MIDAIR COLLISIONS IN U. S. CIVIL AVIATION - 1968

A SPECIAL ACCIDENT PREVENTION STUDY

JULY, 1969

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D. C. 20591

M1
P

NATIONAL TRANSPORTATION SAFETY BOARD

The National Transportation Safety Board was created by an Act of Congress in 1966, which simultaneously established the Nation's first Department of Transportation headed by a Cabinet-level Secretary. The Safety Board is headed by five Members appointed by the President and approved by the Senate.

Unlike the other functioning segments of the Federal Government that were brought together under the Department of Transportation, the Safety Board is autonomous.

The Safety Board is charged with a continuing across-the-board review of the general safety picture in all modes of transportation. Among other responsibilities it has broad powers in the investigation and cause determination of transportation accidents and may review on appeal the suspension, amendment, modification, revocation, or denial of any certificate or license issued by the Secretary of Transportation or by any Administrator under him.

The Safety Board's authority extends specifically over U.S. civil aviation, maritime, railroad, highway, and pipeline safety. Except for civil aviation, the Board delegates the greater percentage of its accident cause determination directly to the agencies under the Department of Transportation that are principally concerned. However, the Board can assert its authority in any of these transportation fields and makes a final determination of cause in unusual or catastrophic accidents in all modes of transportation. Moreover, Board Members or designated staff, participate frequently as "official observers" during accident investigations. By exercising its authority of recommendation, the Safety Board is continuously involved in the prevention of transportation accidents and enhancement of safety.

In the field of civil aviation safety, the Board conducts its own investigations and determines the cause of all air carrier accidents, all fatal lightplane accidents, helicopter and air taxi accidents and other special accidents or incidents it may desire to take over. It has delegated to the Federal Aviation Administration of the Department of Transportation the authority to investigate accidents involving nonfatal helicopters, aerial applicators, amateur-built and restricted aircraft, and nonfatal light plane accidents, except those involving air carriers (including air taxi operators) and midair collisions. However, the Board reserves to itself the right to determine the cause. The Board is staffed for its aviation safety operations by virtue of having taken over the Bureau of Safety of the Civil Aeronautics Board.

MIDAIR COLLISIONS IN U. S. CIVIL AVIATION

1968

A Special Accident Prevention Study

JULY 1969

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D. C. 20591

Midair Collisions

TABLE OF CONTENTS

	Pages
List of Illustrations	iii
Summary	1
Introduction	3
Facts and Discussion	5
A. Data	5
B. Weather	6
C. ATC and Operations	7
D. Collision Avoidance Systems	15
E. Cockpit Visibility	19
F. Conclusions	23
G. Recommendations	26

Charts and Tables

Table 1	Date and Location of 1968 Midair Collision Accidents	31
Table 2	Convergence Angles	33
Figure 1	Fatal and Nonfatal Accidents	35
Figure 2	Type of Flying	35
Figure 3	Proximity to Airport	37
Figure 4	Phase of Operations	37
Figure 5	Flight Plan	39
Figure 6	Altitude of Occurrence	39
Figure 7	Time of Occurrence	41
Figure 8	Pilot Time	43
Figure 9	Midair Collision Relative Runway	45

Table of Contents

Appendices

		Page
Appendix 1	Brief of Accidents	47
Appendix 2	Injury Table	67
Appendix 3	Kind of Flying by Injury Index	69
Appendix 4	Airport Proximity by Injury Index	71
Appendix 5	Phase of Operation by Injury Index	73
Appendix 6	Month of Occurrence by Type of Weather Conditions	75
Appendix 7	Type of Operator by Conditions of Light	76
Appendix 8	Phase of Operation by Conditions of Light	77
Appendix 9	Chronology of the Airline Search for a Collision Avoidance System	79
Appendix 10	Collision Avoidance and the Pilot	93

LIST OF ILLUSTRATIONS

	Pages
List of Midair Collision Accidents - 1968	30
Convergence Angles	31
Fatal and Nonfatal Midair Collisions 1968	32
Type of Flying	32
Proximity to Airport	33
Phase of Operation	33
Flight Plan	34
Altitude of Occurrence	34
Time of Occurrence	35
Pilot Time	36
Midair Collision Accidents Relative to Runway	37

SUMMARY

The study showed that during calendar 1968 there were 38 midair collisions involving 76 aircraft, a 46-percent increase in the number of midair collisions over the 1967 figure. In every 1968 midair collision accident, a general aviation aircraft was involved. In three cases, an air carrier was involved with a general aviation aircraft. In one case, a military aircraft was involved with a general aviation aircraft. In the remaining 34 instances, the collisions were between two general aviation aircraft.

Twenty-four of the 38 collisions resulted in 71 fatalities--all occupants of general aviation aircraft. The 1968 fatality figure is 55 percent lower than the 1967 midair collision fatality figure. There were no fatalities in the air carrier aircraft in 1968, but in 1967 the three air carrier aircraft accounted for the vast majority of the fatalities. There were three air carrier aircraft involved in 1967 midair collisions and three in 1968 midair collisions.

Most of the 1968 midair collision accidents occurred at or near an uncontrolled airport, below 5000 feet, in Visual Flight Rules (VFR) weather during the summer months and on the weekend.

The traffic in the airspace involved in the 1968 midair collision accidents was not congested, and the closure rate between the aircraft involved was well below the cruise speed of the aircraft involved.

The air traffic control system was a factor in approximately 20 percent of the collisions, as was dual instruction. However, the majority of the midair collision accidents in 1968 occurred at uncontrolled airports in low-density traffic. The major problem in the midair collision accidents was the failure of the pilot to adhere to the "see and be seen" concept--a concept that well may be, at least in high-density terminal areas, on its way to becoming outmoded, unsafe, and incompatible with saturated operating environments.

Several recommendations on pilot awareness, pilot and controller education, air traffic control procedures and operations, airport pattern identifications, anti-collision lights, and aircraft certification process are included in the report.

INTRODUCTION

The midair collision hazard continues in spite of marked improvements in aircraft design, the air traffic control system and associated equipment. The human element continues to be a major factor; pilots are not adhering to safe flying techniques and/or existing flying rules which may now stand to be reviewed for improving compatibility with human performance capabilities and the operating environment. The midair collision problem is further complicated by the phenomenal growth, in the recent past, of the U. S. civil aviation fleet in both numbers of aircraft and hours flown. In this light, extension of separation criteria to aircraft operating VFR within a control zone may now be warranted. The air traffic control system needs now to assume a more extensive responsibility for the safe operation of aircraft under the jurisdiction of the tower--within this airspace.

It is estimated that within the next 10 years, three times the present number of passengers will fly. About 10 times more cargo will be carried. Variations in air carrier speed and passenger carrying capacity will increase threefold. The number of general aviation aircraft will double. FAA towers will control three times the present traffic, and IFR traffic at airports will more than double. In an environment of a mix of jumbo jets and light aircraft, of supersonic transport and STOL aircraft, the midair collision threat will tend to increase in geometric proportion. It is conceivable that in the near future a single midair collision could result in the loss of a thousand lives.

Improvements in collision avoidance equipment are under development, but unfortunately many of these are not yet in production, are economically prohibitive, or are still drawing board concepts. Additionally, studies are being made to seek improvements in the ATC system.

To examine every related cause of midair collisions would necessitate an in-depth study of every segment of the overall safety system. It would include such items as airport planning and development, airport congestion, the control of the airways system, weather reporting, radar surveillance control of air traffic, communications, rules and regulations, design of aircraft, aircrew training, and all of the factors that relate to human errors. Such an examination is far beyond the scope of this very limited study which deals specifically with the analysis of data concerning the 38 midair collisions of 1968 and the conclusions which can be drawn from such a study.

The study includes a survey of existing midair collision literature, a review of the 1968 midair collision accident reports, and an analysis of numerous automatic data processing readouts on various pertinent midair collision factors.

FACTS & DISCUSSION

A. Data

Standard automatic data processing computer readouts and selected data readouts of the 38 collisions were analyzed and evaluated. Additionally, a case-by-case review of the investigators' reports was conducted to provide further insight into each collision accident for factors not recorded in the automatic data processing readouts. Witness statements, detailed radio communications, wreckage photos, terrain or airport drawings, and other items were referred to where relevant.

The following accident data combinations were studied:*

- Airport Proximity by Injury Index
- Total Pilot Hours and Hours in Type
- Type of Operation by Injury Index
- Briefs of Accidents - Midair Collisions 1968
- Cause/Factor Table
- First Phase of Operation by Injury Index
- First Type of Accident by Aircraft Damage
- Altitude of Occurrence
- Kind of Flying by Injury Index
- Month of Occurrence by Type of Weather Conditions
- Type of Operator by Conditions of Light
- Phase of Operation by Conditions of Light

---

*See Appendices 1 thru 8

B. Weather

Selected weather data available from locations nearest to the collision sites were reviewed in detail. In all cases, weather conditions were VFR (ceiling 1,000 feet and visibility 3 miles) or better, as far as could be determined. The weather was considered to have been clear in nine cases, with only high clouds reported in 10 others, while middle and/or low clouds existed in the remaining cases. There were 16 cases where clouds prevailed at or below 5,000 feet (above ground level), but in only four of these were ceilings (broken or overcast) in existence. Haze, or haze and smoke, were likely to have been in the area in six instances. Although precipitation was not reported over the immediate accident site in any case, there probably was precipitation in the general area in 11 cases, and it would have been showery in nature.

C. ATC & Operations

ATC

Air Traffic Control service was involved in seven of the 1968 midair collisions. In all seven, traffic congestion, the tower controller's visibility limitations, and inadequacies of VFR traffic flow procedures were found to contribute to the chain of events leading up to the collisions. In one case involving an air carrier aircraft, human performance limitations on the part of the controller were considered to have been contributory. However, the final responsibility to see and avoid other aircraft under visual conditions continues to rest with the pilot.

Integrating aircraft into the traffic pattern from different positions around the airport was a factor in the midair collision problem. For example, Aircraft A was practicing touch-and-go landings, Aircraft B reported 5 miles out and was given instructions to report straight in final at 2 miles. Aircraft C also in the traffic pattern was told by the control tower operator to report downwind. Aircraft B was then cleared to land following Aircraft A. Aircraft B reported that he did not have his traffic in sight. Aircraft C was then given sequence number two to land following Aircraft B. It was at this point that C overtook and collided with B. While the tower was remiss in issuing clearances to aircraft before their spacing was assured, additionally, the pilots involved should have taken corrective action when they did not have each other in sight. Aircraft C, although cleared for a long straight in final approach, was in fact breaking into the normal traffic pattern flow. Whenever the normal flow of the traffic pattern is so penetrated, both the pilots and the controller must reassess their mental images of the existing traffic situation.

In still another case, Aircraft A was cleared to land. Aircraft B was following too close to Aircraft A and the tower controller instructed Aircraft B to go around. Aircraft B complied with the controller's instruction. Meanwhile Aircraft C was progressing toward the downwind leg of the traffic pattern. Aircraft D was on final and was the object of the controller's attention. Aircraft B, on go-around, collided with Aircraft C as Aircraft C was entering the downwind leg. Had the controller reassessed the out-of-flow problem created by the go-around traffic, he might have alerted the two aircraft to each other's presence and also assured proper spacing of the aircraft.

Midair collisions are very rare at airports where the traffic flow is directed in a positive and orderly manner. In this regard in 1955 the CAA (Civil Aeronautics Administration) made a study which traced the ground tracks of aircraft in the traffic pattern at certain airports. Such studies may be in order at this time for all controlled airports so as to understand and minimize out-of-flow problems while standardizing controllers' reactions to out-of-flow conditions when they do occur.

Of course, any attempt to standardize traffic flow entry and departure routes must consider the pilots who are not familiar with the local landmarks. For example, in one midair collision accident, a Canadian pilot, unfamiliar with the area, was asked for his position by the tower. The pilot did not respond. Shortly thereafter the pilot was involved in a midair collision. It is logical to assume that the pilot's attention was diverted from looking outside for traffic to perhaps looking at the chart and/or ground landmarks. A local VFR approach chart, if available, might have prevented this collision.

In still another case, adherence to a standard entry procedure might have prevented the collision where an airliner and a small trainer were instructed to enter the traffic pattern in the same area. The controller who directed these aircraft did not verify if either aircraft had the other in sight. The controller in this case was indecisive in assigning a runway to the airliner, thus allowing the captain to choose his own course of action. This led to multiple communications which might have been better used in spacing traffic in a positive manner.

Positive air traffic control is sometimes affected by unusual topographical features such as mountains. In one midair collision accident, the controller was restricted in routing aircraft in and out of his area because of the high terrain. In a case in point, an airliner was required to make a steep descent which may have increased the in-cockpit duties of the crew to the detriment of observing local traffic. Also, high terrain dictated the number of access corridors available to the controller, thus increasing congestion in a limited airspace. A comprehensive study of airports of this nature may reveal needed improvements in directing VFR traffic in controlled airspace.

Not all of the tower controller's problems are in aviation. Often an airport is in an area of smoke-producing factories. Investigation has shown that smoke may have been a factor in two pilots' inability to see each other. The smoke was definitely a factor limiting the tower controller's vision. The controller in this case reported the smoke obscuration of the crosswind leg as a daily occurrence. Entry and departure routes to such airports should be adjusted until positive action against air pollution is taken in those areas.

Another procedural problem was present in a midair collision accident where Aircraft A was engaged in a practice instrument approach training flight in VFR conditions. The pilot of Aircraft A conducted his practice approach on the proper approach control frequency throughout. The approach controller did not require the pilot to change to local tower control frequency at the outer marker, as is the general practice. Aircraft B was approaching the same runway on local control frequency. In this case neither pilot knew, from radio communications, of the other's existence. They were occupying the same airspace under different controllers. True, they were VFR and should have seen one another, but insistence by the controllers on standard procedures might have prevented this collision.

Operations

Twenty-four of the 38 midair collisions occurred over or in the vicinity of an airport. Twenty of these occurred while approaching to land. Two occurred during the takeoff phase and two occurred when one of the aircraft was descending to the airport. Figure 9 is a diagram showing an imaginary funnel closing in on the approach end of a runway. The two collisions that occurred during the takeoff and the two that occurred during the descent to the airport are not shown. It will be seen that the number of midair collisions increased on final approach getting worse at position of flare-out.

The area shown in Figure 9 is not only the area of greatest concentration of aircraft but also that part of the traffic pattern where a pilot is engaged in the most vulnerable and critical part of the flight--the landing. Increased attention is given to the landing gear, flaps, attitude control, and airspeed. He is concerned with wind speed and direction and possible traffic on the ground. He endeavors to position his aircraft at such an altitude and distance as to enable an approach best suited to the prevailing conditions. He may have to be attentive to instructions from air traffic control and be concerned with positioning his aircraft in the right sequence to land. At times the weather conditions may force him to divide his attention and consequently interfere with his piloting duties.

The airport pattern (Figure 9) conditions are such that aircraft of different configuration, flown by pilots of varying skill, close on each other without being seen by either pilot. Unlike the surface highway, there is no dividing line and a separate lane for the fast and the slow, but rather three dimensions with which to contend, and a journey that must end in a single lane.

It takes two to collide but only one need be careless. Statistics in 1968 show all are vulnerable, from the pilot with 15,000 hours to the pilot on his first solo. Instructor pilots seem more vulnerable than the average pilot. Fifty percent of the collisions around the airport involved flight instructors. Perhaps it is because they spend more time in the traffic pattern and have additional activities and related distractions in teaching and monitoring their students' actions.

Fourteen of the midair collisions occurred away from an airport under the following circumstances:

(a) Three involved agricultural aircraft. One during a ferry flight and two on-the-job aerial spraying.

(b) One occurred where one of the aircraft was engaged in instructional training.

(c) One occurred where both aircraft were engaged in instructional training.

(d) One occurred where one of the aircraft was engaged in instrument flying training.

(e) One occurred between aircraft being flown in formation beyond pilot abilities, with one pilot under the influence of alcohol.

(f) One occurred between aircraft on pleasure flights and both pilots under the influence of alcohol.

(g) One occurred in normal cruise where the cockpit side window curtain of one was found to have been drawn.

(h) One occurred between aircraft of the same organization while herding horses.

(i) One occurred between aircraft of the same organization while spotting fish.

(j) One occurred between two gliders while soaring in the same thermal.

(k) One, involving a military aircraft, occurred in the vicinity of a military training area.

(1) One occurred in Alaska where the silhouette of a crossing aircraft blended with the snow covered background.

From Figure 8, it will be seen that 25 of the midair collisions involved pilots with more than a total of 1,000 hours pilot-time. However, 32 of the collisions involved pilots with less than 100 hours in type as opposed to seven who had less than 1,000 hours in type. From the statistics on total pilot-time, an inference can be drawn that while all pilots are equally vulnerable to collisions, experienced pilots were involved in significantly high numbers.

A more significant inference is that pilots with less time in type are more vulnerable to collisions because of their greater attention to cockpit details and to flying the plane.

Limitation of the pilot's capability to detect visually other aircraft and the importance of the contrast aspects as they relate to visual detection were recognized and considered in the analysis of data in this study.

D. Collision Avoidance Systems

The airlines have been searching for a suitable midair collision avoidance system (CAS) for over a decade. During this period a number of technological schemes were submitted and tested, each having its own unique limitations. Although none were considered to be satisfactory, this flurry of technical activity serves as a basis for the eventual development of time-frequency technology, a methodology that holds substantial promise. The traffic scheme currently envisioned is a cooperative one, that is, all participating aircraft must have similar equipment aboard.

The Air Transport Association of America has been instrumental in the formulation of the technical specifications for the time-frequency system and its technical working group issued a set of such technical standards on June 30, 1967. Basically, these technical guidelines provide for an indication of the hazard presented by the detected aircraft, a determination as to whether a maneuver is required and an indication of the evasive action necessary to maintain safe separation. The time-frequency message format consists of range, range rate, and altitude.

