their homes and families? Are Pilot's travel days associated with the latter part of the week? Without more information these questions cannot be answered.

a. Regional Distribution versus Day of the Week

Over the years, many operators have moved their required management to a centralized location and de-centralized their flight operations. As an example, one large 135 operator, who holds commuter and on-demand operating authority, has based their required management in Anchorage, AK, while maintaining operations in locations such as Bethel, Emmonak, and St. Marys, AK. The question was whether or not the location of management played a part in these VFR into IMC crashes. The databases contained no information as to the primary location of the required management. A review of 5 operators showed that each outlying station had a station manager. However, this person usually was not one of the management individuals required by the Federal Aviation Regulations. Operations in rural Alaska take place throughout the week. Many flights may be occurring during the weekends and after hours. Again, this information is difficult to obtain because of the lack of record keeping. It is important to note, that this record keeping information is not required of the operator by any FAA regulations.

The review of the 5 operators showed that the required management, on occasions, would travel to the outlying stations. Although the management required by the FARs is responsible for the safety of all flight operations, there is no requirement or clear guidance in either the regulations or the company manuals for the required management to personally monitor flight activities during the after hours, or weekend time frames. However, the regulations are clear and require that operational control be maintained during air carrier operations. The FARs specifically assigns operational control to the Director of Operations and the Pilot in FAR Part 135 flight operations.

Table 6 below is a depiction of the regional distribution of VFR into IMC crashes based on the day of the week. The data shows that Friday is still the day with the highest VFR into IMC crashes (20), followed by Thursday and Saturday, each with 16 crashes.

Table 6

Frequency distribution of crashes during the day of the week versus regions. All Certificates, n=98

Day of the Week		Region	Frequency	Percent	Valid Percent	Cumulative Percent
Monday	Valid	Y-K Delta	2	18.2	18.2	18.2
		SouthCentral AK	3	27.3	27.3	45.5
		Southeastern AK	3	27.3	27.3	72.7
		Fairbanks Interior	1	9.1	9.1	81.8
		OTZ-OME Interior	2	18.2	18.2	100.0
		Total	11	100.0	100.0	
Tuesday	Valid	Y-K Delta	4	57.1	57.1	57.1
		SouthCentral AK	1	14.3	14.3	71.4
		Southeastern AK	1	14.3	14.3	85.7
		OTZ-OME Interior	1	14.3	14.3	100.0
		Total	7	100.0	100.0	
Wednesday	Valid	Y-K Delta	5	33.3	33.3	33.3
		SouthCentral AK	3	20.0	20.0	53.3
		Southeastern AK	5	33.3	33.3	86.7
		Fairbanks Interior	1	6.7	6.7	93.3
		OTZ-OME Interior	1	6.7	6.7	100.0
		Total	15	100.0	100.0	
Thursday	Valid	Y-K Delta	4	25.0	25.0	25.0
		SouthCentral AK	2	12.5	12.5	37.5
		Southeastern AK	2	12.5	12.5	50.0
		OTZ-OME Interior	5	31.3	31.3	81.3
		North Slope	2	12.5	12.5	93.8
		Aleutian Chain	1	6.3	6.3	100.0
		Total	16	100.0	100.0	
Friday	Valid	Y-K Delta	4	20.0	20.0	20.0
		SouthCentral AK	6	30.0	30.0	50.0
		Southeastern AK	5	25.0	25.0	75.0
		Fairbanks Interior	1	5.0	5.0	80.0
		OTZ-OME Interior	1	5.0	5.0	85.0
		North Slope	2	10.0	10.0	95.0
		Aleutian Chain	1	5.0	5.0	100.0
		Total	20	100.0	100.0	
Saturday	Valid	Y-K Delta	5	31.3	31.3	31.3
		SouthCentral AK	4	25.0	25.0	56.3
		OTZ-OME Interior	4	25.0	25.0	81.3
		North Slope	1	6.3	6.3	87.5
		Aleutian Chain	2	12.5	12.5	100.0
		Total	16	100.0	100.0	
Sunday	Valid	Y-K Delta	3	23.1	23.1	23.1
		SouthCentral AK	2	15.4	15.4	38.5
		Southeastern AK	4	30.8	30.8	69.2
		OTZ-OME Interior	4	30.8	30.8	100.0
		Total	13	100.0	100.0	

Because of the relatively low number of cases, there does not appear to be any major statistical anomaly. However, because of the relatively new management systems employed by many of the air carriers where the FAR required management is not co-located, more information would need to be gathered during investigations to determine the following:

1. Does the air carrier's frequency of flights increase during the latter part of the week, thereby increasing their "benefit driven risk[15]." (exposure)
2. Does the required management visit the outlying stations early in the week and leave prior to the weekend?
3. Do the pilots live near their base of operation or do they travel home for the weekends?
4. If flight crewmembers travel home on the weekends, is Friday their last day of work.
5. Are flight crewmembers scheduled to depart Friday evenings after their days work?
6. What repercussions do the flight crewmembers suffer if they miss their flight for home?

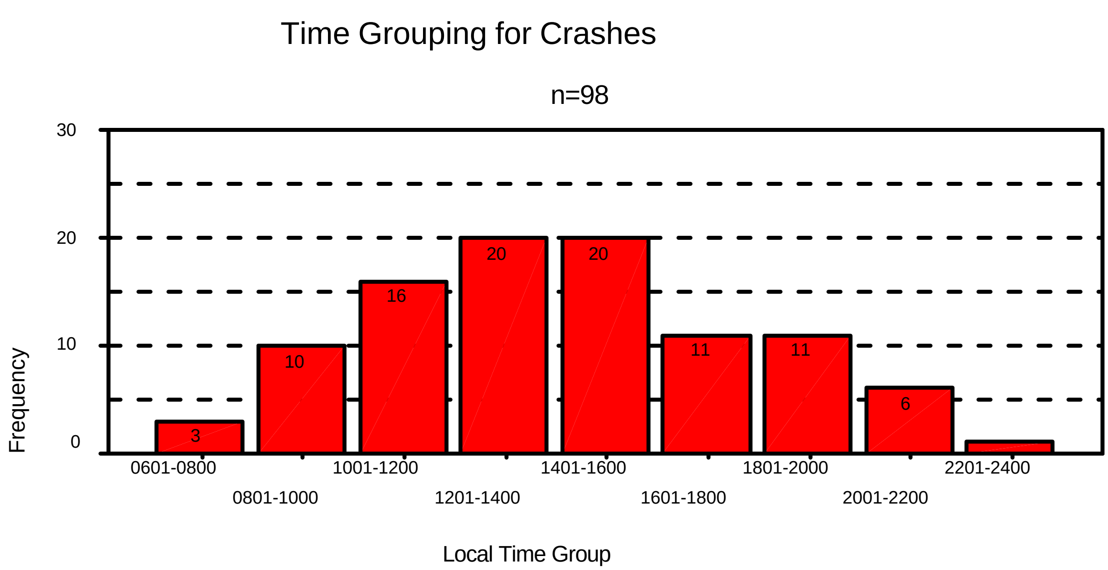
These questions are unanswered in this analysis because of insufficient information. This information has never been gathered because there has been no venue in which to store and no reason to analyze "soft[16]" data. The recent development of some limited analysis tools used to identify human factors as issues and concerns has changed the need for this data collection.

9. Time of Day Distribution

Chart 22 below shows the distribution of crashes based on 2-hour time groups. The 2-hour time groups were chosen arbitrarily and their grouping has no other significance.

This distribution, however, may be representative of the exposure based on departure times and number of flights during daylight hours. More research is needed. In any case, the afternoon hours appear to have the most significant frequency of crashes. More in-depth research needs to be accomplished to determine if there may be some association with physiological and/or biological factors.

