

AIRCRAFT ACCIDENT REPORT

Adopted: June 30, 1969

OZARK AIR LINES, INC.,
DC-9, N970Z AND
INTERSTATE AIRMOTIVE, INC.,
CESSNA 150F, N8669G
ST. LOUIS, MISSOURI
MARCH 27, 1968

NATIONAL TRANSPORTATION SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
WASHINGTON D.C. 20591

OZARK AIR **LINES**. INC.,
 DC-9, N970Z AND
 INTERSTATE AIRMOTIVE, INC.,
 CESSNA 150F, N8669G
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SYNOPSIS

An Ozark Air Lines, Inc., X!-9, N970Z, and an Interstate Airmotive, Inc., Cessna 150F, N8669G, collided in flight approximately 1.5 miles north of Lambert Field, St. Louis, Missouri, at approximately 1757 c.s.t., March 27, 1968. Both aircraft were in the landing pattern for Runway 17, under the jurisdiction of the St. Louis Tower, when the accident occurred. The Cessna was demolished by the collision and ground impact, and both occupants were fatally injured. The DC-9 sustained light damage and was able to effect a safe landing. None of the 44 passengers or five crewmembers was injured.

At the time of the collision the weather was high, thin, broken clouds, with 15 miles visibility. Daylight weather conditions existed.

The Safety Board determines that the probable cause of this midair collision was the combination of: the inadequacy of current VFR separation standards in controlled airspace, the crew of the X!-9 not sighting the Cessna in time to avoid it, the absence of VFR traffic pattern procedures to enhance an orderly flow of landing aircraft, the local controller not assuring that important landing information issued to the Cessna, was received and understood under the circumstances of a heavy traffic situation without radar assistance, and the Cessna crew's deviation from their traffic pattern instructions and/or their continuation to a critical point in the traffic pattern without informing the local controller of the progress of the flight.

1. INVESTIGATION

1.1 History of the Flight

An Ozark Air Lines, Inc., (Ozark) DC-9, N970Z, and an Interstate Airmotive, Inc., Cessna 150F, N8669G, collided in flight approximately 1-1/2 miles north of Lambert Field, St. Louis, Missouri, on March 27, 1968, at approximately 1757 1/ c.s.t. Both aircraft were in the landing traffic pattern for Runway 17, under the control of the St. Louis Tower, when the accident occurred. Following the collision, the DC-9 continued its approach and landed safely on Runway 17. Damage to the Ozark aircraft was light and no injuries were sustained by the passengers or crew. The Cessna fell to the ground immediately after the collision and both occupants received fatal injuries. The aircraft was demolished. The collision occurred during daylight conditions, at 38°45' North Latitude and 90°22' West Longitude.

Ozark 965

Ozark 965, a DC-9, N970Z, was a regularly scheduled passenger flight which originated in Chicago, Illinois, and terminated at St. **Louis**, Missouri, with an en route stop at Peoria, Illinois.

Ozark 965 departed from Peoria at approximately 1731 with 44 passengers and a crew of five. 2/ The flight proceeded routinely to the St. Louis area in accordance with its Instrument Flight Rules (IFR) clearance and, at approximately 1749, radar control of the aircraft was transferred from Kansas City Air Route Traffic Control Center (ARTCC) to St. Louis Approach Control. The flight was advised that it was in radar contact and was cleared to descend from 6,000 feet to 2,600 feet on a heading of 190°, with radar vectors to the outer marker (LOM), for an ILS approach to Runway 12 right (R).

The first officer was flying the aircraft from the copilot's seat during the approach.

Prior to reaching the LOM, Ozark 965 reported that it had the airport in sight. Approach Control then advised, "OK, you can start a left turn then for one seven if you like, you're cleared for a one two right ILS approach or a contact approach, contact the tower now one one

1/ **A** times herein are central standard based on the 24-hour clock.

2/ A check captain occupied the jumpseat, but was not conducting any official check on this flight.

eight point five." Ozark 965 responded, "OK, ah now runway's one seven you say?" Approach Control confirmed that the active runway was 17 and reported the winds to be 170" at 15 to 20 knots. Ozark 965 acknowledged this transmission at 1755:20. Approach Control then observed the aircraft's target on the radarscope beginning a left turn. This turn was commenced at a point estimated by the controller to be about 1 mile north of the LOM. (See Attachment No. 1.)

At 1756:09, the flight reported to the St. Louis Tower, "Ozark 965 on a right base." The tower controller visually observed the flight on a right base leg to Runway 17 and also observed a light aircraft in the proximity of the DC-9, which also appeared to be on a right base leg to Runway 17. Ozark 965 was cleared to land on Runway 17 following a Cessna which was on a short final and at this time (1756:31) was advised, ". . . traffic is a Cessna looks like ahead and to your right maybe to your left there northeast bound." 3/ Although the statements of the crewmembers do not refer to this traffic advisory, they did hear it. One member commented, "I don't see it (out there) at all," and another replied "Naw." 4/ Another traffic advisory was given to the flight at 1757:06 (approximately 6 seconds prior to the collision), "Ozark nine six five traffic's that Cessna off to your right looks like he's eastbound."

According to the cockpit crewmembers, all looked to the right at this time and observed the bulk of an aircraft abeam the cockpit area. The captain rolled his controls hard left and added power in an attempt to avoid the other aircraft. A thump of impact was then heard and felt. Following the collision, the aircraft proved to be controllable and the approach was continued to a normal landing on Runway 17 at approximately 1758.

