SPECIAL STUDY

MIDAIR COLLISIONS IN U.S. CIVIL AVIATION 1969 - 1970

ADOPTED: JUNE 7, 1972

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Washington, D. C. 20591
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FOREWORD

The National Transportation Safety Board was created by the Department of Transportation Act of 1966 which simultaneously established the Nation's first Department of Transportation. The Safety Board began to function April 1, 1967.

The Congress established the Safety Board as an autonomous agency in transportation safety activities. The Board is directed to report to the Congress annually on the conduct of its functions under the Act and the effectiveness of accident investigations in the Department, together with such recommendations for legislation as it may deem appropriate. The Board is charged with:

- a continuing across-the-board review of safety in all modes of transportation;
- determining cause or probable cause of transportation accidents and reporting the facts, conditions, and circumstances relating to such accidents;
- reviewing on appeal the suspension, amendment, modification, revocation, or denial of any certificate or license issued by the Secretary or by an Administrator;
- investigating, determining probable cause, and reporting of all aviation accidents, as defined by title VII of the Federal Aviation Act;
- conducting special studies and investigations to determine what best will tend to reduce or eliminate aviation accidents; and
- making public its findings, reports, and recommendations.

Furthermore, in order to fulfill its mission, the Board is authorized to:

- make recommendations to the Secretary or Administrators which, in its opinion, will tend to prevent transportation accidents and promote transportation safety;
- conduct special studies on matters pertaining to safety in transportation and the prevention of accidents;
- insure that, in cases in which it is required to determine cause or probable cause, reports of investigation adequately state the circumstances of the accident involved;

- initiate on its own motion the conducting of rail, highway, or pipeline accident investigations as the Board deems necessary or appropriate;
- make recommendations to the Secretary or Administrators concerning rules, regulations, and procedures for the conduct of accident investigations;
- request the Secretary or Administrators to initiate specific accident investigations or conduct further investigations;
- arrange for the personal participation of Members or other personnel of the Board in accident investigations conducted by the Secretary or Administrators in such cases as it deems appropriate; and
- request from the Secretary or Administrators notification of transportation accidents and reports of such accidents as the Board deems necessary.

The responsibility and authority of the National Transportation Safety Board are derived from:

The Department of Transportation Act, October 15, 1966 (80 Stat. 931, 49 U.S.C. 1954); and

The Federal Aviation Act of 1958, August 23, 1958, as amended, (72 Stat. 731, 49 U.S.C. 1301).

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National Transportation Safety Board
Washington, D.C. 20591
Special Study

Adopted: June 7, 1972

Midair Collisions in U.S. Civil Aviation – 1969-1970

SUMMARY

In July 1969, the National Transportation Safety Board released the report of a special accident prevention study entitled "Midair Collisions in U. S. Civil Aviation." That study of 38 midair collisions, which occurred in calendar year 1968, involved 76 aircraft, 24 of the 38 collisions resulting in 71 fatalities -- all occupants of general aviation aircraft.

The Safety Board convened a public hearing on the midair collision problem early in November 1969, several weeks after the fatal collision of an Allegheny Airlines Douglas DC-9 and a general aviation Piper PA-28. The collision occured near Indianapolis, Indiana, on September 9, 1969.

The public hearing and the accident prevention study resulted in certain conclusions. From these conclusions, 25 recommendations were forwarded to the Federal Aviation Administration.

During 1968, the Federal Aviation Administration released a study of near-midair collisions which contained 20 recommendations. A review of both the Safety Board's and the FAA's past recommendations to prevent midair collisions will be found in Appendix 16.

There were 27 midair collision accidents and four incidents during 1969. There were 37 accidents and one incident during 1970. As of September 20, 1971, there were 23 midair collision accidents for the year. All of these mishaps followed essentially the same pattern as the collisions which occurred in 1968. There were, however, more fatalities in 1969 as a result of two midair collisions involving an air carrier and a general aviation aircraft.

As in 1968, most of the 1969/1970 midair collision accidents occurred at or near an uncontrolled airport at altitudes below 100 feet, in Visual Flight Rules (VFR) weather, during daylight hours on weekends. However, in contrast to the high incidence of accidents during the summer months of 1968, the 1969 and 1970 accidents were almost equally distributed throughout the year. As in 1968, most aircraft were not on a flight plan and were involved in pleasure flying.

In 1969 and 1970, most of the collisions occurred in uncongested airspace at low closure rates. As in 1968, the main causal problem was the failure or inability of the pilot to adhere effectively to the "see-and-avoid" concept which is still considered to be the primary method available for maintaining separation between controlled and uncontrolled aircraft.

Reference to the attached data reveals that 70 percent of the 1969 and 56 percent of the 1970 midair collision accidents occurred in the vicinity of the traffic pattern environment. Of these, 90 percent of the 1969 and 57 percent of the 1970 pattern area accidents occurred during the final approach and landing phases.

Uncontrolled airports present a serious hazard to aviation safety in that 34 percent of the 1968, 56 percent of the 1969, and 38 percent of

the 1970 midair collision accidents occurred at airports where there was no control tower.

The greatest midair collision hazard, considered from the viewpoint of the numbers of aircraft involved, exists in the vicinity of both controlled and uncontrolled airports. However, on the other hand, a large percentage of the fatalities occur during operations in the en route environment.

Not only is there a need for emphasis on the implementation of tighter controls and improved aircrew surveillance in the airport environment, but also there is an urgent requirement for preventative measures to reduce those high-fatality accidents which occur at higher altitudes.

Great strides have been made since 1968 in the development of collision avoidance systems and proximity warning indicators; however, avoidance equipment is still not economically feasible for most of the general aviation pilots.

INTRODUCTION

This report is promulgated for the purpose of updating the 1968 midair collision study and includes a review of the 1969 and 1970 midair collision reports, a listing of 1971 midair collisions that have occurred up to September 20, 1971, and an analysis of automatic data processing (ADP) "briefs" of various pertinent midair collision accident data.

The annual midair collision accident rate continues to persist in spite of aircraft design improvements and expansion of the air traffic control system with its associated equipment.

The need for suitable systems and techniques for the reduction of midair collisions increases with the growth of civil aviation. Although the rate of growth of civil aviation has been reduced by an economic recession, it is still estimated that within the next decade, three times the present number of passengers will fly. About 10 times more cargo will be carried. The speed of air carrier aircraft will continue to vary, and the passenger carrying capacity will increase threefold. The number of general aviation aircraft will double. In an environment of a mix of jumbo jets and light aircraft, of supersonic transport and short takeoff and landing (STOL) aircraft, the midair collision threat will tend to increase in geometric proportion. It is conceivable that in the future, a single midair collision could result in the loss of a thousand lives.

FACTS AND DISCUSSION

A. *Data*

Standard ADP computer readouts and selected data readouts of 38 accidents of 1968, 27 accidents of 1969, and of the 37 accidents of 1970 were analyzed and evaluated. 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 Condition
- Type of Operator by Conditions of Light
- Phase of Operation by Conditions of Light

B. *Weather*

Weather data available from locations nearest to the collision sites were reviewed. In 26 of the 27 accidents during 1969 and in all 37 accidents during 1970, weather conditions were VFR (ceiling 1,000 feet and visibility 3 miles) or better.

Obstructions to vision in the form of haze or fog were known to have been in the area of the collision in eight of the 1969 cases and in eight of the 1970 cases. Sun glare was considered to be a factor in several of the 1969 accidents.

C. *Air Traffic Control and Operations*

Air Traffic Control

Air Traffic Control (ATC)service was involved in midair collisions during 1968, 1969, and 1970 in seven, eight, and eight accidents, respectively. Traffic congestion, tower controllers' visibility limitations, and inherent inadequacies of visual flight rules (VFR) traffic flow procedures contributed to the chain of events leading up to the collisions. Human performance limitations on the part of the controller were considered to have been contributory in one 1968 case involving an air carrier aircraft.

Operations

The following table depicts the number of midair collisions which occurred over or in the immediate vicinity of an airport.

Midair Collision Accidents	1968	1969	1970
Total	38	27	37
In Vicinity of Airports	24	19	20

Figures 11 thru 13 depict imaginary traffic patterns with the midair collisions plotted for each year. It can be readily seen that the number of collisions each year moved progressively closer to the approach end of the runway with maximum frequency at the position of landing flare.

The area shown in Figures 11, 12, and 13 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. The pilot is concerned with wind velocity and direction and aircraft 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 must, in the case of tower control operations, be attentive to landing instructions, and he tends to concentrate his attention to positioning his aircraft in the proper sequence for landing. At times the weather conditions may force him to divide his attention further and consequently compound his piloting duties.

Airport traffic conditions frequently are such that aircraft with different performance capabilities operated by pilots of varying skill levels may close on each other without being seen by either pilot. Statistics for the 3-year period show that pilots of all levels of experience and skill – from those with 20,000 hours to the one on his first solo, are involved in collisions. Approximately 37 percent of the collisions near an airport involved flight instructors. Perhaps that is because they are exposed to more time in the traffic pattern and have additional activities and related distractions in teaching and monitoring their students' actions.

In 1968, 14 of the midair collisions occurred outside the airport environment under the following circumstances:

1. Three involved agricultural aircraft, one during a ferry flight and two on-the-job aerial spraying.
2. One occurred while one of the aircraft was engaged in instructional training.
3. One occurred while both aircraft were engaged in ins ructional training.
4. One occurred while one of the aircraft was engaged in instrument flying training.
5. One occurred between aircraft being flown in formation beyond pilot abilities, with one pilot under the influence of alcohol.
6. One occurred between aircraft on pleasure flights and both pilots under the influence of alcohol.
7. One occurred in normal curise where the cockpit side window curtain of one was found to have been drawn.
8. One occurred between aircraft of the same organization while herding horses.
9. One occurred between aircraft of the same organization while spotting fish.
10. One occurred between two gliders while soaring in the same thermal.
11. One, involving a military aircraft, occurred in the vicinity of a military training area.
12. One occurred in Alaska where the silhouette of a crossing aircraft blended with the snow covered background.

Seven of the midair collisions which occurred outside the airport environment during 1969 were under the following conditions:

1. Two (one involving a military aircraft) occurred because of failure to see and avoid due to sun glare.
2. One, involving a light aircraft and an air carrier, was due to deficiencies of the ATC system.
3. One, involving a light aircraft and an air carrier, occurred when neither pilot saw or attempted to avoid the other under VFR conditions.

4. One occurred while the aircraft were engaged in formation flight.

5. One occurred because of failure of either pilot to see and avoid the other during margianl weather conditions.

6. One occurred when a high-speed military jet overtook and collided with a light aircraft.

In 1970, 11 midair collisions away from an airport occurred under the following conditions:

1. Two involved military aircraft in the vicinity of military training areas.

2. One involved agricultural aircraft during spraying operations.

3. One occurred between aircraft engaged in a fish spotting operation.

4. One occurred when personnel in one aircraft attempted to photograph the other aircraft.

5. One occurred when a pilot exceeded his capabilities during formation flight.

6. One occurred when one of the aircraft was engaged in instructional training.

7. One occurred when one of the aircraft was being flown by a student on his first solo.

8. One involved two aircraft on cross-country flights.

9. One occurred while one aircraft was engaged in sky diving activities.

10. One occurred in an extremely remote area. The activities of the aircraft remain unknown.

Figures 8, 9 and 10 depict total pilot time and time-in-type for the period 1968 - 1970. It should be noted that pilots with more than 1,000 hours total time were involved in a total of 72 collisions (1968 - 25; 1969 - 23; 1770 - 24). From the statistics on total pilot time, the inference can be drawn that, whereas all pilots are vulnerable to collisions, experienced pilots were involved in significantly higher numbers. This is, no doubt, due to the greater exposure to midair hazard.

Pilots with less than 100 hours time-in-type were involved in 68 collisions (1968 - 32; 1969 - 21; 1970 - 25) whereas those with over 1,000 hours time-in-type were involved in only 22 (1968 - 7; 1969 - 8; 1970 - 7). The inference of these facts 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 aircraft.

D. *Status of the Collision Avoidance System and Pilot Warning Instrument Programs*

The definitions of Collision Avoidance System (CAS) and Pilot Warning Instrument[1] (PWI) as applied to this section are as follows:

> CAS - An all-weather system which detects all potentially dangerous intruders, automatically evaluates the degree of the threat, and if necessary, indicates to the pilot a safe evasive maneuver.
>
> PWI - A device utilized when weather conditions permit visual flight rule (VFR) operations, and it simply increases the probability of a pilot visually detecting other aircraft in his vicinity, after which the pilot must make the necessary evaluation and decision on evasive maneuver, if required.

The definition of "cooperative system" versus "noncooperative system" is also appropriate. A "cooperative system" is one which affords protection only to those aircraft which are suitably equipped with cooperating systems; that is, actively exchanging electronic information with each other. A "noncooperative system" would warn the pilot of an equipped aircraft of the proximity of any other aircraft, similarly equipped or not.

[1] Sometimes referred to as Promixity Warning Indicator.

The aviation industry during the last 12 to 15 years has been engaged in avionics research in efforts to develop practical and economically feasible CAS and PWI systems which would be compatible with each other and with the air traffic control system.

The search has been pursued by the Collision Prevention Advisory Group (COPAG). The present composition of COPAG includes representatives from FAA (Chairman), National Aeronautics and Space Administration (NASA), National Transportation Safety Board (NTSB), Army, Navy, Air Force, Air Transport Association (ATA), Aircraft Owners and Pilots Association (AOPA), Air Line Pilots Association (ALPA), National Business Aircraft Association (NBAA), National Pilots Association (NPA), and National Air Transportation Conferences, Inc. (NATC). Since its inception, COPAG has kept abreast of all of the CAS and PWI programs.

The Air Transport Association of America (ATA), through a Technical Working Group (TWG), has been ins rumental in the formation of the technical specifications for the T/F system. The TWG is composed of representatives from the major avionics firms, interested government agencies, and industry experts in the T/F technology.

As of September 1971, it was estimated that the ATA and participating manufacturers have invested in excess of 10 million dollars into the program. Equipment has been built by Bendix, McDonnel Douglas, Sierra Research, and Wilcox to the specification prepared by the TWG. Flight testing and evaluation have been completed, and no major technical problems have been encountered.

The FAA's schedule calls for the installation of the ground network in the 1974 to 1978 time frame. This fits the proposed CAS implementation schedule of the air carriers.

CAS for general aviation aircraft has not been overlooked for an effort is underway now by the NASA to develop a low-cost system. Also, McDonnell Douglas has developed, with their own funds, a low-cost, compatible system which is called "Micro-CAS."

The following is a quote of an FAA summary[2] of where we stand today in the CAS and PWI areas and what the FAA's near-term future efforts will be:

CAS

"1. We are coordinating internally the agency's position on the McDonnell Douglas petition for an operational frequency license. This should be forwarded to the Federal Communications Commission (FCC) shortly.

"2. A Request for Proposals (RFP) will be issued in the first quarter of Fiscal Year 1972 for a study to determine the number, type, location, and implementation priority of the required synchronizing ground stations.

"3. An existing contract is looking into the possibility of providing a ground/air synchronization function via suitable modified DME's. Results from this contract are expected in early 1972.

"4. A Request for Proposals will be issued in the first quarter of Fiscal Year 1972 for the development of a more accurate and sophisticated ground station which will also be capable of testing the operation of the airborne CAS equipment.

"5. An RFP will be issued in the first or second quarter of Fiscal Year 1972 for the investigation of the utilization of bearing and bearing-derived data in the CAS threat evaluation and escape maneuver logics.

"6. An RFP, if necessary, will be issued in the third or fourth quarter of Fiscal Year 1972 for the further development of low-cost T/F compatible CAS.

"7. CAS/ATC simulation will continue as required.

"8. We are participating with the Navy in the test and evaluation of the RCA correlator, the data processing heart of their SECANT CAS."

[2] A presentation by Mr. John L. Brennan, "FAA CAS/PWI Program Past - Present - Future," October 1971.

PWI

"1. Continuing our analytical and simulation work to specify the content and accuracies required of the information data exchange.

"2. In parallel, continue the evaluation of existing hardware and issue an RFP for additional developmental systems to insure, as best we can, that no promising stone is left unturned.

"3. Upon results from these programs, marry the best technologies to the PWI performance requirements."