This CAS is presently in the hardward development stage with flight evaluation planned for 1969. The projected costs of the system are about $15,000 to $30,000 per aircraft and, unless unusual difficulties are encountered during the tests, the installation cycle may start as early as the end of 1970 and extend to full fleet protection by 1972.

While the general aviation fleet could incorporate and command all of the sophisticated protection a time-frequency CAS system offers, the relative equipment costs, in light of the present state of the art, would preclude widespread acceptance among that segment of the fleet most in need of such protection.

Various technical innovations over the years have been oriented primarily toward enhancing visual conspicuity of the aircraft, e.g., paints and paint patterns, visual aids, exterior lighting, etc. While each of these various schemes may have some unique individual merits, their collective impact is not considered to be adequate in resolving the present and projected midair collision hazards.

In July 1968, the FAA's National Aviation Facilities Experimental Center (NAFEC) completed an evaluation of certain low-cost collision avoidance ground training equipment to determine how a pilot's search under normal VFR conditions might be enhanced by improve scan/search techniques. Basically the project utilizes a 35mm slide projector which displays the intruder aircraft. Both the azimuth and the slide exposure time are controlled, as well as the intruder aircraft's wing span dimensions and viewing distances. FAA is presently developing a small number of these "view/scan" packages to offer to flight training schools for experimental purposes.

In conjunction with FAA, two automatic pilot-warning indicators (PWI) are being considered by the National Aeronautics and Space Administration, one at the NASA Langley Research Center and the other at the NASA Electronics Research Center. Both are doing PWI simulation work.

The Langley PWI, with a transmitter-receiver in the "protected" aircraft and a transponder in the "intruder" aircraft, is basically a cooperative Doppler radar. Preliminary flight tests were completed in February, March, and April of this year and further tests are scheduled for this coming July and August. The Electronics Research PWI (9 month contract for hardware let in August 1968) uses the Xenon strobe discharge beacons mounted on all aircraft using the system, supplemented by silicon photoelectric detectors in the protected aircraft. This system appears to be the "least cooperative" of all PWI's since purchase of only the emission portion, the strobe discharge beacons, would significantly enhance visual conspicuity.

Recent discussion with FAA regarding the status of PWI technology indicates that there are perhaps six to eight manufacturers presently conducting significant research and development of infrared/strobe light devices. Some of these manufacturers hope to perform prototype flight tests this summer and foresee market delivery as early as the end of the current calendar year.

Additional data on state of the art and chronology of development of anti-collision/collision avoidance systems are included in Appendix 9.

Cockpit Visibility

In most midair collision accidents, the probable cause was determined to be: "Pilot in command failed to see and avoid other aircraft."

A detailed analysis of the 1968 midair collisions was undertaken to determine if the pilot failed to see other aircraft because of poor visibility due to cockpit design.

Part 23 of the Federal Aviation Regulations Airworthiness Standards does not spell out minimum design criteria regarding cockpit visibility in general aviation aircraft. Therefore, the analysis of cockpit visibility of 1968 midair collision accidents centered around the reported facts and circumstances concerning each accident. In some cases, without survivors or witnesses, the physical evidence was not conducive to an objective analysis of the visibility problem.

The cockpit visibility study was further complicated by the unorthodox behavior of some of the pilots. There were several cases where (1) pilots ignored standard traffic pattern procedures, (2) pilots flew under the influence of alcohol, (3) pilots flew unauthorized formation flights, and (4) one student pilot took a friend for an airplane ride. Under such circumstances, one can assume that good cockpit visibility would be of little use to the aforementioned pilots. Unfortunately, such pilots as described above do occupy the airspace and therefore must be considered in the cockpit visibility study.

Particular attention was directed to comparing the convergence angles with the flight maneuvers of the two aircraft, in an attempt to determine if cockpit vision was restricted by the aircraft structure and therefore a contributing factor in the collision. In any discussion of this nature, two schools of thought immediately assert themselves. One group maintains that the high-wing airplane affords the best cockpit visibility and the other group favors the low-wing airplane. This report does not presume to settle that controversy; however, it will indicate that both sides have merit and limitations. Table 2 was compiled to show angles and phase of operation by high- and low-wing aircraft involvement in each 1968 midair collision accident.

There were two high-wing aircraft for each one low-wing aircraft involved in the 1968 midair collisions. This generally follows the aircraft population figures for high- and low-wing aircraft.

In considering midair collisions, one tends to think of two aircraft closing head-on at a fast closure speed. However, as indicated on the chart, there were only two head-on collisions in 1968. In one case it was determined that the instructor pilot could have seen the other aircraft. Presumably, the instructor pilot was giving instrument instruction and his attention was inside the cockpit. It is possible that the pilot of the other aircraft, flying straight and level, could not have seen the instructor's airplane, as it was under the nose of his airplane.

The majority of collisions occurred between aircraft converging on a near 0° angle as shown in Table 2. Of the 13 collisions in the 0° to 10° angle range, it was noted that the final approach and landing was by far the most hazardous phase of the flight. In several of these accidents, one aircraft overtook the other from the top and rear. On the surface, this situation may indicate a cockpit visibility problem; however, one should consider that both airplanes, if normal procedures were followed, were within sight of each other earlier in the traffic pattern or on the initial approach to the airport. There were several cases where surviving pilots admitted they saw the other traffic, but had lost sight of it somewhere in the traffic pattern or mistook another airplane for the one previously sighted.

Flight instructors would, normally, be expected to exercise a higher than average degree of vigilance. However, 10 flight instructors were involved in midair collisions. If they are indeed more vigilant, one might surmise that cockpit visibility deficiencies account for such flight instructor involvement. On the other hand, a cockpit visibility problem is not indicated when the instructor and student fly in and out of a busy uncontrolled airport safely on a cross-country trip only to come to the home airport and collide with the only other aircraft in the air for several miles.

In almost all the midair collision accidents, it was determined that at least one pilot was in a position to see the other aircraft, and in many cases it was determined that both pilots could have seen each other's aircraft. Cockpit obstructions such as window posts, opaque sun visors, and instrument panel shields restrict the pilot's view.

F. Conclusions

While there was no evidence of adverse weather having been a significant factor in any of the 38 midair collision accidents, haze and/or smoke were likely to have been in the area in six instances; precipitation, showery in nature, was probably in the general area in 11 cases. All 38, however, occurred during daylight hours under VFR conditions. It was found in eight cases where, during descent, one aircraft overtook another, low and at slow closure rates, that inherent aircraft design restrictions to vision reduced the pilots' ability to see the other aircraft. The pilot's lack of compensation for this in his maneuvers was a significant factor in nearly all the midair collisions.

It was noted that most collisions occurred in areas and periods of greatest general aviation activity, and that the most likely time and place for collisions to occur would be on bright clear Sunday afternoons in August at uncontrolled airports.

It was also noted that two of every three collisions occurred at an airport, that the pattern of collisions started during the descent to the airport, that it gradually increased while entering the landing pattern, and that the most critical period is the final turn-in right up to the airport threshold and flare-out. It is during this critical period that four of every five collisions at or near airports occurred. It was also noted that the experienced and inexperienced pilots were equally vulnerable and 50 percent of collisions at or near airports involved a flight instructor. Also, inexperience in type of aircraft being flown rather than total pilot-time was noted in the greater portion of them.

Generally, the collisions that occurred away from an airport involved the following pattern: two pilots, a team on the same mission and aware of each other's presence, flew into each other. Examples of these are: a pair of ferry pilots, a pair herding horses, a pair spotting fish, a pair of aerial applicators spraying, a pair endeavoring to fly formation beyond their skill, a pair flying formation while under the influence of alcohol. There were a few exceptions to this pattern. For example, a silhouette of a crossing aircraft was unobserved against the snow background in Alaska. A pilot flying in the vicinity of a military training area was involved in a collision with one of a military formation whose leader's attention was drawn away from forward visual scanning.

In analyzing these cases, it can be said with justification that well applied air traffic control (where these services are provided), and pilot vigilance could have prevented the collisions which occurred at or near airports. With equal justification it can be said that most of the collisions that occurred away from the airports could have been avoided if pilots had not flown under the influence of alcohol; had they adhered to the "see and be seen" concept; had they been aware of their limitations so as not to attempt to fly in formation beyond their skill; and had they not maneuvered into a blind spot when temporarily losing sight of their companion aircraft.

It was noted that two of every three collisions resulted in fatalities. There were three 1968 collisions involving air carriers. Fortunately, none of these proved fatal to occupants of the air carrier aircraft. For this reason, although the 1968 midair collisions increased by 46 percent, there were 55 percent fewer total fatalities than in the year 1967.

Much can be done to eliminate the 1968 type collision. Consideration must now be given to assuring more positive VFR traffic separation, guidance and control both at our major passenger airports and in areas and periods of greatest general aviation activity; to improving radar surveillance; to improving certain air traffic control system procedures and provisions; to reemphasize the education of pilots, their instructors and controllers with regard to collision avoidance awareness; and to developing practicable and economically feasible collision avoidance devices for general aviation aircraft.

G. Recommendations

The National Transportation Safety Board, after review and analysis of the 1968 midair collision accident data, recommends that pilots of every rating make themselves aware of the increasing threat of midair collisions in civil aviation, to civil aviation, itself, to themselves, and to the lives and property of others.

In addition to reemphasizing and instilling the need for constant collision avoidance pilot awareness and alertness, certain basic common sense practices need to be reemphasized with regard to alcohol involvement and inadequate preflight preparation for flying in pairs or formation flying.

All pilots should become aware of and exercise every precaution against the midair collision potentials at controlled high density terminal arrival and departure areas, as well as at uncontrolled low-density traffic general aviation airports.

All pilots should renew their emphasis on well-disciplined, good and precise flying techniques and habits, (see Appendix 10 of this report); and should compensate for the inherent design restrictions to vision of the aircraft being flown.

Toward the prevention of midair collision accidents, the Safety Board recommends that the pilot organizations such as the Air Line Pilots Association, Aircraft Owners and Pilots Organization, Allied Pilots Association, Flight Safety Foundation, National Air Taxi Conference, tional Business Aircraft Association, National Pilots Association, Inc.--and the numerous publishers of aviation periodicals each make an effort to publicize the findings of this study of midair collisions in 1968, as well as promoting, wherever appropriate, the principles of collision avoidance awareness on the part of pilots.

The Safety Board also recommends that the owners and operators of airports, and other responsible local, municipal, county and State authorities undertake to assure that VFR approach and departure traffic pattern procedures are established at every airport. Further, that such procedures be clearly identified and made known to pilots.

The Safety Board further recommends that the manufacturers of general aviation aircraft direct their attention to the need for increased visual conspicuity of small, as well as large, airplanes.

Notwithstanding these recommendations addressed to the aviation community, the National Transportation Safety Board recommends that the Administrator of the Federal Aviation Administration:

1. Undertake an educational program to make both pilots and controllers more aware of the midair collision problem, and to make pilots aware that most midair collisions occur at or near airports in clear weather and in daylight hours.

2. Establish a continuing program to assure indoctrination and continuing awareness on the part of all pilots to the midair collision potential and avoidance techniques (i.e., "see and be seen" concept, descent, turn, and climb maneuvering techniques, etc.).
3. Examine more stringently all pilot applicants for their external cockpit vigilance, with particular attention to pilots who are tested for flight instructor ratings.
4. Provide special warning and guidance to pilots who are required by the nature of their operations to fly in pairs.
5. Inform all certificated flight instructors of the high statistical significance of their involvement in midair collisions.
6. Encourage all instructor pilots to notify the control tower operator, at airports where a tower is manned, regarding first solo flights, and require the tower operator to advise other traffic in the pattern about such flights.
7. Conduct detailed traffic flow studies for all high-volume general aviation controlled airports with a view to improving the VFR traffic flow techniques of the ATC personnel.
8. Designate climb and descent corridors for high-performance aircraft at high-density airports.

9. Irrespective of the provisions contained in Part 91 of the Federal Aviation Regulations, establish standard entry, departure, and go-around procedures for each uncontrolled airport.

10. In cooperation with ESSA, develop and produce VFR approach and departure charts for selected airports with a high volume of traffic.

11. In addition to the requirements of Section 91.89 of Part 91 of the Federal Aviation Regulations, develop a requirement for the installation of surface pattern indicators (for day and night) at smaller airports which would define specific patterns, particularly the base leg and the final approach.

12. Reevaluate visual conspicuity standards for all civil aircraft.

13. Consider the establishment of requirements for the installation and day and night operation of high-intensity white flashing lights on all civil aircraft.

14. Support the expeditious development of low-cost Collision Avoidance Systems for all civil aircraft.

MIDAIR COLLISIONS 1968

	[illegible] State	Date		Place & State	Date
[illegible]	[illegible] Fla.	1/19/68	20.	Woodbury, Tenn.	7/31/68
[illegible]	[illegible]lin, Ind.	2/18/68	21.	Rock River, Wyo.	8/1/68
[illegible]	[illegible]dale, Wash.	2/24/68	22.	Lexington, Neb.	8/3/68
[illegible]	[illegible]n Jose, Calif.	2/25/68	23.	Milwaukee, Wis.	8/4/68
5.	[illegible]nai, Alaska	3/16/68	24.	Chesapeake, Va.	8/6/68
6.	Puyallup, Wash.	3/24/68	25.	Cleburne, Texas	8/14/68
7.	St. Louis, Mo.	3/27/68	26.	Hayward, Calif.	8/14/68
8.	Columbus, Ohio	4/10/68	27.	Barre Plains, Mass.	8/18/68
9.	Kansas City, Mo.	4/10/68	28.	Calif. City, Calif.	8/24/68
10.	Pascagoula, Miss.	4/13/68	29.	Beaumont, Texas	8/28/68
11.	Bakersfield, Calif.	5/19/68	30.	Flushing, N.Y.	9/8/68
12.	Phoneton, Ohio	5/20/68	31.	Bitter Creek, Wyo.	9/16/68
13.	Norman, Oklahoma	5/30/68	32.	Hamilton, Ohio	9/15/68
14.	Denver, Colo.	6/12/68	33.	Miami, Fla.	10/5/68
15.	Indian Springs, Nev.	6/20/68	34.	Dixon, Calif.	10/24/68
16.	Reseda, Calif.	7/3/68	35.	Calipatria, Calif.	10/27/68
17.	Danbury, Conn.	7/7/68	36.	Santa Paula, Calif.	12/8/68
18.	Crows Landing, Calif.	7/16/68	37.	Sandwich, Ill.	12/8/68
19.	Wyandanch, N. Y.	7/28/68	38.	Rome, Georgia	12/20/68

Table 1

CONVERGENCE ANGLE	AIRCRAFT TYPE OF WING			PHASE OF OPERATION BY ACCIDENT										CONV. ANGLE TOTALS
				LANDING FINAL APPROACH / LANDING FINAL APPROACH	LANDING FINAL APPROACH / CRUISE	TRAFFIC PATTERN CIRCLE / T/P CIRCLE	LANDING LEVEL OFF / LANDING LEVEL OFF	CRUISE / CRUISE	CRUISE / CLIMB	CRUISE / DESCENT	CRUISE / TRAFFIC PATTERN CIRCLE	TAKE OFF INITIAL CLIMB / TAKE OFF INITIAL CLIMB	DESCENT / DESCENT	
0-10°	HIGH	HIGH	6	1		1	3	1						13
	LOW	LOW	2	1				1						
	LOW	HIGH	5	3			1	1						
11-30°	HIGH	HIGH	1	1										3
	LOW	LOW												
	LOW	HIGH	2	1	1									
31-50°	HIGH	HIGH												4
	LOW	LOW	2	1		1								
	LOW	HIGH	2					1		1				
51-70°	HIGH	HIGH	1						1					2
	LOW	LOW												
	LOW	HIGH	1										1	
71-90°	HIGH	HIGH	3	1				1				1		5
	LOW	LOW												
	LOW	HIGH	2			1				1				
91-110°	HIGH	HIGH	1									1		1
	LOW	LOW												
	LOW	HIGH												
171-180°	HIGH	HIGH	1					1						2
	LOW	LOW												
	LOW	HIGH	1								1			
	TOTAL			9	1	3	4	6	1	2	1	2	1	
	HIGH	HIGH	13											
	LOW &	LOW	4											
	LOW	HIGH	13											

NOTE:
8 Accidents omitted from this study for lack of evidence.