Interstate Airmotive Cessna 150F

Cessna 150F, N8669G, was scheduled for an instructor-training flight of 1-1/2 hours duration from 1630 to 1800. Records of the St. Louis Tower indicate that N8669G took off at 1623. No information is available concerning the conduct or the whereabouts of the flight until 1754:00 when the flight reported to St. Louis Tower, "Six nine golf St. Charles

3/ All radio communications between St. Louis Tower, Ozark Flight. 965, and Cessna N8669G are included in Section 1.9 Communications.

4/ A transcript of pertinent conversation from the cockpit voice recorder is contained in Appendix C.

with golf." 5/ Tower frequency congestion resulted in a short handling delay, and about 1755, Cessna N8669G was cleared to report right downwind leg for landing Runway 17. This transmission was not acknowledged by the Cessna. 6/ The next communication with N8669G by the Tower was at 1756:43, "Six nine golf if that's you out there about to turn final pull out to your ah well just proceed straight on across the final and enter on a left base leg for runway one seven. You'll be following an Ozark DC-9 turning final about two out, maybe to your left and above you, you have him?" Cessna N8669G replied, "Six nine golf roger." The collision occurred several seconds later and the Cessna fell to the ground about 1-1/2 miles north of the approach end of Runway 17.

Evidence indicated that, at the time of the collision, the instructor-pilot was in the left pilot's seat and the instructor-trainee was occupying the right pilot's seat.

The aircraft were not observed by eyewitnesses on the ground except during approximately the last 1-1/2 miles of flight before the collision. Witnesses generally agreed that the E-9 was in a descending right turn and overtaking the Cessna which was below and to the right of the E-9. The witnesses stated that the Cessna was in level flight proceeding towards the southeast when the collision occurred.

The local controller and other controllers in the tower visually observed the Ozark DC-9 and Cessna N8669G for approximately 50 seconds, during the last approximate 1-1/2 to 2 miles of their flight paths prior to the collision. Traffic advisories were given to each aircraft, relative to the other, based on the visual observations of the local controller. Radar installed in the tower cab was not utilized in the control of the aircraft as its scope presentation was not suitable for interpretation under the existing daylight conditions.

5/ Automatic Terminal Information Service (ATIS) is available in St. Louis, Missouri. The information current at this time was designated "Golf" and consisted of the following: "Thin broken cirroform, visibility 15, temperature 79° wind 180" at 20. Altimeter 3004. Runway 12 ILS approach in use. Circle to land Runway 17. Departure, on Runways 17 and 12 IFR frequency 119.9 IFR transponder equipped squawk 1,000 just before departure. Inform St. Louis approach control, tower, or ground control you have received information Golf."

6/ During this time period, St. Louis Tower was attempting to control a considerable number of flights in the St. Louis control zone. Multiple instructions were being issued in the same transmission to different flights. Instructions or advisories were not acknowledged verbally in a number of instances.

1.2 Injuries to Persons

<u>Injuries</u>	<u>Crew</u>	<u>Wssengers</u>	<u>Others</u>
Fatal	2 (N8669G)	0	0
Nonfatal	0	0	0
None	5	44	

1.3 Damage to Aircraft

Ozark 965 sustained damage confined to the lower side of the right wing and right landing flap.

N8699G was demolished.

1.4 Other Damage

The Cessna wreckage fell in an open parking lot, inflicting negligible damage to ground property.

1.5 Crew Information

The crews of both aircraft were properly certificated and qualified to conduct their respective flights. (For detailed information see Appendix A.)

1.6 Aircraft Information

Both aircraft were properly certificated and maintained in accordance with existing requirements. (See Appendix B.)

1.7 Meteorological Information

The surface weather observation taken at the time of the accident by the Weather Bureau at St. Louis was: 1801, Special, high thin broken clouds, visibility 15 miles, temperature 69°F., dew point 45°F., wind 170° at 18 knots, gusts 24 knots, altimeter setting 30.06 inches.

Information obtained from the U. S. Naval Observatory indicated a sun angle azimuth 271° from true north, 3" above the horizon. Official sunset was 1819.

1.8 Aids to Navigation

Not involved.

1.9 Communications

There were no reported difficulties with air/ground communications between the St. Louis Tower and any of the flights operating in the St. Louis area during the significant time period of this accident.

The tape recording of radio communications between the local controller and the crews of those aircraft on the ground and in the air shows that there were numerous voice transmissions made on the Tower frequency during the 3-minute time period preceding the collision. This recording further reveals that, within this time period, the local controller was involved in communications with approximately seven aircraft on the airport and eight aircraft that were inbound for landing. Voice transmissions on the Tower frequency presented a pattern of near-continuous speech. Instructions to as many as four flights were given by the controller in a single transmission and verbal acknowledgment for the instructions was not received in a number of instances. The communications tape shows that departure and arrival operations were being conducted to Runway 17, with both left and right traffic patterns being utilized. Runway 12R was also being utilized for departures and arrivals for those who elected to use it.

Pertinent Transmissions and Times

LEGEND:

STL A/C - **St.** Louis Tower Approach Control
OZ 965 - Ozark Air Lines Flight 965, DC-9
STL L/C - **St.** Louis Tower Local Control
N69G - N8669G, Cessna 150

(1749:00 approximate start of tape recording)

St. Louis Approach Control

1749:37	OZ 965	Ozark nine sixty five level at six with golf.
1749:41	STL A/C	Ozark nine sixty five St. Louis approach control in radar contact descend to two thousand six hundred heading of about one nine zero, be vectors runway one two right.
1749:52	OZ 965	Out of six for twenty six and ah one nine zero.
1749:59	STL A/C	Roger and that's ah one two right ILS ah vector there.
1750:02	OZ 965	okay.
1751:53	STL A/C	Ozark nine sixty five traffic at one o'clock three miles southbound.
	OZ 965	Nine sixty five no contact.
	STL A/C	Roger.

