TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. NTSB-AAR-77-2	2. Government Accession No. / 3. Recipient's Catalog No.
4. Title and Subtitle Aircraft Accident Report - Midair Collision, Reeds Aviation, Inc., Piper PA-28R-200, N7941C and Piper PA-28-181, N8592C, near Huntsville, Missouri, July 24, 1976	5. Report Date April 14, 1977 / 6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
9. Performing Organization Name and Address National Transportation Safety Board Bureau of Accident Investigation Washington, D.C. 20594	10. Work Unit No. 1977-A / 11. Contract or Grant No. / 13. Type of Report and Period Covered Aircraft Accident Report July 24, 1976
12. Sponsoring Agency Name and Address **NATIONAL TRANSPORTATION SAFETY BOARD** **Washington, D. C.** 20594	14. Sponsoring Agency Code
15. Supplementary Notes	

16. Abstract

About 0921 e.d.t., on July 24, 1976, a Piper PA-28-181 (N8592C) and Reeds Aviation, Inc., Piper PA-28R-200 (N7941C) collided in midair at 6,000 feet near Huntsville, Missouri. The pilot and two passengers aboard N7941C and the pilot and one passenger aboard N8592C were killed; both aircraft were destroyed. Piper N8592C, a private flight operating under instrument flight rules and under the control of Kansas City air route traffic control center, was en route from Urbana, Illinois, to Emporia, Kansas. Piper N7941C, an air taxi/charter flight operating under visual flight rules and without a flight plan, was climbing en route from Salisbury, Missouri, to the Chicago, Illinois, area.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of each pilot to maintain adequate vigilance.

17. Key Words Midair collision; see-and-avoid; radar advisories; lack of vigilance; collision geometry; primary target; secondary target.		18. Distribution Statement This document is available to the public through the National Technical Information Service, Springfield, Virginia 22151	
19. Security Classification (of this report) UNCLASSIFIED	20. Security Classification (of this page) UNCLASSIFIED	21. No. of Pages 24	22. Price

NTSB Form 1765.2 (Rev. 9/74)

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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

Adopted: April 14, 1977

MIDAIR COLLISION
REEDS AVIATION, INC., PIPER PA-28R-200, N7941C
AND
PIPER PA-28-181, N8592C
NEAR HUNTSVILLE, MISSOURI
JULY 24, 1976

SYNOPSIS

About 0921 c.d.t., on July 24, 1976, a Piper PA-28-181 (N8592C) and Reeds Aviation, Inc., Piper PA-28R-200 (N7941C) collided in midair at 6,000 feet near Huntsville, Missouri. The pilot and two passengers aboard N7941C and the pilot and one passenger aboard N8592C were killed; both aircraft were destroyed. Piper N8592C, a private flight operating under instrument flight rules and under the control of Kansas City air route traffic control center, was en route from Urbana, Illinois, to Emporia, Kansas. Piper N7941C, an air taxi/charter flight operating under visual flight rules and without a flight plan, was climbing en route from Salisbury, Missouri, to the Chicago, Illinois, area.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of each pilot to maintain adequate vigilance.

1. FACTUAL INFORMATION

1.1 History of the Flights

Piper PA-28-181, N8592C

Piper PA-28, N8592C, was owned by Illini Aviation, Inc., of Urbana, Illinois, a fixed-base operator. On July 24, 1976, it had been rented for a pleasure flight to Emporia, Kansas. About 0540 1/ the pilot telephoned the Decatur, Illinois, Flight Service Station (FSS) and requested a weather briefing for a flight to Emporia, Kansas. After the briefing, the pilot filed an instrument flight rules (IFR) flight plan from Illini Airport, Urbana, Illinois, direct to Capitol, Illinois; victor 50 2/ to Quincy, Illinois; victor 116 to Macon, Missouri; victor 424 to Blue Springs, Missouri, and victor 10 to Emporia, Kansas. The pilot requested an altitude of 6,000 feet.

At 0719, N8592C, with the pilot and one passenger aboard, departed Illini Airport. The pilot contacted Champaign, Illinois, tower for his IFR clearance and was advised to contact Champaign Approach Control which issued his clearance direct to Capital, then as filed, to maintain 6,000 feet and to squawk 0101.

The flight was subsequently controlled by Decatur approach control and Springfield, Illinois, approach control, then by the Kansas City air route traffic control center.

At 0817 Kansas City ARTCC, sector C-13, accepted a radar handoff from Springfield, Illinois, approach control. (A radar handoff is a change of control jurisdiction and responsibility via radar and generally occurs before communication frequency change.) The flight was controlled by this sector for about 40 minutes, and then, at 0900, N8592C contacted sector C-1 (also in Kansas City Center).

Between 0902 and 0904, N8592C was issued a traffic advisory regarding eastbound transponder-equipped VFR traffic. The pilot acknowledged the advisory, but did not report seeing the traffic. At 0914, another VFR traffic advisory was given for another northwest-bound aircraft, which was also transponder-equipped; the pilot acknowledged the advisory, but did not report visual contact.

At 0922, the Kansas City controller called N8592C to inform him that they had lost his transponder reply and requested that he recycle code 6225. N8592C did not acknowledge this transmission, nor were any other transmissions received from the aircraft.

1/ All times herein are central daylight time, based on the 24-hour clock.
2/ A Federal airway using VOR's (very high frequency omminidirectional range stations) as navigational aids.

PA-28R-200, N7941C

On July 24, 1976, Reeds Aviation, Inc., PA-20, N7941C, was being operated as an air taxi/charter flight for two passengers from Salisbury, Missouri, to the Chicago, Illinois, area.

About 0840, the pilot of N7941C telephoned the Columbia, Missouri, FSS, and requested a pilot-weather briefing to Davenport, Iowa, and was given available weather. He acknowledged receipt of the weather information, but he did not file a flight plan, he did not give any information as to his destination, and he did not give an estimated time of departure.

At 0910, N7941C departed Arnsperger Airport, near Salisbury, Missouri, on a visual flight rules (VFR) flight. No flight plan was filed, and there is no record of the pilot's having contacted any Federal Aviation Administration (FAA) air traffic control facility either before or during the flight. N7941C was climbing northeast toward Macon VOR 3/ when it collided with N8592C. N8592C was proceeding at 6,000 feet on victor 424 and was about 7 miles southwest of Macon VOR when the planes collided.

After the accident, the pilot of a twin Cessna, N7987Q, which was at an altitude of 7,600 feet, saw black smoke at his 10:30 position and contacted Kansas City ARTCC stating, "...I was glancing that way, the sky was clear and all a sudden there was just a black puff. It's right now at just about my ten ten thirty position just like a flak explosion from World War II identical to it...."