Chart 22



[15] Benefit Drive Risk – derived from the four risk categories – Kobelnyk, 1991
The four risk categories are as follows: Uniformed risk; Informed Risk; Benefit Driven Risk; Pointless Risk. Benefit Driven Risk is defined, as any risk taken that would benefit the individual, operator, or anyone who caused the flight, in monetary terms, or other beneficial remuneration.

[16] "Soft" data is considered to be data dealing with human factors issued. This type of data is not necessarily supported by hard evidence except in cases of surviving flight crewmember interviews. Those interviews, in the past, have yielded a tremendous amount of information about human factors and that more data needs to be gathered.

a. Regional Distribution of Events Based on Time Groups

Table 7 shows the regional distribution of the categorized crashes based on time groups. The sampling was relatively small and the distribution appears to coincide with the hours of business and the daylight hours. However, this table shows that two regions have a slightly significant number of crashes during a specific time group. The Y-K Delta region shows 8 crashes during the 1401 to 1600 hour time frame and the SouthEastern and Kotzebue-Nome regions each show 6 crashes during the 1201 to 1400 hour time frame. These regions and time groups fall into the highest depicted time group category.

This information could be significant in terms of human factors. Human factors deals with the physiological and psychological aspects of the human. More research is needed to determine the significance of these time frames in these two regions.

Table 7
All Certificates, n=98

Local Time Group * Region Crosstabulation

Count

		Region							
		Y-K Delta	SouthCentral AK	Southeastern AK	Fairbanks Interior	OTZ-OME Interior	North Slope	Aleutian Chain	Total
Local Time Group	0601-0800	0	2	1	0	0	0	0	3
	0801-1000	4	2	3	0	1	0	0	10
	1001-1200	4	2	3	2	3	1	1	16
	1201-1400	3	3	6	0	6	0	2	20
	1401-1600	8	3	4	1	3	1	0	20
	1601-1800	4	3	1	0	1	1	1	11
	1801-2000	2	5	1	0	3	0	0	11
	2001-2200	1	1	1	0	1	2	0	6
	2201-2400	1	0	0	0	0	0	0	1
Total		27	21	20	3	18	5	4	98

Again, information on air carrier risk exposure based on flying hours was not available for this study. This information may reflect the normal hours of business in relationship to the tourist industry in specific regions. Also, further research is needed to identify possible associated factors such as localized weather conditions or phenomenon.

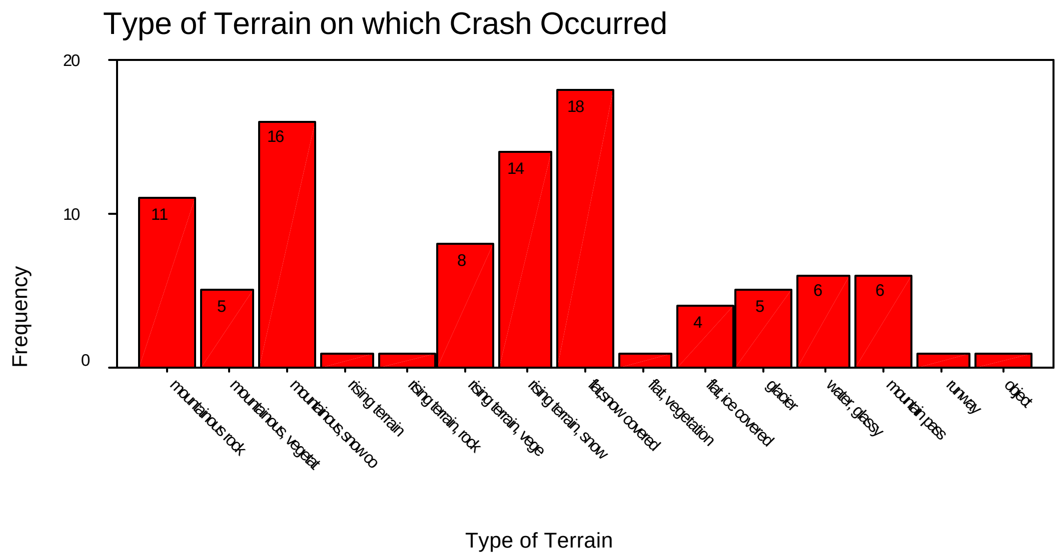
10. Terrain and Light Conditions

Since much of Alaska's flying is marked with long hours of daylight (summer) and long hours of darkness (winter), information concerning the terrain and light conditions was gathered and analyzed.

a. Terrain Conditions

This analysis showed that the greatest frequency of VFR into IMC crashes occurred on flat snow covered terrain, followed by mountainous snow covered terrain, and then by rising snow-covered terrain. However, these three highest frequency bars all involve snow-covered terrain, which accounts for approximately 49 percent of the crashes studied.

Chart 23
All Certificates



Since Alaska is considered to be a mostly mountainous region, it would have been no surprise if most VFR into IMC crashes occurred in mountainous terrain. However, it is a surprise that the highest category is "flat snow covered" terrain and the highest category for active certificates is "rising snow covered"[17]

b. Regional Distribution of Terrain Conditions

The cross tabulation table of the regional distribution of VFR into IMC crashes shows that the Y-K Delta region has a total of 12 crashes involving flat, snow covered terrain, which is the highest single number in this table. The other two significant numbers are found in SouthEastern Alaska with 6 crashes in mountainous, rock terrain, and then the Kotzebue-Nome region with 8 crashes in mountainous, snow covered terrain. This terrain distribution is not unusual base upon the topography of each of the regions.

Table 8
All Certificates, n=98

Type of Terrain * Region Crosstabulation

Count

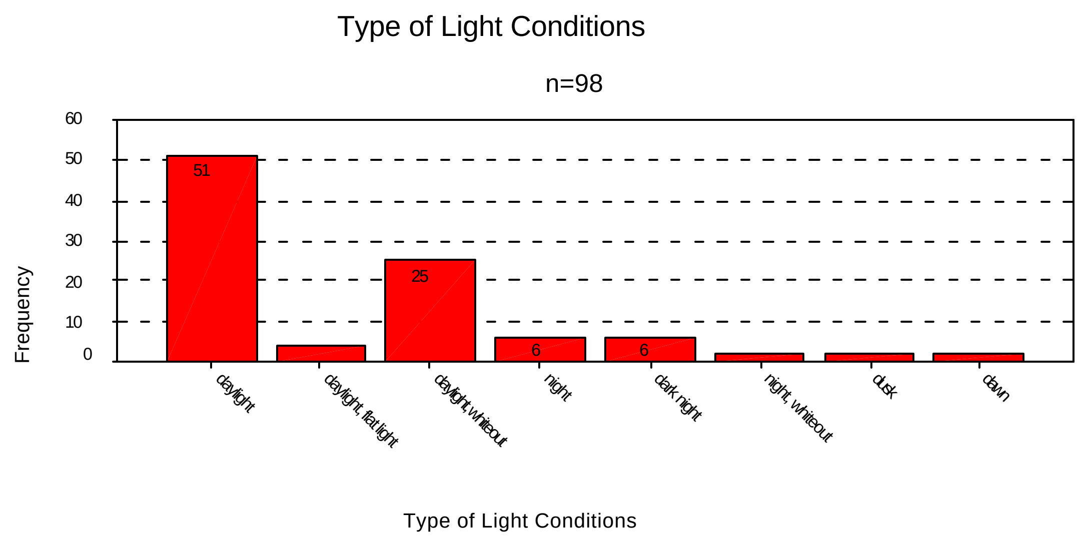
		Region							
		Y-K Delta	SouthCentral AK	Southeastern AK	Fairbanks Interior	OTZ-OME Interior	North Slope	Aleutian Chain	Total
Type of Terrain	mountainous rock	2	3	6	0	0	0	0	11
	mountainous, vegetation	2	2	1	0	0	0	0	5
	mountainous, snow covered	0	5	1	1	8	0	1	16
	rising terrain	0	0	1	0	0	0	0	1
	rising terrain, rock	1	0	0	0	0	0	0	1
	rising terrain, vegetation	3	1	2	0	1	0	1	8
	rising terrain, snow covered	4	4	0	0	4	0	2	14
	flat,snow covered	12	0	0	1	2	3	0	18
	flat, vegetation	0	0	0	0	0	1	0	1
	flat, ice covered	1	0	0	0	2	1	0	4
	glacier	0	1	4	0	0	0	0	5
	water, glassy	1	3	2	0	0	0	0	6
	mountain pass	0	2	3	1	0	0	0	6
	runway	1	0	0	0	0	0	0	1
	object	0	0	0	0	1	0	0	1
Total		27	21	20	3	18	5	4	98

