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AIRCRAFT SERIOUS INCIDENT
INVESTIGATION REPORT

PRIVATELY OWNED
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ACADEMIC CORPORATE BODY HIRATAGAKUEN
J A 8 3 1 H

February 28, 2019

JTSB Japan Transport Safety Board

The objective of the investigation conducted by the Japan Transport Safety Board in accordance with the Act for Establishment of the Japan Transport Safety Board and with Annex 13 to the Convention on International Civil Aviation is to prevent future accidents and incidents. It is not the purpose of the investigation to apportion blame or liability.

Kazuhiro Nakahashi
Chairman
Japan Transport Safety Board

Note:

This report is a translation of the Japanese original investigation report. The text in Japanese shall prevail in the interpretation of the report.

AIRCRAFT SERIOUS INCIDENT INVESTIGATION REPORT

A SITUATION WHERE A PILOT IN COMMAND OF AN AIRCRAFT RECOGNIZED A RISK OF COLLISION OR CONTACT WITH ANY OTHER AIRCRAFT OVER AKASHI CITY, HYOGO PREFECTURE AT 16:24 JST, NOVEMBER 11, 2017

1. PRIVATELY OWNED ROBINSON R44 II (ROTORCRAFT), JA274J

2. ACADEMIC CORPORATE BODY HIRATAGAKUEN EUROCOPTOR EC135P2+ (ROTORCRAFT), JA831H

January 25, 2015
Adopted by the Japan Transport Safety Board

Chairman Kazuhiro Nakahashi
Member Toru Miyashita
Member Toshiyuki Ishikawa
Member Yuichi Marui
Member Keiji Tanaka
Member Miwa Nakanishi

1. PROCESS AND PROGRESS OF THE INVESTIGATION

1.1 Summary of the Serious Incident	On Saturday, November 11, 2017, a privately owned Robinson R44 II, registered JA274J, took off from Yao Airport and was flying toward Taishi Temporary Helipad in Hyogo Prefecture. Meanwhile, a Eurocopter EC135P2+, registered JA831H, operated by Academic Corporate Body HIRATAGAKUEN, took off from Hyogo Prefectural Kakogawa Medical Center Temporary Helipad and was flying toward JA Hyogo Minami-Uozumi Rice Center. Then, JA274J and JA831H were closely approaching each other over Akashi City in Hyogo Prefecture, and the pilot of JA274J took evasive actions as having recognized the risk of collision.
1.2 Outline of the Serious Incident Investigation	On November 15, 2017, the pilot in command (PIC) of a privately owned Robinson R44 II, registered JA274J, submitted a Near Collision Report to the Ministry of Land, Infrastructure, Transport and Tourism (A report pursuant to the provision of Article 76-2 of Civil Aeronautics Act and Article 166-5 of Ordinance of the Enforcement of the Civil Aeronautics Act [Ordinance of Ministry of Transport No. 56 of July 31, 1952]). Consequently, it is classified as a serious incident.

	On November 15, 2017, the Japan Transport Safety Board (JTSB) designated an investigator-in-charge and an investigator to investigate this serious incident. Although this incident was notified to the United States of America and the Federal Republic of Germany as the States of Design and Manufacture of the aircraft whose pilot submitted the Near Collision Report and of the other aircraft, respectively, the States did not designate their accredited representatives. Comments were invited from parties relevant to the cause of the serious incident and the Relevant States.