A ground witness, who was working in a field stated, "I had heard the noise of a plane. I thought it was loud for one so I looked up; what seemed to be practically straight up when I was facing north. When I looked up, I saw two planes, one going east and the other one going west. I said, Oh, ...they are going to cross, and by the time I had said it, they collided. There was a ball of fire, the bang of an explosion, and a big puff of black smoke. Then the planes started falling. One plane, that there was the most left of, spiraled and came down in slow motion close to the point of impact. The other one was blown into thousands of pieces and drifted west and south." This witness did not see either airplane take evasive action.

A "D-LOG" plot 4/ containing target information was supplied by Kansas City center. The "DPICT," 5/ indicated that at 0919:57, the flightpath of N8592C was toward the southwest; the last radar return received from N8592C was at 0921:09.

3/ A very high frequency navigational aid referred to as an omnirange.

4/ A D-LOG plot is basically a computer printout of radar information available for presentation to a controller in a selected geographical area and during a selected time period.

5/ DPICT is a depiction of selected information available for presentation on a radarscope.

According to the D-LOG plot, a primary target appeared at 0921:05; at 0921:17 another primary target appeared northeast of the first target and after the assumed time of the accident.

The planes collided during clear daylight conditions at geographical coordinates 39" 38' N latitude and 92° 34' W longitude.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Other
Fatal	2	3	0
Nonfatal	0	0	0
None	0	0	

1.3 Damage to Aircraft

Both aircraft were destroyed by in-flight collision and ground impact.

1.4 Other Damage

Crops in a field were damaged.

1.5 Personnel Information

The pilots of both aircraft and the Kansas City Center controller, who was working the radar position for the accident area, were qualified for their respective operations. (See Appendix B.)

1.6 Aircraft Information

Both aircraft were certificated and maintained in accordance with FAA regulations and requirements. Both aircraft were within their respective weight and balance limits. (See Appendix C.)

1.7 Meteorological Information

According to witnesses, the sky was clear and the visibility was estimated to be over 15 miles with no restrictions when the planes collided.

The nearest official weather reporting station is located at Kirksville, Missouri, which is about 35 statute miles north of the accident site. Pertinent surface weather observations for the Kirksville area were as follows:

0900 -- Scattered clouds at 25,000 feet, visibility--10 miles, temperature--78°F., dewpoint--65°F., wind--360' at 10 kn, altimeter setting--30.17.

1001 -- Scattered clouds at 25,000 feet. visibility--10 miles, temperature--81°F., dewpoint--63°F, wind--350° at 9 kn, altimeter setting--30.18.

1.8 Aids to Navigation

Postaccident checks of all pertinent navigational aids indicated that all equipment was operating properly. The radar system in use at the Kansas City ARTCC was the NAS en route stage A, model 3 equipment and subsystems. The radar antenna closest to the accident site is at coordinates 40" 17' 52" N latitude and 92° 34' 31" W longitude--about 41 nmi north of the accident site. The elevation of the antenna site is 1,032 feet m.s.l. with a 2° antenna tilt. The radar is an AN/FPS-7C with a secondary radar, which is the ATCBI-4. The pulse rate of the radar transmitter was not staggered, the blind speed is 51 kn, range setting is usually 100 miles; during narrow-band operation, the moving target crossover indicator is set at 128 miles, which is necessary because of propagation conditions.

After the accident, a series of flight checks were made of the Kirksville radar site to determine if the present performance was equal to the performance obtained during the commissioning flight inspections on August 27, 28, and 29, 1973. At that time, the report on the initial flight inspection stated, "The only useable video from this radar system was the secondary radar information. This was observed both on broad and narrow band. Based on this, it would appear that during periods when there is a ten point spread between temperature and dewpoint, we should normally expect to use only secondary radar information from this site."

Eight hours after the accident, a flight check was conducted using a Piper PA-28R-200 to simulate as closely as possible the flight of N7941C. The check was begun at 3,000 feet over Salisbury (near Arnsperger Airport); a climb was initiated and the course was in the direction of the Macon VOR. As in the actual flight of N7941C, no transponder signal was transmitted. When the flight check aircraft was flown over the path of the VFR aircraft, a useable primary radar target was displayed about five times during 9 minutes of flight. Each target display lasted 12 seconds.

Secondary radar returns were observed by the controller for N8592C when the aircraft was operating in the Kansas City center area. No secondary radar target returns were obtained from N7941C.

1.9 Communications

There was no evidence that either flight had communications difficulty.

1.10 Aerodrome Information

Not applicable

1.11 Flight Recorders

Neither aircraft was equipped, nor was either required to be equipped, with a cockpit voice recorder or a flight data recorder.

1.12 Wreckage and Impact Information

The wreckages of both aircraft were located in an area of cornfields, open uncultivated fields, and heavily wooded sections. Portions of both aircraft were scattered over an area about 1 1/2 miles long and 1/2 mile wide.

Piper PA-28R, N7941C

The aircraft, which was painted green, gold, and white, separated into several sections during the collision. The engine, a portion of the fuselage, and the empennage dropped almost vertically to the ground.

The left wing assembly, with the main landing gear and sections of the cabin and cargo floor attached; a portion **of** the aft fuselage, including the horizontal stabilizer and rudder; the engine and propeller assembly; and the nose gear assembly were found together.

One blade of the propeller had separated about **12** inches from the tip. The separated outboard portion of the blade was recovered in the area where the interior sections of the aircraft had come to rest. The leading edge of the separate portion of the blade and the inboard section showed evidence of severe impact and torsional twisting. Red paint smudges were found on the face of the separated portion of the blade. The other blade showed evidence of impact damage in the tip area with deep chordwise scratches across its face.

Examination of the engine disclosed a propeller slice through the top cylinder on the left side of the engine and a deep groove in the cylinder fins. The propeller also pulled the push rods and housings from the engine. After it struck the engine, the blade also cut through the top engine mount.

The aft portion of the fuselage structure, with a section of the empennage still attached, came to rest in an upright position. The vertical stabilizer had separated from the fuselage and was not located in the vicinity of the main wreckage. The rudder showed evidence of extensive damage. Although it had separated from the vertical stabilizer, it remained attached to the main wreckage by the rudder post and control cables.

The right wing assembly, with the right main landing gear attached, had separated from the aircraft. The gear assembly was in the partially extended position. The entire right fuel tank area was split from the leading edge of the wing. The leading edge structure for the fuel tank area was crushed aft and black scrape marks were visible. These scrape marks, which matched tire scrapes, were particularly prominent in the fuel tank area.

The aircraft was equipped with a red rotating beacon; however, it could not be determined if the beacon was operating at the time of the collision.

Piper PA-28-181, N8592C

The aircraft, which was painted red, white, and blue, separated into several sections during the collision. The forward section of the aircraft, consisting of the engine, the nose gear assembly, a portion of the pilot's instrument panel, the pilot's seat, and a section of the lower fuselage structure, was recovered as one piece. The forward section of the aircraft had dropped to the ground in a nose-low vertical attitude, and the engine was buried in the ground up to its firewall.

The nose wheel assembly, with the fork and scissors attached, was located in the vicinity of the main wreckage. The nose gear fork was bent and distorted. Heavy white paint smudges were found on the nose gear tire. These smudges matched the paint from the leading edge of the right wing of N7941C.