[17] The term rising snow-covered terrain differs from mountainous terrain in that the terrain gradually rises from an imperceptible noticeable rise. This type of terrain, when coded by NTSB investigators is not normally association with mountains and is subjective. There was no attempt in this study to review the types of terrain for coded accuracy.

c. Light Conditions

The light condition for the overall data set is shown in chart 24 below. This chart shows that 51 percent of the crashes occurred during daylight hours and another 25 percent occurred during daylight, whiteout conditions. This means that over 75 percent of VFR into IMC crashes occurred during daylight hours. Again, this information should be compared to the flying hour exposure of the air carriers and their normal hours of business. The significant number, however, is that only 25 percent of these crashes have been attributed to whiteout conditions. Based on information from chart 23, where 49 percent of these crashes have occurred on snow covered terrain, it would have been a reasonable assumption for whiteout conditions to have played a larger factor in the VFR into IMC crashes.

Chart 24
All Certificates



d. Regional Distribution of Light Conditions

Examination of Table 9, which is a regional distribution of light conditions involving VFR into IMC crashes, shows the two highest categories are daylight and daylight with whiteout conditions. The distribution shows no significant difference from the overall statistical analysis.

Table 9
All Certificates, n-98

Region * Type of Light Conditions Crosstabulation

Count

		Type of Light Conditions								
		daylight	daylight, flat light	daylight, whiteout	night	dark night	night, whiteout	dusk	dawn	Total
Region	Y-K Delta	14	0	9	1	1	1	1	0	27
	SouthCentral AK	12	0	4	3	1	1	0	0	21
	Southeastern AK	14	2	2	0	0	0	0	2	20
	Fairbanks Interior	2	1	0	0	0	0	0	0	3
	OTZ-OME Interior	5	1	8	0	3	0	1	0	18
	North Slope	2	0	0	2	1	0	0	0	5
	Aleutian Chain	2	0	2	0	0	0	0	0	4
Total		51	4	25	6	6	2	2	2	98

11. Direction, Distance, and Leg of Flight

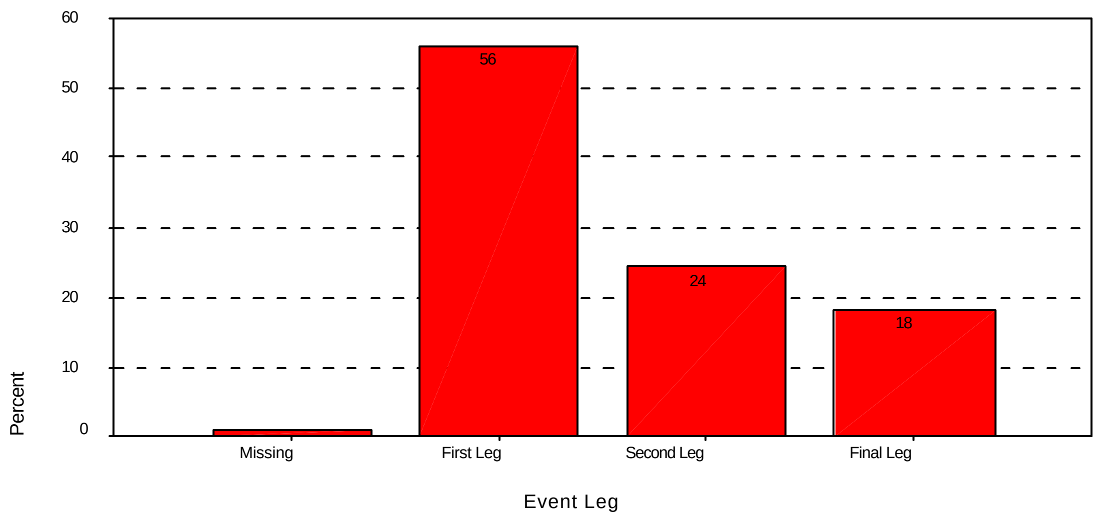
This next section was an attempt to determine the direction of flight, either inbound or outbound, the distance from the departure point or airport, and which leg of flight the crash occurred once VFR into IMC conditions were encountered.

a. Direction and Leg of Flight

Chart 25, page 49, shows that over 56 percent of the VFR into IMC crashes occurred during the first leg of flight, either outbound from the departure airport, or inbound to the first destination. The determining factor for inbound or outbound legs was the point of no return, the midway point for that leg of flight. The developed SPSS database also had columns for third, fourth, fifth, and sixth legs of flights. The analysis did not show any crashes in these successive legs of flight. The significance of this information shows that most of the VFR into IMC crashes occurred during the first leg of flight.

This review is important because an age-old argument[18] used by operators and the industry is that there is insufficient weather reporting facilities to adequately assess the weather prior to departure. If 50 percent of these crashes occurred during the first leg of flight some consideration must be given to determine if weather information was available prior to departure, if the flight crew used the weather, and the weather information's accuracy.

Chart 25
All Certificates, n=98
Leg Event

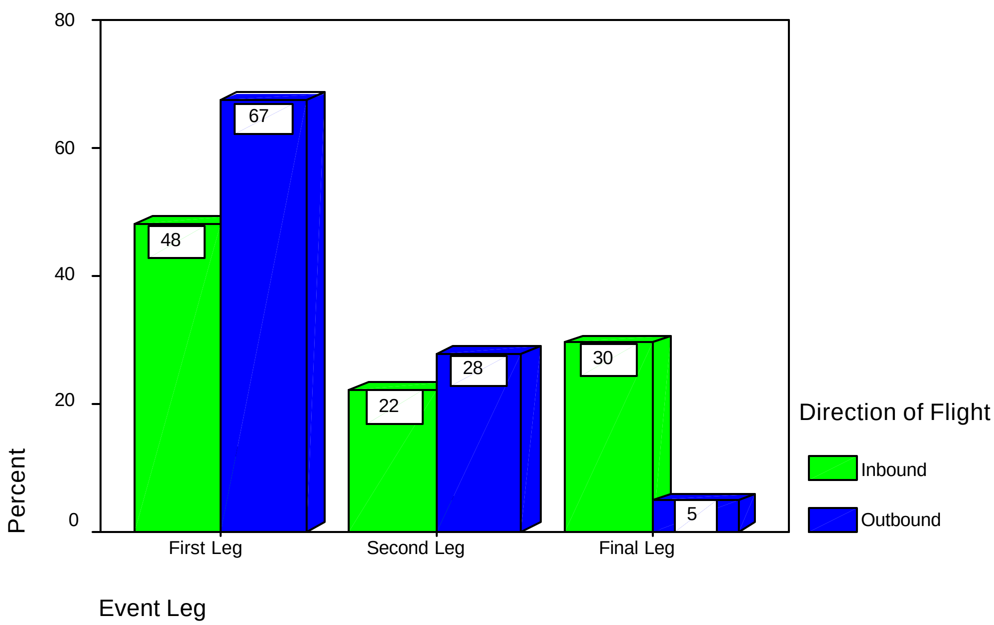


The second leg of flight accounted for only 24 percent of the VFR into IMC crashes distributed evenly between inbound and outbound legs as shown in Chart 26. Chart 25 also shows the final leg of flight, which had 18 percent of the crashes. The final leg was determined to be that leg of flight where a full stop, flight termination landing was to occur. This leg could have been the return leg of a single leg flight, or the final leg of a multiple leg flight. Flights consisting of only one leg were classed as outbound or inbound in the first leg column.