1752:25 OZ 965 Nine sixty five **has** the traffic.

1752:29 STL A/C Roger.

1752:32 OZ 965 He's at twenty five hundred.

1752:34 STL A/C Okay.

1754:32 STL A/C Ozark nine sixty five traffic two o'clock two miles northbound.

1754:37 OZ 965 Got him.

1754:51 STL A/C Ozark nine sixty five I'll turn you on right at the marker.

1754:55 OZ 965 Okay, we've got the airport in sight.

1754:59 STL A/C Okay, you can start a left turn then ah for one seven if you like, you're cleared for **a** one two right ILS approach or **a** contact approach, contact the tower **now** one one eight point five.

1755:08 OZ 965 Okay, ah **now** runways one seven you say?

STL A/C Yeah, the active runway is one seven, the wind is one seven zero degrees one five to two zero.

1755:20 OZ 965 Okay.

St. Louis Tower Frequency

1754:00 N69G (Unintelligible) six nine golf St. Charles with golf.

1754:04 STL L/C Six niner golf stand by I'll get to you in a moment. Frontier four seventy **SIX** a right turn off cross one two contact ground control. Cessna one seven yankee runway one two right is cleared for takeoff. Eastern three eighty six you gonna land twelve or seventeen?

1754:43 STL L/C I/ Okay, two two **ima** I have you in sight, and six niner golf report right downwind runway one seven, and who's the other aircraft at St. Charles?

I/ Between this transmission and the one at 1756:43, there were 24 total-air/ground transmissions on Tower frequency.

1756:09 OZ 965 Ozark nine sixty five on a right base.

1756:12 STL L/C Roger, Cessna six four delta cleared for takeoff runway one seven.

1756:21 STL L/C Aircraft southeast for one seven roger, Cessna seven zero fox is cleared to land runway one seven and Ozark nine sixty five that you on the base?

1756:29 OZ 965 Yes Sir.

1756:31 STL L/C **Okay**, you're number two to follow a Cessna on a real short final for one seven and traffic is a Cessna looks like ahead and to your right maybe to your left there northeastbound.

1756:43 STL L/C Six nine golf if that's you out there about to turn final pull out to your **ah** well just proceed straight on across the final and enter on a left base leg for runway one seven. You'll be following an Ozark DC nine turning final about two out maybe to your left and above you, you have him?

1756:58 N69G Six nine golf roger.

1757:06 STL L/C Ozark nine sixty five traffic's that Cessna off to your right looks like he's wa eastbound.

1757:12 (Collision)

1.10 Aerodrome and Ground Facilities

Not involved. (See Attachment No. 1 for runway and tower layout of Lambert Field.)

1.11 Flight Recorders

Ozark Flight 965 was equipped with a Fairchild Model 5424-50Z flight data recorder. A readout of the last 4 minutes of flight showed that the aircraft approached the outer marker in accordance with its clearance and that, at approximately 2 minutes 8 seconds before the collision, a descending left turn from an altitude of 2,600 feet m.s.l., was commenced. The left turn and descent continued until 1 minute 3 seconds before impact when the heading stabilized at approximately 100°, with the airspeed decreasing from 194 knots to 172 knots. At this point, the aircraft was passing through an altitude of 2,200 feet m.s.l., descending at approximately 800 feet per minute. Approximately 23 seconds prior to the collision, a

right turn of about 2.3° per second was initiated and was continued until just seconds before the collision. At the time of collision, the DC-9 was at an altitude of approximately 1,100 feet m.s.l., on a heading of 160° and at an indicated airspeed of 135 knots. The altitude trace rises and falls sharply and the vertical acceleration trace rises to a plus 2.4 "g" and decreases to 0 "g" during the same period. (These excursions correlate with the captain's statement that, in an attempt to avoid N8669G, he added power, banked sharply to the left and then leveled the wings.) Following these excursions, the recording shows **that** the aircraft then continued its descent to touchdown.

Ozark 965 was also equipped with a United Control model V557 cockpit voice recorder. Recordings found on the cockpit area microphone (CAM) channel revealed **that** the cockpit speaker was being utilized by the crew and **that** the radio transmissions on tower frequency (118.5 MHz) emanating from this speaker were of sufficient volume to be clearly heard by the crew. During the period of time ~~from~~ the first advisory until the final advisory there was no discussion or checklist activity taking place in the cockpit. (See Appendix C.)

N8669G was not equipped with flight recorders and none were required.

1.12 Wreckage

The wreckage of N8669G was separated in two sections. The entire fuselage and left wing were located 6,500 feet from the approach end and on the extended centerline of Runway 17. The right wing of the aircraft was found approximately 900 feet north of the main wreckage.

Examination of this wreckage revealed no evidence of pre-impact malfunctions or distress in the aircraft powerplant, structure, or systems. The propeller blades were bent and broken, with one blade end missing. The flaps were in the "up" position. Several scratch marks were evident on the upper portion of the Cessna's left wing leading-edge section at the wing root area. These marks ran forward and inboard on a 45° angle to the lateral axis.

Damage to the Ozark 965 was confined to the underside of the right wing in line with the vortilon and the right wing flaps. A fuel tank access plate on the lower wing was cut open. Black and yellow paint smears were evident on the access plate and on the adjacent areas. Red paint smears were evident on the lower surface of the damaged right wing flap. (The Cessna was trimmed in red; the propeller was painted black and yellow.) Scratch and scar marks in the area forward of the DC-9 center spar extended aft and inboard on a 60° angle to the lateral axis of the aircraft.