TABLE 2

NUMBER OF FATAL AND NON-FATAL COLLISIONS

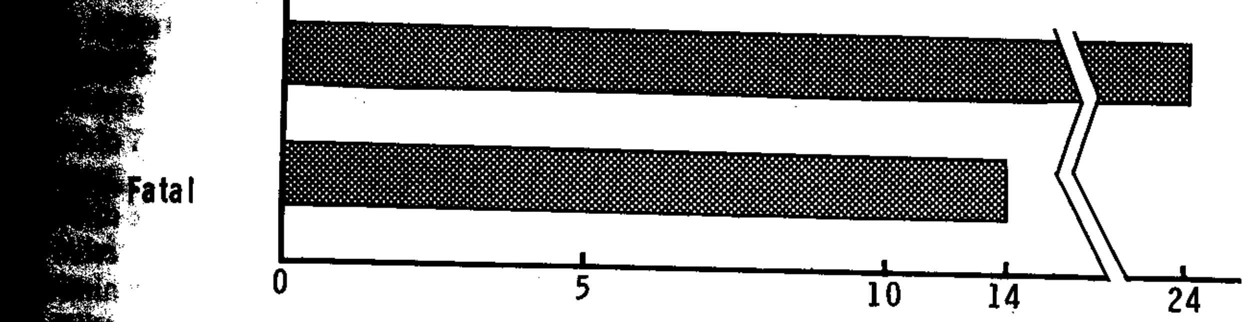


Figure 1

TYPE OF FLYING BY NUMBER OF AIRCRAFT (76 Aircraft)

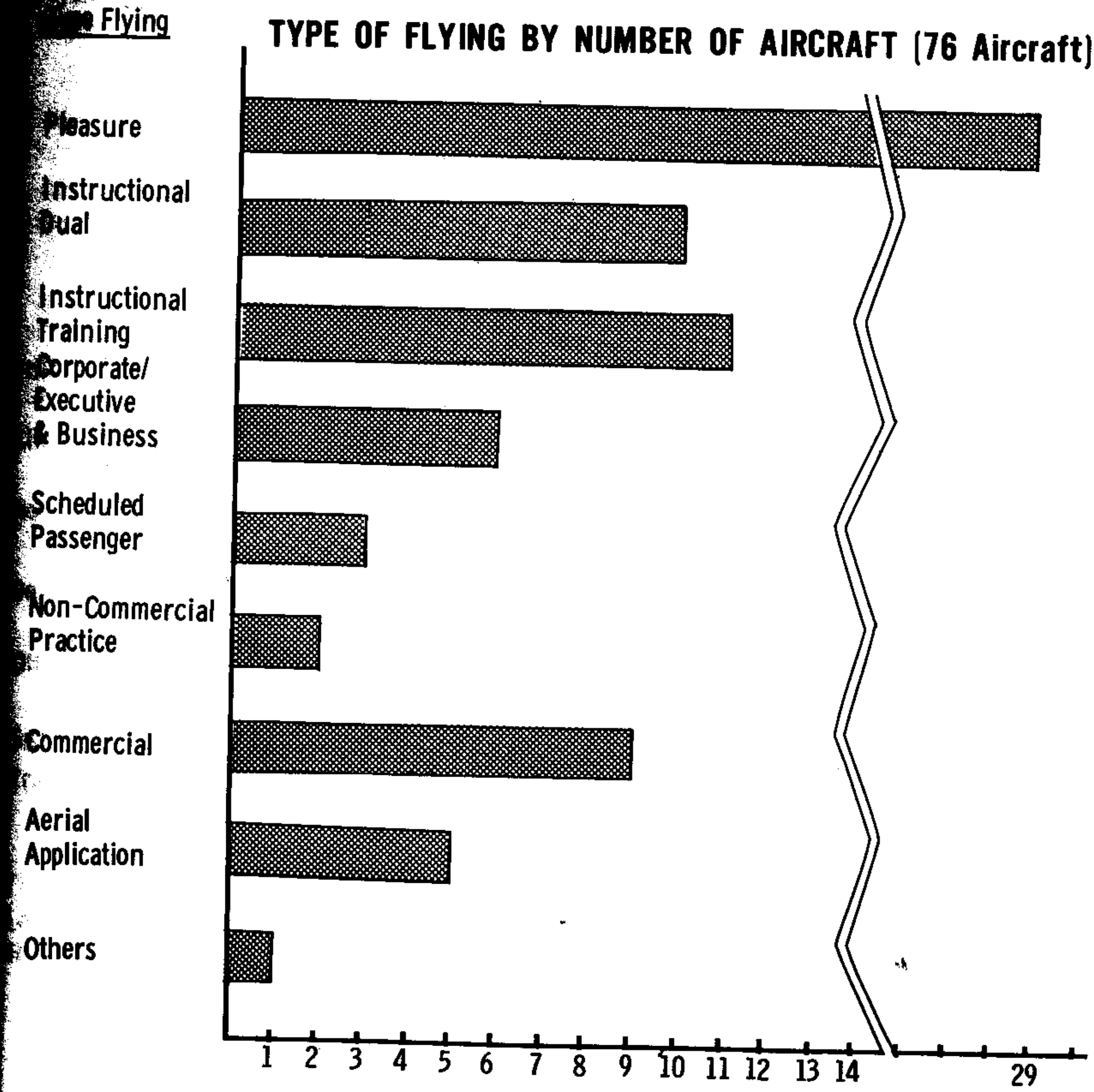


Figure 2

PROXIMITY TO AIRPORT

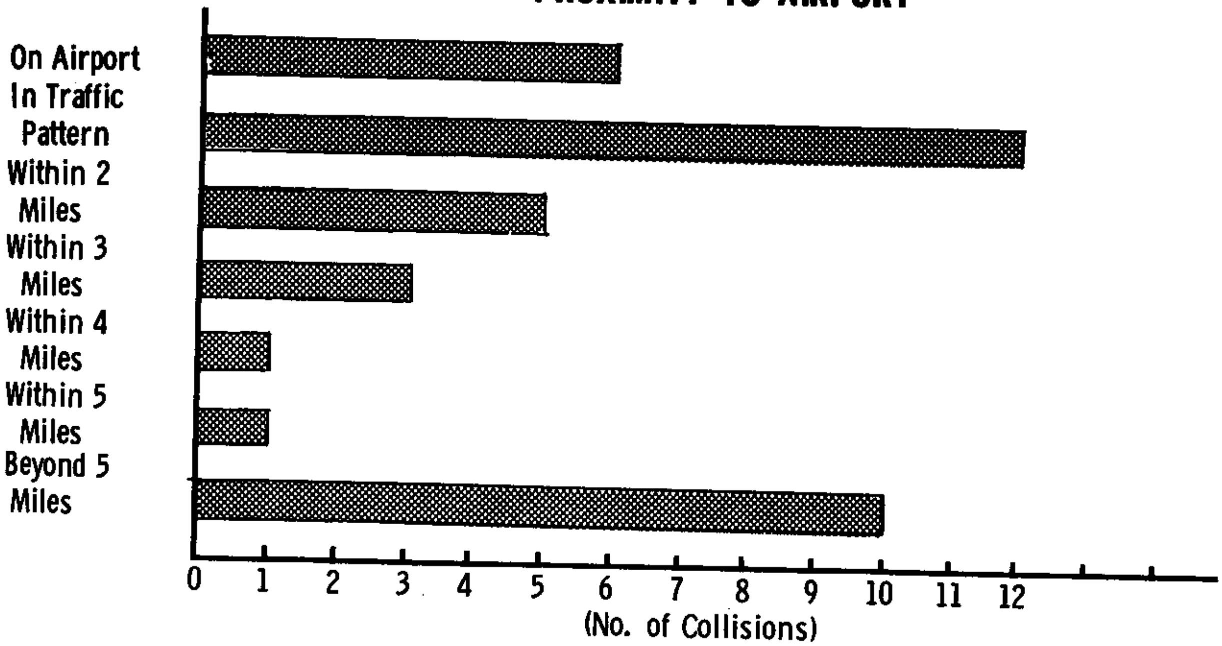


Figure 3

PHASE OF OPERATIONS BY AIRCRAFT (76 Aircraft)

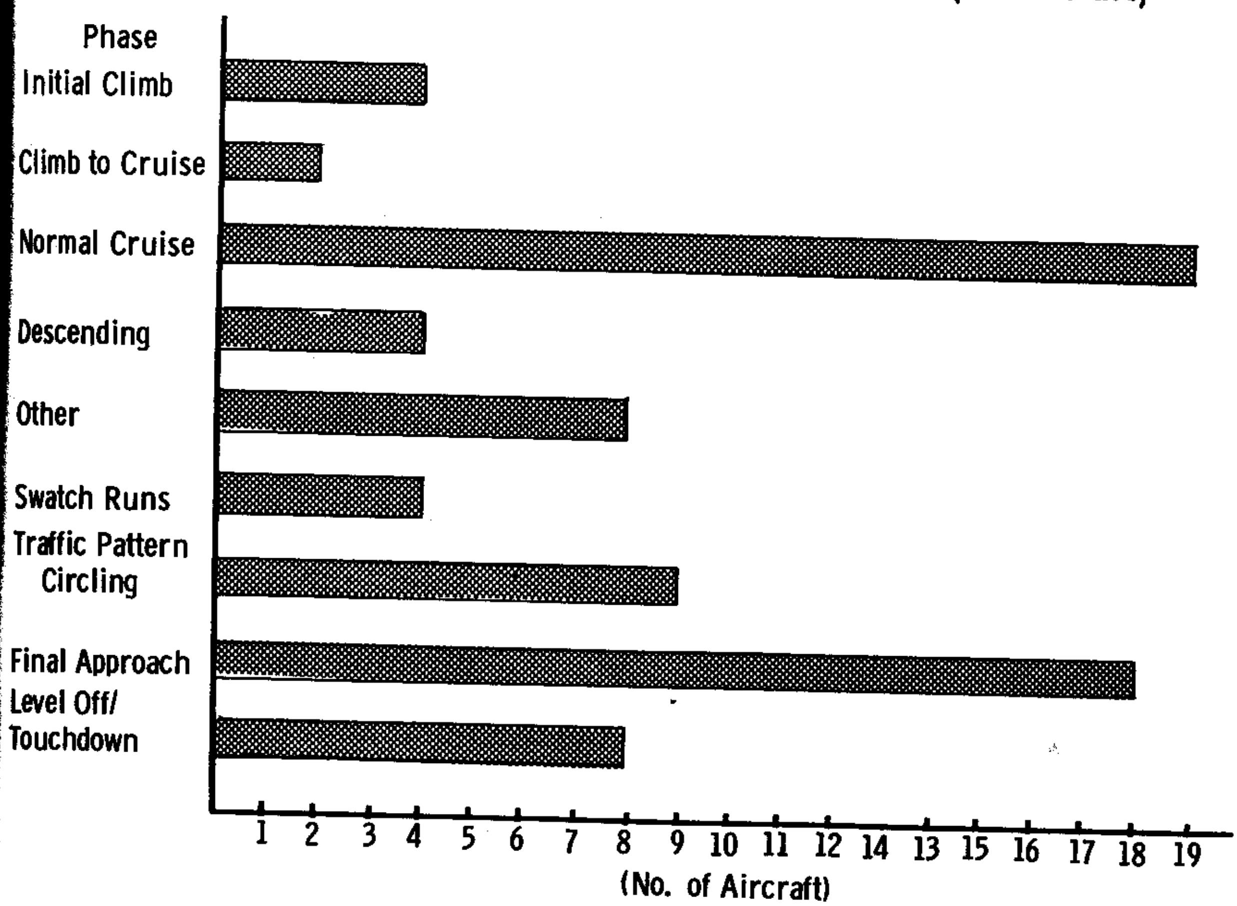


Figure 4

FLIGHT PLAN BY AIRCRAFT (76 Aircraft)

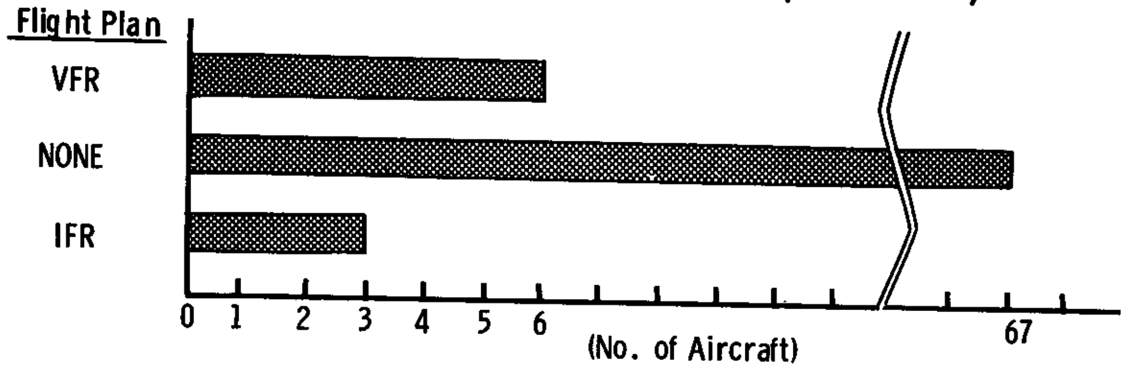


Figure 5

ALTITUDE OF OCCURRENCE ABOVE GROUND (6 Unknown Factors)