"In conclusion, we can report good progress on a CAS for voluntary use by the airlines, and optimistic signs pointing to possible cost reduction efforts to enable the military and general aviation to participate in the system. We have, however, far too little experience and too many unanswered questions to be able to predict if or when such a system will become a requirement. While we cannot report as much progress in the PWI area, I think we can say that our existing program will enable us to make firm recommendations in this regard in approximately two years time."

With respect to midair collision equipment, the conclusion the Safety Board reaches, based upon actual accident experience as well as the threat identified by near-midair collision data, is simply that there is no single, clear cut, partial-remedial approach that holds the potential for eliminating the midair collision hazard. Rather, the continued treatment of each of the elements of the system, that is, the man, the machine, the environment, and the management of these elements within the system -- as a total system -- would represent the most effective and beneficial solution of the problem.

The recommendations which have evolved from our accident investigations have, indeed, directed attention to each of these areas, taking into account in each case, each of the other aspects of the "system."

For the most part, over the past several years, the response of the aviation community (including civil regulatory and research agencies, military, air carrier, general aviation and industry) has been cumulatively constructive. We have recommended extension of pilot training aimed at increased vigilance and awareness; upgrading of pilot experience and proficiency standards for instrument flight rules (IFR) operations, operational control improvement; reasonable restricted airspace extension aimed at improved compatibility and separation, where necessary, of IFR-VFR, high- and low-speed traffic mixes; regulatory changes for more "universal" or standardized patterns for uncontrolled airports; graphic terminal information and guidance for pilots and controllers; conspicuity, visibility, and lighting standards and procedures for all civil aircraft; expeditious development of cost-beneficial, collision-avoidance hardware, procedures for its use and related installation and operational standards; acceleration of improved navigation systems for both en route and terminal area operation; review of airport planning standards; and extended radar detection capabilities.

Responses to these recommendations have been good. Positive and, effective complete or partial action has been taken by the recipients of our recommendations in most cases. "Partial," usually has been due to technological limitations as opposed to any lack of philosophical agreement or cooperation on the part of the aviation community. With regard to the CAS/PWI equipment specifically, we are aware that during the past year there have been tests with drone aircraft, simulation tests, and airborne tests to evaluate equipment, concepts and hardware.

On 31 December 1971, the FAA discontinued its four-year policy of granting immunity from enforcement action to persons reporting near midair collisions. Whether the cessation of immunity will dry up extensive free reporting, thus possibly giving a false indication of reductions in the potential midair collision hazard,

remains to be seen. The Safety Board believes the midair collision prevention system is not developed to the extent that we no longer need to continue to assess, measure, and analyze the hazard.

E. *Conclusions*

The most significant finding of this study was the fact that the problem still persists regardless of the tremendous amount of effort that has been directed during the past few years towards the prevention of midair collisions. In fact, all of the 1969, 70 and 71 accidents followed approximately the same pattern as those of 1968.

Most of the 1969-70 midair accidents occurred at or near an uncontrolled airport, at low altitudes (100 feet or less), at low closure rates, in visual flight conditions, during daylight, on weekends, and between general aviation aircraft.

This study revealed that the majority (78 percent) of the midair collisions which occurred during the 3-year period could have been avoided by the see-and-avoid concept if the aircrews had conformed to the existing flight rules, followed sound cockpit procedures, and if the aircraft involved had been more conspicuous. Also there is a need for improved training techniques to assist both the student and the more experienced pilot to develop a mental state of readiness for the unexpected and how to avoid a collision when one was imminent. This conclusion is based on the fact that the majority of accidents occur during daylight, in good visual flight conditions and at low closure speeds.

In the airport environment where 63 percent of all the accidents occurred, there was a disregard for the right-of-way of other aircraft, a lack of adherence to proper pattern procedures, and a lack of knowledge and alertness for the possibility of a midair collision, even though it was evident that all the ingredients existed.

Assessments indicate that 49 percent of the accidents may have been avoided if all aircraft had been radio equipped and adhered to improved procedures requiring mandatory position calls in the vicinity of uncontrolled airport areas. It was also indicated that 24 percent of the accidents may have been avoided if there had been published standard traffic patterns at all airports.

The study also uncovered facts which reemphasize the need for a continued and extensive effort toward the development of low-cost cooperative CAS and PWI equipment, compatible with each other and with the ATC environment. This equipment would enhance the see-and-be-seen concept but, except for high closure rates and during IFR operations, could not be relied upon as the primary deterrent for midair collisions.

In support of this, the study revealed that 82 percent of the accidents may have been avoided if all aircraft above 12,500 pounds had been equipped with compatible CAS and PWI, all turbine aircraft had been equipped with compatible CAS and PWI, and all aircraft below 12,500 pounds, except specialized aircraft, had been equipped with compatible PWI. However, this conclusion must be modified with the knowledge that, in the majority of the cases, stricter compliance with the see-and-avoid concept might also have avoided the accident.

In the remainder of accidents (22 percent), it is apparent that utilizing see-and-avoid concepts would not have prevented the mid-air collision for many reasons such as high closure rates, closure positions, etc.

With the predicted rapid increase in growth in civil aviation, the increase in air traffic congestion moves toward a saturation point which, in turn, increases the collision potential in the vicinity of airports to an acute level.

The immediate problem is readily apparent, but the solution, although easily recognized, is not so easily implemented. The courses of action are numerous, but the first actions must be the implementation of tighter, more stringent controls to separate VFR and IFR traffic and to instill in all pilots, both civil and military, the necessity for following proper cockpit sur-

veillance techniques in regard to collision avoidance awareness. The "see-and-avoid" concept, although less reliable as increased speeds result in faster rates of closure, remains the main preventive technique at and in the vicinity of airports. It should be noted that most of the airport-related midair collisions would not have occurred if the flightcrews had followed proper surveillance and separation techniques.

Another course of action is the reduction of the midair collision potential through the use of collision avoidance and proximity warning systems. The costs of the initial equipment produced in low-volume quantity are presently prohibitive to the vast majority of the users of airspaces; therefore, emphasis on continued research must be made so that equipment costs can be lowered to acceptable levels in order that procurement for all aircraft is feasible.

Continued improvement of our air traffic control system and increased emphasis on the implementation of Stages I, II, and III for radar sequencing and separation for VFR flights is still another urgent requirement.

Proper control of the proliferation of new airports is also required. At present, the FAA cannot prevent the construction of an airport even if it is built in the vicinity of a major airport or airports, thereby increasing the midair collision potential.

The small, reflective surface of light aircraft is not sufficient to provide adequate primary radar returns; therefore, there are no means for radar controllers to see the aircraft and provide an advisory unless the aircraft is transponder equipped.

Considering the continued projected growth of civil aviation over the next decade, elimination of the midair collision hazard is considered to be the most urgent and serious problem and can only be accomplished by joint cooperative action by the entire aviation community. Even the current rate cannot be maintained at the present level, considering the increased exposure anticipated.

The Safety Board concludes that in view of the expiration of the FAA's near midair collision immunity provisions, no effective evaluation system exists to measure, assess, analyze and predict trends resulting from various improvements and development programs for midair collision avoidance systems.

F. *Recommendations*

Review of the 1969/1970 and to-date 1971 collision data emphasizes the continued need for all pilots to make themselves aware of the ever-increasing threat of midair collisions in 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 other common-sense practices need to be reemphasized, such as nonconsumption of alcohol and necessary 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, precise flying techniques and habits and should compensate for the inherent design restrictions to vision of the aircraft being flown.

As the result of a recent midair collision and numerous near midair collisions all air carriers are encouraged to utilize both their landing lights and high intensity anticollision lights during all flight operations in and near the vicinity of terminal areas.

Also, as recommended in the 1968 report, the Safety Board recommends that the owners and operators of airports and other responsible local, municipal, county and State authorities undertake measures to assure that VFR approach and

departure traffic pattern procedures are established at every airport. Further, the Board recommends that such procedures be clearly identified and made known to pilots.

The Safety Board also 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 Federal Aviation Administration:

1. Take additional steps through their accident prevention specialists to alert the general aviation community of the increasing potential of the midair collision hazard in the vicinity of airports.

2. Develop a total midair collision prevention system approach to include training, education, procedures, ATC equipment and practices, and the development of collision avoidance systems and proximity warning instruments that are cost feasible to the general aviation community.

3. Require general aviation aircraft, when equipped, to utilize at all times both landing lights and anticollision lights during the approach and takeoff phases of operation and while operating in terminal or other high-density areas.

4. After a designated date, require the daytime use of high-intensity white lights on all air carrier aircraft.

5. Expedite the implementation of standard traffic pattern altitudes at all airports.

6. Review and reconsider the feasibility of requiring radar reflectors on all civil aircraft.

7. Expedite the planned implementation of terminal control area and terminal radar separation of VFR and IFR traffic and examine the potential benefits of high-speed climb and descent corridor access and egress therefrom.

8. Designate high-speed climb and descent corridors between the top of the TCA (Terminal Control Areas) and the floor of the PCA (Positive Control Areas) for high density traffic areas.

9. Study the feasibility of providing funding support and implementation of small mobile control facilities for periods of high-density traffic operation at uncontrolled airports to reduce collision hazard.

10. Develop a system to evaluate the effectiveness of improvements and developments in midair collision avoidance systems, to assess, measure, and analyze hazard trends.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/ JOHN H. REED
Chairman

/s/ OSCAR M. LAUREL
Member

/s/ FRANCIS H. McADAMS
Member

/s/ LOUIS M. THAYER
Member

/s/ ISABEL A. BURGESS
Member

June 7, 1972.

TABLE 1 – MIDAIR COLLISION ACCIDENTS
U. S. CIVIL AVIATION
1969

	FILE NUMBER	AIRCRAFT REGIST.	DATE	LOCATION	AIRCRAFT		INJURY INDEX
					MAKE	MODEL	
1.	1 0016	N7374J	090969	NFAIRLAND, IND	PIPER	PA-28	FATAL
		N988VJ	090969	NFAIRLAND, IND	DOUGLAS	DC-9	FATAL
2.	1 0051	N7567A	080369	FORT WORTH, TEX	BOEING	707	FATAL
		N79073	080369	FORT WORTH, TEX	CESSNA	172K	FATAL
3.	1 0052	N1304T	020669	HARLINGEN, TEX	DOUGLAS	DC-9	SERIOUS
		N4531R	020669	HARLINGEN, TEX	PIPER	PA-28	SERIOUS
4.	3 0032	N3081J	021669	SALEM, MICH	CESSNA	150	NONE
		N6906D	021669	SALEM, MICH	PIPER	PA-22	NONE
5.	3 0033	N7868F	021769	VINCENNES, IND	CESSNA	150	SERIOUS
		N8059S	021769	VINCENNES, IND	CESSNA	150	SERIOUS
6.	3 0034	N3488J	022669	MANVEL, TEX	CESSNA	150	FATAL
		N5204P	022669	MANVEL, TEX	PIPER	PA-24	FATAL
7.	3 0154	N22790	031969	KANSAS CITY, KANS	CESSNA	150H	FATAL
		N73997	031969	KANSAS CITY, KANS	BELL	47G2A1	FATAL
8.	3 0740	N23140	042369	MIDDLETOWN, RI	CESSNA	150H	FATAL
		N248PA	042369	MIDDLETOWN, RI	BEECH	95-55	FATAL
9.	3 0778	N2380G	051269	SALEM, OREG	CESSNA	182B	NONE
		N5369Z	051269	SALEM, OREG	PIPER	PA-22	NONE
10.	3 1185	N85071	060269	SNOHOMISH, WASH	AERONCA	7AC	FATAL
		N9060K	060269	SNOHOMISH, WASH	STINSON	108-1	FATAL
11.	3 1196	N4101P	061469	NWATERFORD, CONN	PIPER	PA-23	FATAL
		N441SR	061469	NWATERFORD, CONN	BEECH	35-B33	FATAL
12.	3 1672	N3488P	042069	EL PASO, TEX	PIPER	PA-23	MINOR
		UAF58-19	042069	EL PASO, TEX	CESSNA	T-37B	MINOR
13.	3 1692	N4906J	030569	JULIAN, CALIF	PIPER	PA-28	NONE
		UBN14915	030569	JULIAN, CALIF	L-T-V	F-8J	NONE

TABLE 1 (CONTINUED)

	FILE NUMBER	AIRCRAFT REGIST.	DATE	LOCATION	AIRCRAFT MAKE	AIRCRAFT MODEL	INJURY INDEX
14.	3 2481	N3735Y	073069	BOISE, ID	CESSNA	210D	FATAL
		N9550Q	073069	BOISE, ID	BEECH	V35	FATAL
15.	3 2484	N3187J	082669	GASTONIA, NC	CESSNA	150G	FATAL
		N51158	082669	GASTONIA, NC	CESSNA	150J	FATAL
16.	3 2540	N4204J	092369	EDGEWATER, MD	PIPER	PA-28	FATAL
		N4979Z	092369	EDGEWATER, MD	PIPER	PA-22	FATAL
17.	3 2705	N5868B	092169	PEARLAND, TEX	CESSNA	172G	NONE
		N6722F	092169	PEARLAND, TEX	CESSNA	150F	NONE
18.	3 2744	N6009T	111669	PRAIRIE VIEW, ILL	CESSNA	150	NONE
		N7058R	111669	PRAIRIE VIEW, ILL	PIPER	PA-28	NONE
19.	3 2746	N5566F	111869	NORWOOD, MASS	PIPER	PA-28	NONE
		N98289	111869	NORWOOD, MASS	PIPER	PA-28	NONE
20.	3 2747	N1805J	112569	BRIDGEPORT, NJ	PIPER	PA-28	NONE
		N43148	112569	BRIDGEPORT, NJ	TAYLORCRAFT	BC12-D	NONE
21.	3 3050	N2468D	113069	SANTA PAULA, CALIF	CESSNA	170B	NONE
		N741S	113069	SANTA PAULA, CALIF	STARDUSTER	SWAN	NONE
22.	3 3528	N4032Z	062769	FLORA, MISS	PIPER	PA-18	NONE
		N4982Y	062769	FLORA, MISS	PIPER	PA-25	NONE
23.	3 3566	N6068T	110469	DENVER, COLO	CESSNA	150D	FATAL
		N9719W	110469	DENVER, COLO	PIPER	PA-28	FATAL
24.	3 3744	N60244	102669	SACRAMENTO, CALIF	CESSNA	150	SERIOUS
		N6560F	102669	SACRAMENTO, CALIF	CESSNA	150F	SERIOUS
25.	3 3775	N42242	011569	SAN FRANCISCO, CAL	CESSNA	182L	NONE
		N973PS	011569	SAN FRANCISCO, CAL	BOEING	727	NONE
26.	3 4690	N50005	071569	PLYMOUTH, MICH	CESSNA	150H	SERIOUS
		N9741J	071569	PLYMOUTH, MICH	PIPER	PA-28	SERIOUS
27.	3 4703	N39983	120969	SANTA PAULA, CALIF	TAYLORCRAFT	BC-12D	NONE
		N7043X	120969	SANTA PAULA, CALIF	CESSNA	150A	NONE

TABLE 2 – MIDAIR COLLISION ACCIDENTS
U. S. CIVIL AVIATION
1970

	FILE NUMBER	AIRCRAFT REGIST.	DATE	LOCATION	AIRCRAFT		INJURY INDEX
					MAKE	MODEL	
1.	K027	AF 10166	112070	WICHITA, KANS	REPUBLIC	F-105D	FATAL
		N1717M	112070	WICHITA, KANS	CESSNA	337	FATAL
2.	3 0022	N22419	010470	COLLINSVILLE, ILL	CESSNA	150H	FATAL
		N22519	010470	COLLINSVILLE, ILL	CESSNA	150H	FATAL
3.	3 0030	N83800	020870	SNOHOMISH, WASH	AERONCA	7AC	FATAL
		N9057B	020870	SNOHOMISH, WASH	AERONCA	7FC	FATAL
4.	3 0032	N5567F	021970	FRASER, MICH	PIPER	PA-28	FATAL
		N8797S	021970	FRASER, MICH	CESSNA	150	FATAL
5.	3 0139	N5731F	011770	E. HARTFORD, CONN	PIPER	PA-28	FATAL
		N7442J	011770	E. HARTFORD, CONN	PIPER	PA-28R	FATAL
6.	3 0149	N9512F	020570	KANSAS CITY, MO	HUGHES	269B	MINOR
		N9538F	020570	KANSAS CITY, MO	HUGHES	269B	MINOR
7.	3 0173	N6847Y	012370	TULSA, OKLA	PIPER	PA-23	NONE
		N8327G	012370	TULSA, OKLA	CESSNA	150F	NONE
8.	3 0319	N3004U	022270	NEW ORLEANS, LA	CESSNA	172E	FATAL
		N61023	022270	NEW ORLEANS, LA	CESSNA	150J	FATAL
9.	3 0436	N2213J	061870	BURLINGTON, WIS	CESSNA	150G	NONE
		N6571E	061870	BURLINGTON, WIS	CESSNA	175	NONE
10.	3 0437	N3551Y	053170	EDENVILLE, MICH	CESSNA	182	NONE
		N7745Y	053170	EDENVILLE, MICH	PIPER	PA-30	NONE
11.	3 0449	N1883E	041170	SO. ST. PAUL, MINN	AERONCA	7AC	MINOR
		N9206X	041170	SO. ST. PAUL, MINN	CESSNA	182	MINOR
12.	3 0451	ANG61044	052570	LA PORTE, TEX	GEN DYNAMIC	F-102A	NONE
		N1093T	052570	LA PORTE, TEX	PIPER	PA-28	NONE
13.	3 0554	N6811F	040970	TUCSON, ARIZ	CESSNA	150F	SERIOUS
		N9696A	040970	TUCSON, ARIZ	CESSNA	140A	SERIOUS