[18] As an NTSB investigator in the Alaska Office for 15 years, this argument has been proffered during many accident investigations. This information is based upon professional experience in the field.

The next chart, Chart 26, is a comparison of the direction of flight versus the leg of flight during which the crash took place. Again the chart shows only three legs, the first, the second, and the final leg. This shows that 67 percent of flights crashed during the first leg while outbound from its original departure point. Where as 48 percent of flights on the first leg, crashed while inbound to their first stop or destination. The significance is that on the first leg and the second leg there was a higher percentage of crashes while the flight was on the outbound leg of flight. The final leg had a higher percentage of crashes on the inbound leg, which could be attributed to a "get-home-itis"[19] human factors issue.

Chart 26
All Certificates, n=98
Direction of Flight versus Leg of Flight



After reviewing the above data and determining that most VFR into IMC crashes occurred on the first leg of flight, the following questions were raised.

1. How far from the airport was the crash?
2. Did the pilot have weather reporting facilities available?
3. How far away were these facilities?
4. Was the pilot aware of the weather?
5. Could the pilot have gotten in-flight weather reports?
6. Was there an instrument approach available?
7. How far away was the instrument approach procedure from the crash site.

The next few charts will attempt to answer these questions.

[19] Get-home -itis is a term normally associated with flight crews or passengers whose benefit driven risk far outweighs the informed risk. The pilot, or through client pressure, decides that continuing the flight is preferable to any delays; such as the last leg of the day and everyone wants to go home.

b. Distance from Airport

Chart 27 shows the distance from the airport of the 98 VFR into IMC crashes used in this study. Approximately 28 percent of the crashes occurred within 5 miles of the airport. This chart does not distinguish if the airport was the departure airport, first leg destination airport, or the final destination airport. Some of the information was not contained in the accident reports and could not be constructed from available data. For those cases with missing or unavailable data, they were included and are listed as missing or undeterminable. The data categorized in this chart is mutually exclusive. Once a crash was included in one category, it was not included in another.

Chart 27
All Certificates
Distance of Crash from Airport
n=98

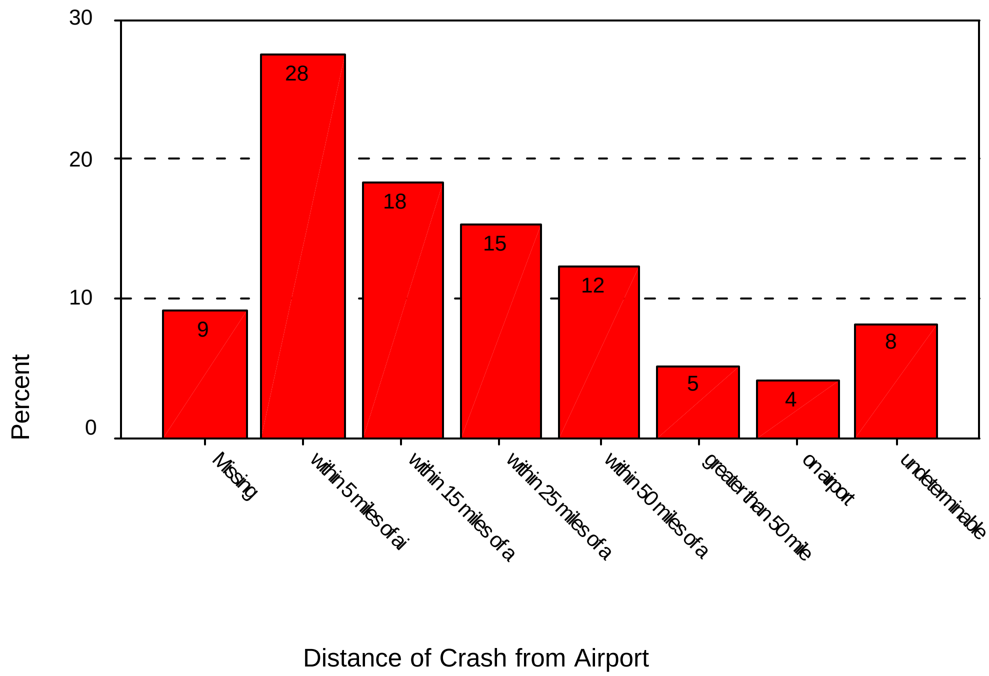


Chart 27 shows that if the distances from the airport of 5, 15, and 25 mile categories are grouped together, they account for approximately 53 percent of the VFR into IMC crashes. This means that over half of the VFR into IMC crashes occurred within 25 miles of an airport.

c. Regional Distribution of Distance, Direction, and Leg

The information contained in the cross tabulation table, table 10, listed on page 49, shows the regional distribution of the direction, distance, and leg of flight. Although the overall data set shows that most VFR into IMC crashes occurred on the first leg, outbound from the departure airport, and within 25 miles of the airport, the regional distribution shows some different data sets. The Y-K Delta region, as an example has a total of 11 crashes occurring within 25 miles of the airport and 9 of those 11 crashes occurred during the first leg of flight while inbound to their destination. This difference means that against the overall data set, flights in the Y-K Delta are traveling beyond their point of no return during their first leg of flight. This may be significant when this information is compared to the type of terrain associated with the Y-K Delta region.

Table 10

Direction of Flight * Region * Distance of Crash from Airport * Event Leg Crosstabulation