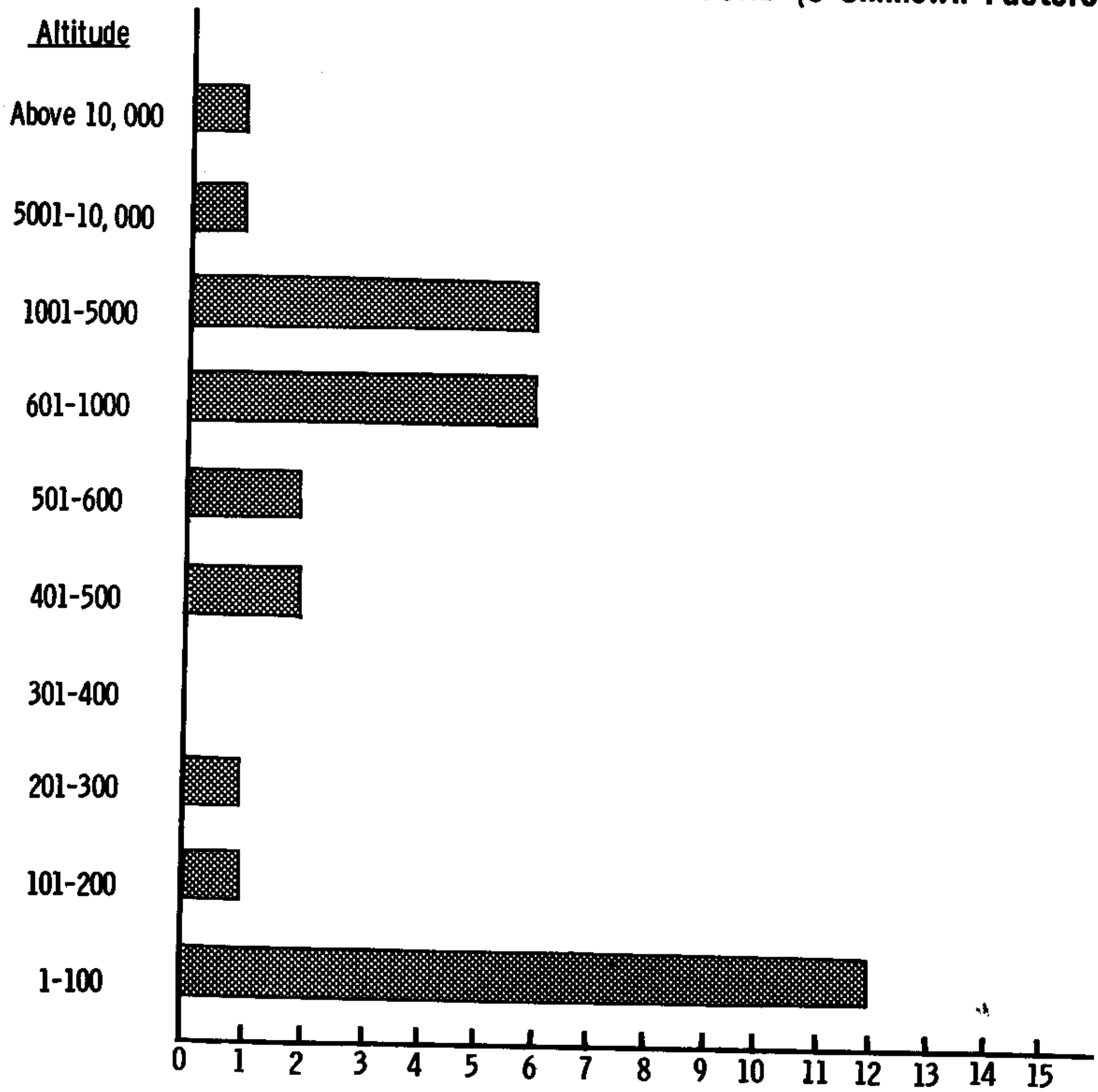


Figure 6

TIME OF OCCURRENCE

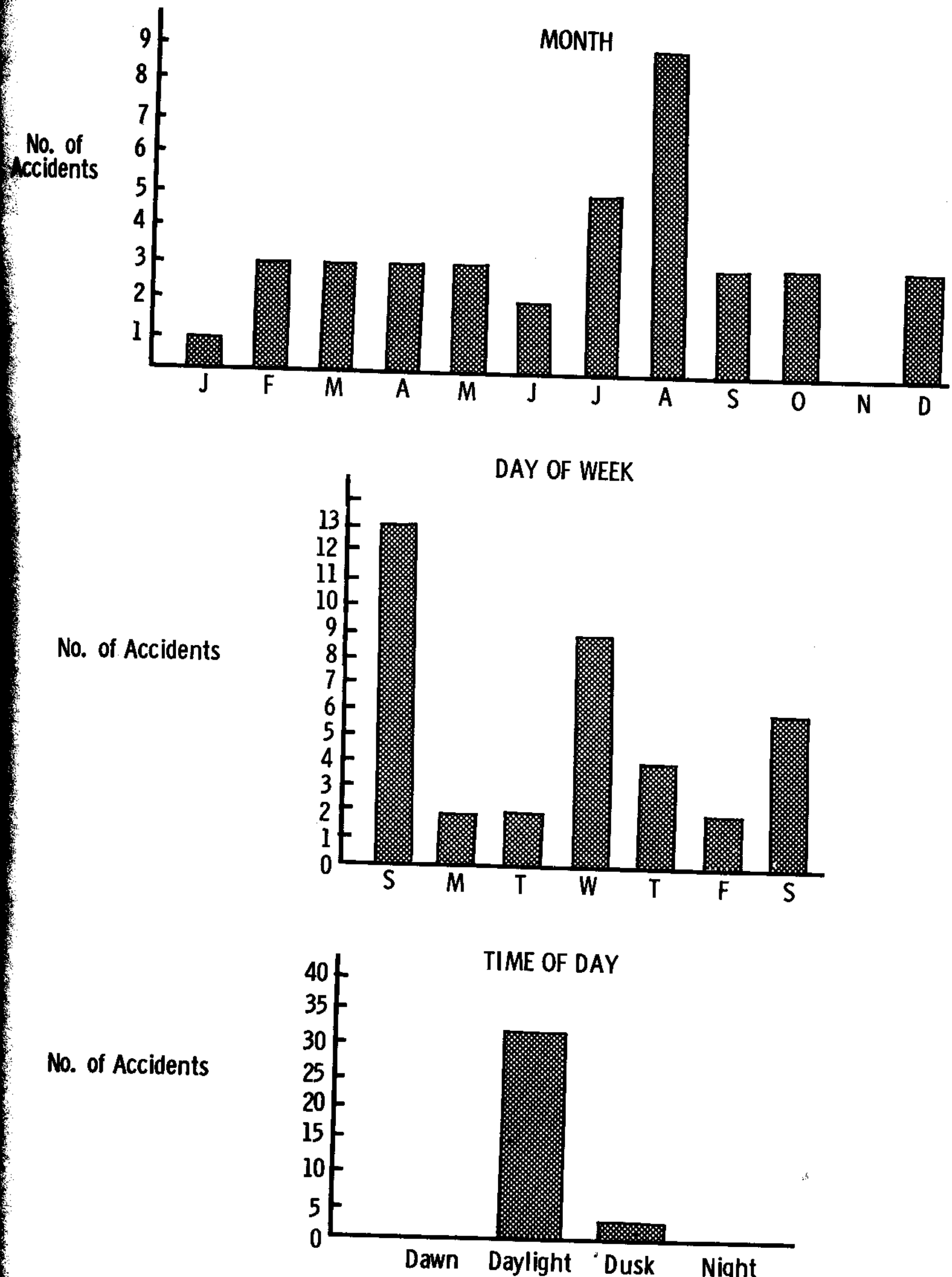


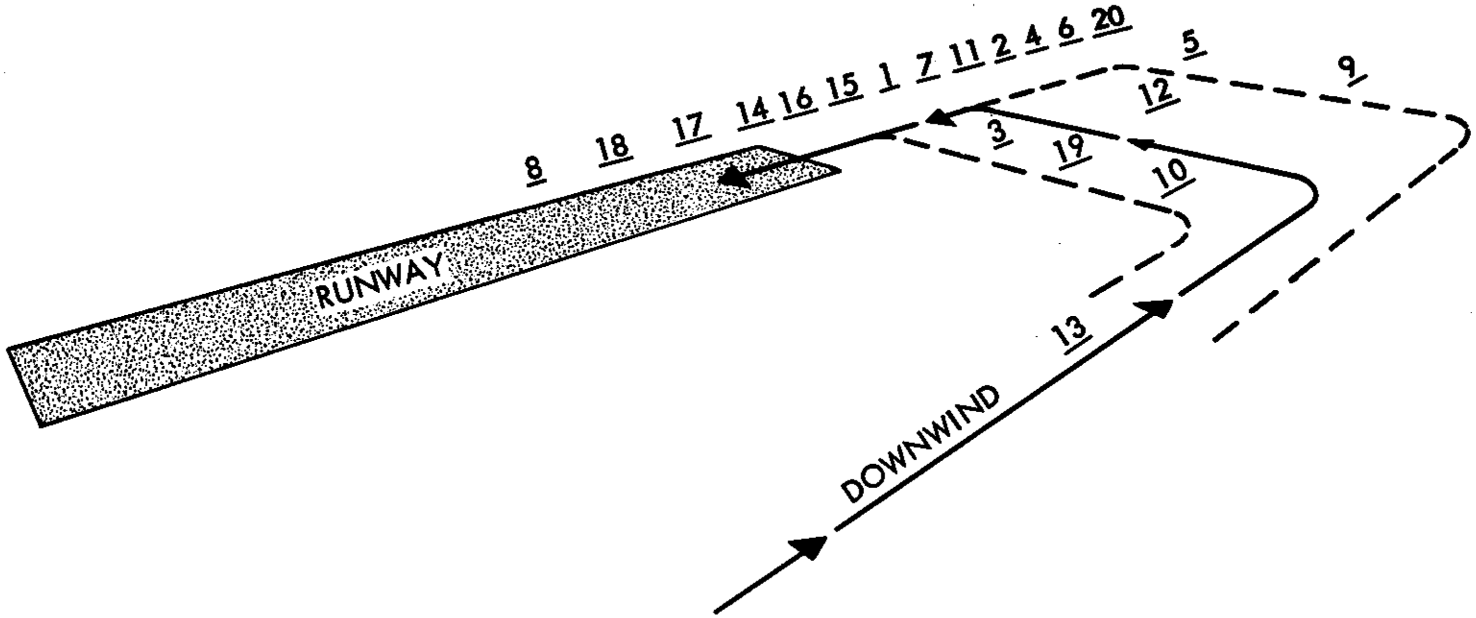
Figure 7

PILOT TIME

	Hours				
	1-90	100-199	200-299	300-399	1000 or More
Total Time	14	8	7	16	25
ime In Type	32	11	4	8	7

Pilot at Controls. Total Time & Time-in Type
(Total Time of 6 not known. Time-in type of 14 not known)

Figure 8



Approximate Position of 20 Mid-Air Collisions that Occurred in the Down-Wind, Base-Leg and Final Approach.

Docket Numbers

1. 3-0136
2. 3-0550
3. 3-0566 (Flight Instructor)
4. 3-0951 (" ")
5. 3-1996 (" ")
6. 3-2000
7. 3-2001
8. 3-2044 (Flight Instructor)
9. 3-2052
10. 3-2054 (Flight Instructor)
11. 3-2122 (" ")
12. 3-2123 (" ")
13. 3-2125 (" ")
14. 3-2167
15. 3-2378
16. 3-2396
17. 3-3983
18. 3-4004
19. 3-4803 (Flight Instructor)
20. 3-4836 (" ")

Figure 9

NATIONAL TRANSPORTATION SAFETY BOARD

DEPARTMENT OF TRANSPORTATION

WASHINGTON, D. C. 20591

BRIEFS OF ACCIDENTS

INVOLVING

U. S. CIVIL AVIATION

MID-AIR COLLISONS

1968

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
E-0008	8/14/68 TIME - 0850	CLEBURNE,TEX	CESSNA 188A H-K962X DAMAGE -DESTROYED	CR- 1 0 0 PX- 0 0 0 OT- 1 0 0	MISCELLANEOUS FERRY	COMMERCIAL, AGE 40, 4000 TOTAL HOURS, 150 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
INFLIGHT NORMAL CRUISE

UNDER INVESTIGATION

FIRE AFTER IMPACT
REMARKS- OPERATOR,ACFT FERRYING CO. COLUMBIA,S.A.REGISTRY.DEMOLISHED BY FIRE AND IMPACT.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
E-0008	8/14/68 TIME - 0850	CLEBURNE,TEX	CESSNA 188A H-K965X DAMAGE -DESTROYED	CR- 1 0 0 PX- 0 0 0 OT- 1 0 0	MISCELLANEOUS FERRY	COMMERCIAL, AGE 26, 1250 TOTAL HOURS, 60 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
INFLIGHT NORMAL CRUISE

UNDER INVESTIGATION

FIRE AFTER IMPACT
REMARKS- OPERATOR,ACFT FERRYING CO. COLUMBIA,S.A.REGISTRY.DEMOLISHED BY FIRE AND IMPACT.

```
DOCKET   DATE            LOCATION        AIRCRAFT DATA        INJURIES        FLIGHT               PILOT DATA
                                                                  F  S M/N    PURPOSE

1-0021   6/12/68  NR.DENVER,COLO         CESSNA 337            CR-  0  0  1  MISCELLANEOUS        COMMERCIAL,   AGE 36, 5000
         TIME - 0719                     N-2212X               PX-  0  0  1    POLICE PATROL      TOTAL HOURS, 200 IN TYPE.
                                         DAMAGE -SUBSTANTIAL   OT-  0  0 62
  TYPE OF ACCIDENT                                                  PHASE OF OPERATION
     COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                           INFLIGHT  DESCENDING

  PROBABLE CAUSE
     MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT
  REMARKS- LANDED AT ARPT,NO FURTHER DAMAGE.


1-0021   6/12/68  NR.DENVER,COLO         BOEING 727            CR-  0  0  7  PASSG S-D            AIRLINE TRANSPORT,   AGE 43,
         TIME - 0719                     N-7086U               PX-  0  0 55                       16000 TOTAL HOURS, 2400 IN
                                         DAMAGE -MINOR         OT-  0  0  2                       TYPE.
  OPERATOR - UNITED AIR LINES,INC.
  TYPE OF ACCIDENT                                                  PHASE OF OPERATION
     COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                           INFLIGHT  DESCENDING

  PROBABLE CAUSE
     PILOT IN COMMAND -   FAILED TO SEE AND AVOID OTHER AIRCRAFT
  REMARKS- LANDED AT ARPT,NO FURTHER DAMAGE.


3-0136   1/19/68  MIAMI,FLA              CESSNA 150            CR-  0  0  1  NONCOMMERCIAL        PRIVATE,   AGE 31, 104 TOTAL
         TIME - 1715                     N-3940J               PX-  0  0  0    PRACTICE           HOURS, 7 IN TYPE.
                                         DAMAGE -SUBSTANTIAL   OT-  0  0  1
  TYPE OF ACCIDENT                                                  PHASE OF OPERATION
     COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                           LANDING  FINAL APPROACH

  PROBABLE CAUSE
     PILOT IN COMMAND -   FAILED TO SEE AND AVOID OTHER AIRCRAFT
     PILOT IN COMMAND -   FAILED TO FOLLOW APPROVED PROCEDURES,DIRECTIVES,ETC
  FACTOR
     MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT
  REMARKS- N3940J STRUCK N7018X. N3940J HAD FLOWN RT HAND PATTERN TO UNCONTROLLED ARPT.


3-0136   1/19/68  MIAMI,FLA              CESSNA 150            CR-  0  0  1  INSTRUCTIONAL        STUDENT,   AGE 42, 31 TOTAL
         TIME - 1715                     N-7018X               PX-  0  0  0    TRAINING           HOURS, ALL IN TYPE.
                                         DAMAGE -MINOR         OT-  0  0  1
  TYPE OF ACCIDENT                                                  PHASE OF OPERATION
     COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                           LANDING  FINAL APPROACH

  PROBABLE CAUSE
     PILOT IN COMMAND -   FAILED TO SEE AND AVOID OTHER AIRCRAFT
  FACTOR
     MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT
  REMARKS- CESSNA N3940J STRUCK CESSNA N7018X.N3940J HAD FLOWN RT-HAND PATTERN ON HIS APPROACH TO FINAL.
```

3-0550 2/18/68 FRANKLIN,IND
TIME - 1715 '
STINSON 108 | N-8905K | DAMAGE -DESTROYED
CR- 1 0 0 | PX- 0 1 0 | OT- 1 0 0
NONCOMMERCIAL PLEASURE
PRIVATE, AGE 36, 164 TOTAL HOURS, 33 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT
PHASE OF OPERATION
LANDING FINAL APPROACH

PROBABLE CAUSE
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT
REMARKS- N9516W OVERTOOK AND DESCENDED INTO N8905K.N9516W FLEW NORMAL PATTERN.N8905K MADE LONG,LOW APPROACH

3-0550 2/18/68 FRANKLIN,IND
TIME - 1715
PIPER PA-28 | N-9516W | DAMAGE -DESTROYED
CR- 1 0 0 | PX- 0 0 0 | OT- 1 1 0
INSTRUCTIONAL TRAINING
STUDENT, AGE 25, 18 TOTAL HOURS, ALL IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT
PHASE OF OPERATION
LANDING FINAL APPROACH

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
REMARKS- N9516W OVERTOOK AND DESCENDED INTO N8905K.N9516W FLEW NORMAL PATTERN.N8905K MADE LONG,LOW APPROACH

3-0566 2/25/68 SAN JOSE,CALIF
TIME - 1826
TAYLORCRAFTBC12-D | N-43420 | DAMAGE -SUBSTANTIAL
CR- 0 0 1 | PX- 0 0 0 | OT- 0 0 1
NONCOMMERCIAL PLEASURE
PRIVATE, AGE 37, 267 TOTAL HOURS, 76 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT
PHASE OF OPERATION
LANDING TRAFFIC PATTERN-CIRCLING

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT

3-0566 2/25/68 SAN JOSE,CALIF
TIME - 1826
PIPER PA-28 | N-4507J | DAMAGE -SUBSTANTIAL
CR- 0 0 1 | PX- 0 0 0 | OT- 0 0 1
NONCOMMERCIAL PLEASURE
COMMERCIAL,FL.INSTR., AGE 34, 672 TOTAL HOURS, 600 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT
PHASE OF OPERATION
LANDING TRAFFIC PATTERN-CIRCLING

PROBABLE CAUSE
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT

3-0951 3/24/68 PUYALLUP,WASH
TIME - 1136
CESSNA 172 | N-6069A | DAMAGE -DESTROYED
CR- 1 0 0 | PX- 1 0 0 | OT- 2 0 0
NONCOMMERCIAL PLEASURE
PRIVATE, AGE 48, 692 TOTAL HOURS, 162 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT
PHASE OF OPERATION
LANDING FINAL APPROACH

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT
FACTOR
PILOT IN COMMAND - FAILED TO FOLLOW APPROVED PROCEDURES,DIRECTIVES,ETC
REMARKS- BOTH PLTS FLEW OPPOSITE PATTERNS [illegible]

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-0951	3/24/68 TIME - 1136	PUYALLUP,WASH	CESSNA 150H N-6543S DAMAGE -DESTROYED	CR- 2 0 0 PX- 0 0 0 OT- 2 0 0	INSTRUCTIONAL DUAL	COMMERCIAL,FL.INSTR., AGE 35, 2319 TOTAL HOURS, 41 IN TYPE.

PHASE OF OPERATION
LANDING FINAL APPROACH

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PROBABLE CAUSE
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
FIRE AFTER IMPACT
REMARKS- BOTH PLTS FLEW OPPOSITE PATTERNS,FAILED TO SEE EACH OTHER.N6069A FLEW IMPROPER PATTERN.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-1055	3/16/68 TIME - 1040	NR.KENAI,ALAS	PIPER PA-18 N-232T DAMAGE -DESTROYED	CR- 1 0 0 PX- 1 0 0 OT- 2 0 0	NONCOMMERCIAL PLEASURE	PRIVATE, AGE 27, 104 TOTAL HOURS, 95 IN TYPE.

PHASE OF OPERATION
INFLIGHT NORMAL CRUISE

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT
FIRE AFTER IMPACT
REMARKS- BOTH PLTS FAILED TO SEE EACH OTHER.N232T WHITE,BLENDED WITH SNOW COVERED BACKGROUND.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-1055	3/16/68 TIME - 1040	NR.KENAI,ALAS	PIPER PA-18 N-3792Z DAMAGE -DESTROYED	CR- 1 0 0 PX- 1 0 0 OT- 2 0 0	NONCOMMERCIAL PLEASURE	PRIVATE, AGE 27, 138 TOTAL HOURS, 99 IN TYPE.

PHASE OF OPERATION
INFLIGHT NORMAL CRUISE

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT
REMARKS- BOTH PLTS FAILED TO SEE EACH OTHER.N232T WHITE,BLENDED WITH SNOW COVERED BACKGROUND.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-1578	5/19/68 TIME - 1415	NR.BAKERSFIELD,CALIF	AERONCA 7AC N-3537E DAMAGE -DESTROYED	CR- 1 0 0 PX- 1 0 0 OT- 2 0 0	NONCOMMERCIAL PLEASURE	PRIVATE, AGE 26, 203 TOTAL HOURS, 135 IN TYPE.