TABLE 2 (CONTINUED)

	FILE NUMBER	AIRCRAFT REGIST.	DATE	LOCATION	AIRCRAFT MAKE	AIRCRAFT MODEL	INJURY INDEX
14.	3 0561	AF580501	061970	NMYRTLE BEACH, SC	LOCKHEED	T-33A	NONE
		N7585P	061970	NMYRTLE BEACH, SC	PIPER	PA-24	NONE
15.	3 0612	N4695J	042270	RAMONA, CALIF	PIPER	PA-28R	NONE
		N61183	042270	RAMONA, CALIF	CESSNA	150J	NONE
16.	3 0812	N3038X	012570	SONORA, CALIF	CESSNA	150F	NONE
		N7049N	012570	SONORA, CALIF	BEECH	V35A	NONE
17.	3 0870	N3994B	050270	DEWEYVILLE, TEX	BOEING	E75	FATAL
		N5356N	050270	DEWEYVILLE, TEX	BOEING	E75	FATAL
18.	3 0918	N30501	070770	CRAWFORD, OKLA	PIPER	J3C-65	FATAL
		N7622Z	070770	CRAWFORD, OKLA	PIPER	PA-25	FATAL
19.	3 1051	N6181F	030770	GULF OF MEXICO	CESSNA	210	FATAL
		N7554X	030770	GULF OF MEXICO	CESSNA	172	FATAL
20.	3 1052	N4126Z	031870	LAKELAND, FLA	PIPER	PA-18	FATAL
		USN15445	031870	LAKELAND, FLA	LTV	A-7B	FATAL
21.	3 1067	N34324	061470	SCAPPOOSE, OREG	MEYERS	OTW	FATAL
		N49146	061470	SCAPPOOSE, OREG	AERONCA	L-3C	FATAL
22.	3 1069	N2627P	081270	XENIA, ILL	PIPER	PA-22	FATAL
		N971LL	081270	XENIA, ILL	CESSNA	310D	NONE
23.	3 1106	N7341	050370	TEHACHAPI, CALIF	SCHLEICHER	K7	FATAL
		N7793S	050370	TEHACHAPI, CALIF	SCHWEIZER	SGS126	FATAL
24.	3 1128	N5942W	021470	NPLACERVILLE, CALIF	PIPER	PA-28	FATAL
		N7902D	021470	NPLACERVILLE, CALIF	BEECH	H35	FATAL
25.	3 1223	N5933T	082770	OSAGE, IOWA	CESSNA	150D	FATAL
		N9912H	082770	OSAGE, IOWA	BOEING	B75N1	FATAL
26.	3 1327	N5790T	071070	FRESNO, CALIF	CESSNA	172	NONE
		N5926W	071070	FRESNO, CALIF	PIPER	PA-28	NONE
27.	3 1346	N5071W	101770	GILA BEND, ARIZ	PIPER	PA-28	NONE
		N5868F	101770	GILA BEND, ARIZ	CESSNA	210G	NONE

TABLE 2 (CONTINUED)

	FILE NUMBER	AIRCRAFT REGIST.	DATE	LOCATION	AIRCRAFT MAKE	AIRCRAFT MODEL	INJURY INDEX
28.	3 1428	N6200R	101270	ANOKA, MINN	CESSNA	150E	NONE
		N8348N	101270	ANOKA, MINN	BEECH	E33A	NONE
29.	3 1547	N6577Q	091170	PLAINVIEW, TEX	ALON	A-2	FATAL
		N8738G	091170	PLAINVIEW, TEX	CESSNA	150	FATAL
30.	3 1619	N71605	111870	VIDALIA, LA	CESSNA	182M	FATAL
		N905B	111870	VIDALIA, LA	BEECH	D50E	FATAL
31.	3 1676	N6664P	122870	SACATON, ARIZ	PIPER	PA-24	FATAL
		N7342V	122870	SACATON, ARIZ	BELLANCA	17-30	FATAL
32.	3 1782	N1757C	110170	MISSOULA, MONT	CESSNA	180	FATAL
		N3875H	110170	MISSOULA, MONT	ERCO	415-CD	FATAL
33.	3 2023	N4907J	042970	ASHFORD, ALA	PIPER	PA-28R	NONE
		USA65-12	042970	ASHFORD, ALA	BEECH	T-42A	NONE
34.	3 2393	N2499V	122270	MINERAL WELLS, TEX	CESSNA	140	NONE
		N9582Y	122270	MINERAL WELLS, TEX	BEECH	95-A55	NONE
35.	3 2447	N4045Q	121970	WAUKESHA, WIS	CESSNA	402	FATAL
		N6175G	121970	WAUKESHA, WIS	CESSNA	150K	FATAL
36.	3 2943	N6728J	112170	VACAVILLE, CALIF	PIPER	PA-28	MINOR
		N7080S	112170	VACAVILLE, CALIF	CESSNA	150	MINOR
37.	3 3914	CF-DBR	110170	SEATTLE, WASH	MOONEY	M20C	FATAL
		N92711	110170	SEATTLE, WASH	CESSNA	182N	FATAL

TABLE 3 – ACCIDENT LISTING INVOLVING MIDAIR COLLISIONS
U. S. CIVIL AVIATION
1971 (INCOMPLETE)

	FILE NUMBER	AIRCRAFT REGIST.	DATE	LOCATION	AIRCRAFT		INJURY INDEX
					MAKE	MODEL	
1.	A013	N3393B	082471	KENAI, ALAS	PIPER	PA-18	FATAL
		N3652S	082471	KENAI, ALAS	CESSNA	150	FATAL
2.	C014	N7883P	081771	BARDSTOWN, KY	PIPER	PA-24	FATAL
		N84596	081771	BARDSTOWN, KY	CESSNA	172K	FATAL
3.	C062	N46654	030971	NSUSSEX, WIS	CESSNA	172K	NONE
		N80311	030971	NSUSSEX, WIS	CESSNA	172H	NONE
4.	C072	N3384W	040571	HINSDALE, ILL	PIPER	PA-32	SERIOUS
		N7055G	040571	HINSDALE, ILL	CESSNA	172	SERIOUS
5.	F005	N4994P	071971	GULF OF MEXICO	PIPER	PA-18	FATAL
		N9079M	071971	GULF OF MEXICO	CESSNA	180H	FATAL
6.	F048	N23323	021771	NWEST MEMPHIS, ARK	CESSNA	150H	NONE
		N2996J	021771	NWEST MEMPHIS, ARK	CESSNA	150G	NONE
7.	F051	N100UT	021971	AUSTIN, TEX	BEECH	100	NONE
		N7468G	021971	AUSTIN, TEX	CESSNA	172K	NONE
8.	F068	N7213S	040371	DALLAS, TEX	CESSNA	150	NONE
		N8765N	040371	DALLAS, TEX	PIPER	PA-28	NONE
9.	K044	N4678L	020671	NMARSHALLTOWN,IOWA	CESSNA	172	FATAL
		N6936T	020671	NMARSHALLTOWN,IOWA	CESSNA	310D	FATAL
10.	L011	N47330	080471	COMPTON, CALIF	BOEING	707	SERIOUS
		N61011	080471	COMPTON, CALIF	CESSNA	150	SERIOUS
11.	L054	N51290	022171	CORONA, CALIF	CESSNA	150	NONE
		N6866W	022171	CORONA, CALIF	PIPER	PA-28	SERIOUS
12.	N076	N22785	010271	DANBURY, CONN	CESSNA	150	NONE
		N7999L	010271	DANBURY, CONN	BEECH	A23-24	NONE
13.	N078	N60942	010971	EDISON, NJ	CESSNA	150	FATAL
		N7595A	010971	EDISON, NJ	BOEING	707	FATAL

TABLE 3 (CONTINUED)

	FILE NUMBER	AIRCRAFT REGIST.	DATE	LOCATION	AIRCRAFT		INJURY INDEX
					MAKE	MODEL	
14.	N118	N1046C	060571	CAPE MAY, NJ	N. AMERICAN	SNJ-5	FATAL
		N1974M	060571	CAPE MAY, NJ	N. AMERICAN	AT6-D	FATAL
15.	N119	N3626F	060571	CAPE MAY, NJ	N. AMERICAN	SNJ-5	FATAL
		N5489V	060571	CAPE MAY, NJ	N. AMERICAN	AT6-D	FATAL
16.	S005	N3558G	080271	NNYSSA, OREG	CALLAIR	A-9	FATAL
		N5270	080271	NNYSSA, OREG	GRUMMAN	G-164A	FATAL
17.	YC12	N375MC	072971	NPENDLETON, OREG	CALLAIR	A-9	FATAL
		N7607V	072971	NPENDLETON, OREG	CALLAIR	A-9	FATAL
18.	Z010	N9345	060671	DUARTE, CALIF	DOUGLAS	DC-9	FATAL
		USN51458	060671	DUARTE, CALIF	MCDONNELL	F4B	FATAL

CONVERGENCE ANGLE	AIRCRAFT TYPE OF WING		PHASE OF OPERATION BY ACCIDENT										1968
			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 INITAL CLIMB TAKE OFF INITAL CLIMB	DESCENT DESCENT	CONV. ANGLE TOTALS
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 4

HORIZONTAL COLLISION ANGLE	AIRCRAFT TYPE OF WING		PHASE OF OPERATION BY AIRCRAFT — 1969										
			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	COLL. ANGLE TOTAL
0-10°	HIGH HIGH	5	3			2							
	LOW LOW	2	2										10
	LOW HIGH	3	3			1							
11-30°	HIGH HIGH												
	LOW LOW												4
	LOW HIGH	4	2				1				1		
31-50°	HIGH HIGH	1	1										
	LOW LOW	3	1				1						3
	LOW HIGH												
51-70°	HIGH HIGH												
	LOW LOW												
	LOW HIGH												
71-90°	HIGH HIGH												
	LOW LOW												1
	LOW HIGH	1					1						
91-110°	HIGH HIGH												
	LOW LOW	1											1
	LOW HIGH								1				
111-180°	HIGH HIGH	1			1								
	LOW LOW												2
	LOW HIGH	1					1						
	TOTAL		11		1	3	4		1		1		
	HIGH HIGH	7											
	LOW LOW	5											
	LOW HIGH	9											

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

TABLE 5

HORIZONTAL COLLISION ANGLE	AIRCRAFT TYPE OF WING		PHASE OF OPERATION BY AIRCRAFT 1970										
			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	COLL. ANGLE TOTAL
0-10°	HIGH HIGH	3	2		1								
	LOW LOW	2					2						11
	LOW HIGH	6	5				1						
11-30°	HIGH HIGH												
	LOW LOW	2	1					1					4
	LOW HIGH	2	1						1				
31-50°	HIGH HIGH												
	LOW LOW												3
	LOW HIGH	3	1		2								
51-70°	HIGH HIGH												
	LOW LOW												
	LOW HIGH												
71-90°	HIGH HIGH												
	LOW LOW												2
	LOW HIGH	2			1		1						
91-110°	HIGH HIGH	1					1						
	LOW LOW	2					1			1			3
	LOW HIGH												
111-180°	HIGH HIGH	1			1								
	LOW LOW	1							1				5
	LOW HIGH	3					1		1		1		
	TOTAL		10		5		7	1	3	1	1		
	HIGH HIGH	5											
	LOW LOW	7											
	LOW HIGH	16											

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

TABLE 6

NUMBER OF FATAL AND NON–FATAL COLLISIONS

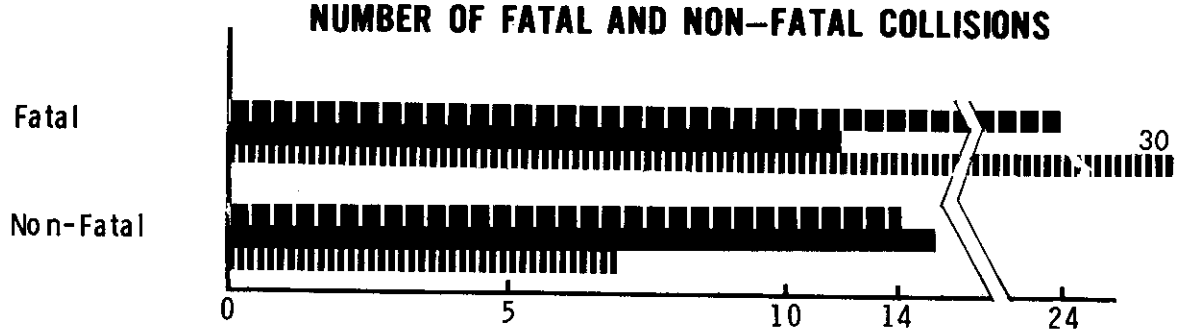


Figure 1

TYPE OF FLYING BY NUMBER OF AIRCRAFT

(1968–76 Aircraft; 1969–54 Aircraft; 1970–74 Aircraft)