2. FACTUAL INFORMATION

2.1 History of the Flight	(1) Following is an outline of the Near Collision Report submitted by the pilot in command (hereinafter referred to as "the PIC") of a privately owned Robinson R44 II, registered JA274J (hereinafter referred to as "Aircraft A"). Date and Time of incident: About 16:25 Japan Standard Time (JST,UTC+9hours), November 11, 2017 Position at time of incident: Over Uozumicho, Akashi City, Hyogo Prefecture Phase of flight: During level flight at an Altitude between 1,000 and 1,100 ft in a magnetic heading of 290°, at a speed of 90 kt Other aircraft: Rotorcraft painted red and white Position of other aircraft and distances between aircraft first sighting: The direction between 1 and 2 o'clock, horizontal distance between 5 and 10 km, 200 ft downward Position of other aircraft and distances between aircraft at closest proximity: The direction of 12 o'clock, horizontal distance between 30 and 60 m, vertical difference between 100 and 200 ft Proximity situation: Converging or Crossing courses Evasive action: Aircraft making report: Yes (right turn climb); Other aircraft: Unknown (right turn descent) (2) Based on air traffic control communications, radar tracking records, records provided by the Japan Civil Aviation Bureau, as well as the statements of the PICs of Aircraft A and Eurocopter EC135P2+, registered JA831H (hereinafter referred to as "Aircraft B"), operated by academic corporate body HIRATAGAKUEN and the mechanic (for outside watch) of Aircraft B, the history of the flight by both aircraft is summarized below. The privately owned Aircraft A took off from Yao Airport at 15:58 on

November 11, 2017 and was flying toward Taishi Temporary Helipad under

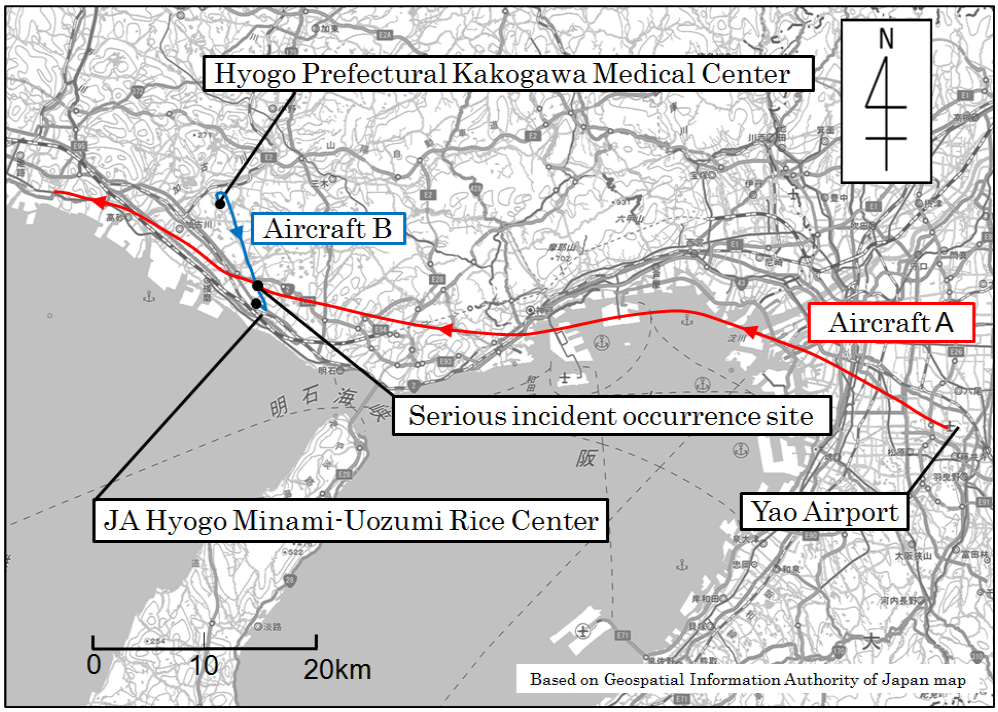
Photo: Aircraft in the Serious Incident

VFR*1 with only the PIC in the right pilot seat.

On the other hand, in response to the request for the emergency medical service, Aircraft B took off from Hyogo Prefectural Kakogawa Medical Center Temporary Helipad at 16:22 on November 11, 2017 and was flying toward JA Hyogo Minami-Uozumi Rice Center, under VFR with the PIC in the right pilot seat and the mechanic as an outside watch in the left pilot seat, and two medical experts in the aft seats. During flight, the mechanic assisted the PIC in accordance with the internal regulations by monitoring the instruments and others and looking outside of Aircraft B.