The propeller assembly had separated from the engine at the flange. The propeller was located about ***50*** yards north of the main wreckage of N8592C. One blade of the propeller was bent slightly aft. The other blade was bent aft about 90°, with the bending concentrated about 12 inches out from the hub. This blade tip was severely damaged, and there were a number of deep, regularly spaced grooves **on** the leading edge of the blade. Green paint smudges were also found on the face of the blade in the tip area and along the leading edge. One half of the propeller spinner and the spinner bulkhead was torn and crushed. The remaining half showed no evidence of damage.

Examination of the engine showed that a propeller had struck and severed the aft portion of the right rear cylinder head.

The right wing assembly, with the landing gear attached, separated from the aircraft and came to rest about 1 1/2 miles south of the main wreckage. The landing gear's speed fairing was intact and attached to the landing gear assembly; there was no evidence of collision or impact damage.

The top section of the engine cowling, which had separated from the aircraft, was also located about 1 mile south of the wreckage area. The cowling shaved evidence of severe fire damage. The grass area on which the cowling came to rest was also burned.

The left wing, with the landing gear assembly attached, had separated from the aircraft and was located about a mile south of the main wreckage. The leading edge of the wing was crushed aft. The wheel's speed fairing was broken and the tire had been cut by a propeller. Green and gold paint smudges were found on the tire.

Fragments of the aircraft structure were recovered throughout the wreckage site. Sections of the exterior skin were coated with engine oil and soot. The interior trim and seats, which had been torn free from the aircraft, were intermingled with the seats and trim from N7941C.

The aircraft was equipped with a red rotating beacon, but whether it was operating at the time of the accident could not be determined.

1.13 Medical and Pathological Information

The two pilots sustained multiple blunt force traumatic injuries. Pathological and toxicological tests could not be performed on the pilot of N8592C. No pathological examination was conducted on the pilot of N7941C; toxicological tests were negative.

The two persons who were seated in the right forward and rear seats of N7941C and the person who occupied the right front seat on N8592C sustained massive slashing-type traumatic injuries.

Medical records indicate that the pilot of N8592C had previously been issued a waiver for deficient right eye corrected distant vision. The pilot's eye examination of June 9, 1975, showed distant vision: Right eye 20/200 corrected to 20/100, left eye 20/30 corrected to 20/20, and both eyes 20/30 corrected to 20/20. The near vision test indicated: Right eye 20/200 corrected to 20/100, left eye 20/50 corrected to 20/20, and both eyes 20/50 corrected to 20/20.

On December 16, 1971, the FAA had issued to the pilot a Statement of Demonstrated Ability, with the limitation "must wear glasses for distant vision while flying." The physical defects noted were: "Left eye, 20/200 corrected to 20/70." There were no subsequent limitations issued.

The Armed Forces Institute of Pathology (AFIP) reviewed the pilot's medical examination records from 1969 to 1975 in order to determine if his deficient right eye distant vision was a factor in this accident. AFIP physicians and FAA physicians stated that the pilot's deficient right eye vision was not a factor in his ability to detect the other aircraft and to judge correctly the threat of a collision.

1.14 Fire

A small explosion occurred at the time of the collision. The main fire damage was confined to the engine cowling of N8592C. The cowling continued to burn until ground impact. The resulting grass fire was extinguished after burning a path about 10 feet wide and 50 feet long.

1.15 Survival Aspects

This accident was not survivable.

1.16 Tests and Research

1.16.1 Visibility Study

The probable collison geometry was reconstructed from data contained in the Kansas City ARTCC's **D-LOG** for the time of the accident. The only data available were a precollision radar target of N7941C (aircraft No. 1) and a DPICT of the flightpath of N8592C (aircraft No. 2), both derived from the **D-LOG.**

For aircraft No. 1, a magnetic course of 42° was assumed, based upon the approximate magnetic course from Arnsperger Airport to the collision point. It was assumed that the collision occurred on, **or** near, the 241° radial from the MACON **VOR.** The groundspeed of aircraft **No.** 1 was assumed to be 115 kn.

From the DPICT of aircraft No. 2, a groundspeed of 84 kn was derived with the aircraft on a magnetic course of 241°. The aircraft's altitude was **6,000** feet m.s.l. (See Appendix **E.)**

A visibility study was conducted to determine the field of visibility from each cockpit. The FAA provided binocular photographs taken of similar aircraft which illustrated the external visibility available from each aircraft's left front seat. These photographs do not account for movement or displacement of the occupant's head, eyes, or torso. Therefore, these movements either singularly **or** in combination will affect the occupant's external vision with regard to cockpit window structure and protuberance. The visibility study indicated that neither pilot's outside view would have been obstructed in the vicinity **of** the other aircraft's target.

1.17 Additional Information

None

1.18 New Investigation Techniques

None

2. ANALYSIS

Both aircraft were certificated, equipped, and maintained in accordance with applicable regulations and procedures. There was no evidence of preaccident failure of the structures, systems, or components of either aircraft. Since visibility was unrestricted, the Safety Board concludes that weather was not a factor.

Both pilots were qualified for the flights. There is no evidence to suggest impairment or incapacitation of the pilot of N7941C. The pilot of N8592C had a history of deficient corrected distant vision in his right eye. His 1975 medical examination record contained no Statement of Demonstrated Ability. He was issued a Class III medical certificate even though his right eye corrected distant vision did not meet the requirements of 14 CFR 61. 6/ However, based on expert medical opinion, the Safety Board concludes that this defect was not a causal factor in this accident.

Before the collision, the Kansas City center controller had radio and radar contact with N8592C, which was operating on an IFR flight plan. No radio or confirmed radar contact was established with N7941C during the aircraft's climb from Salisbury, Missouri, to the collision point.

When N8592C was under the control of the Kansas City center, the controller twice advised the pilot of conflicting traffic which was based upon transponder returns from these aircraft. The first advisory was given when N8592C was about 25 miles east of the Macon VOR station, and the second advisory was given when N8592C was about 10 miles east of Macon. The pilot acknowledged receipt of both of these advisories, and reported that he was "looking". Re never reported having the traffic in sight. No traffic advisories were issued to N8592C after it passed the Macon VOR and assumed a southwesterly heading.

Based on the D-LOG plot, the ARTCC's radar display primary target return, assumed to be N7941C, appeared about 6 seconds before the collision. The second primary target appeared after the flightpaths crossed and is believed to be accident debris. The flightpath of N7941C is believed to have been a straight line toward the Macon VOR station, with the aircraft in a climbing attitude from the Arnsperger Airport to the collision point. When the planes collided, N7941C's heading was 042°. N8592C would have been flying at an assigned altitude of 6,000 feet indicated altitude and on an approximate heading of 241°.

6/ 14 CFR 67.17(b)(1) "Distant visual acuity of 20/50 or better in each eye separetely, without correction; or if the vision in either or both eyes is poorer than 20/50 and is corrected to 20/30 or better in each eye with corrective glasses, the applicant may be qualified on the condition that he wears those glasses while exercising the privileges of his airman certificate."