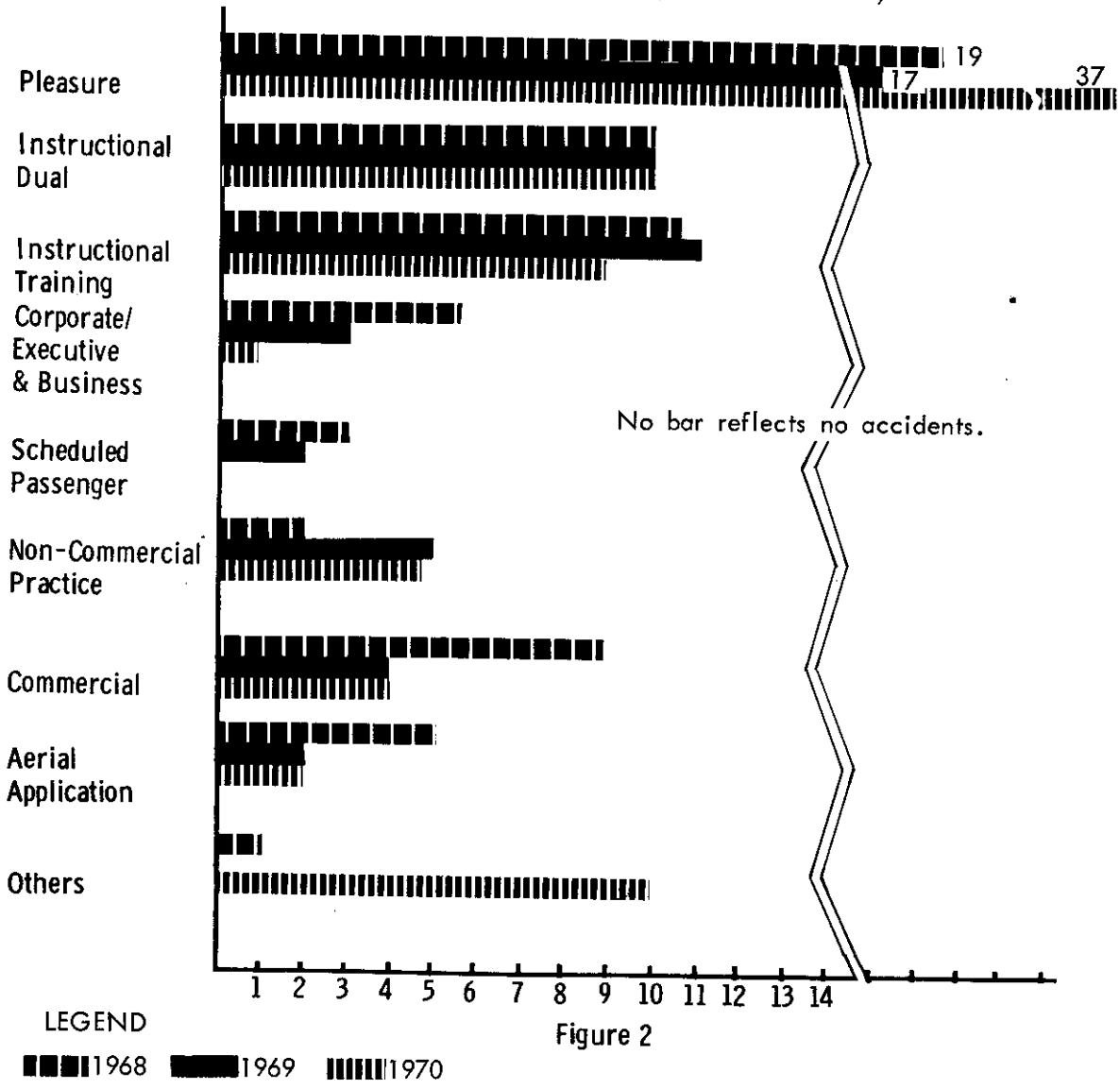


Figure 2

PROXIMITY TO AIRPORT

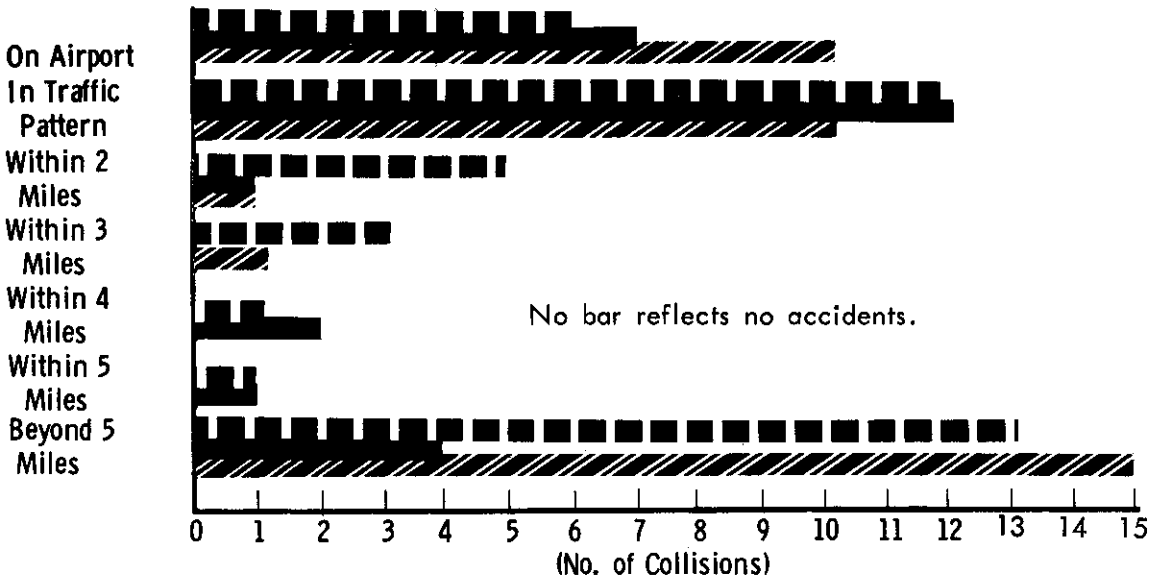


Figure 3

PHASE OF OPERATIONS BY AIRCRAFT

(1968-76 Aircraft; 1969-54 Aircraft; 1970-74 Aircraft)

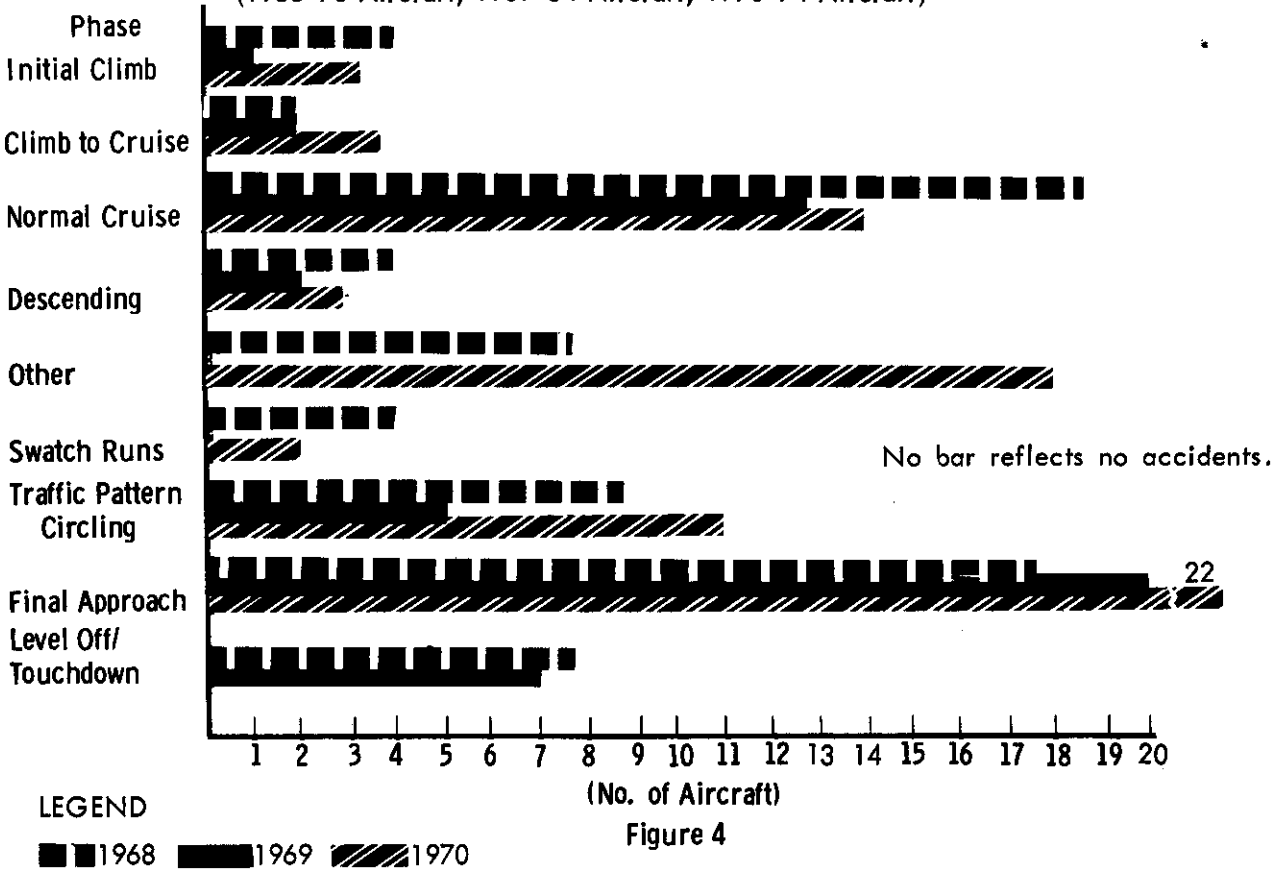


Figure 4

FLIGHT PLAN BY AIRCRAFT

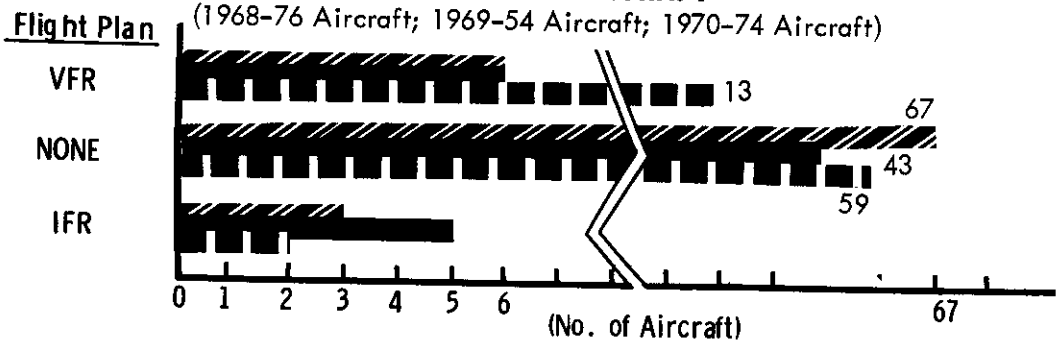


Figure 5

ALTITUDE OF OCCURRENCE ABOVE GROUND

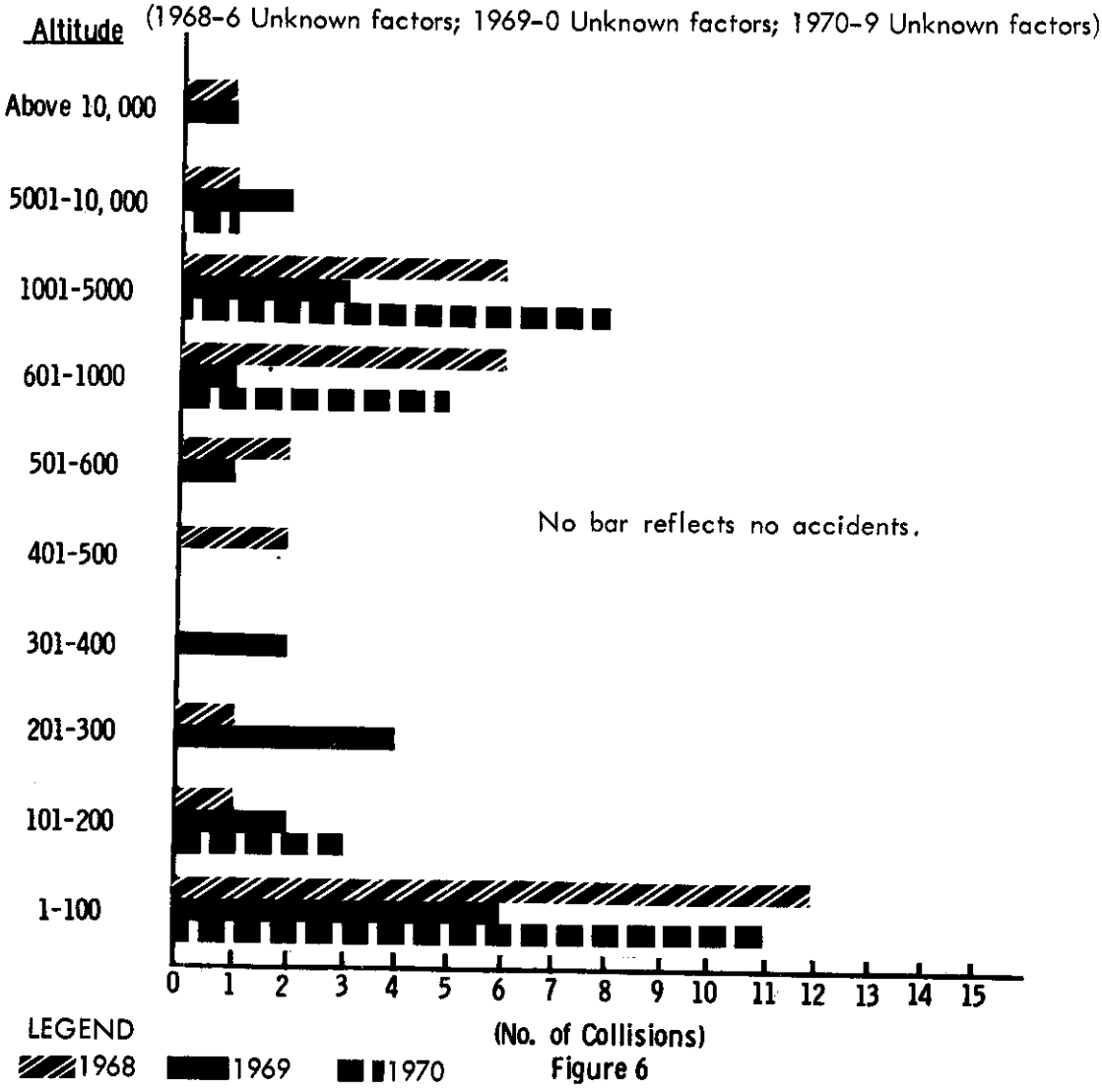


Figure 6

TIME OF OCCURRENCE

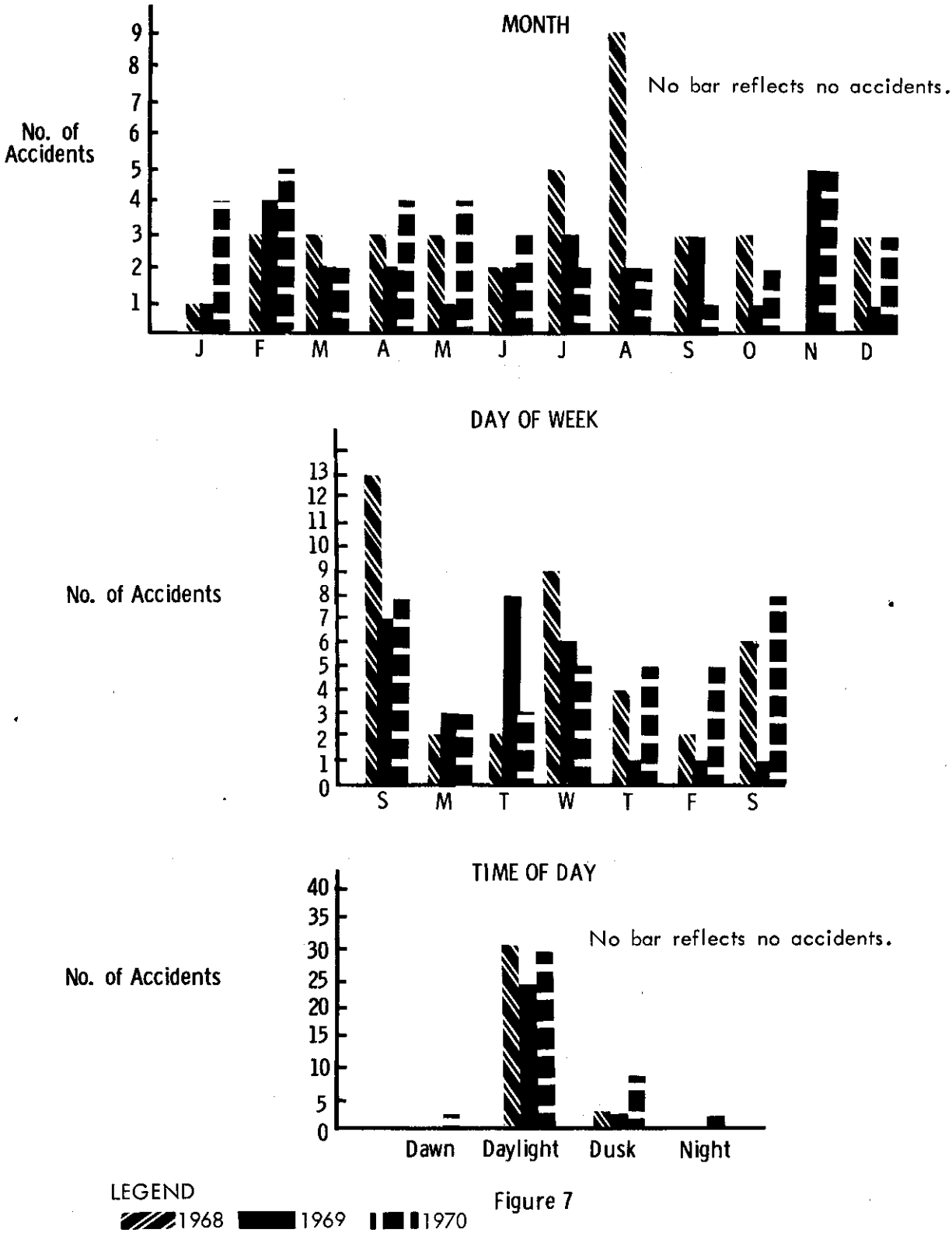


Figure 7

PILOT TIME (1968)