PHASE OF OPERATION
INFLIGHT OTHER

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PROBABLE CAUSE
PILOT IN COMMAND - MISJUDGED CLEARANCE
FACTOR
PILOT IN COMMAND - ATTEMPTED OPERATION BEYOND EXPERIENCE/ABILITY LEVEL
MISCELLANEOUS ACTS,CONDITIONS - ALCOHOLIC IMPAIRMENT OF EFFICIENCY AND JUDGEMENT
REMARKS- FORMATION FLYING.BLOOD ALCOHOL LEVEL 63 MG PCT.OVER TOOK,STRUCK PIPER N57253.

```
DOCKET   DATE            LOCATION            AIRCRAFT DATA         INJURIES          FLIGHT              PILOT DATA
                                                                   F  S M/N          PURPOSE
--------------------------------------------------------------------------------------------------------------------------------
3-1578   5/19/68  NR.BAKERFIELD,CALIF   PIPER J-3            CR-  1  0  0   NONCOMMERCIAL       PRIVATE,    AGE 21, 242 TOTAL
         TIME - 1415                    N-57253              PX-  1  0  0     PLEASURE          HOURS, 25 IN TYPE.
                                        DAMAGE -DESTROYED    OT-  2  0  0
         TYPE OF ACCIDENT                                          PHASE OF OPERATION
            COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                   INFLIGHT  OTHER

         PROBABLE CAUSE
            MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT
         FACTOR
            PILOT IN COMMAND -   ATTEMPTED OPERATION BEYOND EXPERIENCE/ABILITY LEVEL
         REMARKS- FORMATION FLYING.STRUCK BY AERONCA N3537E.


3-1996   4/10/68  COLUMBUS,OHIO         PIPER PA-28          CR-  2  0  0   INSTRUCTIONAL       COMMERCIAL,FL.INSTR., AGE 26,
         TIME - 1510                    N-4239J              PX-  0  0  0     DUAL              1067 TOTAL HOURS, 490 IN TYPE.
                                        DAMAGE -DESTROYED    OT-  0  0  1
         TYPE OF ACCIDENT                                          PHASE OF OPERATION
            COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                   LANDING  FINAL APPROACH

         PROBABLE CAUSE
            MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT
         FACTOR
            TRAFFIC CONTROL PERSONNEL -   OTHER
         REMARKS- APPCON DIDNT ADVS N4239J TO MONITOR OR CTC CTL TWR AFT ISSUING CLNC FOR PRACTICE ILS,LOW APPROACH.


3-1996   4/10/68  COLUMBUS,OHIO         BEECH V35            CR-  0  0  1   NONCOMMERCIAL       COMMERCIAL,   AGE 44, 7127
         TIME - 1510                    N-8318N              PX-  0  0  0     BUSINESS          TOTAL HOURS, 125 IN TYPE.
                                        DAMAGE -SUBSTANTIAL  OT-  2  0  0
         TYPE OF ACCIDENT                                          PHASE OF OPERATION
            COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                   LANDING  FINAL APPROACH

         PROBABLE CAUSE
            PILOT IN COMMAND -   FAILED TO SEE AND AVOID OTHER AIRCRAFT
         FACTOR
            TRAFFIC CONTROL PERSONNEL -   OTHER
         REMARKS- APPCON DIDNT ADVS N4239J TO MONITOR OR CTC CTL TWR AFT ISSUING CLNC FOR PRACTICE ILS,LOW APPROACH.


3-2000   4/10/68  KANSAS CITY,MO        CESSNA 150           CR-  0  0  1   INSTRUCTIONAL       PRIVATE,    AGE 25, 75 TOTAL
         TIME - 1730                    N-6386S              PX-  0  0  0     TRAINING          HOURS, 40 IN TYPE.
                                        DAMAGE -SUBSTANTIAL  OT-  1  0  0
         TYPE OF ACCIDENT                                          PHASE OF OPERATION
            COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                   INFLIGHT  NORMAL CRUISE

         PROBABLE CAUSE
            PILOT IN COMMAND -   FAILED TO SEE AND AVOID OTHER AIRCRAFT
            MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT
         FACTOR
            AIRPORT CONDITIONS -   OTHER
            MISCELLANEOUS ACTS,CONDITIONS -   SUNGLARE
         REMARKS- FCTY SMOKE OBSCURS TWR VIEW OF RNWY 35 X-WIND TRFC.PLT N9210P FAILED TO SEE,AVOID N6386S.
```

DOCKET DATE LOCATION AIRCRAFT DATA INJURIES F S M/N FLIGHT PURPOSE PILOT DATA

3-2000 4/10/68 KANSAS CITY,MO
TIME - 1730
PIPER PA-24
N-9210P
DAMAGE -DESTROYED
CR- 1 0 0
PX- 0 0 0
OT- 0 0 1
NONCOMMERCIAL
BUSINESS
PRIVATE, AGE 51, 2323 TOTAL HOURS, 152 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT
PHASE OF OPERATION
INFLIGHT DESCENDING

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT
FACTOR
AIRPORT CONDITIONS - OTHER
REMARKS- FCTY SMOKE OBSCURS TWR VIEW OF RNWY 35 X-WIND TRFC. PLT N6386S FAILED TO SEE,AVOID N9210P.

3-2001 8/18/68 BARRE PLAINS,MASS
TIME - 1415
TAYLORCRAFTBC12-D
N-43118
DAMAGE -SUBSTANTIAL
CR- 0 0 1
PX- 0 0 0
OT- 0 0 1
NONCOMMERCIAL
PLEASURE
COMMERCIAL, AGE 28, 201 TOTAL HOURS, 83 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT
PHASE OF OPERATION
LANDING FINAL APPROACH

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT

3-2001 8/18/68 BARRE PLAINS,MASS
TIME - 1415
PIPER PA-22
N-5945Z
DAMAGE -SUBSTANTIAL
CR- 0 0 1
PX- 0 0 0
OT- 0 0 1
INSTRUCTIONAL
TRAINING
STUDENT, AGE 42, 43 TOTAL HOURS, 33 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT
PHASE OF OPERATION
LANDING FINAL APPROACH

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT

3-2044 7/7/68 DANBURY,CONN
TIME - 1649
PIPER PA-28
N-4397J
DAMAGE -SUBSTANTIAL
CR- 0 0 1
PX- 0 0 0
OT- 0 0 2
INSTRUCTIONAL
SOLO
PRIVATE, AGE 18, 133 TOTAL HOURS, 105 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT
PHASE OF OPERATION
LANDING LEVEL OFF/TOUCHDOWN

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
FACTOR
MISCELLANEOUS ACTS,CONDITIONS - SUNGLARE
REMARKS- N4397J LANDED ON N5162Z. COLLIDED DURING LNDG FLARE. BOTH AIRBORNE.

BRIEFS OF ACCIDENTS

```
DOCKET   DATE          LOCATION          AIRCRAFT DATA      INJURIES         FLIGHT            PILOT DATA
                                                              F  S M/N       PURPOSE

3-2044   7/7/68  DANBURY,CONN           PIPER PA-22         CR-  0  0  2   INSTRUCTIONAL      COMMERCIAL,FL.INSTR., AGE 21,
         TIME - 1649                    N-5162Z             PX-  0  0  0     DUAL             1510 TOTAL HOURS, 350 IN TYPE.
                                        DAMAGE -SUBSTANTIAL OT-  0  0  1
   TYPE OF ACCIDENT                                              PHASE OF OPERATION
      COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                       LANDING  LEVEL OFF/TOUCHDOWN

   PROBABLE CAUSE
      MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT
   REMARKS- N4397J LANDED ON N5162Z. COLLIDED DURING LANDING FLARE, BOTH AIRBORNE.


3-2051   7/16/68  CROWS LNDNG,CALIF     PIPER PA-25         CR-  0  0  1   COMMERCIAL         COMMERCIAL,   AGE 35, 1218
         TIME - 0600                    N-4574Y             PX-  0  0  0     AERIAL APPLIC    TOTAL HOURS, 314 IN TYPE.
                                        DAMAGE -DESTROYED   OT-  0  0  1
   TYPE OF ACCIDENT                                              PHASE OF OPERATION
      COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                       INFLIGHT  STARTING SWATH RUN

   PROBABLE CAUSE
      PILOT IN COMMAND -   EXERCISED POOR JUDGMENT
   REMARKS- PLT OF N4574Y FAILED TO ASSURE FIELD WAS CLEAR OF OTHER ACFT BEFORE STARTING SWATH RUN.


3-2051   7/16/68  CROWS LNDNG,CALIF     FAIRCHILD WM-62C    CR-  0  0  1   COMMERCIAL         COMMERCIAL,   AGE 33, 2400
         TIME - 0600                    N-68444             PX-  0  0  0     AERIAL APPLIC    TOTAL HOURS, 2100 IN TYPE.
                                        DAMAGE -SUBSTANTIAL OT-  0  0  1
   TYPE OF ACCIDENT                                              PHASE OF OPERATION
      COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                       INFLIGHT  SWATH RUN

   PROBABLE CAUSE
      MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT
   REMARKS- SPRAYING ALFALFA.PLT OF N4574Y INITIATED SWATH RUN BELOW POWER LINE,OUT OF RISING SUN.


3-2052   7/28/68  WYANDANCH,NY          PIPER PA-23         CR-  1  0  0   NONCOMMERCIAL      PRIVATE,   AGE 46, 456 TOTAL
         TIME - 1926                    N-5980Y             PX-  3  0  0     PLEASURE         HOURS, 35 IN TYPE.
                                        DAMAGE -DESTROYED   OT-  4  0  0
   TYPE OF ACCIDENT                                              PHASE OF OPERATION
      COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                       LANDING  TRAFFIC PATTERN-CIRCLING

   PROBABLE CAUSE
      PILOT IN COMMAND -   FAILED TO SEE AND AVOID OTHER AIRCRAFT
      MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT
   FIRE AFTER IMPACT
```

BRIEFS OF ACCIDENTS

```
DOCKET   DATE               LOCATION            AIRCRAFT DATA       INJURIES          FLIGHT           PILOT DATA
                                                                     F  S M/N         PURPOSE

3-2052   7/28/68  WYANDANCH,NY                  PIPER PA-28         CR- 1  0  0   NONCOMMERCIAL    PRIVATE,   AGE 25, 47 TOTAL
         TIME - 1926                            N-7162R             PX- 3  0  0     PLEASURE       HOURS, 5 IN TYPE.
                                                DAMAGE -DESTROYED   OT- 4  0  0
                                                                      PHASE OF OPERATION
     TYPE OF ACCIDENT                                                   LANDING  TRAFFIC PATTERN-CIRCLING
        COLLISION WITH AIRCRAFT  BOTH IN FLIGHT

     PROBABLE CAUSE
        PILOT IN COMMAND -   FAILED TO SEE AND AVOID OTHER AIRCRAFT
        MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT


3-2054   5/20/68  PHONETON,OHIO                 CESSNA 120          CR- 2  0  0   NONCOMMERCIAL    AGE 63, 355 TOTAL HOURS, 158 IN
         TIME - 1200                            C-F-KUE             PX- 0  0  0     PLEASURE       TYPE.
                                                DAMAGE -DESTROYED   OT- 1  0  0
                                                                      PHASE OF OPERATION
     TYPE OF ACCIDENT                                                   INFLIGHT  NORMAL CRUISE
        COLLISION WITH AIRCRAFT  BOTH IN FLIGHT

     PROBABLE CAUSE
        PILOT IN COMMAND -   FAILED TO SEE AND AVOID OTHER AIRCRAFT
     FACTOR
        PILOT IN COMMAND -   INADEQUATE PREFLIGHT PREPARATION AND/OR PLANNING
     REMARKS- N3773Q,TURNING ON DOWNWIND LEG,WAS STRUCK BY CF-KUE IN RT REAR.CF-KUE PLT UNFAMILIAR WITH TRAFFIC.


3-2054   5/20/68  PHONETON,OHIO                 BEECH 95-C55        CR- 1  0  0   NONCOMMERCIAL    COMMERCIAL,FL.INSTR., AGE 38,
         TIME - 1200                            N-3773Q             PX- 0  0  0     CORP/EXEC      7941 TOTAL HOURS, 572 IN TYPE.
                                                DAMAGE -DESTROYED   OT- 2  0  0
                                                                      PHASE OF OPERATION
     TYPE OF ACCIDENT                                                   LANDING  TRAFFIC PATTERN-CIRCLING
        COLLISION WITH AIRCRAFT  BOTH IN FLIGHT

     PROBABLE CAUSE
        MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT
     REMARKS- N3773Q,TURNING ON DOWNWIND LEG,WAS STRUCK BY CF-KUE IN RT REAR.CF-KUE PLT UNFAMILIAR WITH TRAFFIC.


3-2055   6/20/68  INDIAN SPRNGS,NEV             MOONEY M20A         CR- 1  0  0   NONCOMMERCIAL    PRIVATE,   AGE 45, 668 TOTAL
         TIME - 0816                            N-1092B             PX- 4  0  0     PLEASURE       HOURS, 125 IN TYPE.
                                                DAMAGE -DESTROYED   OT- 0  0  2
                                                                      PHASE OF OPERATION
     TYPE OF ACCIDENT                                                   INFLIGHT  NORMAL CRUISE
        COLLISION WITH AIRCRAFT  BOTH IN FLIGHT

     PROBABLE CAUSE
        MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT
```

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES	F	S	M/N	FLIGHT PURPOSE	PILOT DATA
3-2055	6/20/68 TIME - 0816	INDIAN SPRNGS,NEV	REPUBLIC F-105 U-SAF624422 DAMAGE -MINOR	CR- PX- OT-	0 0 5	0 0 0	2 0 0	NONCOMMERCIAL PRACTICE	AGE UNKNOWN, UNKNOWN TOTAL HOURS, UNKNOWN IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
INFLIGHT NORMAL CRUISE

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
REMARKS- LANDED SAFELY AT USAF BASE.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES	F	S	M/N	FLIGHT PURPOSE	PILOT DATA
3-2056	8/6/68 TIME - 1335	CHESAPEAKE,VA	PIPER PA-22 N-5929Z DAMAGE -DESTROYED	CR- PX- OT-	1 0 1	0 0 0	0 0 0	INSTRUCTIONAL TRAINING	STUDENT, AGE 16, 27 TOTAL HOURS, 25 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
INFLIGHT NORMAL CRUISE

PROBABLE CAUSE
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES	F	S	M/N	FLIGHT PURPOSE	PILOT DATA
3-2056	8/6/68 TIME - 1335	CHESAPEAKE,VA	CESSNA T-210H N-6908R DAMAGE -DESTROYED	CR- PX- OT-	1 0 1	0 0 0	0 0 0	NONCOMMERCIAL CORP/EXEC	COMMERCIAL, AGE 30, 407 TOTAL HOURS, 94 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
INFLIGHT CLIMB TO CRUISE

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
FIRE AFTER IMPACT

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES	F	S	M/N	FLIGHT PURPOSE	PILOT DATA
3-2122	8/3/68 TIME - 1955	LEXINGTON,NEBR	AERONCA 7AC N-2966E DAMAGE -DESTROYED	CR- PX- OT-	0 0 0	1 0 2	0 0 1	COMMERCIAL AERIAL APPLIC	COMMERCIAL,FL.INSTR., AGE 54, 15550 TOTAL HOURS, 1000 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
LANDING FINAL APPROACH

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT
FACTOR
MISCELLANEOUS ACTS,CONDITIONS - POORLY PLANNED APPROACH
REMARKS- PLT OF N2966E MADE RT HAND,NON-STANDARD,PATTERN ENTRY.PLT OF N5560P MADE STANDARD LT HAND PATTERN.

```
DOCKET   DATE            LOCATION            AIRCRAFT DATA       INJURIES      FLIGHT            PILOT DATA
                                                                   F  S M/N    PURPOSE

3-2122   8/3/68  LEXINGTON,NEBR          PIPER PA-24          CR-  0  1  0   NONCOMMERCIAL     COMMERCIAL,FL.INSTR., AGE 67,
         TIME - 1955                     N-5560P              PX-  0  1  1     BUSINESS        9956 TOTAL HOURS, 2200 IN TYPE.
                                         DAMAGE -DESTROYED    OT-  0  1  0
       TYPE OF ACCIDENT                                           PHASE OF OPERATION
          COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                    LANDING  FINAL APPROACH

       PROBABLE CAUSE
          PILOT IN COMMAND -   FAILED TO SEE AND AVOID OTHER AIRCRAFT
          MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT


3-2123   2/24/68  NR.FERNDALE,WASH       BEECH D18S           CR-  0  0  2   INSTRUCTIONAL     COMMERCIAL,FL.INSTR., AGE 46,
         TIME - 1701                     N-4545               PX-  0  0  0     DUAL            6680 TOTAL HOURS, 183 IN TYPE.
                                         DAMAGE -SUBSTANTIAL  OT-  2  0  0
       TYPE OF ACCIDENT                                           PHASE OF OPERATION
          COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                    LANDING  FINAL APPROACH

       PROBABLE CAUSE
          PILOT IN COMMAND -   FAILED TO SEE AND AVOID OTHER AIRCRAFT
          MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT
       REMARKS- BOTH PLTS FAILED TO SEE EACH OTHER. N4545 LANDED SAFELY,N8062C CRASHED.


3-2123   2/24/68  NR.FERNDALE,WASH       PIPER PA-18          CR-  1  0  0   NONCOMMERCIAL     STUDENT,   AGE 41, 12 TOTAL
         TIME - 1701                     N-8062C              PX-  1  0  0     PLEASURE        HOURS, 4 IN TYPE.
                                         DAMAGE -DESTROYED    OT-  0  0  2
       TYPE OF ACCIDENT                                           PHASE OF OPERATION
          COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                    INFLIGHT  NORMAL CRUISE

       PROBABLE CAUSE
          PILOT IN COMMAND -   FAILED TO SEE AND AVOID OTHER AIRCRAFT
          MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT
       REMARKS- BOTH PLTS FAILED TO SEE EACH OTHER. N4545 LANDED SAFELY.N8062C CRASHED.


3-2125   7/3/68  RESEDA,CALIF            CESSNA 150           CR-  2  0  0   INSTRUCTIONAL     COMMERCIAL,FL.INSTR., AGE 42,
         TIME - 1541                     N-7188S              PX-  0  0  0     DUAL            7200 TOTAL HOURS, 5000 IN TYPE.
                                         DAMAGE -DESTROYED    OT-  0  0  2
       TYPE OF ACCIDENT                                           PHASE OF OPERATION
          COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                    INFLIGHT  CLIMB TO CRUISE

       PROBABLE CAUSE
          PILOT IN COMMAND -   FAILED TO SEE AND AVOID OTHER AIRCRAFT
          MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT
       FIRE AFTER IMPACT
       REMARKS- BOTH PLTS FAILED TO SEE EACH OTHER. N8394H LANDED SAFELY,N7188S CRASHED IN RESIDENTIAL AREA.
```

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES	F	S	M/N	FLIGHT PURPOSE	PILOT DATA
3-2125	7/3/68 TIME - 1541	RESEDA,CALIF	DOUGLAS A-26B N-8394H DAMAGE -SUBSTANTIAL	CR- PX- OT-	0 0 2	0 0 0	2 0 0	NONCOMMERCIAL CORP/EXEC	AIRLINE TRANSPORT, AGE 45, 15391 TOTAL HOURS, 285 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
LANDING TRAFFIC PATTERN-CIRCLING

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT
REMARKS- BOTH PLTS FAILED TO SEE EACH OTHER. N8394H LANDED SAFELY,N7188S CRASHED IN RESIDENTIAL AREA.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES	F	S	M/N	FLIGHT PURPOSE	PILOT DATA
3-2166	8/1/68 TIME - 0920	ROCK RIVER,WYO	BEECH K35 N-3069C DAMAGE -DESTROYED	CR- PX- OT-	2 0 4	0 0 0	0 0 0	NONCOMMERCIAL PLEASURE	COMMERCIAL, AGE 51, 500 TOTAL HOURS, UNKNOWN IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
INFLIGHT NORMAL CRUISE