In most cases, a primary target located 5,000 feet above ground level and with no obstructions between it and the radar site would cause a primary target indication. However, radar performance for primary returns is sometimes unpredictable. Therefore, each radar site is flight checked when it is commissioned and the performance data that are obtained becomes the standard for that particular site.

The commissioning flight check report for the Kirksville site indicates that the only useable video from this radar site was the secondary (transponder-equipped) radar returns. This flight check had been noted during the morning hours of 0800 to 1000. Coincidentally, the accident occurred between 0900 and 1000. Nevertheless, the radar performance, as indicated by the results of the postaccident flight check, was equal to, or better than, the standards established during commissioning. Severely irregular propagation effects caused by atmospheric disturbances were prevalent on both the commissioning flight check and postaccident flight check between 0800 and 1000. This is the main reason that during one segment of the check the transponder of the test aircraft was turned off to simulate N7941C and only 4 to 5 primary radar returns out of a possible 45 were depicted on the narrow-band ARTCC radar display. With the transponder of the test aircraft turned on to simulate the flight of N8592C, the target display was consistent along a 20-mile segment of victor 424, the airway being flown by N8592C at the time of the accident.

Although N7941C had a transponder aboard, it was either not working properly or was not turned on. On both the commissioning flight and flight check of the Kirksville radar site, the secondary radar performance was reliable. According to the D-LOG plot, N8592C presented a consistent return. Had the transponder aboard N7941C been functioning, it would have appeared on the D-LOG plot from which the DPICT was derived.

The examination of the recovered wreckage indicates that aircraft N8592C and aircraft N7941C were on a near head-on course at the moment of collision.

Aircraft N8592C contacted the right side of the cockpit and cabin of aircraft N7941C. When the planes collided, one propeller blade of each propeller assembly impacted the engine of the other aircraft, as evidenced by the evenly spaced grooves on the leading edge of the damaged blade of N8592C's propeller assembly. This blade was also bent aft about 90°. The fractured blade section of N7941C's propeller assembly showed severe impact damage on its leading edge with red scrape marks on the face surface of the blade. The opposite blades of both aircraft propeller assemblies showed little or no impact damage.

After initial impact, the propeller and engine of aircraft N8592C penetrated the forward right side of aircraft N7941C, which caused the complete destruction of its cockpit and cabin structure. At

the same time, the fixed nose gear and left main gear of aircraft N8592C penetrated the right wing's leading edge of aircraft N7941C in the area of the fuel tank and inboard section of wing adjacent to the fuselage. The nose gear penetrated the wing fuel tank. Black tire scrapes were found on the crushed inboard wing's leading edge structure.

The reconstructed collision geometry indicates that N7941C would have been located about 11° to the left of the eye reference point of N8592C and would have had a flightpath angle of about +4° in its climb. N8592C would have been about 8" to the right of N7941C's eye reference point. Referencing these 8" and 11° sight lines to the binocular photographs indicates that neither aircraft would have been "masked" by passengers, structure, or interior furnishings. Moreover, offsetting each target to account for crosswinds shows no obscuration from either pilot's location.

In an effort to determine why each pilot apparently did not see and avoid the other, the Safety Board examined the following factors:

(1) The angle at which both aircraft were converging (about 161°) would have caused the apparent size of each aircraft to have been reduced considerably because of foreshortening. In this type of situation, the target's wing and tail surfaces are not discernible and essentially only the head-on view of the aircraft is presented to the viewer.

(2) Targets of each aircraft would not have been masked by aircraft structure and each target would have remained essentially in the same location for at least the final 60 seconds. Under laboratory conditions, a target having an area of 0.4 minutes^2 of arc can be nominally detected using foveal vision. These data were obtained under controlled conditions and do not account for fatigue, vibration, the observer's physical condition or fatigue, aberrations of the aircraft windshield, refraction of light, and loss of light transmissivity through any medium, such as atmospheric haze, rain or windshields. Both targets would have been very small when viewed from either pilot's position and would have appeared in their peripheral vision with respect to the eye reference point. The low rate of closure would have permitted both pilots to see the other aircraft for at least 30 seconds before the collision if each pilot was looking directly at the target. However, according to a ground witness, neither pilot initiated an evasive maneuver.

(3) The pilots' ability to reacquire the target after it is first sighted must also be considered. Typically when a target is sighted during a pilot's scan he will make an initial judgment as to whether or not it is a threat; if, the target is judged not to be a threat, the pilot will continue scanning other portions of the sky. Generally, the areas which are scanned routinely and frequently are

limited to the front of the aircraft, less frequently to the sides of the aircraft, and, above and below it. When a target is small, it is often difficult to reacquire the target in foveal vision during subsequent scans, unless the target is conspicious. Although both aircraft were white (except for trim), they would not have been conspicious until both aircraft were relatively close to each other -- in this case about 30 seconds before impact. N8592C would have appeared as a black dot against the sky and N7941C would have appeared as a black dot against the terrain or slightly above the horizon. Only when the two aircraft got closer to each other would their paint schemes have become apparent with the almost head-on relationship between the aircraft.

If the pilot of N8592C did see N7941C, he may not have recognized that the two aircraft were on a collision course. The pilot had little flight time (310 hours since November 1969, and only 60 hours since June 1973). The pilot of N8592C had received some training or familarization with the "fixity of target" principle during his flight training. This principle states that when an airborne target remains in a fixed position in the windshield, a collision course with the target is indicated. To prevent the collision, the course or altitude of one of the aircraft must be adjusted. Implied in this principle is the pilot's ability to discern zero rate of change of the other aircraft's heading or speed, or both. The size of the target, depending upon the rate of closure between both aircraft, may change drastically in the last few seconds before the collision.

The pilot of N8592C, who was operating on an IFR clearance, had been issued two traffic advisories before the collision. He acknowledged receipt of the ATC advisories but did not report that he saw the targets. His inexperience, the IFR operation, and the *two* previous advisories could combine to cause this pilot to believe that he would be provided further advisories of conflicting traffic before the other aircraft might be expected to become visible.

The Safety Board believes that inadequate vigilance on the part of both pilots, more than any other factor, appears to have been the predominant cause of collision. The relatively low closure rates, the location of each target in each aircraft windshield, and the 6 or more miles visibility would have combined to permit each pilot ample opportunity to see the other aircraft in time to prevent the collision.

The pilot of N8592C had only one passenger, who was located in the other front seat. Since the passenger was not a pilot, she would not be expected to maintain a level of vigilance comparable to that expected of the pilot. Operating on an IFR clearance, the pilot may have relaxed his vigilance and may not have maintained an adequate outside scan. Any distractions such as referring to maps, explaining the operation of the aircraft to his passenger, or sightseeing would have further compromised his vigilance.