HOURS

	1-99	100-199	200-299	300-999	1000 or More	Unknown
TOTAL TIME	14	8	7	16	25	6
TIME IN TYPE	32	11	4	8	7	14

FIGURE 8

PILOT TIME (1969)

HOURS

	1-99	100-199	200-299	300-399	400-999	1000 or More	Unknown
TOTAL TIME	11	7	4	4	3	23	2
TIME IN TYPE	21	6	2	2	6	8	9

FIGURE 9

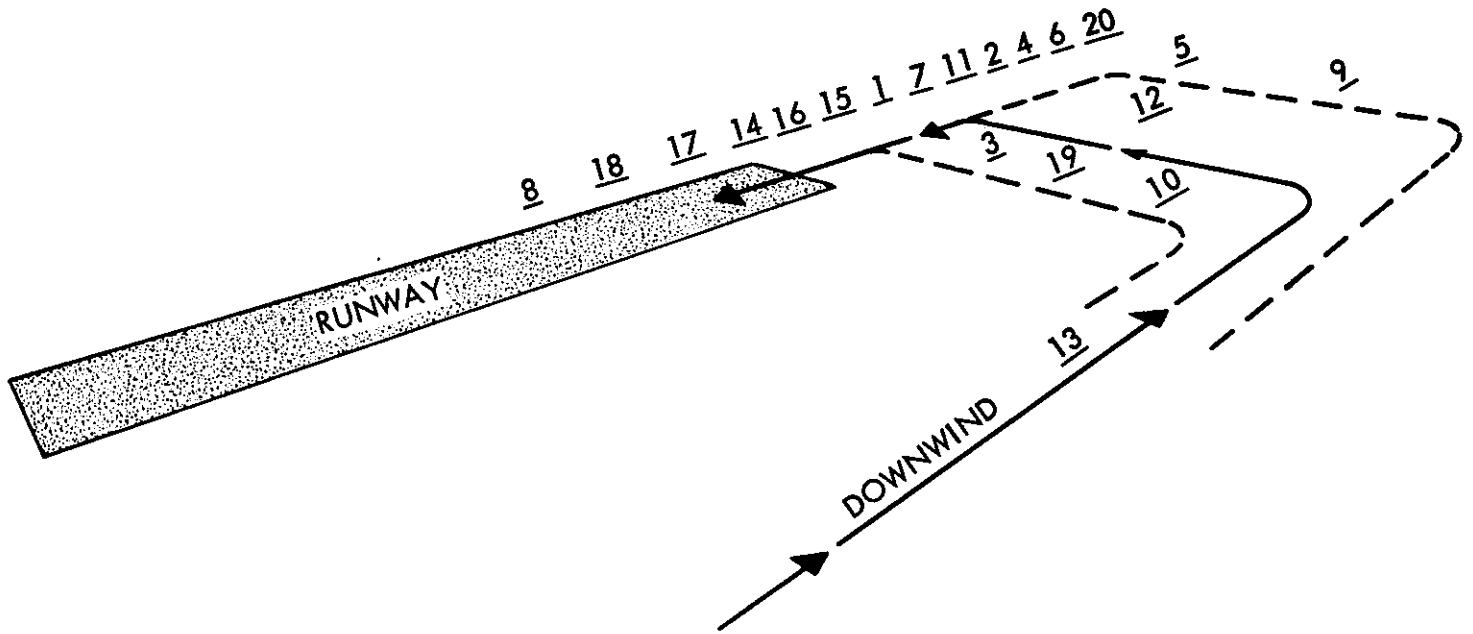
PILOT TIME (1970)

HOURS

	1-99	100-199	200-299	300-399	400-999	1000 or More	Unknown
TOTAL TIME	8	8	3	3	14	24	14
TIME IN TYPE	25	11	2	3	7	7	19

FIGURE 10

Pilot at Controls. Total Time & Time-in Type



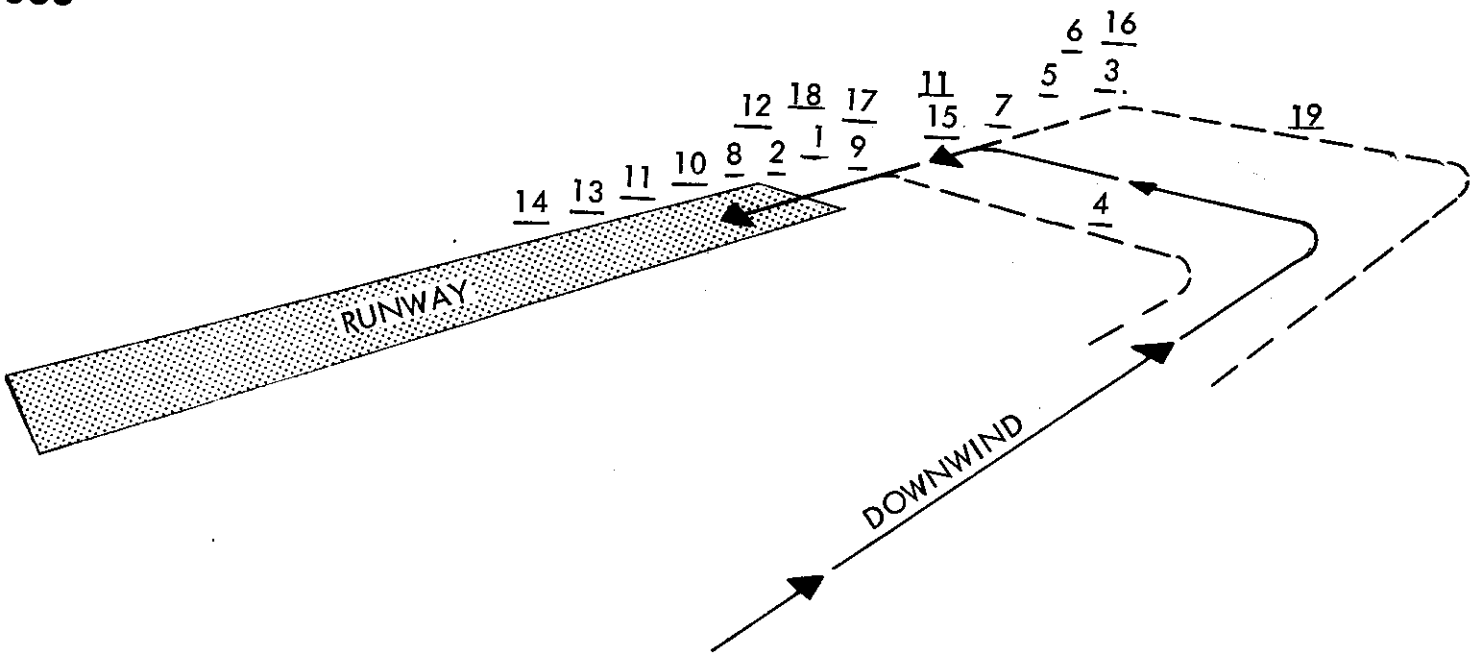
Approximate Position of 20 Mid-Air Collisions that Occurred in the Down-Wind, Base-Leg and Final Approach.

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 11

1969



Approximate Position of 19 Mid-Air Collisions that Occurred in the Down-Wind, Base-Leg and Final Approach.

DOCKET NUMBER

1. 1-0032
2. 3-0033
3. 1-0052
4. 3-0154
5. 3-0740
6. 3-0778
7. 3-1185
8. 3-2484
9. 3-2540
10. 3-2705
11. 3-2744
12. 3-2746
13. 3-2747
14. 3-3050
15. 3-3528
16. 3-3566
17. 3-3744
18. 3-4690
19. 3-4703

FIGURE 12

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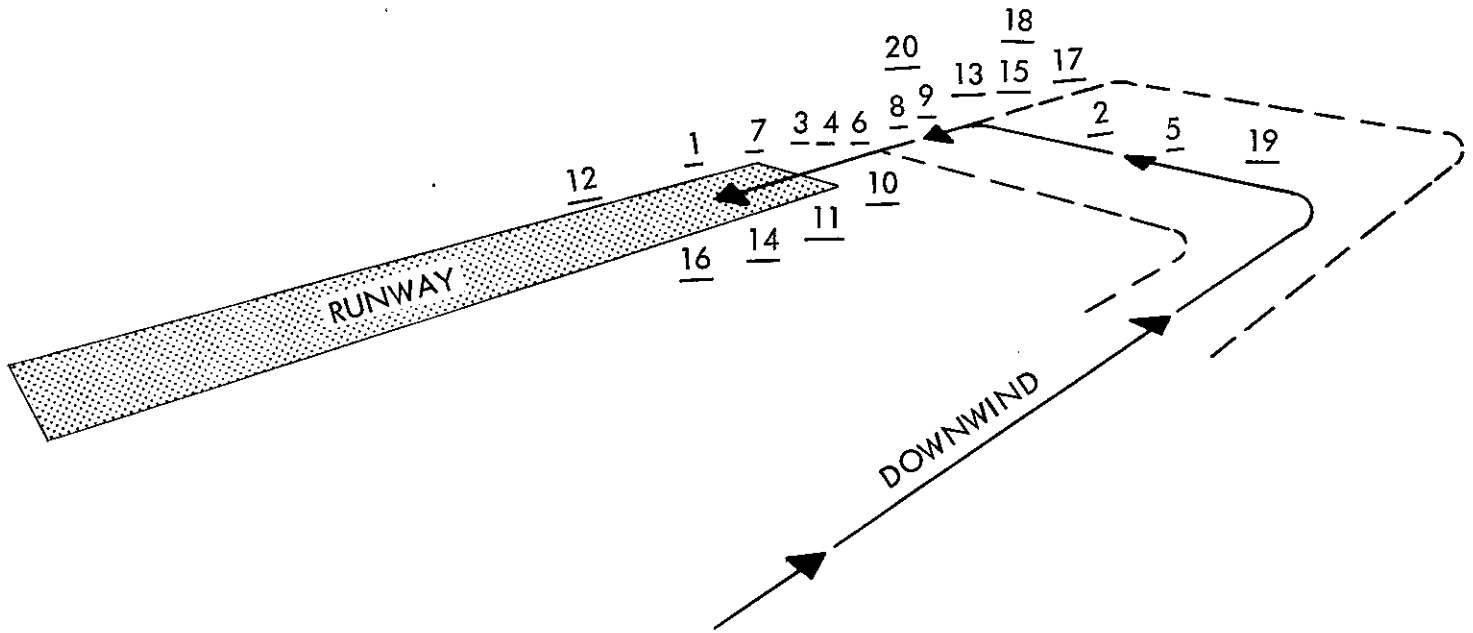

Approximate Position of 20 Mid-Air Collisions that Occurred in the Down-Wind, Base-Leg and Final Approach.

Docket Numbers

1. 3-0449
2. 3-0554
3. 3-0612
4. 3-1547
5. 3-1067
6. 3-1223
7. 3-1346
8. 3-1428
9. 3-16-19
10. 3-2447
11. K627
12. 3-2943
13. 3-3914
14. 3-0022
15. 3-0030
16. 3-0032
17. 3-0139
18. 3-0173
19. 3-0319
20. 3-0436

FIGURE 13

INJURY TABLE – 1969
MIDAIR COLLISIONS
U. S. CIVIL AVIATION
1969

APPENDIX 1

	INJURIES					
OCCUPANT	FATAL	SERIOUS	MINOR	NONE	UNKNOWN	TOTAL
PILOT	18	4	1	31		54
COPILOT	3			2		5
DUAL STUDENT	3	1	2	4		10
CHECK PILOT						
FLIGHT ENGINEER				2		2
NAVIGATOR						
CABIN ATTENDANT	2			5		7
EXTRA CREW				3		3
PASSENGERS	93			84		177
TOTAL	119	5	3	131	ABOARD	258
OTHER AIRCRAFT						
OTHER GROUND						
GRAND TOTAL	119	5	3	131		258

INVOLVES 27 TOTAL ACCIDENTS
INVOLVES 11 FATAL ACCIDENTS

INJURY TABLE – 1970
MIDAIR COLLISIONS
U. S. CIVIL AVIATION
1970

APPENDIX 2

OCCUPANT	INJURIES						TOTAL
	FATAL	SERIOUS	MINOR	NONE	UNKNOWN		
PILOT	30	2	4	38			74
COPILOT			1	2			3
DUAL STUDENT	4	1	1	5			11
CHECK PILOT				1			1
FLIGHT ENGINEER							
NAVIGATOR							
CABIN ATTENDANT							
EXTRA CREW							
PASSENGERS	21		2	31			54
TOTAL	55	3	8	77		ABOARD	143
OTHER AIRCRAFT							
OTHER GROUND			1				1
GRAND TOTAL	55	3	9	77			144

INVOLVES 37 TOTAL ACCIDENTS
INVOLVES 21 FATAL ACCIDENTS

ANALYTIC TABLE
KIND OF FLYING BY INJURY INDEX – 1969
INJURY INDEX

APPENDIX 3

KIND OF FLYING	FATAL	SERIOUS	MINOR	NONE	RECORDS	ACCIDENTS	PERCENT
INSTRUCTIONAL							
DUAL	5		1	3	9	8	16.67
SOLO				2	2	2	3.70
CHECK							
TRAINING	5	2		2	9	6	16.67
NONCOMMERCIAL							
PLEASURE	8	2		7	17	13	31.48
PRACTICE	1	2		2	5	4	9.26
BUSINESS		1		2	3	3	5.56
CORPORATE/EXECUTIVE							
AERIAL SURVEY							
COMPANY FLIGHT							
OTHER							
COMMERCIAL							
AERIAL APPLICATION							
ASSOCIATED CROP CONTROL ACTIV				2	2	1	3.70
FIRE CONTROL							
ASSOCIATED FIRE CONTROL ACTIV							
AERIAL MAPPING/PHOTOGRAPHY			1		1	1	1.85
AERIAL ADVERTISING							
POWER AND PIPELINE PATROL							
FISH SPOTTING							
AIR TAXI-PASSENGER OPERATIONS	1			2	3	2	5.56
AIR TAXI-CARGO OPERATIONS							
CONSTRUCTION WORK							
SCHEDULED PASSENGER SERVICE							
SCHEDULED CARGO SERVICE							

APPENDIX 3 (CONTINUED)

KIND OF FLYING	FATAL	SERIOUS	MINOR	NONE	RECORDS	ACCIDENTS	PERCENT
COMMERCIAL							
NONSCHEDULED/CHARTER REVENUE							
NONSCHEDULED/CHARTER REVENUE							
MILITARY CONTRACT–PASSENGER							
MILITARY CONTRACT–CARGO							
CONTRACT/CHARTER–CARGO–DOMEST							
CONTRACT/CHARTER–PASSENGER–DO							
CONTRACT/CHARTER–CARGO–INTERN							
CONTRACT/CHARTER–PASSENGER–IN							
OTHER							
UNKNOWN/NOT REPORTED							
MISCELLANEOUS							
EXPERIMENTATION							
TEST							
DEMONSTRATION							
FERRY							
SEARCH AND RESCUE							
AIR SHOW/AIR RACING							
PARACHUTE JUMP							
PARACHUTE JUMP IN CONNECTION							
TOWING GLIDERS							
SEEDING CLOUDS							
HUNTING							
POLICE PATROL							
HIGHWAY TRAFFIC ADVISORY							
ALL OTHER PUBLIC FLYING							
OTHER							
UNKNOWN/NOT REPORTED							
OTHER							

APPENDIX 3 (CONTINUED)

KIND OF FLYING	FATAL	SERIOUS	MINOR	NONE	RECORDS	ACCIDENTS	PERCENT
RECORDS	22	8	2	22	54		
ACCIDENTS	11	4	1	11		27	
PERCENT	.0 40.7	14.8	3.7	40.7 .0 .0			