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT
MISSING AIRCRAFT-LATER RECOVERED
REMARKS- RECOVERY DATE-8/2/68.RIGHT WINDOW CURTAIN CLOSED

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES	F	S	M/N	FLIGHT PURPOSE	PILOT DATA
3-2166	8/1/68 TIME - 0920	ROCK RIVER,WYO	CESSNA 210 N-8236Z DAMAGE -DESTROYED	CR- PX- OT-	1 3 2	0 0 0	0 0 0	NONCOMMERCIAL PLEASURE	PRIVATE, AGE 42, 434 TOTAL HOURS, 255 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
INFLIGHT NORMAL CRUISE

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT
MISSING AIRCRAFT-LATER RECOVERED
REMARKS- RECOVERY DATE-8/2/68.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES	F	S	M/N	FLIGHT PURPOSE	PILOT DATA
3-2167	8/14/68 TIME - 1758	HAYWARD,CALIF	CESSNA 150 N-7819E DAMAGE -SUBSTANTIAL	CR- PX- OT-	0 0 0	0 0 0	1 0 1	INSTRUCTIONAL TRAINING	STUDENT, AGE 20, 20 TOTAL HOURS, 14 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
LANDING FINAL APPROACH

PROBABLE CAUSE
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT
FACTOR
TRAFFIC CONTROL PERSONNEL - ISSUED IMPROPER OR CONFLICTING INSTRUCTIONS
FAILURE TO ADVISE OF UNSAFE AIRPORT CONDITION INADEQUATE SPACING OF AIRCRAFT
REMARKS- N8329P WAS CLEARED NO 2 TO LAND WHEN THERE WERE 2 ACFT AHEAD OF IT ON FINAL APPROACH.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-2167	8/14/68 TIME - 1758	HAYWARD,CALIF	PIPER PA-24 N-8329P DAMAGE -MINOR	CR- 0 0 1 PX- 0 0 0 OT- 0 0 1	NONCOMMERCIAL PLEASURE	PRIVATE, AGE 32, 305 TOTAL HOURS, 87 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
LANDING FINAL APPROACH

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
FACTOR
TRAFFIC CONTROL PERSONNEL - ISSUED IMPROPER OR CONFLICTING INSTRUCTIONS
FAILURE TO ADVISE OF UNSAFE AIRPORT CONDITION INADEQUATE SPACING OF AIRCRAFT
REMARKS- N8329P WAS CLEARED NO 2 TO LAND WHEN THERE WERE 2 ACFT AHEAD OF IT ON FINAL APPROACH.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-2168	8/24/68 TIME - 1250	CALIF CITY,CALIF	SZD FOKA-4 N-204FZ DAMAGE -SUBSTANTIAL	CR- 0 0 1 PX- 0 0 0 OT- 0 0 1	NONCOMMERCIAL PLEASURE	PRIVATE, AGE 32, 155 TOTAL HOURS, 77 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
INFLIGHT OTHER

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT
REMARKS- SUCCESSFUL LDG AT ARPT.CIRCLING LT IN THERMAL.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-2168	8/24/68 TIME - 1250	CALIF.CITY,CALIF	GLASFUEGEL H301 N-301F DAMAGE -DESTROYED	CR- 0 0 1 PX- 0 0 0 OT- 0 0 1	NONCOMMERCIAL PLEASURE	COMMERCIAL, AGE 40, 455 TOTAL HOURS, 150 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
INFLIGHT OTHER

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT
REMARKS- PLT PARACHUTED SAFELY. CIRCLING LT IN THERMAL.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-2375	5/30/68 TIME - 0700	NORMAN,OKLA	CESSNA 337B N-2308S DAMAGE -SUBSTANTIAL	CR- 0 0 1 PX- 0 0 1 OT- 0 0 1	NONCOMMERCIAL PLEASURE	COMMERCIAL, AGE 40, 944 TOTAL HOURS, 57 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
TAKEOFF INITIAL CLIMB

PROBABLE CAUSE
PILOT IN COMMAND - EXERCISED POOR JUDGMENT
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT
FACTOR
AIRPORT CONDITIONS - OTHER

```
DOCKET   DATE          LOCATION          AIRCRAFT DATA        INJURIES          FLIGHT              PILOT DATA
                                                               F  S M/N         PURPOSE
-------------------------------------------------------------------------------------------------------------------
3-2375   5/30/68  NORMAN,OKLA            CESSNA 150F          CR-  0  0  1   INSTRUCTIONAL        STUDENT,    AGE 25, 9 TOTAL
         TIME - 0700                     N-8396G              PX-  0  0  0     SOLO               HOURS, ALL IN TYPE.
                                         DAMAGE -SUBSTANTIAL  OT-  0  0  2
        TYPE OF ACCIDENT                                              PHASE OF OPERATION
          COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                       TAKEOFF  INITIAL CLIMB

        PROBABLE CAUSE
          PILOT IN COMMAND -   FAILED TO SEE AND AVOID OTHER AIRCRAFT
          FLIGHT INSTRUCTOR -   INADEQUATE SUPERVISION OF FLIGHT
          MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT
        FACTOR
          AIRPORT CONDITIONS -   OTHER
        REMARKS- INSTR FAILED TO KEEP SURVEILLANCE OVER OTHER ARPT TRAFFIC.TERRAIN OBSTRUCTIONS BETWEEN RNWYS.


3-2378   9/8/68  FLUSHING,NY             CESSNA 402           CR-  0  0  1   COMMERCIAL           COMMERCIAL,   AGE 47, 6805
         TIME - 1455                     N-8283F              PX-  0  0  6     AIR TAXI - PASSG   TOTAL HOURS, 169 IN TYPE.
                                         DAMAGE -SUBSTANTIAL  OT-  2  2  0
        TYPE OF ACCIDENT                                              PHASE OF OPERATION
          COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                       LANDING  FINAL APPROACH

        PROBABLE CAUSE
          PILOT IN COMMAND -   FAILED TO SEE AND AVOID OTHER AIRCRAFT


3-2378   9/8/68  FLUSHING,NY             PIPER PA-28          CR-  1  0  0   COMMERCIAL           COMMERCIAL,   AGE 54, 4000
         TIME - 1455                     N-8828W              PX-  1  2  0     AIR TAXI - PASSG   TOTAL HOURS,  UNKNOWN IN TYPE.
                                         DAMAGE -DESTROYED    OT-  0  0  7
        TYPE OF ACCIDENT                                              PHASE OF OPERATION
          COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                       LANDING  FINAL APPROACH

        PROBABLE CAUSE
          MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT


3-2396   9/15/68  HAMILTON,OHIO          CESSNA 150           CR-  0  0  1   NONCOMMERCIAL        PRIVATE,    AGE 48, 350 TOTAL
         TIME - 0855                     N-3314J              PX-  0  0  1     PLEASURE           HOURS, 46 IN TYPE.
                                         DAMAGE -SUBSTANTIAL  OT-  0  0  1
        TYPE OF ACCIDENT                                              PHASE OF OPERATION
          COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                       LANDING  LEVEL OFF/TOUCHDOWN

        PROBABLE CAUSE
          PILOT IN COMMAND -   FAILED TO SEE AND AVOID OTHER AIRCRAFT
        REMARKS- CESSNA N3314J DESCENDED ON TO THE TOP OF N5994T.UN-CONTROLLED ARPT.
```

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-2396	9/15/68 TIME - 0855	HAMILTON,OHIO	CESSNA 150 N-5994T DAMAGE -SUBSTANTIAL	CR- 0 0 1 PX- 0 0 0 OT- 0 0 2	INSTRUCTIONAL TRAINING	STUDENT, AGE 28, 90 TOTAL HOURS, 65 IN TYPE.

PHASE OF OPERATION
LANDING LEVEL OFF/TOUCHDOWN

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PROBABLE CAUSE
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-2443	9/16/68 TIME - 1100	BITTER CREEK,WYO	INTERSTATE S-1A N-37455 DAMAGE -DESTROYED	CR- 0 1 0 PX- 0 0 0 OT- 1 1 0	COMMERCIAL OTHER	COMMERCIAL, AGE 21, 457 TOTAL HOURS, 300 IN TYPE.

PHASE OF OPERATION
INFLIGHT OTHER

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT
UNDER INVESTIGATION

REMARKS- N48100 STRUCK LEFT WG,N37455. BOTH PLTS HERDING HORSES.LOW LEVEL FLT,ROLLING TERRAIN.NO RADIO COMM

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-2443	9/16/68 TIME - 1100	BITTER CREEK,WYO	INTERSTATE S-1B1 N-48100 DAMAGE -DESTROYED	CR- 1 0 0 PX- 0 1 0 OT- 0 1 0	COMMERCIAL OTHER	COMMERCIAL,FL.INSTR., AGE 47, 16103 TOTAL HOURS, 700 IN TYPE.

PHASE OF OPERATION
INFLIGHT OTHER

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
PILOT IN COMMAND - DIVERTED ATTENTION FROM OPERATION OF AIRCRAFT
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT
PILOT IN COMMAND - INADEQUATE PREFLIGHT PREPARATION AND/OR PLANNING
REMARKS- N48100 STRUCK LEFT WG,N37455. BOTH PLTS HERDING HORSES.LOW LEVEL FLT,ROLLING TERRAIN.NO RADIO COMM

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-3188	8/28/68 TIME - 1005	BEAUMONT,TEX	CESSNA 150G N-2654J DAMAGE -DESTROYED	CR- 0 0 2 PX- 0 0 0 OT- 0 0 1	INSTRUCTIONAL DUAL	COMMERCIAL,FL.INSTR., AGE 53, 500 TOTAL HOURS, ALL IN TYPE.

PHASE OF OPERATION
TAKEOFF INITIAL CLIMB

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
MISCELLANEOUS-PERSONNEL - PILOT OF OTHER AIRCRAFT
FACTOR
AIRPORT CONDITIONS - HIGH VEGETATION
REMARKS- N3536J TOOK OFF RNWY 30,N2654J TOOK OFF RNWY 02,COLLISION AT INTERSECTION OF RNWYS.

BRIEFS OF ACCIDENTS

```
DOCKET   DATE              LOCATION          AIRCRAFT DATA      INJURIES        FLIGHT              PILOT DATA
                                                                 F  S M/N       PURPOSE

3-3188   8/28/68  BEAUMONT,TEX              CESSNA 150         CR-  0  0  1    COMMERCIAL          COMMERCIAL,   AGE 37, 3220
         TIME - 1005                        N-3536J            PX-  0  0  0      POWER/PIPELINE    TOTAL HOURS, ALL IN TYPE.
                                            DAMAGE -DESTROYED  OT-  0  0  2
        TYPE OF ACCIDENT                                             PHASE OF OPERATION
          COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                      TAKEOFF  INITIAL CLIMB

        PROBABLE CAUSE
          PILOT IN COMMAND -   FAILED TO SEE AND AVOID OTHER AIRCRAFT
          MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT
        FACTOR
          AIRPORT CONDITIONS -   HIGH VEGETATION
        REMARKS- TALL CROPS BETWEEN RNWYS.UNCONTROLLED ARPT.BOTH RNWYS IN USE,WIND 5 KTS FROM 45 DEGS.


3-3356   7/31/68  WOODBURY,TENN             CESSNA 150         CR-  1  0  0    INSTRUCTIONAL       STUDENT,   AGE 27, 42 TOTAL
         TIME - 1637                        N-5631E            PX-  0  0  0      TRAINING          HOURS, ALL IN TYPE.
                                            DAMAGE -DESTROYED  OT-  0  0  1
        TYPE OF ACCIDENT                                             PHASE OF OPERATION
          COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                      INFLIGHT  NORMAL CRUISE

        PROBABLE CAUSE
          PILOT IN COMMAND -   FAILED TO SEE AND AVOID OTHER AIRCRAFT
          MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT


3-3356   7/31/68  WOODBURY,TENN             CESSNA 150         CR-  0  0  1    INSTRUCTIONAL       STUDENT,   AGE 20, 51 TOTAL
         TIME - 1637                        N-5873E            PX-  0  0  0      TRAINING          HOURS, ALL IN TYPE.
                                            DAMAGE -SUBSTANTIAL OT- 1  0  0
        TYPE OF ACCIDENT                                             PHASE OF OPERATION
          COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                      INFLIGHT  NORMAL CRUISE

        PROBABLE CAUSE
          PILOT IN COMMAND -   FAILED TO SEE AND AVOID OTHER AIRCRAFT
          MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT
        EMERGENCY CIRCUMSTANCES - PRECAUTIONARY LANDING ON AIRPORT
                                  SUSPECTED OR KNOWN AIRCRAFT DAMAGE
        REMARKS- N5873E LANDED SAFELY AT NASHVILLE ARPT.


3-3398   10/24/68  DIXON,CALIF              PIPER PA-25        CR-  1  0  0    COMMERCIAL          COMMERCIAL,   AGE 25, 1400
         TIME - 1045                        N-4688Y            PX-  0  0  0      AERIAL APPLIC     TOTAL HOURS,  UNKNOWN IN TYPE.
                                            DAMAGE -DESTROYED  OT-  1  0  0
        TYPE OF ACCIDENT                                             PHASE OF OPERATION
          COLLISION WITH AIRCRAFT  BOTH IN FLIGHT                      INFLIGHT  PROCEDURE TURNAROUND

        PROBABLE CAUSE
          MISCELLANEOUS-PERSONNEL -   PILOT OF OTHER AIRCRAFT
        FIRE AFTER IMPACT
```

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-3398	10/24/68 TIME - 1045	DIXON,CALIF	PIPER PA-25 N-7742Z DAMAGE -DESTROYED	CR- 1 0 0 PX- 0 0 0 OT- 1 0 0	COMMERCIAL AERIAL APPLIC	COMMERCIAL, AGE 24, 300 TOTAL HOURS, UNKNOWN IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
INFLIGHT PULLUP FROM SWATH RUN

PROBABLE CAUSE
PILOT IN COMMAND - FAILED TO SEE AND AVOID OTHER AIRCRAFT
FIRE AFTER IMPACT
REMARKS- N7742Z OVERTOOK N4688Y DURING LT CLIMBING TURN TO RETURN TO AG STRIP.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-3570	10/27/68 TIME - 1640	CALIPATRIA,CALIF	ERCO 415-C N-3280H DAMAGE -DESTROYED	CR- 1 0 0 PX- 1 0 0 OT- 2 0 0	NONCOMMERCIAL PLEASURE	PRIVATE, AGE 41, UNKNOWN TOTAL HOURS, UNKNOWN IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION

UNDER INVESTIGATION

FIRE AFTER IMPACT
REMARKS- N3280H OVERTOOK AND STRUCK N5847H FROM THE REAR.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-3570	10/27/68 TIME - 1640	CALIPATRIA,CALIF	PIPER PA-16 N-5847H DAMAGE -DESTROYED	CR- 1 0 0 PX- 1 0 0 OT- 2 0 0	NONCOMMERCIAL PLEASURE	STUDENT, AGE 33, 40 TOTAL HOURS, ALL IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
INFLIGHT NORMAL CRUISE

UNDER INVESTIGATION

FIRE AFTER IMPACT
REMARKS- N3280H OVERTOOK AND STRUCK N5847H FROM THE REAR.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-3983	12/8/68 TIME - 1500	SANDWICH,ILL	CESSNA 150E N-3984U DAMAGE -SUBSTANTIAL	CR- 0 0 1 PX- 0 0 0 OT- 0 0 2	NONCOMMERCIAL PLEASURE	PRIVATE, AGE 53, 234 TOTAL HOURS, 94 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
LANDING LEVEL OFF/TOUCHDOWN

UNDER INVESTIGATION

REMARKS- CESSNA N3984U LANDED ON TOP OF FAIRCHILD N81330.UNCONTROLLED ARPT.

BRIEFS OF ACCIDENTS

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-3983	12/8/68 TIME - 1500	SANDWICH,ILL	FAIRCHILD 24 N-81330 DAMAGE -SUBSTANTIAL	CR- 0 0 1 PX- 0 0 1 OT- 0 0 1	NONCOMMERCIAL PLEASURE	PRIVATE, AGE 40, 180 TOTAL HOURS, 60 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
LANDING LEVEL OFF/TOUCHDOWN

UNDER INVESTIGATION

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-4004	12/20/68 TIME - 1645	ROME,GA	CESSNA 182K N-2812R DAMAGE -SUBSTANTIAL	CR- 0 0 1 PX- 0 0 0 OT- 0 0 1	NONCOMMERCIAL PLEASURE	PRIVATE, AGE 34, 220 TOTAL HOURS, 52 IN TYPE.