The pilot of N7941C had departed Arnsperger Airport en route to a number of locations in Missouri and Illinois. From the available information, his flight planning was minimum before takeoff. Based on the pilot's experience and his familiarity with the area, the Safety Board assumed that he would have climbed to the Macon VOR and, from there, set a course to his first destination.

This accident is an example of the limitations of the see-and-avoid concept. It should serve as a reminder to all pilots to constantly maintain vigilance while flying in visual flight conditions regardless of the type flight plan under which they are operating, to request traffic advisories from FAA facilities, and to insure that their transponder is on and functioning properly.

3. CONCLUSIONS

3.1 Findings

1. Both aircraft were certificated and maintained properly.

2. All crewmembers were qualified for the operation involved.

3. N8592C was operating in accordance with an IFR flight plan and was under control of the Kansas City center.

4. The handling of N8592C by the ATC controllers was in accordance with prescribed procedures.

5. N7941C was operating on a VFR cross-country flight without a flight plan.

6. The planes collided on victor airway 424.

7. The pilot of N7941C did not contact an FAA radio facility nor request en route traffic advisories. There is no evidence to indicate that the aircraft's transponder was transmitting the VFR code.

8. There were no restrictions to in-flight visibility in the area of the accident.

9. Primary target information from the radar site was equal to the performance standards established during commissioning.

10. Primary target information is not as reliable as transponder-equipped (secondary) target information.

11. Secondary target information from the Kirksville radar site was reliable.

12. The pilot of N8592C had a history of deficient distant vision in his right eye. His 1975 medical examination records contained no Statement of Demonstrated Ability.

13. The pilot of N8592C was issued a Class-III medical certificate even though his corrected distant vision in his right eye did not meet the minimum requirement of 14 CFR 67(b)(1).

14. Regardless of the deficient distant vision of the pilot of N8592C, he should have been able to detect N7941C in time to avoid the collision.

15. Neither pilot's outside view would have been masked by cockpit structures in the vicinity of the other aircraft's target.

16. No reason could be found for either pilot's not being able to see and avoid the other aircraft in sufficient time to avoid the collision.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of this accident was the failure of both pilots to maintain adequate vigilance.

4. SAFETY RECOMMENDATIONS

As a result of this accident, the National Transportation Safety Board recommended that the Federal Aviation Administration:

"Develop procedures that would enhance the quality control functions at the Civil Aeromedical Institute with respect to the medical certification of airmen. (A-77-5.) (Class II - Priority Followup)

"Issue a Federal Air Surgeon's Bulletin to emphasize to the aviation medical examiners the need for quality control and the need for adherence to the provisions of 14 CFR 67 and the Guide for Aviation Medical Examiners. (A-77-6.) (Class II - Priority Followup)

"Require that all medical certificates be annotated appropriately when that certificate is governed by a statement of demonstrated ability. (A-77-8.) (Class II - Priority Followup)"

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ WEBSTER B. TODD, JR.
Chairman

/s/ KAY BAILEY
Vice Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PHILIP A. HOGUE
Member

/s/ WILLIAM R. HALEY
Member

April 14, 1977

5. APPENDICES

APPENDIX A

INVESTIGATION AND HEARING

1. Investigation

The Safety Board's Kansas City Field Office was notified of the accident about 1050 c.d.t., on July 24, 1976. An investigator from the Kansas City Field Office went immediately to the scene. The Safety Board's Washington based Specialists in Structures, Human Factors, and Air Traffic Control assisted in the investigation. The Federal Aviation Administration was a party to the investigation.

2. Public Hearing

There was no public hearing

APPENDIX B

PERSONNEL INFORMATION

Pilot James Arthur Cook

Mr. James A. Cook, age 27, was employed by Reeds Aviation, Inc., as an air taxi/charter pilot. He held Commercial Pilot Certificate Number 1862261, with ratings in airplane single and multi-engine land and instruments. At the time of the accident, he had accumulated a total of 1,421 hours of pilot time, of which 520 hours were in PA-28 aircraft. Mr. Cook possessed a second-class medical certificate dated December 23, 1975, with no limitations. He had completed a multi-engine check and a biennial review on May 26, 1976. His single engine check was made in a Piper PA-28 aircraft on March 31, 1976.

Pilot Cyrus Mayshark

Mr. Cyrus Mayshark, age 49, possessed Private Pilot Certificate Number 2047146 with ratings in airplane single engine land and instrument. At the time of the accident he had accumulated approximately 461 pilot hours, of which 3 hours were in Piper PA-28-181 model aircraft. Mr. Mayshark possessed a third- class medical certificate dated June 9, 1975, with limitations requiring the holder to wear correcting glasses while exercising the privileges of his airman certificate. The date of the pilot's last biennial flight review was March 23, 1976.

Controller Rex A. Olsen

Controller Olsen who was working the radar and manual position for the area of the accident at the time of the accident attained his full performance level in February, 1975. He began working for the FAA as a developmental controller in May of 1970. His last observed evaluation was in March 1976. His Class-I1 medical certificate was issued September of 1975. He held a private pilot certificate.