ANALYTIC TABLE
KIND OF FLYING BY INJURY INDEX – 1970
INJURY INDEX

APPENDIX 4

KIND OF FLYING	FATAL	SERIOUS	MINOR	NONE	RECORDS	ACCIDENTS	PERCENT
INSTRUCTIONAL							
DUAL	5	1	1	3	10	10	13.51
SOLO	2	1		2	5	4	6.76
CHECK							
TRAINING	1		1	2	4	4	5.41
NONCOMMERCIAL							
PLEASURE	19		1	12	32	23	43.24
PRACTICE	2			2	4	3	5.41
BUSINESS	1			2	3	3	4.05
CORPORATE/EXECUTIVE				1	1	1	1.35
AERIAL SURVEY							
COMPANY FLIGHT							
OTHER							
COMMERCIAL							
AERIAL APPLICATION	2				2	1	2.70
ASSOCIATED CROP CONTROL ACTIV	2				2	1	2.70
FIRE CONTROL							
ASSOCIATED FIRE CONTROL ACTIV							
AERIAL MAPPING/PHOTOGRAPHY							
AERIAL ADVERTISING							
POWER AND PIPELINE PATROL							
FISH SPOTTING	2				2	1	2.70
AIR TAXI–PASSENGER OPERATIONS	1				1	1	1.35
AIR TAXI–CARGO OPERATIONS							
CONSTRUCTION WORK							
SCHEDULED PASSENGER SERVICE							
SCHEDULED CARGO SERVICE							

APPENDIX 4 (CONTINUED)

KIND OF FLYING	FATAL	SERIOUS	MINOR	NONE	RECORDS	ACCIDENTS	PERCENT
COMMERCIAL							
NONSCHEDULED/CHARTER REVENUE							
NONSCHEDULED/CHARTER REVENUE							
MILITARY CONTRACT–PASSENGER							
MILITARY CONTRACT–CARGO							
CONTRACT/CHARTER–CARGO–DOMEST							
CONTRACT/CHARTER–PASSENGER–DO							
CONTRACT/CHARTER–CARGO–INTERN							
CONTRACT/CHARTER–PASSENGER–IN							
OTHER							
UNKNOWN/NOT REPORTED							
MISCELLANEOUS							
EXPERIMENTATION							
TEST							
DEMONSTRATION							
FERRY							
SEARCH AND RESCUE							
AIR SHOW/AIR RACING	2				2	1	2.70
PARACHUTE JUMP	1				1	1	1.35
PARACHUTE JUMP IN CONNECTION							
TOWING GLIDERS							
SEEDING CLOUDS							
HUNTING							
POLICE PATROL	1	2			3	2	4.05
HIGHWAY TRAFFIC ADVISORY							
ALL OTHER PUBLIC FLYING	1		1		2	2	2.70
OTHER							
UNKNOWN/NOT REPORTED							
OTHER							

APPENDIX 4 (CONTINUED)

KIND OF FLYING	FATAL	SERIOUS	MINOR	NONE	RECORDS	ACCIDENTS	PERCENT
RECORDS	41	2	6	25	74		
ACCIDENTS	21	1	3	13		37	
PERCENT	.0 55.4	2.7	8.1	33.8 .0 .0			

ANALYTIC TABLE
AIRPORT PROXIMITY VS INJURY INDEX – 1969
MIDAIR COLLISION ACCIDENTS
U. S. CIVIL AVIATION
INJURY INDEX

APPENDIX 5

PROXIMITY	FATAL	SERIOUS	MINOR	NONE	RECORDS	ACCIDENTS	PERCENT
ON AIRPORT	2	2		10	14	7	25.93
ON SEAPLANE BASE							
ON HELIPORT							
ON BARGE/SHIP/PLATFORM							
IN TRAFFIC PATTERN	6	4		8	18	9	33.33
WITHIN 1/4 MILE	2	2			4	2	7.41
WITHIN 1/2 MILE							
WITHIN 3/4 MILE							
WITHIN 1 MILE	2				2	1	3.70
WITHIN 2 MILES				2	2	1	3.70
WITHIN 3 MILES							
WITHIN 4 MILES	4				4	2	7.41
WITHIN 5 MILES	2				2	1	3.70
BEYOND 5 MILES	4			2	6	3	11.11
UNKNOWN/NOT REPORTED			2		2	1	3.70
OTHER							
RECORDS	22	8	2	22	54		
ACCIDENTS	11	4	1	11		27	
PERCENT	.0 40.7	14.8	3.7	40.7 .0 .0			

ANALYTIC TABLE
AIRPORT PROXIMITY VS INJURY INDEX – 1970
MIDAIR COLLISION ACCIDENTS
U. S. CIVIL AVIATION
INJURY INDEX

APPENDIX 6

PROXIMITY	FATAL	SERIOUS	MINOR	NONE	RECORDS	ACCIDENTS	PERCENT
ON AIRPORT	4	2	4	6	16	8	21.62
ON SEAPLANE BASE							
ON HELIPORT							
ON BARGE/SHIP/PLATFORM							
IN TRAFFIC PATTERN	14			4	18	9	24.32
WITHIN 1/4 MILE	2			2	4	2	5.41
WITHIN 1/2 MILE	2				2	1	2.70
WITHIN 3/4 MILE							
WITHIN 1 MILE	2				2	1	2.70
WITHIN 2 MILES	2				2	1	2.70
WITHIN 3 MILES				2	2	1	2.70
WITHIN 4 MILES	2				2	1	2.70
WITHIN 5 MILES							
BEYOND 5 MILES	11		2	11	24	12	32.43
UNKNOWN/NOT REPORTED	2				2	1	2.70
OTHER							
RECORDS	41	2	6	25	74		
ACCIDENTS	21	1	3	13		37	
PERCENT	.0 55.4	2.7	8.1	33.8	.0 .0		

ANALYTIC TABLE

APPENDIX 7

FIRST PHASE OF OPERATION BY INJURY INDEX – 1969

FIRST OPERATIONAL PHASE	INJURY INDEX						
	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							
AERIAL TAXI TO TAKEOFF							
AERIAL TAXI TO/FROM LANDING							
AERIAL TAXI, OTHER							
TAKEOFF							
RUN							
INITIAL CLIMB			1		1	1	1.85
VERTICAL							
RUNNING							
ABORTED							
ABORTED							
ABORTED							
OTHER							

APPENDIX 7 (CONTINUED)

FIRST OPERATIONAL PHASE	FATAL	SERIOUS	MINOR	NONE	RECORDS	ACCIDENTS	PERCENT
INFLIGHT							
CLIMB TO CRUISE				2	2	1	3.70
NORMAL CRUISE	7		1	2	10	6	18.52
DESCENDING	1		1		2	2	3.70
HOLDING							
HOVERING							
POWER-ON DESCENT							
AUTOROTATIVE DESCENT							
ACROBATICS							
BUZZING							
UNCONTROLLED DESCENT							
EMERGENCY DESCENT							
LOW PASS							
OTHER	2				2	1	3.70
EN ROUTE TO TREAT CROP							
EN ROUTE TO RELOADING AREA							
SURVEY FIELD/AREA							
STARTING SWATH RUN							
SWATH RUN							
FLAREOUT FOR SWATH RUN							
PULLUP FROM SWATH RUN							
ROCEDURE TURNAROUND							
CLEANUP SWATH							
MANEUVER TO AVOID OBSTRUCTION							
RETURN TO STRIP							
LANDING							
TRAFFIC PATTERN-CIRCLING	2			2	4	2	7.41

APPENDIX 7 (CONTINUED)

FIRST OPERATIONAL PHASE	FATAL	SERIOUS	MINOR	NONE	RECORDS	ACCIDENTS	PERCENT
LANDING							
FINAL APPROACH	10	6		10	26	13	48.15
INITIAL APPROACH							
FINAL APPROACH							
LEVEL OFF/TOUCHDOWN		2		5	7	4	12.96
ROLL							
ROLL–ON/RUN–ON							
POWER–ON LANDING							
POWER–OFF AUTOROTATIVE LANDIN							
GO–AROUND							
MISSED APPROACH							
OTHER							
UNKNOWN/NOT REPORTED							
OTHER							
RECORDS	22	8	2	22	54		
ACCIDENTS	11	4	1	11		27	
PERCENT	.0 40.7	14.8	3.7	40.7	.0 .0		

ANALYTIC TABLE
FIRST PHASE OF OPERATION BY INJURY INDEX – 1970
INJURY INDEX

APPENDIX 8

FIRST OPERATIONAL 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							
AERIAL TAXI TO TAKEOFF							
AERIAL TAXI TO/FROM LANDING							
AERIAL TAXI, OTHER							
TAKEOFF							
RUN							
INITIAL CLIMB	3				3	2	4.05
VERTICAL							
RUNNING							
ABORTED							
ABORTED							
ABORTED							
OTHER							

APPENDIX 8 (CONTINUED)

FIRST OPERATIONAL PHASE	FATAL	SERIOUS	MINOR	NONE	RECORDS	ACCIDENTS	PERCENT
INFLIGHT							
CLIMB TO CRUISE	2		1	2	5	5	6.76
NORMAL CRUISE	7			6	13	9	17.57
DESCENDING	1			3	4	4	5.41
HOLDING							
HOVERING							
POWER-ON DESCENT							
AUTOROTATIVE DESCENT							
ACROBATICS							
BIZZING							
UNCONTROLLED DESCENT							
EMERGENCY DESCENT							
LOW PASS							
OTHER	6		1	4	11	7	14.86
EN ROUTE TO TREAT CROP							
EN ROUTE TO RELOADING AREA							
SURVEY FIELD/AREA							
STARTING SWATH RUN							
SWATH RUN							
FLAREOUT FOR SWATH RUN							
PULLUP FROM SWATH RUN							
PROCEDURE TURNAROUND	1				1	1	1.35
CLEANUP SWATH	1				1	1	1.35
MANEUVER TO AVOID OBSTRUCTION							
RETURN TO STRIP	2				2	1	2.70
LANDING							
TRAFFIC PATTERN-CIRCLING	9				9	5	12.16

APPENDIX 8 (CONTINUED)

FIRST OPERATIONAL PHASE	FATAL	SERIOUS	MINOR	NONE	RECORDS	ACCIDENTS	PERCENT
LANDING							
FINAL APPROACH	7	2	2	10	21	11	28.38
INITIAL APPROACH							
FINAL APPROACH	1				1	1	1.35
LEVEL OFF/TOUCHDOWN							
ROLL							
ROLL-ON/RUN-ON							
POWER-ON LANDING							
POWER-OFF AUTOROTATIVE LANDIN							
GO-AROUND			2		2	1	2.70
MISSED APPROACH							
OTHER	1				1	1	1.35
UNKNOWN/NOT REPORTED							
OTHER							
RECORDS	41	2	6	25	74		
ACCIDENTS	21	1	3	13		37	
PERCENT	.0 55.4	2.7	8.1	33.8	.0 .0		

APPENDIX 9

ANALYTIC TABLE
MONTH OF OCCURRENCE BY TYPE OF WEATHER CONDITIONS - 1969
MIDAIR COLLISION ACCIDENTS
U. S. CIVIL AVIATION

MONTH	VFR	IFR	BELOW MINIMUMS	UNKNOWN/ NOT REPORTED	RECORDS	ACCIDENTS
JANUARY	2				2	1
FEBRUARY	8				8	4
MARCH	4				4	2
APRIL	4				4	2
MAY	2				2	1
JUNE	4	2			6	3
JULY	4				4	2
AUGUST	4				4	2
SEPTEMBER	6				6	3
OCTOBER	2				2	1
NOVEMBER	10				10	5
DECEMBER	2				2	1

ANALYTIC TABLE
MONTH OF OCCURRENCE BY TYPE OF WEATHER CONDITIONS – 1970
U. S. CIVIL AVIATION

APPENDIX 10

MONTH	VFR	IFR	BELOW MINIMUMS	UNKNOWN/ NOT REPORTED	RECORDS	ACCIDENTS	PERCENT
JANUARY	8				8	4	10.81
FEBRUARY	10				10	5	13.51
MARCH	4				4	2	5.41
APRIL	8				8	4	10.81
MAY	8				8	4	10.81
JUNE	6				6	3	8.11
JULY	4				4	2	5.41
AUGUST	4				4	2	5.41
SEPTEMBER	2				2	1	2.70
OCTOBER	4				4	2	5.41
NOVEMBER	8				10	5	13.51
DECEMBER	6				6	3	8.11
OTHER							
RECORDS	72				74		
ACCIDENTS	36					37	
PERCENT	97.3	.0	.0	.0			

ANALYTIC TABLE
TYPE OF OPERATION BY CONDITIONS OF LIGHT – 1969
MIDAIR COLLISION ACCIDENTS
U. S. CIVIL AVIATION

APPENDIX 11

TYPE OF OPERATION	DAWN	DAY-LIGHT	DUSK/ TWILIGHT	NIGHT/ DARK	NIGHT/ BRIGHT	UNKNOWN/ NOT REPORTED	RECORDS	ACCIDENTS	PERCENT
FLYING SCHOOL		2		1			3	3	5.56
CORPORATE/EXECUTIVE		4					4	3	7.41
AERIAL APPLICATOR		1					1	1	1.85
PRIVATE OWNER		15	1				16	11	29.63
AIR TAXI OPERATOR		3					3	2	5.56
FIXED BASE OPERATOR		15	3	1			19	15	35.19
FEDERAL-PUBLIC AIRCRAFT		2					2	2	3.70
STATE-PUBLIC AIRCRAFT									
MUNICIPAL-PUBLIC AIRCRAFT									
CIVIL AIR PATROL									
AIRCRAFT MANUFACTURER									
FLYING CLUB (MILITARY)		1					1	1	1.85
FLYING CLUB		2					2	2	3.70
INTRASTATE CARRIER									
CONTRACT CARRIER									
OTHER		1					1	1	1.85
UNKNOWN/NOT REPORTED									
OTHER									
RECORDS		48	4	2			54		
ACCIDENTS		24	2	1				27	
PERCENT	.0	.0 88.9	7.4	3.7	.0	.0 .0			

ANALYTIC TABLE

APPENDIX 12

TYPE OF OPERATOR BY CONDITIONS OF LIGHT – 1970
MIDAIR COLLISION ACCIDENTS
U. S. CIVIL AVIATION

TYPE OF OPERATION	DAWN	DAY-LIGHT	DUSK/ TWILIGHT	NIGHT/ DARK	NIGHT/ BRIGHT	UNKNOWN/ NOT REPORTED	RECORDS	ACCIDENTS	PERCENT
FLYING SCHOOL		5					5	4	6.76
CORPORATE/EXECUTIVE		2					2	2	2.70
AERIAL APPLICATOR		5					5	3	6.76
PRIVATE OWNER		27					27	19	36.49
AIR TAXI OPERATOR		1					1	1	1.35
FIXED BASE OPERATOR		15	2				17	13	22.97
FEDERAL-PUBLIC AIRCRAFT		3					3	3	4.05
STATE-PUBLIC AIRCRAFT		3					3	3	4.05
MUNICIPAL-PUBLIC AIRCRAFT		2					2	1	2.70
CIVIL AIR PATROL									
AIRCRAFT MANUFACTURER									
FLYING CLUB (MILITARY)		3					3	3	4.05
FLYING CLUB		4					4	4*	5.41
INTRASTATE CARRIER									
CONTRACT CARRIER									
OTHER									
UNKNOWN/NOT REPORTED		2					2	1	2.70
OTHER									
RECORDS	2	70	2				74		
ACCIDENTS	1	35	1					37	
PERCENT	2.7	.0 94.6	2.7	.0	.0	.0 .0			

ANALYTIC TABLE
FIRST PHASE OF OPERATION BY CONDITIONS OF LIGHT – 1969
CONDITIONS OF LIGHT

APPENDIX 13

FIRST OPERATIONAL PHASE	DAWN	DAY-LIGHT	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			1				1	1	1.85
VERTICAL									
RUNNING									
ABORTED									
ABORTED									
ABORTED									
OTHER									
INFLIGHT									
CLIMB TO CRUISE									
NORMAL CRUISE									
DESCENDING									
HOLDING									
HOVERING									

APPENDIX 13 (CONTINUED)

FIRST OPERATIONAL PHASE	DAWN	DAY-LIGHT	DUSK/ TWILIGHT	NIGHT/ DARK	NIGHT/ BRIGHT	UNKNOWN/ NOT REPORTED	RECORDS	ACCIDENTS	PERCENT
INFLIGHT									
POWER-ON DESCENT									
AUTOROTATIVE DESCENT									
ACROBATICS									
BUZZING									
UNCONTROLLED DESCENT									
EMERGENCY DESCENT									
LOW PASS									
OTHER			2				2	1	3.70
EN ROUTE TO TREAT CROP									
EN ROUTE TO RELOADING AREA									
SURVEY FIELD/AREA									
STARTING SWATH RUN									
SWATH RUN									
FLAREOUT FOR SWATH RUN									
PULLUP FROM SWATH RUN									
PROCEDURE TURNAROUND									
CLEANUP SWATH									
MANEUVER TO AVOID OBSTRUCTION									
RETURN TO STRIP									
LANDING									
TRAFFIC PATTERN-CIRCLING		4					4	2	7.41
FINAL APPROACH		22	2	2			26	13	48.15
INITIAL APPROACH									
FINAL APPROACH									
LEVEL OFF/TOUCHDOWN		6	1				7	4	12.96
ROLL									
ROLL-ON/RUN-ON									
POWER-ON LANDING									
POWER-OFF AUTOROTATIVE LANDIN									
GO-AROUND									
MISSED APPROACH									
OTHER									