The PIC of Aircraft A identified visually Aircraft B forward right below during flight over Akashi City, however, after that, he was not able to ascertain the heading of Aircraft B because Aircraft B was climbing in a short time while making a turn. Unable to pay attention to only downward when flying on the flight route, once the PIC of Aircraft A lifted his eyes to look forward in order to maintain a lookout on its flight direction and flew at an altitude between 1,000 and 1,200 ft for a while. After that, when the PIC of Aircraft A reverted his eyes to Aircraft B, it appeared that Aircraft B was approaching Aircraft A from the angle of 45° right below Aircraft A and then suddenly it came close to the altitude difference between 100 and 200 ft. Therefore, the PIC of Aircraft A recognized the risk of collision, reduced the speed, tilted the control stick slowly to the right so as not to make a risky haste operation, and took evasive action; and at this moment, to the PIC of Aircraft A, Aircraft B looked as if to make a rapid turn to the right and go descending below Aircraft A, being so close that the sign of "Doctor Heli" shown on the side of its fuselage could be recognized. For this reason, the PIC of Aircraft A thought that Aircraft B had spotted Aircraft A just before flying by and took evasive action. As there was the flight visibility of about 10 km, the PIC of Aircraft A did not see the sun dazzling

*1 "VFR" stands for Visual Flight Rules, the flight rules other than instrument flight rules (IFR). Under VFR, pilots navigate or establish geographical position by visual reference to landmarks on the surface, other airborne aircraft and clouds. Therefore, pilots should also have their responsibility to avoid collision of the surface and other airborne aircraft.

	because it was covered with layers of clouds around the horizon to the left (west). On the other hand, Aircraft B climbed to an altitude of 1,200 ft while making a right turn after taking off, and after that, the PIC of Aircraft B turned his eyes toward its destination, JA Hyogo Minami-Uozumi Rice Center, gradually descending while flying straight, when the mechanic, who had been maintaining a vigilant lookout, found something not clearly identified diagonally forward left. Before long, the mechanic visually identified it as Aircraft A and advised the PIC, saying "Above on the left" for attention to Aircraft A. When the PIC of Aircraft B looked up above on the left, Aircraft A was already passing just above on its left side, therefore, he did not recognize for risk of collision and continued the descent without taking evasive action. The PIC of Aircraft B remembered that it was at 1,000 ft or less when Aircraft B was flying by Aircraft A, but could not figure out how close the proximity to Aircraft A was. This serious incident occurred at about 16:24:06 on November 11, 2017, over Akashi City, Hyogo Prefecture.  Figure 1: Estimated Flight Route
2.2 Injuries to Persons	None
2.3 Damage to Aircraft	None
2.4 Meteorological Information	The weather observations about the time of this serious incident are as follows, which were observed at Akashi Automated weather station, Japan Meteorological Agency, located about 1.4 km southwest of the serious incident occurrence site

	16:20 Precipitation: 0 mm, Temperature: 14.6 °C Wind direction/ Wind velocity (average): Northwest 5.4 m/s (Maximum momentary) 9.3 m/s Sunshine duration: 0 minute 16:30 Precipitation: 0 mm, Temperature: 14.5 °C Wind direction/ Wind velocity (average): Northwest 6.8 m/s (Maximum momentary) 10.4 m/s Sunshine duration: 0 minute Sunset time: 16:58 (Akashi City)
2.5 Additional Information	(1) Aircraft information (at the time of the occurrence of the incident) a) Aircraft A Aircraft type: Robinson R44 II Maximum takeoff weight: 1,134 kg, Single-Engine Piston Land Transponder Activation Lights of Aircraft - Navigation lights (Green and red lights on both sides of the fuselage) On - Anti-collision lights (Strobe red flashing lights on the upper end of the tail boom) On - Landing lights (White lights that illuminate the nose and down ahead of the aircraft) On Radio equipment Equipped with a VHF radio (Monitored to the frequency of Osaka Flight Service Center) b) Aircraft B Aircraft type: Eurocopter EC135P2 + Maximum takeoff weight: 2,950 kg, Multi-Engine Turbine Land Transponder Activation Lights of Aircraft - Navigation lights (Green and red lights on both sides of the horizontal stabilizer and white flashing light on the upper part of the vertical stabilizer) On - Anti-collision lights (Strobe white flashing lights on both sides of fuselage) On - Landing lights (white lights that illuminate the nose and down ahead of the aircraft) On Radio equipment Equipped with two VHF radios (Monitored to intercommunication frequency and the Company radio frequency) (2) Analysis based on radar tracking records The radar tracking records retained distance, azimuth and altitude from the radar antenna to Aircraft A and Aircraft B, respectively. Based on these information, each track of Aircraft A and Aircraft B was created to estimate the position and altitude of both aircraft. (See Figure 2: Proximity of Both Aircraft.)