The DC-9 flightcrew stated that, at the time of the collision, the aircraft was in a landing configuration with flaps set at 50° and the landing gear down.

1.13 Fire

There was no fire on either aircraft prior to or subsequent to the collision.

1.14 Survival Aspects

Following the collision, the DC-9 continued its approach and landed on Runway 17. After touchdown, the tower advised the flight that fuel was leaking from the right side of the aircraft. The right engine was shut down immediately after engine reverse and the left engine was secured later during the rollout. The aircraft was brought to a stop adjacent to a taxiway and all passengers and the crew deplaned through the forward airstair door. No difficulty or significant delays were reported during the evacuation.

Airport fire equipment responded to the emergency and was standing by the aircraft throughout the evacuation.

The Cessna crash was nonsurvivable.

1.15 Tests and Research

A cockpit visibility study was conducted by the Safety Board to determine the physical limitation to visibility from the flightcrew seats in each aircraft involved and to reconstruct the flightpath of each in order to find if those physical limitations would hinder either crew in the detection and observations of the other airplane.

The data developed by the flight recorder group was utilized to establish the flightpath of Ozark 965. The flightpath of N8669G was established utilizing the information obtained from eyewitnesses, operational data, radio communications, and collision scratch marks. The scratch marks indicated that the angle of impact between the two aircraft was 15°, and the respective headings of the DC-9 and Cessna were approximately 162° and 147°.

By method of vector diagram, the heading and airspeed of the Cessna at impact were determined to be 147° and 94.5 knots, respectively.

Ground tracks for both aircraft were plotted, from which ranges and bearings between the two were obtained for the last 2 minutes 21 seconds prior to the collision. Flight recorder data shows that Ozark 965 was in a left turn divergent to N8669G from 2 minutes 10 seconds until approximately 1 minute prior to the collision. From 1 minute before until the

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time of the collision, the Dc-9 (in a right turn and descending at a rate of 920 feet per minute) was overtaking the Cessna. The available data indicates that N8669G was maintaining a constant heading and altitude below Ozark 965 for at least 1 minute prior to the collision. At 1754:51 (the starting point of the study) the two aircraft were estimated to be 16,926 feet apart, and the target source represented by the Cessna was well within the detectable range of vision for the Dc-9 crew.

In order to determine the physical limitations to vision from each cockpit, binocular photographs were taken of a Cessna 150 and a Douglas DC-9 by the FAA's National Aviation Facilities Experimental Center. These photographs utilized a fixed position corresponding to the design eye position for the flightcrews.

The visual angles of the crewmembers from each aircraft were determined from approximately 1 minute before collision to the time of impact. Based on these computations, it was determined that N8669G could have been detected by the first officer during the time period between 1756:09 and 1757:07, for a total of 58 seconds prior to the collision. The captain could have sighted N8669G during the time period 1756:45 to 1757:07, for a total of 22 seconds. The observer could have seen the Cessna during the periods 1756:39 to 1756:45, and 1756:57 to 1757:03, for a total of 12 seconds.

Each aircraft had some physical restrictions to vision of a point target source of the other aircraft. From the normal eye positions of the captain, copilot, and observer of the DC-9, N8669G would be partially obscured by the windshield posts and lower cockpit fuselage at various time periods during the closure of the aircraft. Ozark 965 would not have been visible to the crew of N8669G at any time during this period due to the high wing position of the Cessna 150. (As was stated previously, the paths of the point source targets plotted on the windshields were based on fixed-eye reference points. If the crewmembers shifted their head position these paths would have changed.)

1.16 Pertinent Information

The Arrival Radar (AR) Controller was the first person in the St. Louis facility to provide control services to Ozark 965. He had neither contact with N8669G nor knowledge of that aircraft's operation. The location of his position of operation was in the IFR room below the tower cab. He stated that the facility radar was operating satisfactorily and that radar contact with Ozark 965 was established in the vicinity of Fidelity intersection (approximately 24 miles northeast of the STL LOM). When advised that the airport was in sight, the flight was given the option of making either a

8/ Targets referred to are point sources. It should be noted that as the aircraft converged the visual angles of the targets would increase.

contact approach to Runway 17 or an ILS approach to Runway 12R, and was instructed to contact the tower on the local control frequency. The AR controller stated that the aircraft's position at that time was approximately 1 to 1.5 miles northwest of the LOM, and he did not recall observing the radar target of Ozark 965 after the aircraft initiated a turn toward the airport. At this point, Ozark 965 had, in effect, entered the VFR traffic pattern for the St. Louis Airport and was under the control of the local controller. Arriving and departing traffic was utilizing Runways 17 and 12R. Runway 17 was considered the active runway because of the strong surface winds; however, large aircraft which were less affected by the crosswind component were using Runway 12R.

At the time of the accident, there were six controllers in the tower cab, including the watch supervisor. They included:

- (1) Local Controller - who issues information and clearances to air and vehicular traffic operating on the landing area, to VFR traffic operating in the control zone, and IFR traffic released to local control jurisdiction.
- (2) Ground Controller - who assists other operating positions by handling taxiing aircraft and vehicular traffic on the landing area.
- (3) Flight Data Controller - who receives, posts, and relays flight data concerning IFR traffic and, as directed, assists in the operation of the facility.
- (4) Cab Coordinator - who coordinates and directs the activities of designated positions of operation in the tower cab.
- (5) Watch Supervisor - who supervises all phases of work on a watch in the tower cab and delegates supervisory functions to subordinates, as required.
- (6) Relief Local Controller - who was preparing to assume duties of the local controller.