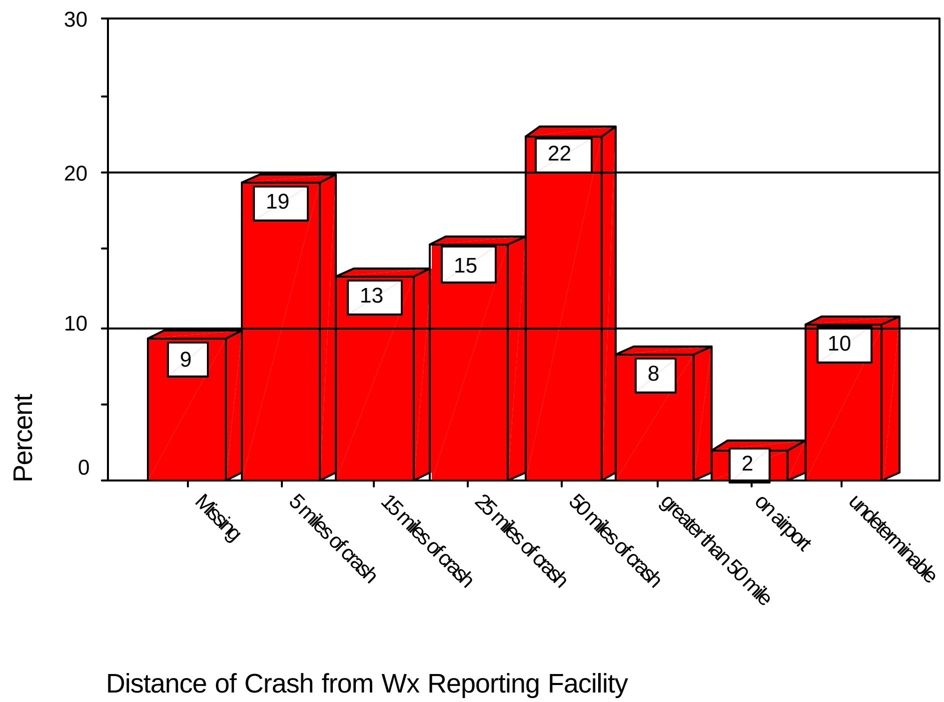
Count

Event Leg	Distance of Crash from Airport			Region							Total
				Y-K Delta	SouthCentral AK	Southeastern AK	Fairbanks Interior	OTZ-OME Interior	North Slope	Aleutian Chain	
First Leg	within 5 miles of airport	Direction of Flight	Inbound	6	3	0		2	4		15
			Outbound	2	0	2		1	0		5
		Total		8	3	2		3	4		20
	within 15 miles of airpo	Direction of Flight	Inbound	3	0	2		1			6
			Outbound	0	2	0		2			4
		Total		3	2	2		3			10
	within 25 miles of airpo	Direction of Flight	Inbound			1		1			2
			Outbound			3		1			4
		Total				4		2			6
	within 50 miles of airpo	Direction of Flight	Outbound	1	1	2				2	6
		Total		1	1	2				2	6
	greater than 50 miles	Direction of Flight	Outbound		1			1			2
		Total			1			1			2
	on airport	Direction of Flight	Inbound	1	1						2
		Total		1	1						2
	undeterminable	Direction of Flight	Outbound	3							3
		Total		3							3
Second Leg	within 5 miles of airport	Direction of Flight	Inbound	1							1
		Total		1							1
	within 15 miles of airpo	Direction of Flight	Inbound	0	3	1		0			4
			Outbound	1	1	0		1			3
		Total		1	4	1		1			7
	within 25 miles of airpo	Direction of Flight	Inbound		0	1	1	0			2
			Outbound		1	1	0	1			3
		Total			1	2	1	1			5
	within 50 miles of airpo	Direction of Flight	Inbound	1	1						2
			Outbound	0	2						2
		Total		1	3						4
	greater than 50 miles	Direction of Flight	Inbound				1				1
		Total					1				1
	on airport	Direction of Flight	Inbound						1		1
		Total							1		1
	undeterminable	Direction of Flight	Outbound	1	1	1					3
		Total		1	1	1					3
	none available	Direction of Flight	Outbound		1						1
		Total			1						1
Final Leg	within 5 miles of airport	Direction of Flight	Inbound	1	1			3			5
			Outbound	1	0			0			1
		Total		2	1			3			6
	within 15 miles of airpo	Direction of Flight	Inbound					1			1
		Total						1			1
	within 25 miles of airpo	Direction of Flight	Inbound			2		1		1	4
		Total				2		1		1	4
	within 50 miles of airpo	Direction of Flight	Inbound	1							1
			Outbound	1							1
		Total		2							2
	greater than 50 miles	Direction of Flight	Inbound	1	1						2
		Total		1	1						2
	on airport	Direction of Flight	Inbound				1				1
		Total					1				1
	undeterminable	Direction of Flight	Inbound	1							1
		Total		1							1

12. Weather Reporting Distance from Crash Site

A review of the previous charts raised more questions. One answered question dealt with where the VFR into IMC crashes occurred in relationship to the airport. The information from Chart 27 shows that 53 percent of these types of crashes occurred within 25 miles of the departure airport. Since these crashes involved VFR into IMC, the next question is logical, did those flights have weather-reporting facilities[20] available. The data in this chart is mutually exclusive.

Chart 28
All Certificates, n=98
Distance of Weather Reporting Facility from Crash Site



When the same distance criteria, 25 miles from the airport, was used to determine the availability of weather facilities, Chart 28 showed that approximately 47 percent of the VFR into IMC crashes had weather reporting facilities available. Approximately 10 percent of the crashes had insufficient detail in the accident reports, or the data was not developable to determine if weather-reporting facilities were available. The accident reports had missing data in 9 percent of the cases.

a. Regional Distribution of Weather Reporting Facilities

The regional distribution of the comparison of weather reporting facilities versus distance from the crash site supports the overall data set and shows no significant difference. Some of the data in the NTSB accident report was not filled out, nor was it found in the NTSB narrative. This data block was then left blank when entered into SPSS and not used in the count calculations for table 11. However, the numbers of crashes in two regions, the Y-K Delta and the SouthCentral regions, have their highest number of crashes in the 50 mile distance. The data in this chart is mutually exclusive.

[20] Weather reporting facility was determined to be any reporting station where information would normally be transmitted to a Flight Service Station for dissemination. This included not only actual observers but AWOS and ASOS as well.

Table 11

Region * Distance of Crash from Wx Reporting Facility Crosstabulation

Count

		Distance of Crash from Wx Reporting Facility							
		within 5 miles of crash	within 15 miles of crash	within 25 miles of crash	within 50 miles of crash	greater than 50 miles	on airport	undeterm inable	Total
Region	Y-K Delta	6	1	1	8	1	1	8	26
	SouthCentral AK	2	6	0	7	3	0	2	20
	Southeastern AK	2	2	8	4	0	0	0	16
	Fairbanks Interior	0	0	1	0	1	1	0	3
	OTZ-OME Interior	6	4	4	1	1	0	0	16
	North Slope	3	0	0	0	2	0	0	5
	Aleutian Chain	0	0	1	2	0	0	0	3
Total		19	13	15	22	8	2	10	89

Case Processing Summary

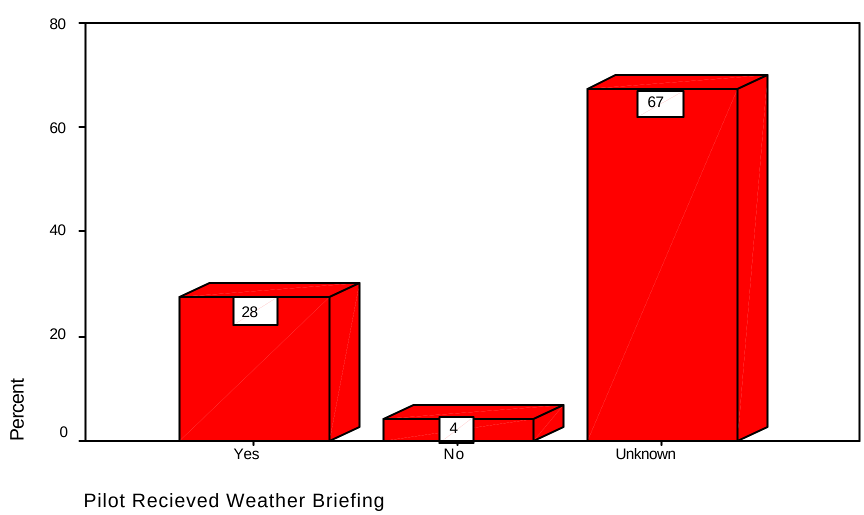
	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Region * Distance of Crash from Wx Reporting Facility	89	90.8%	9	9.2%	98	100.0%

13. Percentage of Pilots Known to have Received a Weather Briefing

A comparison had to be made between weather reporting facility availability and the pilot's use of those facilities in terms of receiving a weather briefing. Previous charts showed that at least 57 percent of the VFR into IMC crashes had weather reporting facilities or information available at some point, either prior to the departure or during the flight. Chart 29 shows that only 28 percent of the pilots were known to have received a weather briefing. This number may be higher, but the NTSB reports were not conclusive in determining whether or not a pilot received a weather briefing. As Chart 29 depicts, 67 percent of the pilots fall into the unknown category.

Pilots in this category may have received a weather briefing from an unapproved source. Since there are no records available, they were placed into the unknown category.

Chart 29
All Certificates, n=98
Percentage of Pilots Known to have received a Weather Briefing



The next question was to determine if the pilot was aware of the weather before departure. To determine this, the NTSB accident reports were reviewed including the narrative sections. If the departure airport had a weather reporting facility, and the weather was reported as less than VFR minimums, (1000 foot ceiling and 3 miles of visibility), it was presumed that the pilot was aware of the weather conditions whether or not he or she had received a weather briefing. It would stand to reason that if a pilot were to step outside and look, the less than VFR weather conditions would have been be noticed.