APPENDIX C

AIRCRAFT INFORMATION

1. Piper PA-28R-200, (Serial No. 28R-7635123) N7941C

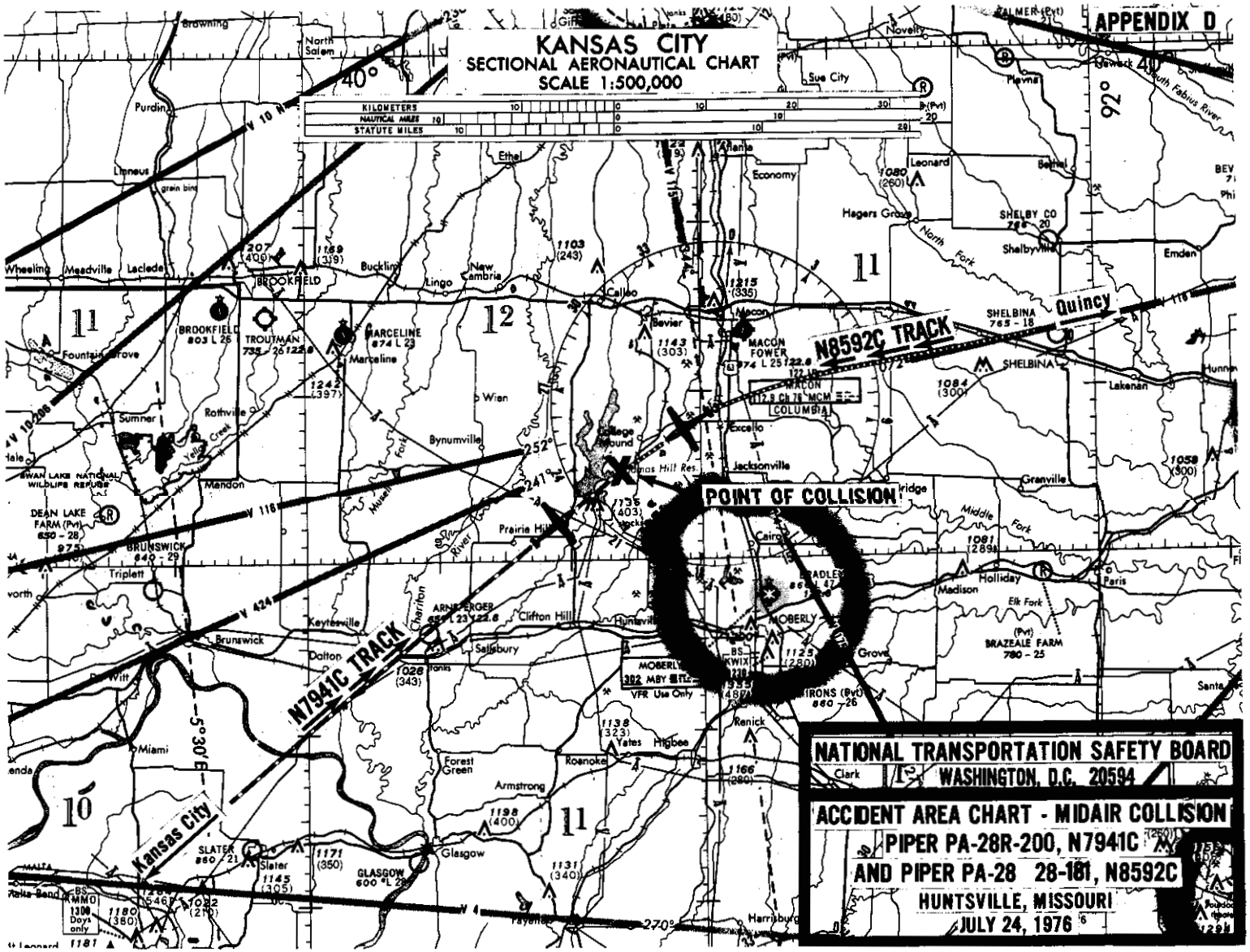
N7941C was owned by Reeds Aviation, Inc., Chillicothe, Missouri, and was being utilized in commercial air taxi/charter service. The aircraft was registered, equipped, and maintained in accordance with applicable FAA requirements. The aircraft had accumulated a total of 319 hours of operations since new, and 12 hours since the last 100-hour inspection.

The aircraft was equipped with a Lycoming Model IO-360-C1C engine with a total time since overhaul of 319 hours and 12 hours since the last 100-hour inspection.

2. Piper PA-28-181, (Serial No. 28-7690151) N8592C

N8592C owned by the Illini Aviation, Inc., Urbana, Illinois, and was being used in normal fixed-base operations. The aircraft was registered, equipped and maintained in accordance with applicable FAA requirements. The total time on the aircraft and engine at the time of the accident could not be determined. According to the records the aircraft had accumulated a total of 165 hours since new, and approximately 67 hours since the last 100-hour inspection.

The aircraft was equipped with a Lycoming Model 0-360 engine.

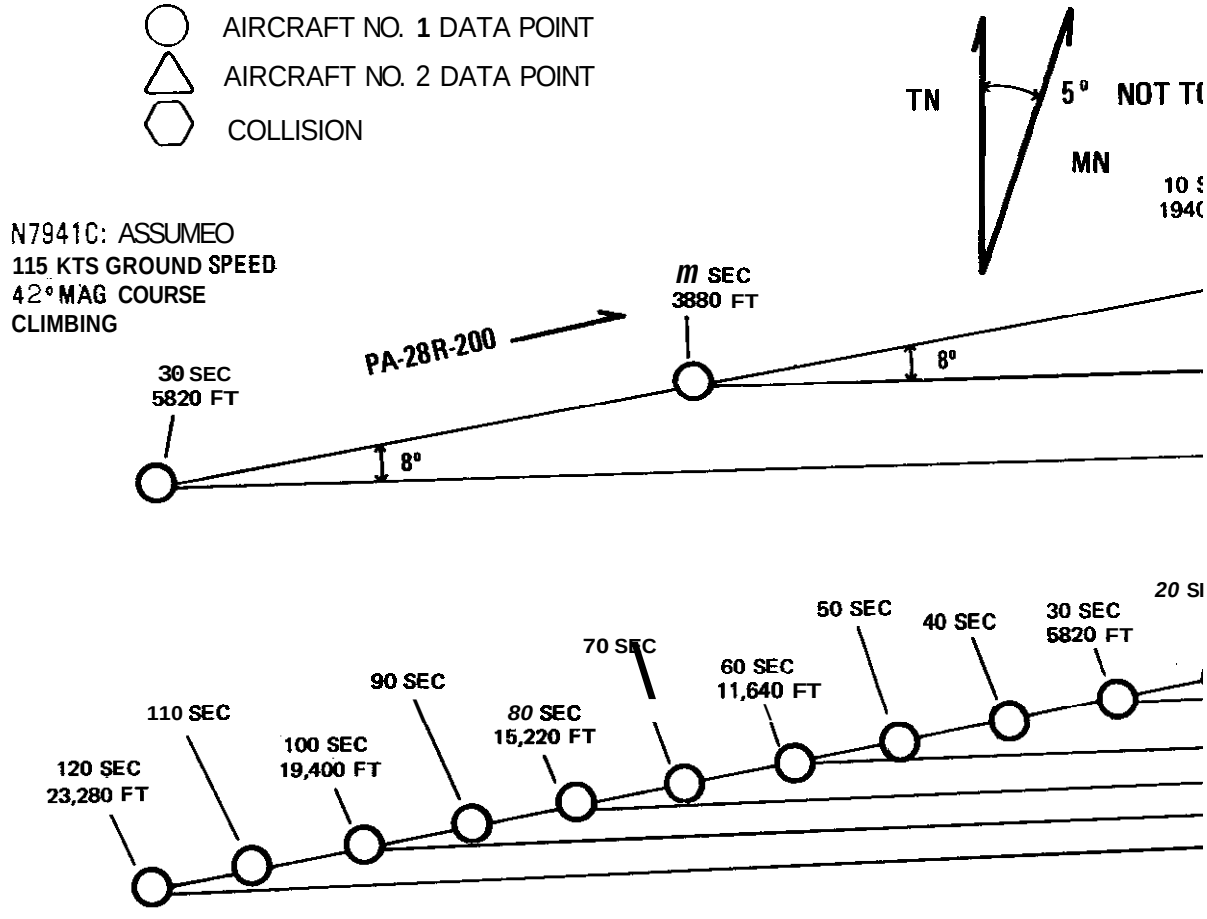

KANSAS CITY
SECTIONAL AERONAUTICAL CHART
SCALE 1:500,000
KILOMETERS
NAUTICAL MILES
STATUTE MILES
POINT OF COLLISION
N8592C TRACK
N7941C TRACK
Kansas City
Quincy
NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594
ACCIDENT AREA CHART - MIDAIR COLLISION
PIPER PA-28R-200, N7941C
AND PIPER PA-28 28-181, N8592C
HUNTSVILLE, MISSOURI
JULY 24, 1976