The general functions of the local controller are further amplified in the FAA Facility Operation Handbook 7230.1 as follows: "A controller is responsible for formulating and issuing clearances and control instructions to provide separation between aircraft and vehicular traffic operating under the jurisdiction of the facility, effecting coordination with appropriate positions of operation and other facilities, providing flight assistance service to aircraft as required. . . ." The procedures to be utilized in the execution of these functions are set forth in FAA Handbook 7110.8 entitled, "Terminal Air Traffic Control." This manual does not specify any

in-flight separation minima for VFR operations within the control zone. In practice, the local controller provides advisories and/or instructions based on the positions of observed or known traffic, contingent upon airport conditions. The controller establishes the sequence of arriving and departing aircraft by requiring various adjustments in the flight or ground operations to achieve proper spacing. There is no required or fixed dimension to such spacing as it pertains to aircraft in flight.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

At the time of the accident, virtually ideal flying weather with unrestricted visibility existed at the St. Louis Airport. However, strong southerly winds were present, and this resulted in the designation of Runway 17 as the primary runway. Since there were no radar sequencing procedures for Runway 17, the AR controller simply cleared Ozark 965 for an ILS approach to Runway 12R or a contact approach to Runway 17, and instructed the flight to contact the local controller on the tower frequency. Such instructions are normally given to IFR flights prior to reaching the LOM (located 5.3 miles northwest of the airport) and in this instance were issued approximately 1.5 miles north of the LOM.

Meanwhile, VFR arriving traffic was required to report prior to entering the control zone (a 5-mile radius), and all arriving aircraft were then being cleared to land on Runways 17 and 12R. Departing traffic was also being interspersed on both runways. This "manual" mixing of aircraft from random reporting points, without the systematic sequencing or surveillance normally provided by the AR controller, greatly increased the workload of the local controller to the point that he was utilizing both left and right landing patterns for Runway 17 in addition to the other approaches to Runway 12R. Aside from the need to sight and identify all traffic, he faced the difficult task of judging relative speeds and distances to provide sequence and spacing. Although this required a maximum amount of pilot/controller coordination through communication, the volume of traffic required almost continuous use of the local control frequency. The controller, of necessity, was issuing instructions to several aircraft in each transmission, and there was limited opportunity for acknowledgments from the pilots to whom the instructions were issued. Thus, the effectiveness of timely communication which, under the circumstances, was the controller's principal means of maintaining an orderly flow of mixed VFR/IFR traffic, began to deteriorate. This was demonstrated at 1754:00 when N8669G reported over St. Charles with information "golf." The tower's reply was: "Six niner golf stand by I'll get to you in a moment. Frontier four seventy six a right turn off cross one two contact ground control. Cessna one seven yankee runway one two right is cleared for takeoff. Eastern three eighty six you gonna land twelve or seventeen?"

At 1754:43, the local controller advised, "Okay, two two ~~tra~~ I have you in sight, and six niner golf report right downwind runway one seven, and who's the other aircraft at St. Charles?" No acknowledgment of either transmission was received from N8669G, and it is obvious that there was limited opportunity for the crew to do so.

At 1756:09, Ozark 965 made its first contact on the tower frequency, "Ozark nine sixty-five on a right base." Although N8669G could have heard this call, the pilots would have had no way of knowing which runway was involved. Indeed, they may have logically assumed that the larger aircraft was approaching Runway 12R. The local controller stated that, after confirming the location of Ozark 965 and observing traffic in its vicinity, he advised at 1756:31, "Okay, you're number two to follow a Cessna on a real short final for one seven and traffic is a Cessna looks like ahead and to your right maybe to your left there northeastbound." The local controller assumed that the Cessna in question was N8669G since it was the only aircraft under his jurisdiction whose position had not specifically been accounted for. After a few seconds pause, he transmitted, "Six nine golf if that's you out there about to turn final ~~pull~~ out to your ~~ah~~ well just proceed straight on across the final and enter on a left base leg for runway one seven. You'll be following an Ozark DC nine turning final about two out maybe to your left and above you, you have him?" At 1756:58, N8669G replied, "Six nine golf roger." The local controller stated that, at this time, N8669G appeared to be across the final approach course, and approximately 1/2 mile from Ozark 965. At this point, 14 seconds prior to collision, both crews had been advised that they were mutual traffic for each other.

Unfortunately, while the crew of Ozark 965 was able to sight the "Cessna on a real short final (N70F)" they were unable to detect N8669G which was, at that time, slightly over 3,500 feet off their right front quarter, according to the visibility study. Further, it appears that while the crew of N8669G heard the instruction to proceed across the final approach course, they either did not hear the traffic advisory warning of the DC-9 or they attached no urgent significance to it and ignored it temporarily.

The local controller again issued a traffic warning to Ozark 965 at 1757:06, "Ozark nine sixty-five traffic's that Cessna off to your right looks like he's wa eastbound." Although no verbal acknowledgment from the crew was recorded, they stated that they did receive this transmission, but it was too late to avoid the collision which occurred at 1757:12.

The cockpit visibility study attempted to establish as accurately as possible what physical restrictions to vision may have hindered each crew in the observation of the other aircraft. N8669G was apparently between Ozark 965 and the airport throughout the period that both were operating in the control zone. Accordingly, the attention of the pilots of N8669G would have been focused toward the airport on their right and away from

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Ozark 965. Additionally, the high-wing construction of the Cessna would have prevented **all** but the most concerted efforts of the crew to see Ozark 965 if they had looked up and to the left. It is presumed that, like the local controller, the crew of N8669G must have assumed **that** they were clear of Ozark 965, and intended to spot that aircraft **after** they had completed their turn to a left base. Another possibility is that they may have been more immediately engrossed in their closure with another light aircraft (N402T), which was already on a left base for Runway 17.