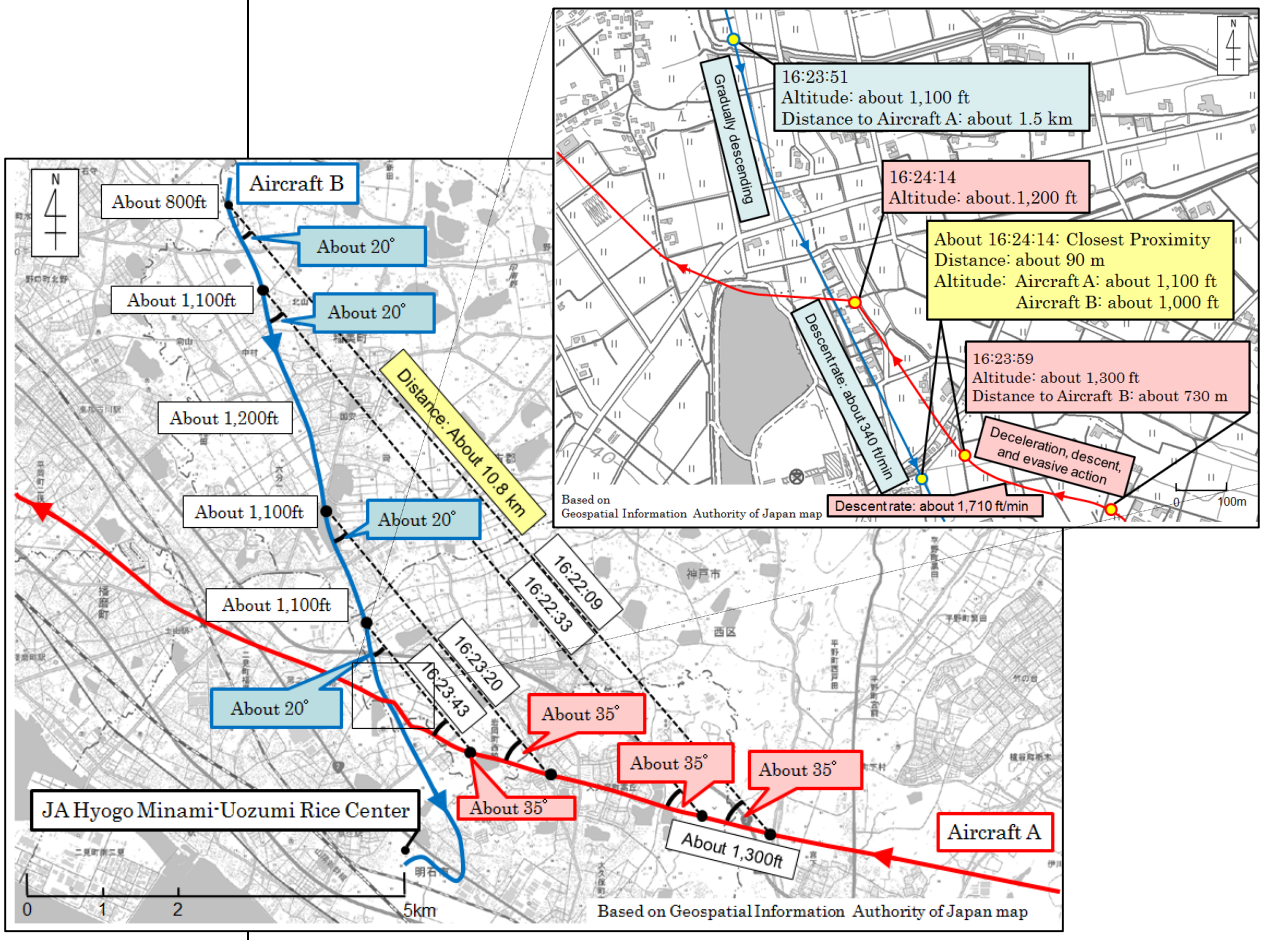


Figure 2: Proximity of Both Aircraft

(3) Collision Course

A collision course is described in page 9-7 of the AIM-J (Aeronautical Information Manual Japan) published by the Japan Aircraft Pilot Association on December 20, 2017 as below.

〖Prevention of Mid-air Collision〗

a. Collision avoidance

Relations between aircraft velocity and human eye capabilities make it almost impossible to visually avoid mid-air collisions in most critical cases. More effective technology is required to perfectly avoid mid-air collisions. Collision avoidance systems *2 *are being developed; however, pilots are basically required to "see and avoid" traffic as obligated by law.*

b. Judgment of collision course

*2 Airborne Collision Avoidance System refers to a system that issues interrogation radio wave to the other aircraft nearby, displays the azimuth, distance and altitude as reported by the interrogated other aircraft, constantly monitors the proximity to other aircraft and provides advice to the pilot depending on the degree of proximity. Airborne Collision Avoidance System is mandated by the Civil Aeronautics Act to be fitted to all aircraft authorized to carry more than 19 passengers, or with a maximum take-off mass of over 5.7 t. Simplified Airborne Collision Avoidance System, which can be installed on small aircraft that are not obligated to install the system, have also been developed.

As obviously shown in Figure 3, if two aircraft approach with the constant relative bearings (α and β), both aircraft are on a collision course. It is known that human eyes are good at finding moving objects, but poor at finding stationary objects.