TYPE OF ACCIDENT

PHASE OF OPERATION
LANDING LEVEL OFF/TOUCHDOWN

UNDER INVESTIGATION

REMARKS- N2812R WAS LOWER ACFT.N2812R FASTER,OVERTOOK N8103S.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-4004	12/20/68 TIME - 1645	ROME,GA	CESSNA 150F N-8103S DAMAGE -SUBSTANTIAL	CR- 0 0 1 PX- 0 0 0 OT- 0 0 1	INSTRUCTIONAL TRAINING	STUDENT, AGE 32, 24 TOTAL HOURS, ALL IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
LANDING LEVEL OFF/TOUCHDOWN

REMARKS- UNCONTROLLED ARPT.N8103S.LANDED ON TOP OF N2812R

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-4444	12/8/68 TIME - 1450	SANTA PAULA,CAL	CESSNA 150B N-1192Y DAMAGE -DESTROYED	CR- 2 0 0 PX- 0 0 0 OT- 3 0 0	INSTRUCTIONAL DUAL	COMMERCIAL,FL.INSTR., AGE 19, 726 TOTAL HOURS, UNKNOWN IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
LANDING TRAFFIC PATTERN-CIRCLING

UNDER INVESTIGATION

REMARKS- N3420S STRUCK N1192Y FROM REAR. BOTH ACFT HAD TURNED FROM CROSSWIND TO DOWNWIND LEG.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-4444	12/8/68 TIME - 1450	SANTA PAULA,CAL	CESSNA 182 N-3420S DAMAGE -DESTROYED	CR- 1 0 0 PX- 2 0 0 OT- 2 0 0	NONCOMMERCIAL PLEASURE	PRIVATE, AGE 21, 142 TOTAL HOURS, UNKNOWN IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
LANDING TRAFFIC PATTERN-CIRCLING

UNDER INVESTIGATION

FIRE AFTER IMPACT
REMARKS- N3420S STRUCK N1192Y FROM REAR. BOTH ACFT HAD TURNED FROM CROSSWIND TO DOWNWIND LEG.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-4803	4/13/68 TIME - 0635	NR.PASCAGOULA,MISS	CHAMPION 7ECA N-96468 DAMAGE -SUBSTANTIAL	CR- 0 0 1 PX- 0 0 0 OT- 1 0 0	COMMERCIAL FISH SPOTTING	COMMERCIAL, AGE 39, 12000 TOTAL HOURS, 4000 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
INFLIGHT OTHER

REMARKS- UNDER INVESTIGATION.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-4803	4/13/68 TIME - 0635	NR.PASCAGOULA,MISS	PIPER PA-18A N-7771D DAMAGE -DESTROYED	CR- 1 0 0 PX- 0 0 0 OT- 0 0 1	COMMERCIAL FISH SPOTTING	COMMERCIAL, AGE 42, 18000 TOTAL HOURS, UNKNOWN IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
INFLIGHT OTHER

REMARKS- UNDER INVESTIGATION.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-4836	10/5/68 TIME - 1437	MIAMI,FLA	CESSNA 177 N-29407 DAMAGE -DESTROYED	CR- 2 0 0 PX- 0 0 0 OT- 1 3 0	INSTRUCTIONAL DUAL	COMMERCIAL,FL.INSTR., AGE 26, 1518 TOTAL HOURS, 200 IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
INFLIGHT NORMAL CRUISE

REMARKS- INSTRUMENT TRAINING FLT.COLLIDED APPROX 880-1290 FT AGL. UNDER INVESTIGATION.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-4836	10/5/68 TIME - 1437	MIAMI,FLA	CESSNA 182J N-3306F DAMAGE -DESTROYED	CR- 0 1 0 PX- 1 2 0 OT- 2 0 0	NONCOMMERCIAL PLEASURE	PRIVATE, AGE 35, 200 TOTAL HOURS, UNKNOWN IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT

PHASE OF OPERATION
INFLIGHT NORMAL CRUISE

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-9005	8/4/68 TIME - 0848	NR.MILWAUKEE,WIS	CONVAIR 580 N-4364S DAMAGE -SUBSTANTIAL	CR- 0 1 2 PX- 0 0 8 OT- 3 0 0	PASSG S-D	AGE UNKNOWN, UNKNOWN TOTAL HOURS, UNKNOWN IN TYPE.

OPERATOR - NORTH CENTRAL AIRLINES,INC.
TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT
UNDER INVESTIGATION

PHASE OF OPERATION
INFLIGHT DESCENDING

REMARKS- UNDER INVESTIGATION. CONVAIR LANDED WITH CESSNA IMBEDDED IN ITS FUSELAGE.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-9005	8/4/68 TIME - 0848	NR.MILWAUKEE,WIS	CESSNA 150 N-8742S DAMAGE -DESTROYED	CR- 1 0 0 PX- 2 0 0 OT- 0 1 10		AGE 19, UNKNOWN TOTAL HOURS, UNKNOWN IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT
UNDER INVESTIGATION

PHASE OF OPERATION
INFLIGHT NORMAL CRUISE

REMARKS- UNDER INVESTIGATION. CONVAIR LANDED WITH CESSNA IMBEDDED IN ITS FUSELAGE.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-9006	3/27/68 TIME - 1800	ST.LOUIS,MO	CESSNA 150 N-8669G DAMAGE -DESTROYED	CR- 2 0 0 PX- 0 0 0 OT- 0 0 42		COMMERCIAL,FL.INSTR., AGE UNKNOWN, UNKNOWN TOTAL HOURS, UNKNOWN IN TYPE.

TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT
UNDER INVESTIGATION

PHASE OF OPERATION
LANDING TRAFFIC PATTERN-CIRCLING

REMARKS- UNDER INVESTIGATION. CESSNA CRASHED IN PARKING LOT,DC-9 CONT APPCH AND LANDED.

DOCKET	DATE	LOCATION	AIRCRAFT DATA	INJURIES F S M/N	FLIGHT PURPOSE	PILOT DATA
3-9006	3/27/68 TIME - 1800	ST.LOUIS,MO	DOUGLAS DC-9 N-9702 DAMAGE -SUBSTANTIAL	CR- 0 0 5 PX- 0 0 37 OT- 2 0 0	PASSG S-D	AGE UNKNOWN, UNKNOWN TOTAL HOURS, UNKNOWN IN TYPE.

OPERATOR - OZARK AIR LINES,INC.
TYPE OF ACCIDENT
COLLISION WITH AIRCRAFT BOTH IN FLIGHT
UNDER INVESTIGATION

PHASE OF OPERATION
LANDING FINAL APPROACH

REMARKS- UNDER INVESTIGATION. CESSNA CRASHED IN PARKING LOT,DC-9 CONT APPCH AND LANDED.

1968

	FATAL	SERIOUS	MINOR	NONE	UNKNOWN		TOTAL
PILOT	36	4	7	29			76
COPILOT	2	1		5			8
DUAL STUDENT	6		1	1			8
CHECK PILOT							
FLIGHT ENGINEER				1			1
NAVIGATOR							
CABIN ATTENDANT				6			6
EXTRA CREW				2			2
PASSENGERS	27	7	1	110			145
TOTAL	71	12	9	154		ABOARD	246
OTHER-AIRCRAFT							
OTHER-GROUND							
GRAND TOTAL	71	12	9	154			246

INVOLVES 38 TOTAL ACCIDENTS
INVOLVES 24 FATAL ACCIDENTS

NOTE: * INCLUDES ONE ACCIDENT INVOLVING TWO FOREIGN REGISTERED AIRCRAFT ON U. S. SOIL. FATAL ACCIDENT INVOLVING TWO PILOT FATALITIES.

ANALYTIC TABLE

KIND OF FLYING BY INJURY INDEX

OF FLYING	INJURY INDEX: FATAL	SERIOUS	MINOR	NONE	RECORDS	ACCIDENTS	PERCENT
STRUCTIONAL							
UAL	7		1	1	9	9	11.84
LO				2	2	2	2.63
ECK							
AINING	5		1	4	10	9	13.16
NCOMMERCIAL							
EASURE	18		3	8	29	21	38.16
ACTICE	1			1	2	2	2.63
SINESS	2	1			3	3	3.95
RPORATE/EXECUTIVE	3				3	3	3.95
RIAL SURVEY							
MPANY FLIGHT							
HER							
MERCIAL							
RIAL APPLICATION	2		2		4	2	5.26
SOCIATED CROP CONTROL ACTIV		1			1	1	1.32
E CONTROL							
OCIATED FIRE CONTROL ACTIV							
IAL MAPPING/PHOTOGRAPHY							
IAL ADVERTISING							
ER AND PIPELINE PATROL			1		1	1	1.32
H SPOTTING	2				2	1	2.63
TAXI-PASSENGER OPERATIONS	2				2	1	2.63
TAXI-CARGO OPERATIONS							
STRUCTION WORK							
EDULED PASSENGER SERVICE							
EDULED CARGO SERVICE							
CHEDULED/CHARTER REVENUE							
CHEDULED/CHARTER REVENUE							
TARY CONTRACT-PASSENGER							
TARY CONTRACT-CARGO							
RACT/CHARTER-CARGO-DOMEST							
RACT/CHARTER-PASSENGER-DO							
RACT/CHARTER-CARGO-INTERN							
RACT/CHARTER-PASSENGER-IN							

ANALYTIC TABLE

KIND OF FLYING BY INJURY INDEX

OF FLYING	INJURY INDEX: FATAL	SERIOUS	MINOR	NONE	RECORDS	ACCIDENTS	PERCE
R	2				2	1	2.6
NR							
ELLANEOUS							
RIMENTATION							
NSTRATION							
Y	2				2	1	2.6
CH AND RESCUE							
SHOW/AIR RACING							
CHUTE JUMP							
CHUTE JUMP IN CONNECTION							
NG GLIDERS							
ING CLOUDS							
ING							
ICE PATROL				1	1	1	1.
OTHER PUBLIC FLYING							
ER	2			1	3	3	3.
/NR							
DS	48	2	8	18	76		
ENTS	24	1	4	9		38	
NT	63.2	2.6	10.5	23.7			

LUDES ONE ACCIDENT/TWO FOREIGN REGISTERED AIRCRAFT ON U.S.SOIL

ANALYTIC TABLE

AIRPORT PROXIMITY BY INJURY INDEX TABLE

MID AIR COLLISIONS 1968
U.S.CIVIL AVIATION *

AIRPORT PROXIMITY	INJURY INDEX: FATAL	SERIOUS	MINOR	NONE	RECORDS	ACCIDENTS	PERCENT
ON AIRPORT	2		2	8	12	6	15.79
ON SEAPLANE BASE							
ON HELIPORT							
ON BARGE/SHIP/PLATFORM							
IN TRAFFIC PATTERN	12	2	2	8	24	12	31.58
WITHIN 1/4 MILE							
WITHIN 1/2 MILE							
WITHIN 3/4 MILE							
WITHIN 1 MILE							
WITHIN 2 MILES	8		2		10	5	13.16
WITHIN 3 MILES	4		2		6	3	7.89
WITHIN 4 MILES	2				2	1	2.63
WITHIN 5 MILES	2				2	1	2.63
BEYOND 5 MILES	18			2	20	10	26.32
UNK/NR							
OTHER							
RECORDS	48	2	8	18	76		
ACCIDENTS	24	1	4	9		38	
PERCENT	63.2	2.6	10.5	23.7			

* INCLUDES ONE ACCIDENT/TWO FOREIGN REGISTERED AIRCRAFT ON U.S.SOIL

ANALYTIC TABLE

FIRST PHASE OF OPERATION BY INJURY INDEX

FIRST ERATIONAL PHASE	FATAL	SERIOUS	MINOR	NONE	RECORDS	ACCIDENTS	PERCENT
STATIC							
STARTING ENGINE/S							
IDLING ENGINE/S							
ENGINE RUNUP							
IDLING ROTORS							
PARKED-ENGINES NOT OPERATING							
OTHER							
TAXI							
TO TAKEOFF							
FROM LANDING							
OTHER							
GROUND TAXI TO TAKEOFF							
GROUND TAXI FROM LANDING							
GROUND TAXI, OTHER							
ERIAL TAXI TO TAKEOFF							
ERIAL TAXI TO/FROM LANDING							
ERIAL TAXI, OTHER							
AKEOFF							
UN							
NITIAL CLIMB			2	2	4	2	5.26
ERTICAL							
UNNING							
BORTED							
BORTED							
BORTED							
THER							
NFLIGHT							
LIMB TO CRUISE	2				2	2	2.63
ORMAL CRUISE	19				19	12	25.00
ESCENDING	2			2	4	3	5.26
OLDING							
OVERING							
OWER-ON DESCENT							
UTOROTATIVE DESCENT							
CROBATICS							

ANALYTIC TABLE

FIRST PHASE OF OPERATION BY INJURY INDEX

FIRST OPERATIONAL PHASE	FATAL	SERIOUS	MINOR	NONE	RECORDS	ACCIDENTS	PERC
	INJURY INDEX						
BUZZING							
UNCONTROLLED DESCENT							
EMERGENCY DESCENT							
LOW PASS							
OTHER	6		2		8	4	10.
EN ROUTE TO TREAT CROP							
EN ROUTE TO RELOADING AREA							
SURVEY FIELD/AREA							
STARTING SWATH RUN			1		1	1	1
SWATH RUN			1		1	1	1
FLAREOUT FOR SWATH RUN							
PULLUP FROM SWATH RUN	1				1	1	1
PROCEDURE TURNAROUND	1				1	1	1
CLEANUP SWATH							
MANEUVER TO AVOID OBSTRUCTION							
RETURN TO STRIP							
LANDING							
TRAFFIC PATTERN-CIRCLING	7			2	9	6	11
FINAL APPROACH	9	2	2	4	17	9	22
INITIAL APPROACH							
FINAL APPROACH	1				1	1	1
LEVEL OFF/TOUCHDOWN				8	8	4	10
ROLL							
ROLL-ON/RUN-ON							
POWER-ON LANDING							
POWER-OFF AUTOROTATIVE LANDIN							
GO-AROUND							
MISSED APPROACH							
OTHER							
UNK/NR							
RECORDS	48	2	8	18	76		
ACCIDENTS	24	1	4	9		38	
PERCENT	63.2	2.6	10.1;	23.7			

INCLUDES ONE ACCIDENT/TWO FOREIGN REGISTERED AIRCRAFT ON U.S.SOIL

ANALYTIC TABLE

MONTH OF OCCURRENCE BY TYPE OF WEATHER CONDITIONS
MID AIR COLLISIONS 1968
U.S.CIVIL AVIATION

(OF OCCURRENCE	VFR	IFR	BELOW MINIMUMS	UNKNOWN/ NOT REPORTED	RECORDS	ACCIDENTS	PERCENT
01	2				2	1	2.63
02	6				6	3	7.89
03	6				6	3	7.89
04	6				6	3	7.89
05	6				6	3	7.89
06	4				4	2	5.26
07	10				10	5	13.16
08	18				18	9	23.68
09	6				6	3	7.89
10	6				6	3	7.89
11							
12	6				6	3	7.89
CORDS	76				76		
CIDENTS	38					38	
RCENT	100.0	.0	.0	.0			

INCLUDES ONE ACCIDENT/TWO FOREIGN REGISTERED AIRCRAFT ON U.S.SOIL

APP. 7

ANALYTIC TABLE

TYPE OF OPERATOR BY CONDITIONS OF LIGHT
MID AIR COLLISIONS *
U. S. CIVIL AVIATION
1968

TYPE OF OPERATOR	DAWN	DAYLIGHT	DUSK/TWILIGHT	NIGHT/DARK	NIGHT/BRIGHT	UNKNOWN/NOT REPORTED	RECORDS	ACCIDENTS	PERCENT
FLYING SCHOOL		6					6	4	7.[illegible]
CORPORATE/EXECUTIVE		8					8	7	10.[illegible]
AERIAL APPLICATOR		5					5	3	6.[illegible]
PRIVATE OWNER		20	2				22	18	28.[illegible]
AIR TAXI OPERATOR		2					2	1	2.[illegible]
FIXED BASE OPERATOR		16	2				18	15	23.[illegible]
FEDERAL-PUBLIC AIRCRAFT		1					1	1	1.[illegible]
STATE-PUBLIC AIRCRAFT		1					1	1	1.[illegible]
MUNICIPAL-PUBLIC AIRCRAFT									
CIVIL AIR PATROL									
AIRCRAFT MANUFACTURER									
FLYING CLUB (MILITARY)									
FLYING CLUB		5					5	5	6.[illegible]
INTRASTATE CARRIER									
CONTRACT CARRIER		1					1	1	1[illegible]
OTHER		5					5	4	6.[illegible]
UNK/NR		2					2	1	2[illegible]
RECORDS		72	4				76		
ACCIDENTS		36	2					38	
PERCENT	.0	94.7	5.3	.0	.0	.0			

* INCLUDES ONE ACCIDENT/TWO FOREIGN REGISTERED AIRCRAFT ON U.S.SOIL

ANALYTIC TABLE

PHASE OF OPERATION BY CONDITIONS OF LIGHT
MID AIR COLLISIONS 1968
U.S.CIVIL AVIATION

FIRST ERATIONAL PHASE	DAWN	DAYLIGHT	DUSK/TWILIGHT	NIGHT/DARK	NIGHT/BRIGHT	UNKNOWN/NOT REPORTED	RECORDS	ACCIDENTS	PERCENT
STATIC									
STARTING ENGINE/S									
IDLING ENGINE/S									
ENGINE RUNUP									
IDLING ROTORS									
PARKED-ENGINES NOT OPERATING									
OTHER									
TAXI									
TO TAKEOFF									
FROM LANDING									
OTHER									
GROUND TAXI TO TAKEOFF									
GROUND TAXI FROM LANDING									
GROUND TAXI, OTHER									
AERIAL TAXI TO TAKEOFF									
AERIAL TAXI TO/FROM LANDING									
AERIAL TAXI, OTHER									
TAKEOFF									
RUN									
INITIAL CLIMB		4					4	2	5.26
VERTICAL									
RUNNING									
ABORTED									
ABORTED									
ABORTED									
OTHER									
INFLIGHT									
CLIMB TO CRUISE		2					2	2	2.63
NORMAL CRUISE		19					19	12	25.00
DESCENDING		4					4	3	5.26
HOLDING									
HOVERING									
POWER-ON DESCENT									
AUTOROTATIVE DESCENT									
ACROBATICS									
BUZZING									

ANALYTIC TABLE

FIRST PHASE OF OPERATION BY CONDITIONS OF LIGHT

FIRST OPERATIONAL PHASE	DAWN	DAYLIGHT	DUSK/TWILIGHT	NIGHT/DARK	NIGHT/BRIGHT	UNKNOWN/NOT REPORTED	RECORDS	ACCI	
			CONDITIONS OF LIGHT						
UNCONTROLLED DESCENT									
EMERGENCY DESCENT									
LOW PASS							8	4	10.5
OTHER		8							
EN ROUTE TO TREAT CROP									
EN ROUTE TO RELOADING AREA									
SURVEY FIELD/AREA							1	1	1.3
STARTING SWATH RUN		1					1	1	1.
SWATH RUN		1							
FLAREOUT FOR SWATH RUN							1	1	1.
PULLUP FROM SWATH RUN		1					1	1	1.
PROCEDURE TURNAROUND		1							
CLEANUP SWATH									
MANEUVER TO AVOID OBSTRUCTION									
RETURN TO STRIP									
LANDING							9	6	11.
TRAFFIC PATTERN-CIRCLING		5	4				17	9	22.
FINAL APPROACH		17							
INITIAL APPROACH							1	1	1.
FINAL APPROACH		1					8	4	10.
LEVEL OFF/TOUCHDOWN		8							
ROLL									
ROLL-ON/RUN-ON									
POWER-ON LANDING									
POWER-OFF AUTOROTATIVE LANDIN									
GO-AROUND									
MISSED APPROACH									
OTHER									
UNK/NR									
							76		
RECORDS		72	4					38	
ACCIDENTS		36	2						
PERCENT	.0	94.7	5.3	.0	.0	.0			

INCLUDES ONE ACCIDENT/TWO FOREIGN REGISTERED AIRCRAFT ON U.S.SOIL

CHRONOLOGY OF THE AIRLINE SEARCH FOR A COLLISION AVOIDANCE SYSTEM

1955: At a joint public meeting of Institute of Radio Engineers and Radio Technical Commission for Aeronautics, ATA requested industry to propose, or produce, a collision avoidance system (CAS). Airline analysis of CAS problem and "inventor's chart" was also circulated among hundreds of inventors, engineers, and manufacturers. No response received.