APPENDIX 13 (CONTINUED)

FIRST OPERATIONAL PHASE	DAWN	DAY-LIGHT	DUSK/ TWILIGHT	NIGHT/ DARK	NIGHT/ BRIGHT	UNKNOWN NOT REPORTED	RECORDS	ACCIDENTS	PERCENT
UNKNOWN/NOT REPORTED									
OTHER									
RECORDS		48	4	2			54		
ACCIDENTS		24	2	1				27	
PERCENT	.0	.0 88.9	7.4	3.7	.0	.0 .0			

ANALYTIC TABLE
FIRST PHASE OF OPERATION BY CONDITIONS OF LIGHT – 1970
CONDITIONS OF LIGHT

APPENDIX 14

FIRST OPERATIONAL PHASE	DAWN	DAY-LIGHT	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	1		2				3	2	4.05
VERTICAL									
RUNNING									
ABORTED									
ABORTED									
ABORTED									
OTHER									
INFLIGHT									
CLIMB TO CRUISE			5				5	5	6.76
NORMAL CRUISE			13				13	9	17.57
DESCENDING			4				4	4	5.41
HOLDING									
HOVERING									

APPENDIX 14 (CONTINUED)

FIRST OPERATIONAL PHASE	DAWN	DAY-LIGHT	DUSK/ TWILIGHT	NIGHT/ DARK	NIGHT/ BRIGHT	UNKNOWN/ NOT REPORTED	RECORDS	ACCIDENTS	PERCENT
INFLIGHT									
POWER-ON DESCENT									
AUTOROTATIVE DESCENT									
ACROBATICS									
BUZZING									
UNCONTROLLED DESCENT									
EMERGENCY DESCENT									
LOW PASS									
OTHER			11				11	7	14.86
EN ROUTE TO TREAT CROP									
EN ROUTE TO RELOADING AREA									
SURVEY FIELD/AREA									
STARTING SWATH RUN									
SWATH RUN									
FLAREOUT FOR SWATH RUN									
PULLUP FROM SWATH RUN									
PROCEDURE TURNAROUND			1				1	1	1.35
CLEANUP SWATH			1				1	1	1.35
MANEUVER TO AVOID OBSTRUCTION									
RETURN TO STRIP			2				2	1	2.70
LANDING									
TRAFFIC PATTERN-CIRCLING			9				9	5	12.16
FINAL APPROACH	1		18	2			21	11	28.38
INITIAL APPROACH									
FINAL APPROACH			1				1	1	1.35
LEVEL OFF/TOUCHDOWN									
ROLL									
ROLL-ON/RUN-ON									
POWER-ON LANDING									
POWER-OFF AUTOROTATIVE LANDIN									
GO-AROUND			2				2	1	2.70
MISSED APPROACH									
OTHER			1				1	1	1.35

APPENDIX 14 (CONTINUED)

FIRST OPERATIONAL PHASE	DAWN	DAY-LIGHT	DUSK/ TWILIGHT	NIGHT/ DARK	NIGHT/ BRIGHT	UNKNOWN NOT REPORTED	RECORDS	ACCIDENTS	PERCENT
UNKNOWN/NOT REPORTED									
OTHER									
RECORDS	2		70	2			74		
ACCIDENTS	1		35	1				37	
PERCENT	2.7		.0 94.6	2.7	.0	.0 .0 .0			

RECOMMENDED MIDAIR COLLISION AVOIDANCE TECHNIQUES

"See-and-Avoid" 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.

Keep your windscreen and windows clean and also keep them clear of obstruction, such as solid sunvisors 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 nacella, 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 converging angle with another aircraft, or the image of the other aircraft on your windscreen is not moving, a collision is probable unless evasive action is taken. 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 east-bound. Below 3,000 feet above ground level (AGL) you're on your own. Update your altimeter setting as often as practicable.

High-Density Area

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 ype, "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, 60 percent of midair collision accidents occur around airports.

Review of Recommendations (1968-1970)

The following is a code for the review of the recommendations presented in the Safety Board's "Special Accident Prevention Study of 1968 Midair Collisions," the Safety Board's report of proceedings relative to the 1969 public hearing concerning midair collisions, and the FAA's "Near Midair Collision Report of 1968":

NTSB 68 - Recommendation from Special Accident Prevention Study of 1968 Midair Collisions with corresponding identification number.

NTSB 69 - Report of Proceedings relative to 1969 Public Hearing concerning midair collision with corresponding identification number.

FAA 68 - Recommendation from FAA Near Midair Collision Report of 1968 with corresponding identification number.

NTSB 70 - Recommendations submitted as a result of specific midair collisions.

Recommendations are grouped into common areas of activity. This grouping provides a better understanding of the status of recommendations.

1. *Recommendation*

NTSB 68/1 - 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.

NTSB 68/2 - Establish a continuing program to assure indoctrination and continuing awareness on the part of all pilots to 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.

NTSB 68/2 - 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-avoid" concept, descent, turn, and climb maneuvering techniques, etc.).

FAA 68/9 - Institute a vigorous pilot education program to stress the fact that the present most effective means to avoid a near midair collision is constant vigilance.

Status

Airman written examinations now contain questions relating to pilot responsibility for collision avoidance. Exam-O-Grams have been prepared and distributed which stress importance of collision avoidance. Collision avoidance is being stressed by flight-instructor clinics composed of teams from the FAA Academy. Commercial pilot and flight instructor test guides have been revised to assure that attention is directed to the airman applicant. The FAA Flight Instructor's Handbook, AC61-16A, revised in 1969, emphasizes the importance of instructing students in collision avoidance. The FAA Training Handbook, AC61-21, emphasizes collision-avoidance procedures. Advisory Circular, AC90-48, titled "Pilot's Role in Collision Avoidance," was issued on March 20, 1970. Amended operations specifications have been issued to domestic and U. S. flag air carriers and some commercial operators to require the use of ramp mikes at regularly used airports without control towers.

2. *Recommendation*

NTSB 68/3 - Examine more stringently all pilot applicants for their external cockpit vigilance, with particular attention to pilots who are tested for flight instructor ratings.

NTSB 68/5 - Inform all certificated flight instructors of the high statistical significance of their involvement in midair collisions.

NTSB 69/9 - Require suitable training aids be used to augment the syllabus when such aids are developed.

NTSB 69/8 - Amend the pilot training requirements in the Federal Aviation Regulations to require the addition of scanning techniques to the training syllabus.

FAA 68/10 - Review flight training syllabuses and airman examinations to assure that airmen are taught and are knowledgeable in those areas which have an impact on operating in today's airspace environment.

Status

The "Pilot Examiner's Manual" has been revised to instruct all examiners to observe and emphasize to all pilot applicants proper collision-avoidance procedures. Handbook 8420.3, "Pilot School Certification," has been amended to require all pilot school curriculums for FAA approval be reviewed to insure that avoidance procedures are emphasized. Pilot written examinations have been revised to increase the number of questions relating to general operations and flight rules. An "advanced Notice of Proposed Rule Making," Notice 70-373, has been issued advising of FAA consideration of regulatory amendments to require flightcrew time-sharing scan training.

3. *Recommendation*

NTSB 68/4 - Provide special warning and guidance to pilots who are required by the nature of their operations to fly in pairs.

Status

Aviation Circular 90-48 cautions pilots flying in pairs to:

- Always keep the other aircraft in sight.
- Avoid formation flight unless properly trained for it.
- Recognize the high potential of midair collision between two aircraft in formation or on the same mission.
- Insure that adequate preflight preparations are made and understood.

4. *Recommendation*

NTSB 68/6 - 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.

Status

Airman's Information Manual and Advisory Circular 90-8 encourage this. Extra assistance is provided to student by controller when student so indicates.

5. *Recommendation*

NTSB 68/7 - 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.

NTSB 69/2 - Accelerate the program to provide separation between high and low performance aircraft in high-density terminal areas.

Status

Implementation of Terminal Control Areas (TCA) at all large air transportation hubs is in progress. FAA Order 7110.22 concerning arrival and departure handling of high-performance airplanes outlines procedures to be used in the FAA "Keep-'em-high" program. This program reduces the mixture of controlled and uncontrolled airplanes in the immediate vicinity of an airport.

6. *Recommendation*

NTSB 68/8 - Designate climb and descent corridors for high-performance aircraft at high-density airports.

FAA 68/1 - Develop and implement, at selected large air transportation hubs, a system which would segregate by regulations or procedures all traffic operating within certain airspace designated for the primary airport (s).

Status

Results of a simulation of an AOPA/ALPA generated terminal control corridor concept is being analyzed. Implementation of terminal control areas at major airports is being expedited with action to implement the remainder of Group I and II TCA's to be completed in the near future.

7. *Recommendation*

NTSB 68/9 - 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.

NTSB 69/7 - Consider convening a special government/industry meeting for the purpose of discussing the factors involved in establishing standard traffic patterns and initiating action leading to their creation.

FAA 68/7 - Review the present regulations, policies and procedures concerning the establishment of airport traffic patterns at airports without a control tower to ensure that traffic patterns are established.

FAA 68/6 - Require management responsible for nontower airports to establish traffic patterns and to publish, distribute, and have these traffic patterns prominently posted.

Status

A "Notice of Proposed Rule Making" on a standard traffic pattern for airports without a control tower was issued on July 14, 1971. The comment period closed on September 27, 1971.

8. *Recommendation*

NTSB 68/10 - In cooperation with Environmental Science Services Administration (ESSA) develop and produce VFR approach and departure charts for selected airports with a high volume of traffic.

Status

The preparation of graphics showing areas of concentrated IFR traffic for the information and guidance of VFR traffic is in progress. These graphics will be included in parts 3 and 4 of the "Airman's Information Manual."

9. *Recommendation*

NTSB 68/11 - 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.

Status

The FAA has issued AC 150/5340-5, "Segmented Circle Airport Marker System," which sets forth standards and practices recommended for airport marking. It was specified that both traffic pattern indicators (L-shaped marker and amber light) were necessary.

The FAA requires traffic pattern indicators at fields where federal aid to airport funds are used and encourages their installation at other airports. Also, a research and development project to develop an inexpensive but effective automatic or semi-automatic landing direction indicator is presently being undertaken by the FAA.

10. *Recommendation*

NTSB 68/12 - Reevaluate visual conspicuity standards for all civil aircraft.

Status

Research by the Research and Development Branch of the FAA failed to develop any factual data that would support this recommendation. They found that a conspicuity increase under one circumstance would not be effective when applied to another circumstance.

11. *Recommendation*

NTSB 68/13 - Consider the establishment of requirements for the installation and day and night operation of high-intensity, white-flashing lights on all civil aircraft.

NTSB 69/10 - Promulgate regulations to require the installation of white anticollision lights on all aircraft as soon as possible (see ANPRM 70-7).

Status

FAR Amendments 23-11, 25-27, 27-6, 29-7, and 91-90, issued on July 1, 1971, amended the regulations to:

- Expand the chromaticity-coordinate range for aviation white.
- Allow the use of either aviation red or white anticollision lights.
- Increase the minimum effective intensities for anticollision lights installed on all aircraft to be type-certificated after the effective date of the pertinent amendments.
- Within one year after the effective date of the amendments, all powered civil aircraft with standard airworthiness certificates will be required to have an approved anticollision light system for night flights.

12. *Recommendations*

NTSB 68/14 - Support the expeditious development of low-cost, collision-avoidance systems for all civil aircraft.

NTSB 69/3 - Encourage the expeditious development of a collision-avoidance system for installation in air carrier aircraft and larger general aviation aircraft.

NTSB 69/4 - Make funds available for the ground equipment which may be necessary for support of CAS systems.

NTSB 69/5 - Sponsor developmental contracts for pilot warning indicator (PWI) system utilizing various technological methods in order to evaluate the practicability of each.

NTSB 69/6 - Develop regulations to require the installation of CAS and PWI systems when they become available.

FAA 68/19 - Direct an extensive effort toward development of an airborne collision-avoidance system, with cockpit displays, as a prime solution to the near midair collision problem.

Status

The FAA states:

"Collision Avoidance System (CAS) - We have been and are involved in a cooperative program with the Air Transport Association (ATA) in the continuing development of a time/frequency version CAS. The collision avoidance system was developed by three different manufacturers, Bendix, McDonnell Douglas, and a team of Sierra Research and Wilcox Electronics, under the direction of the Air Transport Association. Results to date include a comprehensive flight test program involving the three manufacturers' versions of the airborne package. The flight tests were contractor-conducted by Martin Marietta with FAA/NAFEC ground support. The system measurement accuracies, system responses, airplane responses, and pilot responses that were assumed in setting up the system have been verified by a combination of flight

testing, cockpit simulation, and computer modeling of the collision avoidance system. Action is also underway to investigate low-cost compatible systems to allow greater participation by general aviation and military.

"McDonnel Douglas and Piedmont Airlines have announced that Piedmont is purchasing a number of CAS equipments with the first model available in March 1972 and first production units in April 1973.

"A detailed CAS/ATC simulation is now being conducted at NAFEC to understand and, as appropriate, evolve means to minimize any undesirable interactions that might grow out of the introduction of CAS into the ATC system. Plans call for an AT decision by the end of calendar year 1971.

"Flight testing at NAFEC, of the RCA correlator, part of RCA's SECANT PWI/CAS system, is expected to commence this fall.

"The current FAA 10-year plan includes funding for a CAS ground station development, fabrication, and test and evaluation program. Similarly, the plan provides for funding production equipment.

"An engineering requirement for a development Collision Avoidance System ground station has been sent to the Logistics Service for action and is being coordinated. A contract is expected the third quarter of FY-72. A contract has been let for exploration of using existing Government facilities for time dissemination to general aviation aircraft and hardware development following therefrom. Also, a contract is expected the second quarter of FY-72 to define the quantity, type, location, and implementation priority of the required ground station. Plans call for ground station implementation in time period FY-1974-1978.

"*Pilot Warning Instrument (PWI)* - In the PWI area over the past few years we have evaluated and rejected a number of suggested equipments. Today, our main thrust is the investigation of the human factor problems involved so as to better define just what the characteristics of a PWI should be. How well can a pilot see and evaluate at flying speeds? How much time does it take? To what degree can a pilot make use of relative bearing information? These and other questions are under investigation right now, with contracts with Rowland & Co. and Control Data Corp. While pursuing these investigations, we have not ignored the hardware development aspects. In a joint program with NASA and the Department of Transportation's Transportation Systems Center, we are right now evaluating (at our Atlantic City facility) a PWI which utilizes the principle of detecting infrared radiation from an aircraft's exterior (strobe) lighting system. We are also working with the Army, which is presently testing equipment developed by Minneapolis-Honeywell, and we have procured a radar PWI (developed by Cygned) for future (FY-72) flight test and evaluation at NAFEC. Additionally, we are presently (FY-72) staffing performance characteristics for PWI hardware so as to obtain information on everything that is available. We hope to have sufficient data, in two years, for both the industry and the agency to select and defend the proper PWI."[3]

13. *Recommendation*

NTSB 69/11 - Accelerate its efforts in developing certifications, procedural, and rulemaking processes involved in implementing a full area navigation system (RNAV) for utilization throughout the U. S. National Airspace System.

[3] A presentation by Mr. John L. Brennan, "FAA CAS/PWI Program Past - Present - Future" October 1971.

FAA 68/8 - Develop and implement and concept of area navigation for both enroute and terminal air traffic.

Status

Parts 71 and 75 of FAR have been revised for designation of high and low area routes, and Notices of Proposed Rule Making are being issued for approximately 150-high routes.

The initial four transcontinental routes became effective on April 19, 1971, and an additional 11 high routes became effective on August 19. Effort is being made to have all routes available by the end of the calendar year.

FAA regions are presently developing low-area routes on the basis of ATC requirements and user needs.

14. *Recommendation*

NTSB 69/1 - Evaluate the pilot qualifications and minimum airborne equipment necessary for safe operations into high-density terminal areas with a view toward increasing the minimum standards for each.