Furthermore, under FAR Part 135 flight rules, when the ceiling is below 1,000 feet, the pilot must have 2 miles of in-flight visibility while operating in Class E[21] airspace. In some of the crashes, the pilots departed the airport, with a co-located weather reporting facility, under special VFR conditions that required only 1 mile of in-flight visibility in Class D[22] airspace. In the two cases reviewed in this study, the pilot was presumed to have been aware of the weather, and as allowed by the regulations under FAR Part 135, used his or her actual observance of the weather conditions.

Chart 29 shows that only 28 percent of the pilots received a weather briefing. The chart also shows that 67 percent fall into the unknown category. This means that the NTSB accident report contained insufficient data, and other records were not available, to determine if the pilot received a weather briefing. This is significant because it could point to the industry's lack of use of current facilities or it indicates an accident data collection/retention problem.

a. Regional Distribution of Percentage of Pilots who received a Weather Briefing

The regional distribution of this information in Table 12 shows that the Y-K Delta region as having the highest number of unknown cases. Another interesting point of information in this Table is the Kotzebue-Nome region where of the 17 total cases, the table shows that 10 pilots actually received a briefing with only 7 falling into the unknown category.

Table 12

Region * Pilot Recieved Weather Briefing Crosstabulation

Count

		Pilot Recieved Weather Briefing			
		Yes	No	Unknown	Total
Region	Y-K Delta	4	0	23	27
	SouthCentral AK	5	3	13	21
	Southeastern AK	4	1	15	20
	Fairbanks Interior	1	0	2	3
	OTZ-OME Interior	10	0	7	17
	North Slope	3	0	2	5
	Aleutian Chain	0	0	4	4
Total		27	4	66	97

The source for the data in Table 12 was lacking and consequently the information was insufficient to determine if pilots were purposely not receiving a weather briefing. As mentioned in the beginning of this section, pilots may have received a weather briefing or weather information from some other unapproved source.

[21] Class E airspace is considered to be that airspace that is uncontrolled.
[22] Class D airspace is the new nomenclature used in the National Airspace System. Many of the old reports used the old terminology, control zone. This airspace is controlled.

14. Percentage of Pilots Aware of the Weather

More importantly is not whether pilots received a weather briefing but if they were aware of the weather prior to their departure. Under the current Federal Aviation Regulations, a pilot may take off for a destination if there is no weather reporting facility and determine from his/her own observation if the flight is safe to continue. The information used in charts 30 and table 13 came primarily from the NTSB accident report. It was determined by reviewing the data in each accident case used in this study, that if the weather at the departure point was similar to the weather at the accident site, then the pilot was considered to be aware of the weather conditions at the time of departure. Consequently, Chart 30 shows that 73 percent of the pilots were aware of the weather conditions at the time of departure. This information reduces the importance of whether or not the pilot received a weather briefing.

Chart 30
All Certificates, n=97
Percentage of Pilots Aware of the Weather

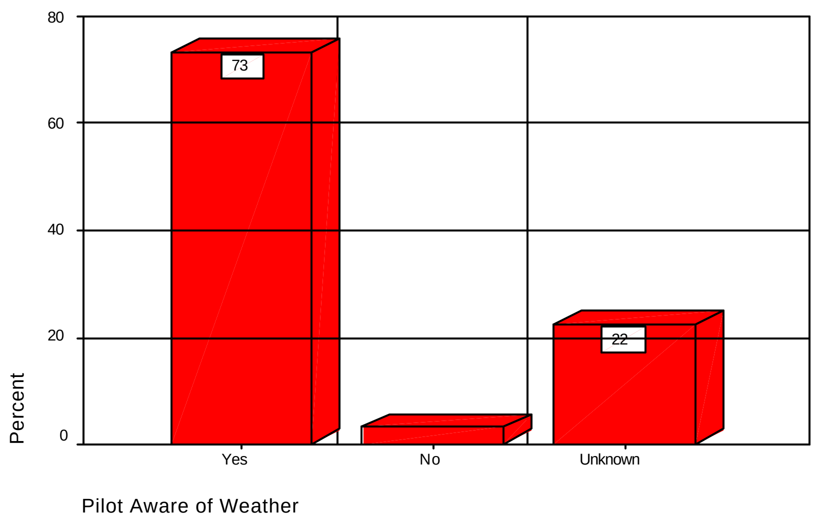


Chart 30 shows that 73 percent of the pilots were aware of the weather conditions either prior to departure, during departure, or just prior to the crash[23].

This statistic is a very rough approximation of subjective data and deserves future increased attention during accident investigations and data gathering. The fatality rate among the flight crewmembers involved in this type of crash is high and resultantly difficult to obtain first hand information to confirm the pilot's knowledge of weather conditions. Other sources[24] of weather information were relied upon to assess the pilot's knowledge of the weather conditions.

[23] Whether or not the pilot was aware of the weather just prior to the crash was determined by analyzing the weather at the departure airport with a weather reporting facility, and the reported weather by rescuers, State Troopers, inspectors, or investigators. If there was no appreciable change in the weather, it was determined that the pilot was aware of the weather conditions along the entire flight path because the weather situation had not changed since the flight's departure.

[24] The investigator in charge of the crash investigation used other sources of weather to determine the crash site weather conditions. Those sources could have included the first people on the crash scene, other pilots, State Troopers, company personnel, rescue personnel, or residents of the area. The source of the weather may or may not be identified in the NTSB's accident report.

a. Regional Distribution of Pilot's Awareness of Weather Conditions

The cross tabulation table shows the regional distribution concerning the pilot's awareness of the weather conditions. The table shows very few numbers in the "no" category indicating that pilots were not aware of the weather conditions at the time of departure. The "unknown" category meant that there was insufficient information in the NTSB accident report to determine the pilot's weather awareness.

Table 13

Region * Pilot Aware of Weather Crosstabulation

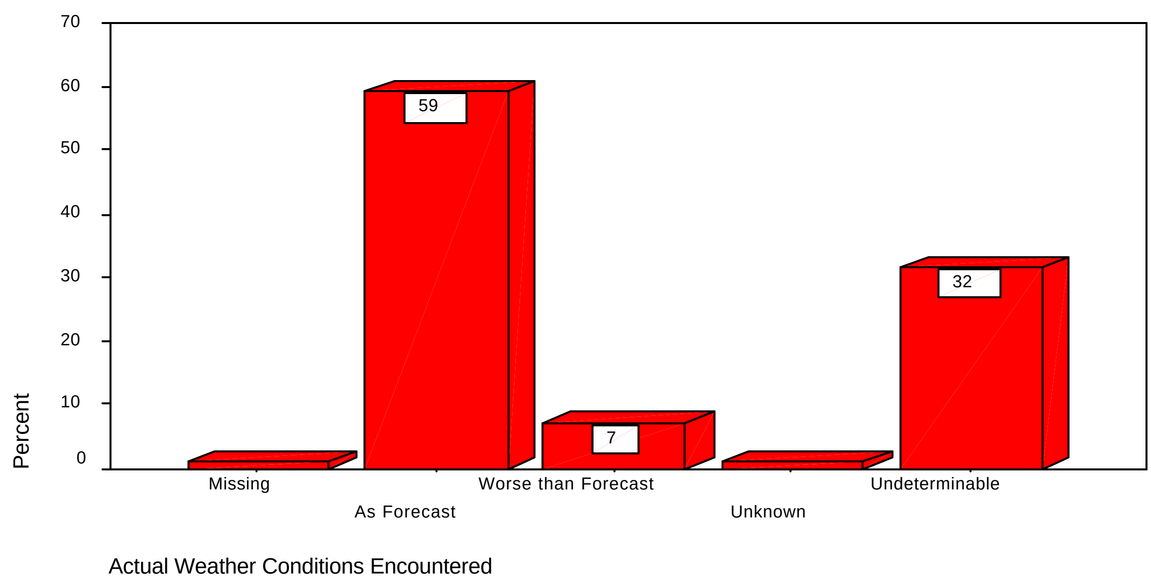
Count

		Pilot Aware of Weather			
		Yes	No	Unknown	Total
Region	Y-K Delta	18	0	9	27
	SouthCentral AK	19	1	1	21
	Southeastern AK	10	2	8	20
	Fairbanks Interior	3	0	0	3
	OTZ-OME Interior	16	0	1	17
	North Slope	5	0	0	5
	Aleutian Chain	1	0	3	4
Total		72	3	22	97

15. Actual Weather Conditions Encountered vs. Forecast Weather

Accuracy of weather information is of paramount importance. However, even though weather forecasts may be inaccurate, it does not relieve any flight crewmember of the responsibility of following the regulations, which require minimum weather conditions for flight. Chart 31 below shows that based on the data contained in the NTSB accident reports, approximately 59 percent of the crashes had weather as forecast. Only 7 percent of the cases the weather was worse than forecast.