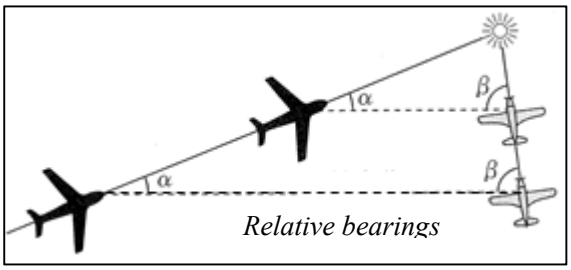


Figure 3: Judgment of Collision Course

Pilots should be aware that finding another aircraft tends to be delayed when the aircraft is on a collision course since the aircraft looks stationary. (Omitted)

c. *How it looks depending on the relative speed*

When the relative speed of aircraft approaching each other is great, there is an incredible change in how the other aircraft looks. That is, there is a phenomenon that, until a certain point, the other aircraft looks very tiny, but suddenly it has become much bigger just before collision, and in the next instant, colliding into each other. (Omitted)

(4) Effective Scanning

Effective scanning is described in page 3 of the Advisory Circular "AC 90-48D" (Subject: Pilots' Role in Collision Avoidance) published by the U.S. Department of Transportation Federal Aviation Administration (hereinafter referred to as "FAA") in 2016 as below.

Effective scanning is accomplished with a series of short, regularly spaced eye movements that bring successive areas of the sky into the central visual field. Each movement should not exceed 10 degrees, and each area should be observed for at least 1 second to enable detection. Although most pilots seem to prefer horizontal back-and-forth eye movements, each pilot should develop a scanning pattern that is most comfortable and then adhere to it to assure optimum scanning.

(5) Reaction Time Taken by Aircraft

Aircraft Identification and Reaction Time is described in page 2 of the Advisory Circular "AC 90-48D" (Subject: Pilots' Role in Collision Avoidance) published by the FAA in 2016 as below.