Ozark 965 executed a gentle left turn, divergent to the general flight-path of N8669G, between 1 and 2 minutes prior to collision and, during the last minute prior to the accident, it was in a descending right turn toward N8669G. Throughout most of this period, the crew should have been aware of the conflicting traffic which was in the general direction **that** their attention should have been focused. Eased on a fixed-eye reference point, only the first officer had a protracted length of time during which N8669G would have been visible in the last minute before collision. However, the amount of sighting time available to each crewmember, based on fixed-eye reference points, cannot be considered valid because **all** of the crewmembers should have been actively engaged in scanning the airspace ahead of the aircraft throughout the approach and, therefore, each could have detected the Cessna at times other than specified in the study. Thus, the Board concludes that with a reasonable degree of vigilance on their **part**, the crew of Ozark 965 should have sighted the Cessna in time to avoid the collision.

The preceding portion of the analysis has dealt mainly with the dynamics of the collision; however, in properly evaluating **all** of the circumstances of the accident, other pertinent factors must also be considered.

First, it must be remembered that the local controller was operating near the maximum of his capabilities in terms of traffic load. Although there was no requirement for him to provide in-flight separation of aircraft operating in the control zone, he was responsible for providing pertinent advisory information to pilots and for establishing an orderly landing sequence. Accomplishment of this task required two-way communication. Pilots need to report their positions, and receive instructions in return. The tempo of transmissions had increased to the point that scarcely 3 to 4 seconds elapsed between necessary reports from pilots and subsequent instructions from the local controller, and there was virtually no time for acknowledgment. Although verbal acknowledgment is not required, since receipt of most instructions becomes evident in the movement of the aircraft, it becomes necessary for the controller to monitor each flight more closely to insure that his instructions are being carried out. In the instant case, the local controller did **not** have assurance that his instructions were being carried out, and in fact they were not. In view of the rapidly increasing traffic situation, it can be seen that it was important for the controller to know that the Cessna had, indeed, received the instructions to report

downwind as this would be the only method by which he would have ample time to see the aircraft and establish a proper landing sequence with other aircraft in the pattern. It appears that, on the contrary, he simply dismissed N8669G from his mind until such time as he would receive the requested call "entering the downwind." Consequently his next conscious awareness of N8669G occurred when he observed the as yet unidentified Cessna in the vicinity of Ozark 965, on the base leg for Runway 17.

It can be argued that first established radio contact between the tower and N8669G did not occur until 14 seconds prior to impact. At this time, the controller's concern for the rapidly developing conflict in traffic is indicated by the fact that he instructed N8669G to fly straight across the final approach course, which was also a risk because N402T was already in a left hand pattern for Runway 17. It is perhaps moot whether the controller forgot about the other traffic, or simply considered this course of action as the lesser of two evils, because it is clear that he was not able to establish landing sequence in an orderly manner. The crew of N402T estimated that they were less than 1/2 mile from the collision point. However, because of the distance and position of the Cessna and the DC-9 from the Tower Cab, the controller could not visually determine the position of N8669G in relation to the extended centerline of Runway 17, and was probably reluctant to issue evasive maneuver instructions to either aircraft because of the difficulty in judging their relative positions.

With a daylight radar display (bright display) it is possible even at that juncture that the controller could have issued effective collision avoidance instructions to the pilot. More importantly, the equipment would have enabled him to prevent development of the situation to this critical point. 9/

Second, the crew of N8669G either did not hear the tower's instructions regarding traffic pattern entry and entered the control zone without two-way radio communication with the tower, or simply failed to comply with the instructions issued. In either event, the flight did not sufficiently inform the tower of the aircraft's progress into the airport landing traffic pattern. Time-distance computations indicate that the aircraft did not enter on a downwind, but proceeded on a direct course from St. Charles to the collision point. If the pilot did not receive the instructions, he should have attempted further contact with the tower before entering the traffic pattern. Instead the flight virtually reached the final approach course and still had no sequence to land. In fact their only transmission, prior to the acknowledgment of instructions to enter a left base, was the initial contact at St. Charles when they entered the control zone. Notwithstanding the fact that information "golf" had provided them with the necessary landing information, it must be concluded that the crew of N8669G did not conform with established operating practices in conducting the approach in the manner they did without at least informing the tower of their progress.

9/ See Recommendations (Section 3).

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Third, the failure of the crew of Ozark 965 to sight N8669G must be considered crucial, if only because it was the final opportunity to avoid the collision. There were three crewmembers aboard the flight instead of the normal two. This constituted an extra set of eyes and yet they failed to see the conflicting traffic. It would seem that the subsequent instructions to N8669G relative to the final approach course would have served as additional impetus to increase their vigilance as they continued in a descending right turn. However, there was no further apparent concern until the controller again pointed out the Cessna with less than 6 seconds to react.

Finally, and of equal importance, the Board believes that this accident shows that the basic philosophy of VFR procedural control used in the air traffic control system must be re-evaluated for adequacy for present and future air traffic operations. It is believed that separation criteria for aircraft operating within a control zone must be established and the air traffic control system must assume a major responsibility for the safe separation of aircraft under jurisdiction of the tower within this airspace. The facts of this accident and others demonstrate that the pilot's visual ability to effect his own separation is not of itself sufficient to assure the level of safety demanded for present and future air operations.