Chart 31
All Certificates, n=98
Actual Weather Conditions Encountered vs Forecast Weather



a. Regional Distribution of Actual Weather Conditions Encountered

The following table was included for review by the reader and to show corroborating data for the charts. Of the 7 regions shown in this table, 3 regions had no weather indicated worse than the forecasted weather. Another significant point is that the unknown numbers are relatively low. However, since the undeterminable number is approximately 32 percent of the total, some of the unknown data is probably included in that category. The Fairbanks Interior Region, as mentioned earlier in this study, has a relatively low number throughout all the categories.

Table 14

Region * Actual Weather Conditions Encountered Crosstabulation

Count

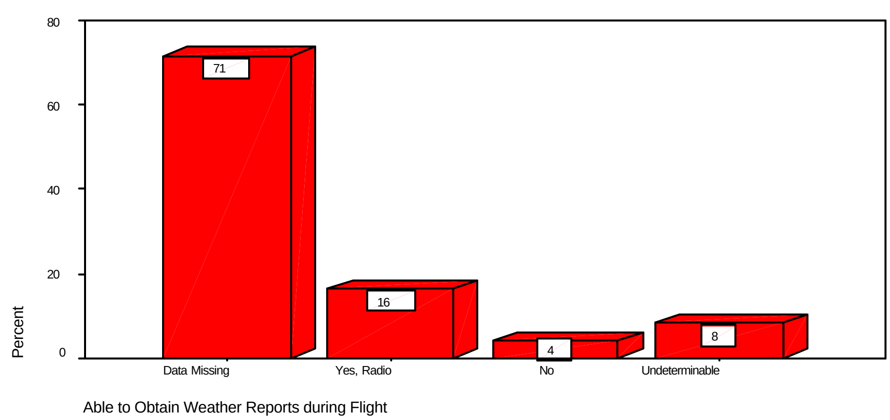
		Actual Weather Conditions Encountered				
		As Forecast	Worse than Forecast	Unknown	Undeterm inable	Total
Region	Y-K Delta	12	2	1	12	27
	SouthCentral AK	15	1	0	5	21
	Southeastern AK	9	2	0	9	20
	Fairbanks Interior	3	0	0	0	3
	OTZ-OME Interior	13	2	0	2	17
	North Slope	4	0	0	1	5
	Aleutian Chain	2	0	0	2	4
Total		58	7	1	31	97

16. Potential for in-flight weather Briefings

An attempt was made to determine how many flights had the ability to obtain in-flight weather information. Each pilot had the potential for receiving in-flight weather information because the aircraft was normally equipped with radio equipment for two-way communication. However, since VHF radio waves effectively travel in a straight line, a surface station would have an electronic horizon of approximately 10 to 12 miles. If either station, such as an aircraft in flight, increases their height above the surface, the distance of the electronic horizon increases. The data contained in the NTSB reports was insufficient to obtain a reasonable determination. However, when analysis of the data could be positively used to determine the pilot's ability to either receive or not receive in-flight weather information, it was so noted in Chart 32.

Chart 32 shows an emphatic 16 percent of the pilots were in a position where the electronic horizon encompassed the intended flight path of the aircraft. Only 4 percent of the flights could not have obtained in-flight weather information. The chart also shows that for 71 percent of the flights there was insufficient information to make any evaluation and these were classed as "data missing".

Chart 32
All Certificates, n=98
Percentage of Flights with Potential for Receiving in-flight Weather Information



a. Regional Distribution of Potential in-flight Weather Availability

The regional distribution of whether or not the pilot could have received in-flight weather shows no appreciable change from the statewide statistical information. This information can be validated by the information mentioned earlier in this study where many of these VFR into IMC crashes took place during the first leg of flight, within 25 miles of the departure airport, all of which had either a weather reporting facility co-located or weather information available.

Table 15

Region * Able to Obtain Weather Reports during Flight Crosstabulation

Count

		Able to Obtain Weather Reports during Flight				Total
		Yes, Radio	No	Undeterminable	Data Missing	
Region	Y-K Delta	3	0	4	20	27
	SouthCentral AK	2	2	1	16	21
	Southeastern AK	1	2	1	16	20
	Fairbanks Interior	2	0	0	1	3
	OTZ-OME Interior	6	0	1	11	18
	North Slope	2	0	1	2	5
	Aleutian Chain	0	0	0	4	4
Total		16	4	8	70	98

17. Instrument Approach Availability

This section of the study attempted to address the role of the IFR infrastructure. Did the flight crews have instrument approach facilities available and how far away from the crash site was the instrument approach facility located?

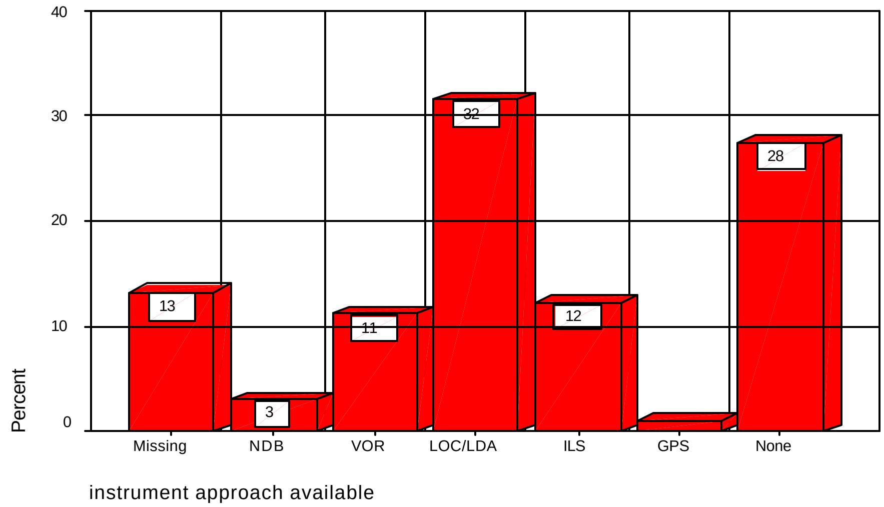
This raised some interesting questions because under FAR Part 135 passenger operations in single engine airplanes, instrument flight in single engine airplanes in IMC conditions is prohibited with the exception of certain aircraft such as the Cessna 208 Caravan. Furthermore, many of the destinations were not equipped with instrument approach facilities and the flight would have to be conducted under visual flight rules regardless.

The data in this study suggests that many of the flights departed in conditions that were less than VFR. Because IFR flight is not authorized in FAR Part 135 single engine passenger carrying operations, the flight crewmembers may have been reluctant to use the facilities available to them, once they found themselves in an undesirable situation.

Chart 33 shows that 28 percent of the crashes had no instrument approach facility available[25] during their flight. The data for 13 percent of the flights was missing or undeterminable. The remainder of the flights, 59 percent, had an instrument approach facility and procedure available during their flight, at the time of their crash.

[25] Instrument approach facility availability was determined to be any facility that was within 25 miles of the crash site.