Event	*Seconds*	
See Object	*0.1*	1.1
Recognize Aircraft	*1.0*	
Become Aware of Collision Course	*5.0*	11.4
Decision to Turn Left or Right	*4.0*	
Muscular Reaction	*0.4*	
Aircraft Lag Time	*2.0*	
TOTAL	*12.5*	

	Figure 4: Aircraft Identification and Reaction Time Chart (6) Measures to Enhance the Visibility As one of measures to prevent recurrence of similar accidents to the mid-air collision between news coverage helicopters that occurred over Akashi City in Hyogo Prefecture in July 1984, following specific examples of measures to enhance the visibility of the aircraft were notified by the Civil Aviation Bureau to aircraft operators through relevant aviation organizations, and when a similar accident occurred afterward, it was requested to take those measures to prevent recurrence. a) Landing lights shall be lit up during flight as much as possible, making efforts to improve the head-on visibility of the aircraft even in the daytime. b) White flashing lights (Strobe) shall be installed to improve the visibility from the side. c) A high visibility coating shall be made on the surface of the airframe and rotor blades to make it easier for the aircraft to be identified visually. (7) Related Laws and Regulations *(Pilot's Obligation for Keeping Watch)* ***Article 71-2*** *Any person who is piloting an aircraft* (Omitted) *shall keep watch so as not to collide with other aircraft or other objects.*

3. ANALYSIS

3.1 Involvement of Weather	None
3.2 Involvement of Pilots	Yes
3.3 Involvement of Aircraft	None
3.4 Analysis of Findings	(1) Weather Conditions The weather conditions, when Aircraft A and Aircraft B approached each other, were visual meteorological conditions (VMC); therefore, it is probable that as the visibility was good, there was no factor, including the position of the sun and others, which would impede the visual identification of the other aircraft. (2) Approaching Situations of Both Aircraft and Visual Identification of the Other Aircraft It is probable that the PICs of both Aircraft were flying while keeping watch outside as usual. It is highly probable that although once the PIC of Aircraft A visually identified Aircraft B, Aircraft A and Aircraft B were flying almost on constant relative angle of a collision course at 16:22:09, with a distance between both aircraft approximately 10.8 km; therefore, the PICs of both aircraft were not able to visually identify each other until just before they approached each other closest at about 16:24:06, with a distance between both aircraft approximately 90 m and their altitude

difference of about 100 ft (Aircraft A: about 1,100 ft, Aircraft B: about 1,000 ft).

According to the statement of the PIC of Aircraft A and the submitted Near Collision Report, Aircraft A reduced speed and climbed while making a right turn during evasive maneuver, and Aircraft B descended while making a quick right turn after approaching from below on the right side of Aircraft A. However, according to the radar tracking records, in fact, Aircraft A changed its heading rightward while descending at a descent rate temporarily higher than that of Aircraft B and started climbing after coming closest to Aircraft B, and Aircraft B was descending from below on the right side of Aircraft A without changing its heading. Based on these records, it is highly probable that to the PIC of Aircraft A, Aircraft B looked as if to approach rapidly from below on the right side of Aircraft A and go descending while making a quick right turn.

As described in the FAA document "AC 90-48D", it will take 1.1 seconds for "See Object" and "Recognize Aircraft", furthermore, 11.4 seconds for "Become Aware of Collision Course", " Decision to Turn Left or Right", "Muscular Reaction" and "Aircraft Lag Time".
(See Figure 4: Aircraft Identification and Reaction Time Chart)

It is probable that because the PIC of Aircraft A noticed Aircraft B climbing while making a right turn, it should have been necessary for the PIC of Aircraft A to maintain a lookout forward as well as watch continuously the behavior of Aircraft B until it could ascertain Aircraft B's heading, and then take evasive action much earlier by considering the reaction time for the aircraft to see and avoid. Afterward, it is probable that as described in "c. How it looks depending on the relative speed" in the AIM-J, because Aircraft B entered the collision course while the PIC of Aircraft A was maintaining a lookout forward, it became difficult for Aircraft A to see how close Aircraft B was approaching; and it was not until just before Aircraft A flew by Aircraft B that the PIC of Aircraft A recognized the collision risk.