2.2 Conclusions

(a) Findings

1. Both aircraft were properly certificated and airworthy.
2. All flight crewmembers were properly certificated.
3. There is no evidence of any malfunction of either aircraft prior to collision.
4. Both aircraft were operating VFR in the control zone.
5. The weather was clear and visibility good.
6. At the time of the accident, Runways 17 and 12R were being utilized by the local controller for arriving and departing aircraft. Both left and right landing traffic patterns were in use for Runway 17 which was the primary runway.
7. Lambert Field has no published VFR traffic pattern procedures.
8. Communications were almost continuous on the local control frequency, and multiple instructions were being issued to different flights in the same transmission.

9. Verbal acknowledgment for instructions was not received by the local controller on a number of occasions.
10. Time and distance calculations indicate that the Cessna proceeded directly from over St. Charles to a right base leg entry for the Landing traffic pattern.
11. The Cessna crew either did not receive the instruction to enter the traffic pattern downwind and entered the control zone without establishing two-way radio communications, or, failed to comply with the issued instructions.
12. The tower issued a traffic advisory to the IS 9 regarding N8669G approximately 41 seconds prior to the collision.
13. Traffic information concerning the DC-9 was given to N8669G by the tower approximately 29 seconds prior to the collision.
14. Ozark pilots, if exercising reasonable vigilance, could have sighted the Cessna in time to avoid the collision. The Cessna crew could not have been expected to see and avoid the E-9.
15. The local controller was unable to determine accurately by visual observation the position of each aircraft with respect to the other.
16. With a daylight radar display, it is possible that the controller could have issued effective collision avoidance instructions.

(b) Probable Cause

The Safety Board determines that the probable cause of this mid-air collision was the combination of: the inadequacy of current VFR separation standards in controlled airspace, the crew of the DC-9 not sighting the Cessna in time to avoid it, the absence of VFR traffic pattern procedures to enhance an orderly flow of landing aircraft, the local controller not assuring that important landing information issued to the Cessna was received and understood under the circumstances of a heavy traffic situation without radar assistance, and the Cessna crew's deviation from their traffic pattern instructions and/or their continuation to a critical point in the traffic pattern without informing the local controller of the progress of the flight.

3. RECOMMENDATIONS

On June 14, 1968, the Board sent a letter to the Federal Aviation Administration recommending that:

- (a) Daylight radar display equipment be installed in the Lambert Field Tower Cab at the earliest possible date.
- (b) Greater utilization of the facility radar be made so as to provide radar sequencing, monitoring, and advisory service on a full-time basis until Phase II of the National Terminal Radar Service Program can be implemented at St. Louis.
- (c) VFR patterns (entry points, tracks, and altitudes) be established for the Lambert Field control zone to be utilized by those aircraft not participating in a radar program.
- (d) All of the above recommended actions be considered for their applicability to other locations similar to St. Louis.

On June 28, 1968, the Administrator in reply to the foregoing recommendations advised that:

- (a) The installation of daylight bright tube radar displays has been completed at the St. Louis Airport.
- (b) Stage II of the National Radar Program, which will involve radar sequencing, monitoring and advisory service to aircraft, was scheduled December 1, 1968.
- (c) The FAA had under consideration the establishing of VFR entry and departure routes for Lambert Field. It was stated, however, that the use of VFR traffic corridors will not eliminate the "mixing bowl" situation somewhere in the airport traffic pattern particularly where multiple runways are in use simultaneously.

(d) All of the above recommended actions are being considered for applicability at other locations which have problems similar to Lambert Field.

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

APPENDIX A

Captain R. J. Fitch, aged 53, held airline transport certificate No. 26107-40 with ratings in E-3, E-4, E-9, L 18, C 46, F 27/227, CV 240/340/440, M 202/404. He had accumulated 24,127 total flying hours of which 800 hours were in the E-9. His last proficiency check was completed November 17, 1967, and his FAA first-class medical certificate was issued September 27, 1967, with the limitation that corrective glasses (near vision) must be worn while flying. He had been off duty for 12 hours 42 minutes prior to this flight.

First Officer W. C. Oltman, aged 43, held airline transport pilot certificate No. 354408 with ratings in DC-3 and airplane single and multiengine land. He had accumulated 9,805 total flying hours of which 1,188 hours were in the E-9. His last proficiency check was completed August 19, 1967, and his FAA first-class medical certificate was issued January 16, 1968, with the limitation that glasses must be worn while flying. He had been off duty for 12 hours 42 minutes prior to this flight.

Captain R. W. Traub, aged 46, held airline transport pilot certificate No. 333086 with ratings in E-3, E-9, CV 240/340/440, F-27, M 202/404. He had accumulated 18,402 total flying hours of which 51 hours were in the DC-9. His last proficiency check was completed March 26, 1968, and his FAA first-class medical certificate was issued November 29, 1967, with no limitations. He had been off duty 15 hours prior to this flight.

Hostess Shirley Waggoner, aged 30, was hired on September 29, 1958. She completed her last emergency procedures training on July 7, 1967.

Hostess Marilyn Schroepfer, aged 27, was hired on July 1, 1965. She completed her last emergency procedures training on July 12, 1967.

Instructor Pilot B. L. Allen, aged 31, held commercial pilot certificate No. 1617257 with ratings for airplane single engine land and flight instructor. He had accumulated 380.7 total flying hours. His last proficiency check was completed on March 26, 1968, in a Cessna 172, and his FAA second-class medical certificate was issued October 31, 1967, with no limitations. He was employed as a part-time instructor by Interstate Airmotive, Inc.

Instructor Pilot-Trainee John Brooks, aged 34, held commercial pilot certificate No. 17905 with a rating for airplane single engine land. He had accumulated 174 total flying hours. His last proficiency check was completed March 13, 1968, and his FAA second-class medical certificate was issued December 11, 1967, without limitations.