1956: Midair collision over the Grand Canyon stimulated interest, resulted in a flood of ideas to ATA.

In July, 1956, ATA sponsored a symposium in Washington, D. C., bringing together experts, engineers and inventors to compare airline requirements against then-current technology.

As an outgrowth of that symposium, Collins Radio, in September, 1956, submitted the first formal proposal to the airlines for a noncooperative pilot warning indicator (PWI) system, which they believed could later be developed into a CAS. Two million dollars worth of airline orders were placed with Collins; but, in the development work that followed, Collins discovered that normal aircraft movements in flight prevented their airborne Doppler radar from making reliable collision prediction, or could create erroneous predictions in a significant percentage of cases. This eliminated the CAS feature of the Collins proposal. So the proposal was withdrawn while Collins continued its analytical work, which has been carried on to this day.

1958: Development of the Tau concept (Tau is range divided by range rate) by Bendix Radio's Dr. J. S. Morrell, following their publication in the midfifties of the first accurate description of the fundamental physics of the airborne collision avoidance problem.

1959: The ATA Collision Avoidance Committee (formed in 1956) continued to monitor and encourage CAS investigations until 1959, when FAA created its Collision Prevention Advisory Group (COPAG). Thereafter, ATA took part in CAS work as a member of COPAG.

1960: Collision between two fighter aircraft being tested by their manufacturer, McDonnell Aircraft Corporation, sparked an all-out effort by McDonnell to develop a CAS for use in their flight test area.

1962: In July 1962, the FAA's Airborne CAS symposium, held in Washington, D. C., gave the first industry-wide briefing on the state of CAS investigations, and received widespread support from all segments of aviation. Bendix Radio described a CAS based on the Tau concept and using one-way ranging, with the ground-bounce technique. With ATA encouragement, Collins Radio outlined a method for testing by computer simulation the features of any proposed CAS technique. This was a major contribution, since it offered for the first time a quick and minimum-cost method of choosing the most promising techniques from among a wide variety of theoretical concepts.

1963: In the fall of 1963, FAA gave Collins a contract to study CAS techniques by simulation.

1965: A report of the Collins study was forwarded to FAA in mid-1965. In essence, Collins told FAA that the simple time-frequency system is the most promising, that it works quite well for the en route case, but has some limitations in the terminal area--where aircraft are most likely to be maneuvering in flight.

At an ATA meeting in April 1965, Collins reported on the results of its studies and McDonnell Aircraft showed the equipment they planned to use in their flight test operation later that year. The airlines were sufficiently impressed with McDonnell's system to invite their experts to brief the Airlines Operations Conference in September 1965. After this briefing, the Conference charged the ATA Air Traffic Control (ATC) Committee with monitoring the development of collision avoidance systems and their relationship with the air traffic control system.

1966: Intensive review of the application of time and frequency techniques to CAS by ATA staff and ATC Committee. Four manufacturers--McDonnell, National, TRG, and Collins--briefed ATC Committee.

October 1966: ATA issued expanded statement of airline policy on CAS, with detailed listing of functional requirements for a CAS meeting airline needs. Document circulated widely throughout industry and government, particularly to electronics manufacturers with experience in time and frequency techniques.

December 1966: ATC Committee of ATA formed CAS Technical Working Group, to study technical details of proposed CAS concepts and prepare draft technical description of system that will meet airline requirements.

1967: First meeting of CAS Technical Working Group in January 1967, for 3 days. Group continued regular monthly meetings thereafter (sometimes twice a month) for a total of 37 meeting days between January 1 and June 30, 1967.

June 14, 1967: ATA asked FAA to have the necessary frequencies designated for CAS.

Technical description of a CAS that will meet airline requirements completed June 30 and distributed to industry, government, and airline early in July.

July 12, 1967: ATA asks FAA to use system technical description:

--- to test, by simulation, the interaction of CAS and ATC in order to verify that operation of such a CAS will not adversely affect ATC.

--- as a starting point for developing a common national system for airborne collision avoidance systems. FAA asked to give early attention to insuring compatibility of civil and military use of CAS techniques.

--- to begin the efforts that will ultimately be needed to secure international agreement on a common international system for airborne CAS.

CAS Equipment for General Aviation

By
W. R. Lewis

This paper discusses minimal collision avoidance equipment which, we believe, has a good probability of being palatable to general aviation. The ideas presented herein are the result of analyzing the ATA description recently circulated by ARINC.

As stated by ATA in their July 12 "Fact Sheet" on CAS, "the airlines seek a common system - and that means a system satisfying <u>all</u> users, both civil and military." The statement could have gone further to point out the fact that of the three user groups the airlines are in the minority, in number of aircraft. I believe the statement could be interpreted to mean that the system <u>must be</u> common to all users in its basic function in order to provide satisfactory usefulness to any one group.

The ATA committee has accomplished a monumental task in forging the CAS concepts to date; however, as ATA states, "a great deal of effort...to simplify the system, reduce equipment cost...and make the advantages of CAS more widely available" must be undertaken.

The only statement in the whole ATA "Fact Sheet" with which I have the slightest quarrel is: "It is recognized that a system of the type now being worked on will be initially beyond the reach of most of general aviation." It is my personal conviction, and others at the Wilcox Company in general agree, that with proper attention to defining the minimum equipment to provide only the basic function, general aviation can, and will, rapidly become equipped to "play in the system."

The functional minimum, which is referenced, concerns: minimum required timing accuracy, a simple and direct method of resynchronization, use of lower numbered time slots, the simplest method of generating and transmitting the altitude signal, a loop gain consistent with aircraft speed, a single transmitter frequency, and the elimination of all on-board memory and computation except that required for the simplest of escape maneuvers.

Each of the factors mentioned in the above paragraph will be discussed later in the light of each factor's effect on any aircraft in the system as well as on the aircraft carrying the minimum equipment.

Timing Accuracy

The timing accuracy, which is proposed in the ATA draft, is one part in 10^8 when participating in the CAS environment. This is roughly equivalent to ± 10-foot error in the distance measurement or ± 5-knot error in the closing rate measurement. For the computation of possible collision courses for general aviation aircraft, this accuracy is more than sufficient. It is, however, fairly practical to achieve and is considered the minimum accuracy consistent with adequate protection for the high-speed aircraft.

To maintain a short-time stability of one part in 10^8 over a 3-second period is not exceedingly difficult; the major problem is determining the start of the 3-second period (epoch) with an accuracy equal to, or greater than, the short-time stability.

If we assume that the epoch start can be accurately established by some other means, and also assume that the crystal's instability is cumulative over the 3-second period, it follows that aircraft with minimum CAS equipment should be assigned the first message slots in the 3-second interval in order that the problem is not compounded. Aircraft which carry atomic clocks or time standards better than the minimum would be assigned slots later in the epoch.

As mentioned above, the determination of the epoch start must be accomplished by some means other than the basic long-time crystal stability. The ATA draft of CAS presupposes some automatic resynchronization to be supplied the minimum CAS equipment. Systems have been operated by Sierra Research, McDonnell Company, and others which have demonstrated the feasibility of resynchronization methods as well as automatic error correction preceding the actual synchronization. The technique of resynchronization with another aircraft or with a ground station will allow the design of relatively inexpensive oscillator circuitry which will be capable of maintaining the desired accuracy. As long as the system parameters are specified in such a manner as to allow the presently envisaged digital circuitry in the resynchronization loop, the manufacturing complexity will not be a major obstacle.

Loop Gain

The transmitter power requirement and receiver calculations in Attachment 3 to the ATA draft are believed to be influenced by airline type aircraft, especially when one considers the 40-nautical-mile minimum operation capability and the 5 db cable loss between the antenna and RF plumbing. The latter indicates a cable length of 40 to 50 feet which is not required by the small aircraft. The figure is estimated to be about 2 db, including effect of antenna VSWR, for both the receiver and the transmitter, or a difference of 3 db.

The operational range of the small aircraft can also be reduced; however, not in direct proportion to the aircraft's speed because the small aircraft must protect, and be protected against, the high speed supersonic craft. Assuming the speed of the small aircraft to be negligible in comparison to the supersonic aircraft, the range could conceivably be halved. This would establish the power at one-fourth that specified in the ATA draft, or about 380 watts. If one also excludes the 3 db cable loss, the 380 watts could drop to 190 watts and still provide 20-nautical-mile coverage. A transmitter providing 500 watts ±3 db at 1,600 kHz, similar to the present ATC transponders, presents few design and manufacturing problems and will provide better than the 20-mile coverage when cooperating with an ATA specified receiver.

The receiving levels are analyzed similarly; however, the 3 db advantage one obtains via the shorter RF cable is nullified by other factors. In inexpensively produced receivers, it is difficult to realize the 1/2 db RF circuit loss and 7-1/2 db receiver noise factor. The RF preselector and duplexer is presently conceived as being similar to the interdigital stripline filters on a solid teflon base as used in present Wilcox ATC transponders and DME receivers for general aviation. This technique provides small, light, stable, and very inexpensive RF elements, however, at the expense of about 5 db more front-end loss. Comparing the minimum CAS receiver to the receiver as calculated in Attachment 3 of the ATA report, we estimate the net difference to be approximately 4 db.

In practice, this can probably be tolerated. When the minimum CAS equipment is cooperating with a supersonic aircraft which has a 1,440-watt transmitter, the minimum receiver would provide service at about 25 nautical miles. This would be comparable to the small aircraft's transmitting range working into the same supersonic aircraft's receiver. When replying or cooperating with another minimum equipment, the range for both would be 12 to 15 nautical miles. We believe this would be satisfactory for aircraft whose speed is below 300 knots.

Single Transmitter Frequency

Although ATA's proposed collision avoidance system allows for the use of four transmitting frequencies, the present draft allows the minimum equipment to be located on one common frequency. Therefore, excluding the problem of maintaining frequency via a precision crystal oscillator, the transmitter is equivalent to the present ATC and DME transmitters being used in general aviation equipment.

Data Capability

The minimum CAS equipment should have the capability to handle only that data required to perform its basic function. There are two parts to its basic function: (1) to provide other aircraft with information, and (2) to process received information to only that degree required to exercise an adequate escape maneuver. An SST aircraft might want to know many things from the smaller aircraft; however, if the SST, via a more complicated computer and memory system, extracts all information available from a set of minimum data provided by the smaller aircraft, the complexity of the minimum equipment can be reduced. As the "name of the game" is "Tag", where one intruding untagged aircraft spoils the whole game, it is of the utmost importance to see to it that all computer and memory functions which have any possibility of being removed from the small aircraft be placed at the ground station or on board the larger aircraft.

Using this philosophy, the only information which needs to be transmitted is (1) the timed range burst from which range and range rate can be determined, and (2) data from some on-board measurement by which another aircraft can determine if he is, or shortly will be, on the same flight level.

The ATA draft seems to allow this minimum set of information, yet infers that even the minimum CAS system should be capable of exchanging altitude and altitude rate information. If the term "altitude information" means only the raw data which is proportional to air pressure or air density, then no data reduction need be accomplished on the small aircraft. A safe flight level can be established in terms of pressure or density in lieu of "feet of separation" by each aircraft. If the ground station or the other aircraft desires to know the small aircraft's altitude, the computation and correction to mean sea level should be accomplished at the end of the circuit where the information in that form is desired. The pressure or density information should come from some means completely independent of the aircraft's altimeter or on-board data system.

As a sidelight, the pressure of density sensing element should be capable of providing an absolute physical measurement which is established in manufacture by some fixed mechanical configuration, preferably requiring no calibration in either manufacture or in the field. The measurement should also be capable of being encoded by simple logic circuitry having no moving parts. Several physical properties of air vary with pressure and/or density which meet the above ground rules. I do not believe that enough effort has yet been spent in the determination of an optimum method of deriving data which varies with the various flight levels. A part of this lack of development can be traced to our shortsighted desire to have flight levels expressed in feet and then to compound this conversion by reducing to some fictitious mean sea level.

I must certainly agree with the person in another former ARINC session who stated that "feet were made to walk on and should have nothing to do with flying."

The ATC transponder, equipped for automatic altitude reporting, has been around for quite a few years; however, only a very small percentage are yet equipped with the altitude encoder. Unless the "flight level" data input is designed and manufactured as an integral part of the CAS equipment and enjoys a design reliability compatible with the CAS function, it can never be considered a successful device. The Wilcox Company is presently exploring several air pressure and/or density sensing elements which can produce outputs to be encoded by simple solid-state logic. The sensitivity, accuracy, and stability promise to be all that is desired.

Conclusions

Present-day technology has demonstrated its ability to provide collision avoidance protection. Many of the military's station-keeping projects and McDonnell's operating EROS system attest to this.

The cost of the airborne equipment to implement such systems has, to date, been very much above what the average small aircraft owner will pay for such protection. The high cost can, however, be reduced if the system is designed to accept basic minimum inputs.

Also, the Wilcox Company is convinced that the general aviation user will equip his aircraft to fit the basic system if, in return, the system provides him with that degree of protection which he would expect after spending about the same amount of money on a new car.

COLLISION AVOIDANCE AND THE PILOT

"See and be Seen" Concept

Seeing is a full-time job for every pilot regardless of the type of aircraft being flown. A pilot must visually scan in all directions, constantly.

Keep your windscreen and windows clean and also keep them clear of obstructions, such as solid sun visors and window curtains.

Obstructions to Pilot Visibility Inherent in Aircraft Design

In many instances, the pilot's view is restricted by the inherent design of the aircraft. A window frame, fuselage structure, a wing, a wing strut, or a nacelle, create a blind spot. On some aircraft the forward fuselage restricts the view in front of and below the aircraft. On low-wing aircraft, the pilot's view is restricted below the aircraft; and on high-wing, above the aircraft. Blind spots due to aircraft design are inevitable, but recognizable, and can be compensated for by the pilot.

Never let down, turn, or climb into a blind area. When letting down, turning, or climbing it is advisable to make a slight left or right turn, or an 'S' turn or a rolling maneuver; whichever is appropriate and practical. Also, where applicable, look for converging shadows on the ground or on the cloud cover.

Radar Advisories

When there is less than 3 miles visibility, file an IFR flight plan or stay out of controlled zones. If operating under marginal visibility flight conditions, take advantage of radar advisories. Contact the appropriate controller (radar), give your identification, position, altitude, heading, destination and type of flight plan. When advised of traffic by the controller, respond in effect with "negative contact" or "have in sight" rather than an ambiguous "Roger."

Vigilance should not be relaxed even though radar traffic service is being provided.

Converging Traffic

When your aircraft is at a constant angle with another aircraft, or the image of the other aircraft on your windscreen is not moving, a collision is imminent. To estimate the altitude of an intruder aircraft, compare the relative position of the target to the horizon. When the target is at the horizon, it is at your altitude. If the target is lower than the horizon, it is at an altitude lower than yours. A target above the horizon should be higher than you.

Once you have spotted an aircraft, don't concentrate on it to the exclusion of other aircraft. Keep track of known traffic, but continue to look for others.

Visual Scanning

The proper technique for daylight visual scanning is for the pilot to systematically move his head and eyes over the entire area of visibility. Using this technique, any contrast or movement in the area of sight will be readily noted by the pilot.

Visual scanning at night requires a different technique. The pilot should depend almost entirely on his peripheral vision. He should, without staring for more than a few seconds at a time, look first in one area without moving his eyes and then to other area and so on. Any light in the area scanned will be noted.

An excellent aid, both in daylight and at night, to the pilot in visual scanning is the high-intensity flashing white light. If you pilot an aircraft equipped with such a light, for your own protection, it is suggested that the light be on at all times while the aircraft is in flight.

Designated Altitude

Always fly at the designated altitude, and remember, even thousands plus 500 feet altitudes westbound and odd, plus 500 feet altitudes eastbound. Below 3,000 feet (AGL) you're on your own. Update your altimeter setting as often as practicable.

High-Density Areas

When flying cross country, avoid high-density areas unless landing. When approaching an airport, call the tower at least 15 miles out and give your aircraft type, "N" number, position, and your intention. If en route, keep 3,000 feet or higher over the airport or well clear, laterally, and call the tower when clear of the "local traffic" area. If landing, be precise in the pattern. Make your turn precisely into the final approach course and stay in line with the centerline of the runway, especially where there are parallel runways. Remember, 65 percent of midair collision accidents occur around airports.

GPO 878-521