It is somewhat likely that the PIC of Aircraft B and its mechanic, who was watching outside, would have been able to visually identify Aircraft A if they had accomplished effective scanning during turn climb before entering a collision course, as described in the FAA document "AC 90-48D". It is probable that because after that, Aircraft A and Aircraft B were on the collision course, Aircraft A seemed very tiny and stationary when looking from Aircraft B; in addition, as approaching the destination, the PIC of Aircraft B was mainly paying attention to its destination and was not able to spot Aircraft A. It is also probable that because the mechanic of Aircraft B was supporting the outside watch and paying attention to things other than the destination, he was able to visually identify Aircraft A even though it was just before they flew by Aircraft A.

It is somewhat likely that getting advice on approaching Aircraft A from the mechanic, the PIC of Aircraft B was able to visually identify

Aircraft A, when, however, Aircraft A had already been out of the collision course; therefore, the PIC of Aircraft B did not recognize for risk of collision, thus did not take evasive action.

It is probable that because both aircraft used different radio frequencies, they were not able to share the position information with each other; therefore, it should have been necessary for both aircraft to make their position report to the ATC facility and the Flight Service Center during flight in order to try to share information and obtain traffic information.

(See Figure 2: Proximity of both aircraft.)

(3) Risk Classification of Aircraft Proximity

Before flying by Aircraft B, Aircraft A had taken evasive action then the course of aircraft had changed. Therefore, it is highly probable that the minimum time to take evasive action was left for Aircraft A. Judging from the above, this serious incident is classified as "Safety not assured (The risk classification of an aircraft proximity in which the safety of the aircraft may have been compromised.)" under the ICAO Doc 4444 Air Traffic Management (PANS-ATM) CHAPTER1. Definitions Aircraft proximity.

(See Attachment: Risk Classification of Aircraft Proximity)

(4) Measures to Reduce the Risk of Collision or Contact

It is probable that in view of the investigation result of this serious incident, following measures shall be effective in order to reduce the risk of collision or contact between VFR aircraft.

a) Pilots should maintain a vigilant lookout by accomplishing effective scanning, keeping in mind that it becomes difficult to find stationary objects as the aircraft on a collision course looks stationary.

b) During flight, pilots should try to share information and obtain traffic information by making its position report to the ATC facility and the Flight Service Center.

c) When operating in the congested area, pilots should turn on effective and available lights such as anti-collision lights, landing lights and others to alert the other aircraft flying nearby.

d) Because Simplified Airborne Collision Avoidance System, which can be installed on small aircraft that are not obligated to install the system, has been developed, it is desirable for the aircraft operators to consider installing these systems on their small aircraft.

4. PROBABLE CAUSES

It is highly probable that in this serious incident, Aircraft A and Aircraft B approached each other because the PICs of both aircraft were not able to recognize each other until just before they came closer to each other.

It is probable that both aircraft were not able to recognize each other until just before they came closer to each other because both aircraft were flying on a collision course, resulting in delay in visually identifying each other.

Attachment: Risk Classification of Aircraft Proximity

ICAO Doc 4444 Air Traffic Management (PANS-ATM) CHAPTER1. DEFINITIONS Aircraft proximity	
Risk Classification	Explanation
Risk of collision	The risk classification of an aircraft proximity in which serious risk of collision has existed.
Safety not assured	The risk classification of an aircraft proximity in which the safety of the aircraft may have been compromised.
No risk of collision	The risk classification of an aircraft proximity in which no risk of collision has existed.
Risk not determined	The risk classification of an aircraft proximity in which insufficient information was available to determine the risk involved, or inconclusive or conflicting evidence precluded such determination.

Note: Air Traffic Management (PANS-ATM) 16.3.2 dictates the determination and classification of the risks according to the above in the incident report for the aircraft proximity.

As a result of the danger assessment, the gray shaded category as above is applicable to this serious incident.