Chart 33
All Certificates, n=98
Instrument Approach Availability



a. Regional Distribution of Instrument Approach Availability

The regional distribution for this information was important because of the remote location of many of the airports in various locations in the State of Alaska. The "no" category was viewed and it showed that the Y-K Delta had the highest number (10) of crashes where no instrument approach facility was available. The Y-K Delta region was followed by the SouthCentral region and then the SouthEastern region with 8 and 4 crashes respectively.

Table 16

Region * instrument approach available Crosstabulation

Count

		instrument approach available						Total
		NDB	VOR	LOC/LDA	ILS	GPS	None	
Region	Y-K Delta	1	3	9	1	0	10	24
	SouthCentral AK	0	3	6	3	0	8	20
	Southeastern AK	0	1	7	3	0	4	15
	Fairbanks Interior	0	1	0	2	0	0	3
	OTZ-OME Interior	0	1	9	2	0	3	15
	North Slope	1	0	0	1	1	2	5
	Aleutian Chain	1	2	0	0	0	0	3
Total		3	11	31	12	1	27	85

Case Processing Summary

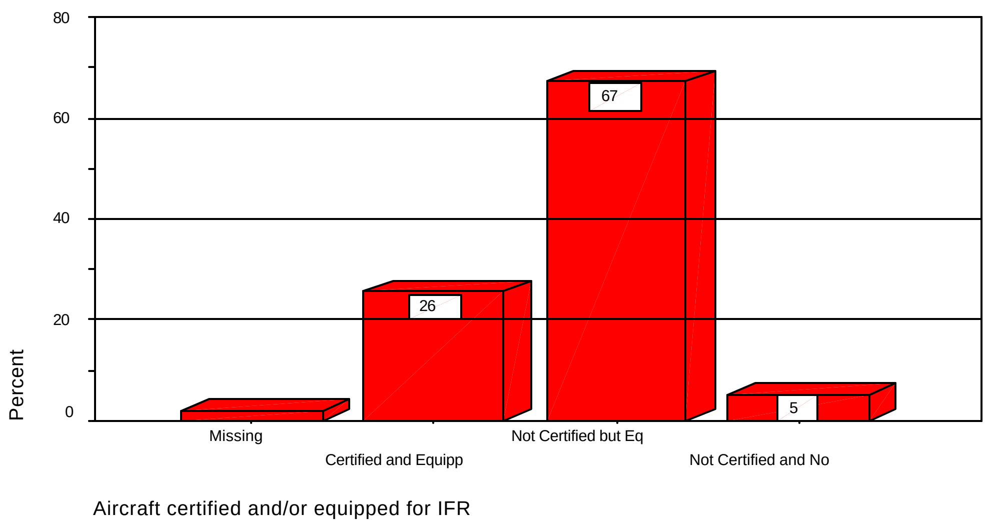
	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Region * instrument approach available	85	86.7%	13	13.3%	98	100.0%

18. Aircraft IFR Certification and Equipment

The information shown in the previous section, section 16, indicated that instrument approach facilities were available to 59 percent of flights involved in VFR into IMC crashes. However, having the facility available does not mean the aircraft or the pilot would be able to use the facility and equipment to the fullest capability. The next two charts show the distribution of aircraft IFR certification and whether or not the aircraft was equipped for IFR flight. Some of this data came directly from the NTSB accident report. Other data had to be gleaned from the narrative and other sources. If an aircraft was normally manufactured with sufficient instrumentation to conduct IFR flight it was assumed to be equipped for IFR flight even though it may not have been certified.

Chart 34 shows that 26 percent of the aircraft involved in VFR into IMC crashes were equipped and certified to operate in IMC. However, the status of the equipment was not determinable and was assumed to be functioning at the time of the crash. The chart shows that 67 percent of the aircraft were equipped but not certified to operate in IMC. Only 5 percent of the aircraft were not equipped nor certified for IMC.

Chart 34
All Certificates, n=98
Aircraft IFR Certification and Equipment



a. Regional Distribution of Aircraft IFR Certification

Regional distribution of aircraft equipment and certification, Table 17, showed no appreciable change. The largest category, aircraft equipped but not certified, remained the largest category in each region with the exception of the North Slop region where 4 out of the 5 aircraft involved in VFR into IMC crashes were equipped and certified for flight into IMC.

Table 17

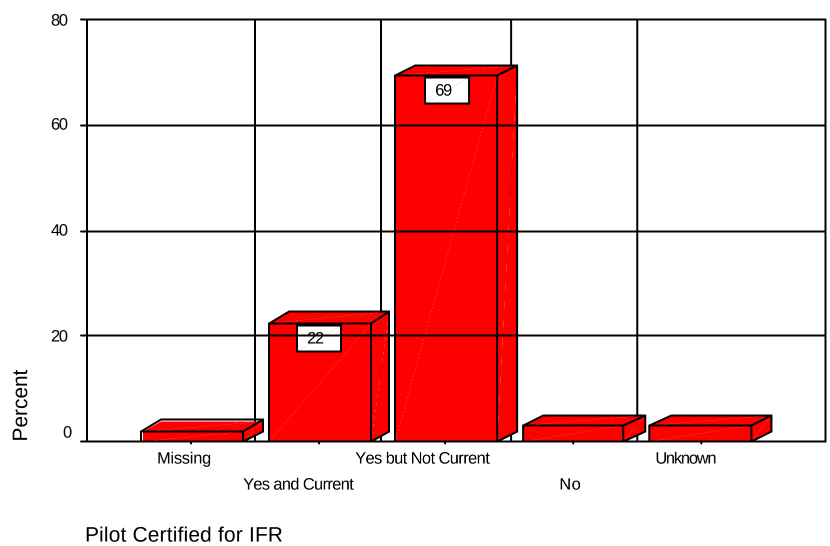
Region * a/c certified and/or equipped for IFR Crosstabulation

			a/c certified and/or equipped for IFR			
			Certified and Equipped	Not Certified but Equipped	Not Certified and Not Equipped	Total
Region	Y-K Delta	Count	5	22	0	27
	SouthCentral AK	Count	5	13	2	20
	Southeastern AK	Count	2	16	2	20
	Fairbanks Interior	Count	0	3	0	3
	OTZ-OME Interior	Count	8	9	0	17
	North Slope	Count	4	0	1	5
	Aleutian Chain	Count	1	3	0	4
Total		Count	25	66	5	96

b. Pilot IFR Certification and Currency

Pilot instrument certification and currency was addressed in Chart 35. This data showed that 22 percent of the pilots involved in VFR into IMC crashes were certificated and current to operate under IFR in IMC conditions. Sixty nine percent of the pilots, although certified to operate under IFR, were considered to not be current based upon the requirements of the type of operation under which the involved certificate holder was authorized. For the purposes of this study, if the pilot was operating an aircraft that was equipped but not certified for IMC operation and the certificate holder did not hold instrument flight rules authorization for that category aircraft, it was assumed that the pilot was not current. Less than 5 percent of the pilots were not certificated to operate under IFR.

Chart 35
All Certificates, n=98
Pilot Instrument Certification and Currency



c. Regional Distribution of Pilot IFR Certification

The data in Table 18 shows the regional distribution of pilot instrument certification and currency. The table appears similar to the aircraft equipment and pilot certificate tables. This simply means that although most commercial pilots are instrument certified, while operating aircraft that may be equipped and not certified, the pilots do not maintain IFR currency.

Table 18

Region * Pilot Certified for IFR Crosstabulation

Count

		Pilot Certified for IFR				
		Yes and Current	Yes but Not Current	No	Unknown	Total
Region	Y-K Delta	4	21	1	1	27
	SouthCentral AK	4	15	1	0	20
	Southeastern AK	1	16	1	2	20
	Fairbanks Interior	0	3	0	0	3
	OTZ-OME Interior	7	10	0	0	17
	North Slope	4	1	0	0	5
	Aleutian Chain	2	2	0	0	4
Total		22	68	3	3	96

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