KEY:

AIRCRAFT NO. 1 DATA POINT

AIRCRAFT NO. 2 DATA POINT

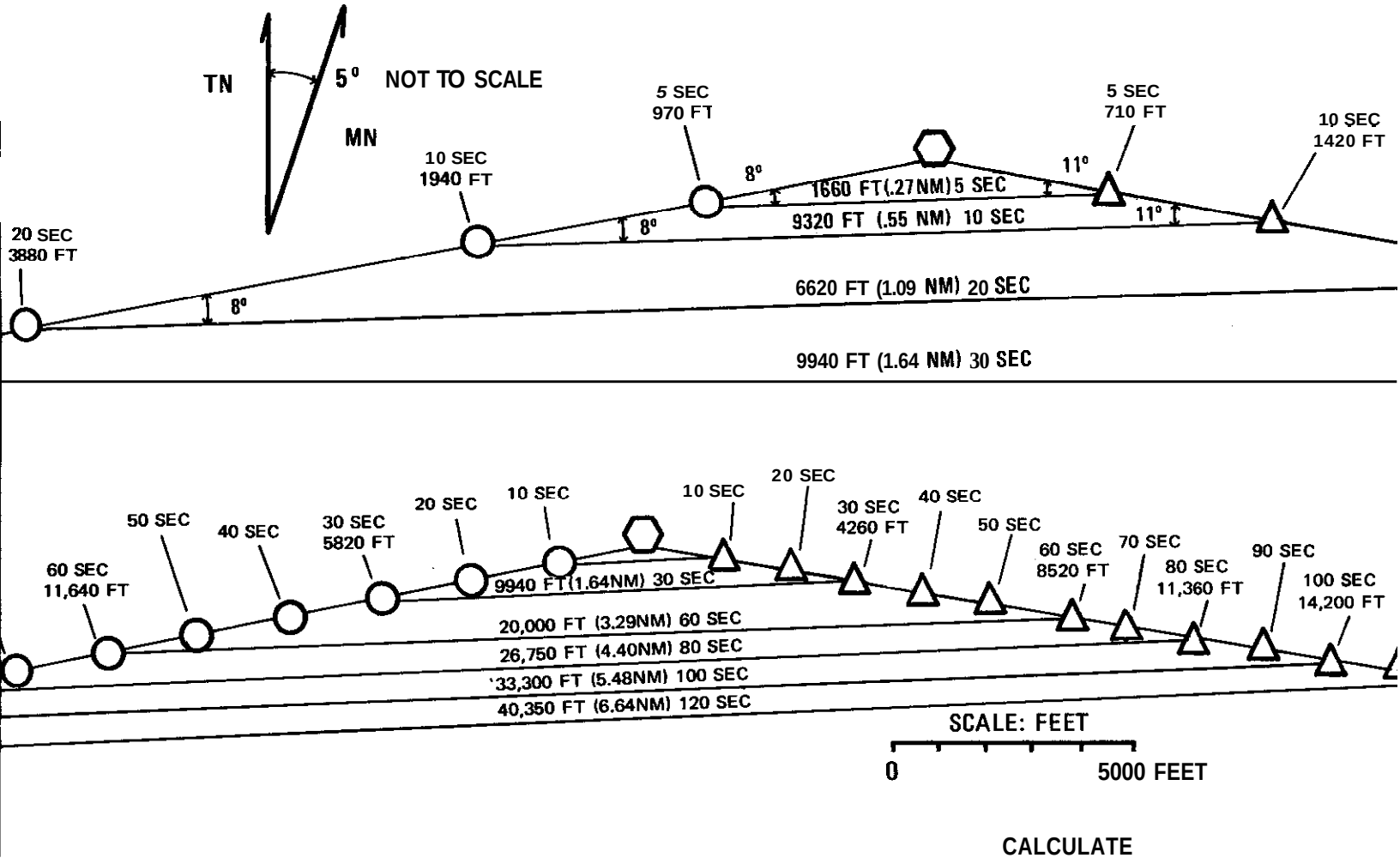
COLLISION



NOTES

CALCULATED RATE OF CLOSURE WAS 196 KNOTS

THIS CHART IS BASED UPON ASSUMEO HEADINGS, SPEEOS AND ALTITUDES FOR BOTH AIRCRAFT. THE PROBABLE COLLISION GEOMETRY AS SHOWN IS INTENDED TO ILLUSTRATE ONLY THE RELATIVE PATHS OF BOTH AIRCRAFT AND NOT INTENDED TO ILLUSTRATE ABSOLUTE DATA FOR EITHER AIRCRAFT.