Status

FAR 91 Amendments 91-78 issued May 20, 1970, specifies operating rules and pilot and equipment requirements for Group I and Group II Terminal Control Areas.

Research and Development is continuing with regard to the radar cross-section enhancement program and toward improvements aimed at further clutter reduction for the primary radar system.

15. *Recommendation*

FAA 68/2 - Implement, at all large air transportation hub locations, a radar separation service for all participating aircraft operating within an established Terminal Radar Service area - STAGE III of the National Terminal Radar Program - (NTRP).

Status

The FAA plans to implement TCA's at all large air transportation hubs, thereby eliminating the need for Stage III of the NTRP. Radar service will be implemented as resources permit.

16. *Recommendation*

FAA 68/3 - Amend the FAR's to require all aircraft operating in a control zone which has an operating control tower to establish two-way radio communication with the tower when at or below 3,500 feet above ground level (AGL).

Status

With the amendment of Parts 1 and 91 of the FAR's, the ceiling of airport traffic areas was raised to 3,000 AGL which requires two-way communication with the tower at altitude below 3,000 feet AGL.

17. *Recommendation*

FAA 68/4 - Publish a map for all large air transportation hubs in the Airman's Information Manual (AIM), to show the areas of concentrated IFR traffic for the information and guidance of pilots operating VFR. Establish a new VFR section in the AIM to include all references pertaining to VFR flight.

Status

The FAA states that they plan to publish a map for all of the large air transportation hubs except for those established as TCA's. However, with experience, they may publish maps for the TCA's. Future plans call for maps of the medium-size hubs.

A new Part 4 of the "Airman's Information Manual" was established in January 1970 and, as maps become available, they will be included in the semi-annual Part 4 or printed in the Part 3 for further transfer to the new Part 4.

18. *Recommendation*

FAA 68/15 - Publish high-density military areas, both training and operational, in apropriate airman information publications.

Status

The "Airman's Information Manual" carries information on high-density military areas and routes.

19. *Recommendation*

FAA 68/11 - Instill a higher degree of motivation among flight crewmembers for improving crew coordination in order to increase vigilance outside the cockpit during all phases of flight.

Status

FAA Flight Standards published Notice 8430.49 on August 4, 1967, which requested all air carriers and general aviation operations inspectors to review cockpit check procedures with their assigned operators and air agencies. Guidelines recommended to be used in evaluating check procedures were made available. These guidelines emphasized crew coordination and the need for continued vigilance of the airspace outside the cockpit.

A dispatch stressing the importance of crew vigilance and cockpit discipline was transmitted to 92 airline presidents in December 1968.

Revision of the FAA Air Carrier Enroute Inspection Report Form 8430-5 was made in May 1969 to include specific FAA observation of cockpit vigilance and crew coordination.

20. *Recommendation*

FAA 68/12 - Encourage all airspace users when operating at or above 10,000 feet to fly on an IFR flight plan, especially military jet fighter type aircraft.

Status

This recommendation was not considered feasible by the FAA Regulatory Council and was withdrawn.

21. *Recommendation*

FAA 68/13 - Amend the FAR's to require 1,000 feet vertical altitude separation immediately below the base of positive control airspace for aircraft operating VFR.

Status

An FAA study found that this recommendation was not feasible.

22. *Recommendation*

FAA 68/14 - Review the location and necessity for established military low-level, high-speed VFR training routes, and ensure maximum publicity of their location and hours of operation.

Status

A review by the FAA regions and the military was completed resulting in a reduction of many of the routes and revision of some of the routes. A listing of all of the revised routes was published.

Notice was accomplished in writing by the Department of Defense, FAA facilities, airport managers, and through charts available from the Coast and Geodetic Survey.

23. *Recommendation*

FAA 68/15 - Review the necessity for operating high-performance military jet aircraft below 10,000 feet, in excess of 250 knots indicated airspeed.

Status

Air Force Manual (AFM) 60-16, General Flight Rules, was revised by the inclusion of a new section entitled, "Aircraft Speed." Both AFM 60-16 and U. S. Navy OPNAV Instructions require their pilots to operate at speeds of 250 knots and lower, below 10,000 feet mean sea level (MSL) to the extent permitted by mission requirements and aircraft characteristics.

24. *Recommendation*

FAA 68/16 - Review the "Hemispheric Rules" for possible elimination of any reference to feet-above-the-surface as a base altitude, and for lowering the cruising altitudes related to mean (MSL) below the presently applicable 3,500 feet MSL.

Status

After consideration by the FAA, it was concluded that implementation of this recommendation was not feasible.

25. *Recommendation*

FAA 68/17 - Review airport planning requirements to ensure that future airport site locations are well clear of instrument approach courses.

Status

The Airport and Airways Development Act which was passed in 1970 provides for the certification of air carrier airports but not for other airports. Methods for gaining early entry into private airport development planning are presently under consideration by the FAA.

On July 1, 1970, the Flight Standards Handbook 8360.19, Flight Procedures and Airspace, was revised requiring that in the analysis of future airport site locations, any conflict with established instrument approach procedures shall be determined.

26. *Recommendation*

FAA 68/18 - Recognize the need for improved cockpit visibility in the development of all future aircraft.

Status

Notice of Proposed Rule Making 71-2 proposed an amendment to incorporate definitive cockpit-vision criteria for transport category airplanes. The comments received are presently being evaluated.

27. *Recommendation*

Two collisions, one involving a Piper PA-28 and a DC-9, and a second involving a Convair and a Cessna, generated a Safety Board recommendation calling for modification of FAR Parts 21 and 23 to require all aircraft under 12,500 pounds, manufactured after some appropriate date, to possess a radar cross section suitable for primary target detection by FAA radar at ranges up to 125-150 miles. This cross-section augmentation should be accomplished during manufacture, using passive reflectors. It was also recommended that the regulations require a minimum level of radar cross-section for aircraft in service permitting them to operate in expanded radar service environments and high-density areas.

Status

The FAA stated that, in a practical manner, there was no passive device presented at that briefing that would achieve adequate primary target returns on ATS radar at 125-150 mile range. They will expedite their research and development efforts in this matter, hoping to develop a practical enhancement device.

In a related action to improve radar detection of small aircraft in terminal areas, FAR 91.90, as amended by Amendment 91-78, effective June 25, 1970, requires operable

transponders on all airplanes operating VFR or IFR within the Group I designated TCA's. FAR 71, as amended by Amendment 71-6, effective June 25, 1970, defines the list of the nine Group I designated TCA's.

Recommendations as a Result of Specific Midair Collisions

NTSB 68 - Midair, Appleton, Ohio, March 2, 1968

The Safety Board recommended that procedures be established wherein descending aircraft which will penetrate the flow of positive control airspace be required to report leaving the appropriate lowest flight level (FL 180 or 240) in order that the controller may be alerted to the potential of conflicting VFR traffic operating in the lower airspace strata along with the descending known and controlled traffic.

STATUS

The FAA issued a notice to traffic control specialists to advise pilots (workload permitting) of other possible conflicting traffic at the time of delivering the descent clearance An ATS Technical Bulletin was issued December 1968.

NTSB 68 - Midair, St. Louis, Mo., March 27, 1968

Establish VFR traffic pattern at Lambert Field, Mo. Also install daylight radar display equipment and make greater use of radar in handling traffic.

STATUS

Daylight radar display was installed at St. Louis, and VFR entry and departure routes were being considered FAA was following up on other aspects.

NTSB 69 - Midair, Hendersonville, N. C., July 19, 1967

The Safety Board recommended that the FAA:

1. Improve ATC communications methods and procedures for IFR in nonradar environment.

2. Expedite increases in ATC radar coverage.

3. Establish more strigent requirements for pilots using IFR system.

4. Require an annual proficiency flight check for all IFR pilots.

STATUS:

1. Current ATC procedures are within the present state of the art and communications facilities.

2. A substantial expansion of radar facilities was planned by FAA within budgetary limits.

3. They reviewed and updated minimum levels of experience and skill of instrument pilots.

4. FAA issued NPRM 71-8 proposing experience and qualification requirements for pilots serving second-in-command and annual proficiency checks for pilots-in-command of U.S. registered aircraft type-certified for more than one pilot.

NTSB 70 - Midair, Milwaukee, Wisc., August 4, 1968

The Safety Board recommended the separation of "known" and "unknown" traffic operations, to the broadest extent practicable, be achieved and that consideration be given to the designation of larger segments of the navigable airspace as positive control areas to include terminal areas.

STATUS

The FAA developed a plan under which all pilots would be controlled within a portion of the airspace surrounding selected high traffic density airports. They also contemplate issuing an NPRM on this subject.

NTSB 70 - Midair, Fairland, Indiana, August 4, 1968

See Recommendation 27 above.

Actions Resulting from Duarte, California, Collision Accident

As a result of the Duarte, California, midair collision between a Hughes Air West DC-9 and a U.S. Marine Corps F-4B, the following letter containing four recommendations was sent to the Secretary of the Department of Defense:

SAFETY RECOMMENDATIONS
A-71-48 thru 51

"The National Transportation Safety Board recently concluded a public hearing to document certain facts surrounding the midair collision between a Hughes Air West DC-9 and a United States Marine Corps (USMC) F-4B jet fighter, which occurred near Duarte, California, on June 6, 1971. Our investigation has not been completed; therefore, no determination has been made as to the probable cause(s) of the accident.

"We are pleased to note the cooperative efforts of the Federal Aviation Administration and the military services to place renewed and additional emphasis on the voluntary use of the air traffic control system to the maximum extent practicable by all military aircraft. This should contribute significantly to the prevention of midair collision accidents involving military and civil aircraft. However, the Safety Board believes that additional steps could be taken by the military services to provide more safeguards for the benefit of all users of the Nation's airspace without inordinate jeopardy to the mission of military flights.

"At this hearing we examined the USMC and United States Navy (USN) flying regulations, operation procedures, and their interrelationship with the Federal Aviation Regulations (FAR's).

"The FAR's prohibit flight at indicated airspeeds above 250 knots (250 KIAS) at all altitudes below 10,000 feet m.s.l Certain military aircraft, whose flight characteristics preclude safe operation at speeds below this limitation, have been granted relief from this provision. The applicable U. S. Navy regulation reiterates the restriction, the waiver relief, and states that operations at airspeeds in excess of 250 KIAS below 10,000 feet m. s.l. should be held to a minimum. Testimony at the hearing established that the F-4B, on this point-to-point cross-country flight, was flown at speeds far in excess of 250 KIAS while below 10,000 feet m.s.l. While no violation of the FAR's or U. S. Navy regulations was involved, the intent of the regulations may well have been circumvented. The Safety Board believes that the DOD should consider rephrasing the regulation to delineate explicitly those instances wherein the 10,000 feet/250 KIAS limitation may be exceeded. Specifically, we believe that there should be only two exceptions to this limitation:

1. Climbs and descents to:
   a. traffic patterns.
   b. authorized and/or designated training areas.
   c. low-level navigation routes.
2. Those instances where either the safety of the crew or aircraft require operations outside the parameters of this limitation.

"Testimony established, also, that low-level, high-airspeed training was being conducted by the USMC at altitudes below 10,000 feet m.s.l. outside of the designated warning areas and off the low-level navigation routes. The Board believes that the DOD should review the necessity for permitting this training to take place in areas other than those specifically set aside for such flying.

"The hearing established, further, that no attempt was made by the pilot of the F-4B to contact the FAA Radar Advisory Service while he was traversing the Los Angeles area. Had this service been used, the F-4B would have been given traffic advisories, and his presence might have been made known to the DC-9.

"USMC witnesses testified to the fact that the radar aboard the F-4B had the capability to afford target avoidance as well as intercept information, and that it has been used to provide separation from other aircraft. There is no published procedure for using it to provide such separation, and its use for that purpose is left to the pilot's discretion. The Board believes that the feasibility of using such military intercept radar for traffic separation information should be explored. Its use for this purpose, if feasible, should be encouraged.

"In view of the above facts, the Safety Board recommends that the DOD take the following actions:

1. Review feasibility of restricting all types of low-level training, which requires airspeeds in excess of the FAR limitations, to designated restricted areas and low-level navigation routes.
2. Rephrase the wording contained in your altitude/airspeed limitations and delineate explicitly those instances wherein airspeeds in excess of the 10,000 feet/250 KIAS limitations are authorized. The Board believes that the exceptions should be limited to the following:
   a. Climbs and descents to traffic patterns, authorized and/or designated training areas and low-level navigation routes.
   b. Those instances where safety of either crew or aircraft require operations in excess of the limitation.
3. Explorethe feasiblity of using the air intercept radar on all military aircraft to provide collision avoidance assistance as an additional aid to the "see and be seen" concept; and should this prove feasible, ins itute and establish procedures to use the radar for this prupose on all flights where its use is not required for more urgent military mission requirements.
4. Institute a program to provide more publicity to the existence, function, and use of the FAA Radar Advisory Service in those instances where VFR flight is required through high-density traffic areas. Consideration should be given to making the request for such service a mandatory procedure.

"Members of our Bureau of Aviation Safety will be available for consultation in this matter if desired."

Also, as the result of the Duarte accident all services of the U. S. military issued directives to all of its U. S., Atlantic, and Pacific Commands. A portion of the Navy-Marine message stated: "In an attempt to prevent midair collisions and increase flight safety, addressees are requested to take the following actions:

"A. Increase the tempo of the dialogue with FAA Regional and local representatives, and accelerate to the greatest extent practicable the maximum allowable integration of naval air operations into the air traffic control system.

"B. Ensure strict compliance with the intent and spirit of that part of the Ref. C, Para. 411, which states, 'In order to decrease the probability of midair collisions, all flights in fixed wing naval aircraft shall be conducted in accordance with instrument flight rules (IFR) to the maximum extent practicable.' This shall be construed to include as a minimum, all point to point and round robin flights utilizing Federal airways and jet routes when the primary purpose of the flight is proficiency, administration or logistics.

When it is necessary to conduct volume training along or through airways; close liaison shall be affected with the appropriate air traffic control agency.

"C. Increase the emphasis on further reductions of aircraft equipment malfunctions, i.e., communications, navigation and identification (CNI) equipment, in the national airspace system as delineated in Ref. D."

The Air Force message called for:

"1. A recent midair collision between a military aircraft on a VFR flight plan and a commercial aircraft on an IFR flight plan resulted in 49 falatilities. The mix of IFR and VFR traffic operating in the same airspace poses a most serious hazard. It is essential that positive action be taken to place the maximum number of USAF operations under positive control.

"2. Recent actions supported by this Headquarters to minimize the midair collision potential include: lowering the base of the positive control area, establishment of high density terminal areas, and deletion of conflicting low-level training routes. Although these actions reduce the midair collision risk, continual command emphasis is required.

"3. Request you again review all operations presently conducted under VFR flight rules and place the maximum number possible within positive control airspace or on IFR flight plans within the air traffic control system. Those operations requiring unusual maneuvers for qualification or training must be conducted in accordance with Paragraph 5-14, AFM 60-16.

The Army message stated:

"The FAA has statutory responsibility for the operation of the National Airspace System. Therefore, the FAA has requested that increased emphasis at all levels be placed on the importance of filing IFR flight plans whenever possible. For Army, AR 95-1, paragraph 3-7A applies. The positive separation provided to aircraft flying under instrument flight rule reduces mid-air collision hazards.

"Commands are requested to effect close coordination through the Department of Army regional representative with the appropriate FAA region to alleviate unidentifiable midair collision hazards."

The Coast Guard message of June 18, 1971, stated:

"The recent midair collision between a military aircraft on a VFR flight plan and a commercial airliner on an IFR flight plan points out a potentially serious hazard of mixed IFR and VFR traffic. In order to decrease this hazard the following action will be taken immediately:

a. All flights of fixed-wing aircraft shall be conducted in accordance with instrument flight rules to the maximum extent practicable.

b. Maintain close liaison with the air traffic control agency to ensure complete interchange of requirements.

c. Do not commence a flight with an inoperable IFF unless operating in a remote area where the urgency of the mission dictates otherwise.

"It is recognized that there are many missions and training flights that must be flown VFR; however, many now VFR could be flown IFR Commanding Officers should reassess their operations and institute necessary measures to ensure compliance with both the intent and spirit of this message."

Subsequent to the accident, FAA expeditied the previously planned lowering of the Positive Control Area from 24,000 feet to 18,000 feet, and the establishment of a Los Angeles Terminal Area (TCA) from the surface to an altitude of 7,000 feet.

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