APPENDIX B

Aircraft Information

N970Z, a Douglas DC-9, S/N 45772, was manufactured May 5, 1966. At the time of the accident the aircraft had a total time of 5172:54 hours.

Aircraft records indicate that N970Z had been maintained in accordance with all company procedures and FAA directives.

The Cessna 150F, N8669G, was owned by Interstate Airmotive, Inc., and had accumulated a total aircraft time of 1392:24 hours at the time of the accident.

A review of **all** available aircraft records indicates that the aircraft was maintained in accordance with approved procedures and directives.

APPENDIX C

LEGEND

- CAM - Cockpit Area Microphone Circuit
- #? - Three men on flight deck. Identity of speaker unknown
- #1 - Voice assumed to be the Captain's
- #2 - Voice assumed to be the Copilot's
- #3 - Voice assumed to be the additional crewmember's
- RDO - Radio transmission from Ozark 965
- TWR - Radio transmission from St. Louis local controller
- SPKR - Radio transmission on tower frequency 118.5 MHz emanating from DC-9 cockpit speaker system
- [] - Recorded sounds or times of significant interest
- * - Unintelligible conversation
- () - Words enclosed within parentheses are not clearly understood and are subject to interpretation. Those shown represent the best interpretation of what the person said.
- - Underlined portions of the transcript are intended to assist the reader to more easily identify crew conversation and pertinent radio transmissions to or from the flight.

CONTENT

- 1755:26 Ozark 965 radio tuned to St. Louis local control frequency. Tower transmissions are emanating from the aircraft's cockpit speaker system and recorded on CAM channel
- 1755:30 SPKR Okay, I'm going to (the terminal)
- 1755:32 SPKR Okay, six four data change your ah transmitter to tower frequency one eighteen point five. Cherokee zero two juliet taxi into position and hold, Delta three sixty five taxi into position and hold on one two [1755:44]

1755:39 CAM#? (You want the other runway)
CAM#? You want - - - - you want - - - one two?
1755:44 CAM#? There's one two ain't it?
1755:44 SPKR Okay, three sixty five
1755:46 CAM#? Yeah
1755:47 SPKR Cherokee two two ~~in~~ runway one seven cleared for take-off. Who's the Cessna
1755:51 CAM [Sound similar to that of landing gear being lowered]
(SPKR
cont.) Up there at one seven for takeoff?
1755:54 CAM Bound of gear warning horn?
1755:54 SPKR Six four delta is that you that just taxied on the runway? I'm not hearing you on tower frequency one eighteen point five change your transmitter [1755:58]
1755:57 CAM? **
1755:58 SPKR Ah - roger do you read me now?
1756:01 SPKR Gotcha now six four delta hold in position. Eastern - ah - three eighty six a right turn off contact ground control
1756:06 SPKR OK
1756:07 SPKR Roger
1756:09 RDO#1 Ozark nine sixty five on a right base
1756:12 SPKR Roger, Cessna six four delta cleared for takeoff runway one seven
1756:17 CAM#? (You got thirty.)
1756:17 SPKR Gee southeast turning downwind for one seven
1756:21 TWR Aircraft southeast for one seven roger, Cessna seven zero fox is cleared to land runway one seven and Ozark nine sixty five that you on the base?
1756:29 RDO#1 Yes sir.

1756:31 TWR Okay, you're number two to follow a Cessna on a real short final for one seven and traffic is a

1756:35 CAM#? (Better slow down)

TWR
(cont.) Cessna looks like ahead and to your right, maybe to your left there northeastbound

1756:43 CAM#? I don't see it (out there) at all

#? Now [1756:47]

1756:43 SPKR Six nine golf if that's you out there about to turn final pull out to your " ah - well just proceed straight on across the final and enter on a left base leg for runway one seven. You'll be following an Ozark DC nine turning final about two out maybe to your left and above you, you have him?

1756:58 SPKR Six nine golf " roger.

1757:01 SPKR (Unintelligible) has got Ozark in sight can we follow him in we're crossing the double highways

1757:06 TWR Ozark nine sixty five traffic's that Cessna off to your right looks like he's wa eastbound [1757:09]

1757:10 CAM#3 Look out!

1757:12 CAM [Collision]

1757:14 SPKR St. Louis tower (Unintelligible)

1757:17 CAM? (Keep the power on)**

? (It's on)

1757:17 SPKR St Louis tower that ah Ozark hit that little one " ah - zero two T calling Ozark or " ah - St. Louis tower.

1757:29 TWR Ozark nine sixty five you OK.

1757:32 CAM#1 Better call the (*)

1757:33 RDO#2 We're OK get that airplane off the ground off the runway

1757:37 SPKR Seven zero fox clear the runway to the right immediately

1757:41 CAM#? Ah (this) hit him pretty hard
1757:47 CAM#? Now ease it back.
1757:50 SPKR St Louis tower Cessna three nine one eight juliet over the river north with golf.
1757:56 CAM [Ozark 965 touchdown on runway]
1757:58 CAM [Sound of reverse thrust]
1758:06 TWR Ozark nine sixty five the equipment is on the way if you want to stop on the runway.
1758:12 RDO#? We're experiencing no difficulty
1758:15 CAM#? I'll take it.
1758:16 TWR Ozark nine sixty five roger, there is fuel looks like leaking from your right side.
1758:20 CAM#? * * *
1758:23 CAM? Take your feet off the brake
1758:25 CAM? I'm off
1758:38 CAM * x *
1758:48 CAM#? (We gonna take em off here)
#? Yeah
1758:51 CAM#? *Man I sure didn't see him
1758:53 CAM Electrical power removed from recorder. End of recording pertaining to flight.