SCALE: FEET

0 5000 FEET

CALCULATE

E OF CLOSURE WAS 196 KNOTS

ED UPON ASSUMED HEADINGS,
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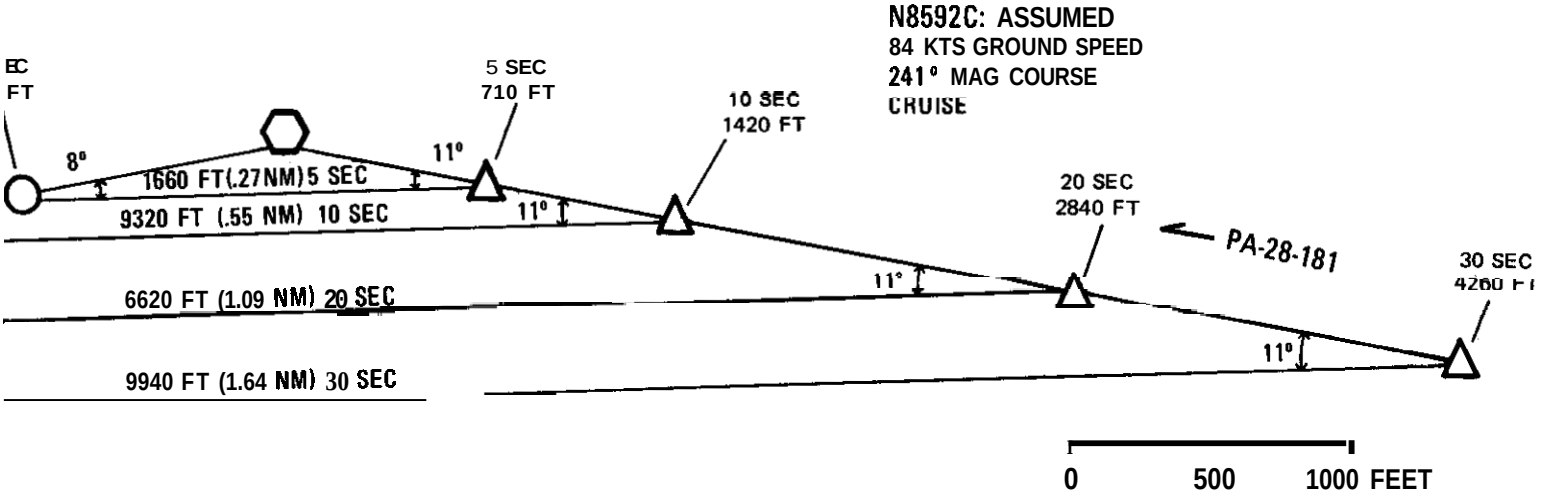
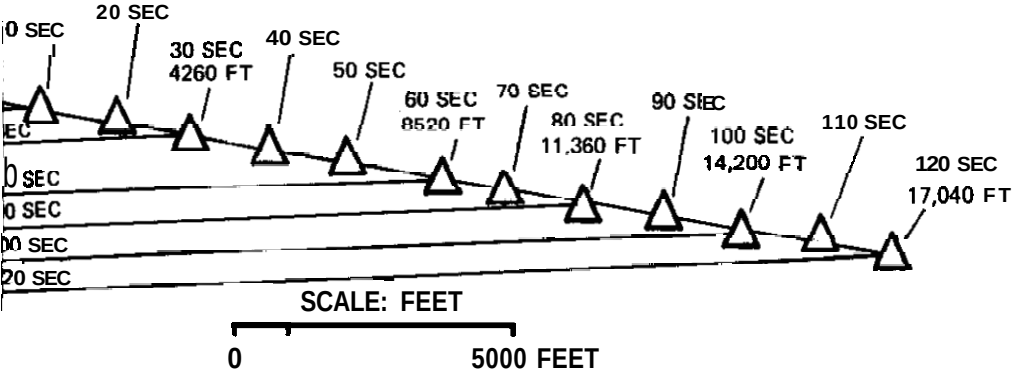
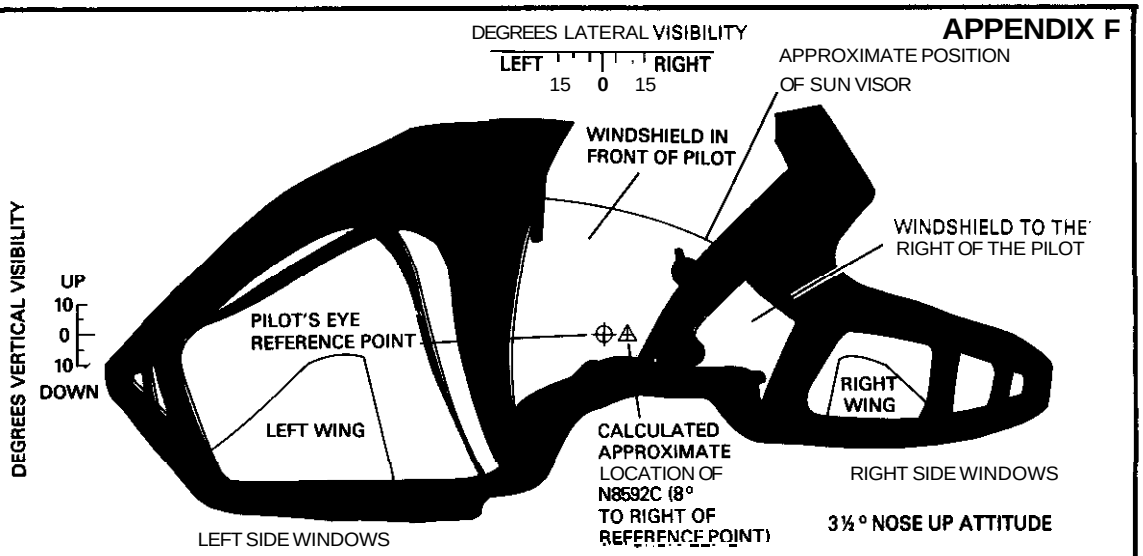




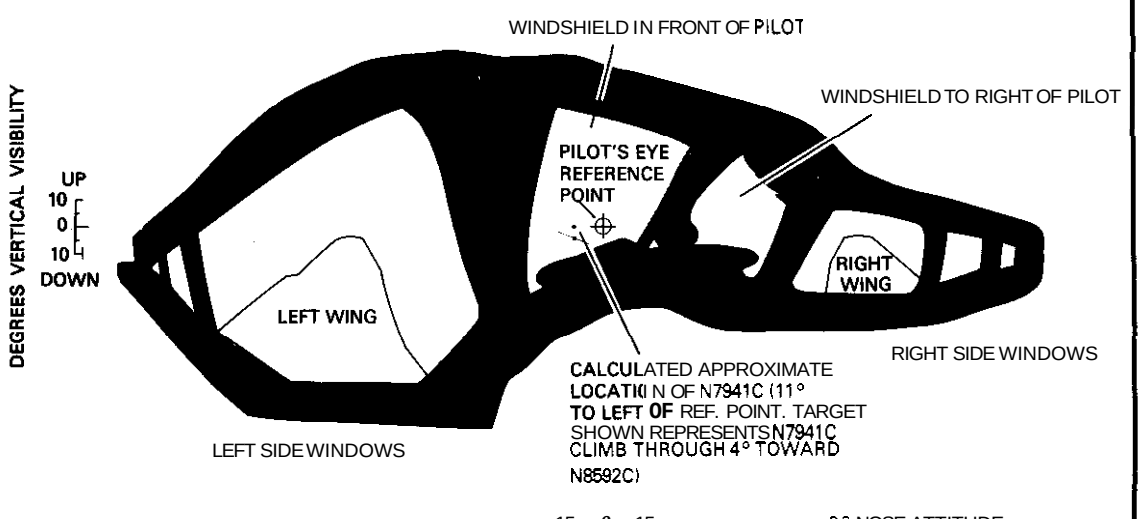
CALCULATE

NATIONAL TRANSPORTATION SAFETY BOARD WASHINGTON, D.C.
RECONSTRUCTED PROBABLE COLLISION GEOMETRY PA 28R-200 N7941C & PA 28-181 N8592 C NEAR HUNTSVILLE, MISSOURI, JULY 24.1976

APPENDIX F



VISIBILITY FROM PA-28R-200 PILOT'S SEAT
REPRESENTS POSSIBLE VISIBILITY FROM N7941C



VISIBILITY FROM PA-28-181 PILOT'S SEAT
REPRESENTS POSSIBLE VISIBILITY FROM N8592C

NOTES
- CLEAR AREAS REPRESENT BINOCULAR VISION
- SHADED AREAS REPRESENT MONOCULAR VISION ONLY
- VISIBILITY FROM BOTH AIRCRAFT IS REFERENCED FROM THE PILOTS DESIGN EYE REFERENCE POINT
- THE LOCATION OF EACH TARGET AS SHOWN IS FOR A PERIOD OF TIME FOR 60 SECONDS PRIOR TO THE COLLISION

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

COCKPIT VISIBILITY
PA-28R-200 AND PA-28-100
NEAR HUNTSVILLE, MISSOURI
JULY 24,1976