Aviation Safety Investigation Report 199303898

Piper Aircraft Corp
Pawnee
Glasflugel Gmbh & Co Kg
Mosquito

24 November 1993

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Aviation Safety Investigation Report

199303898

Occurrence Number: 199303898 **Occurrence Type:** Accident
Location: 3km NE Benalla
State: VIC **Inv Category:** 3
Date: Wednesday 24 November 1993
Time: 1640 hours **Time Zone** ESuT
Highest Injury Level: Fatal
Injuries:

	Fatal	Serious	Minor	None	Total
Crew	1	1	0	0	2
Ground	0	0	0	0	0
Passenger	0	0	0	0	0
Total	**1**	**1**	**0**	**0**	**2**

Aircraft Manufacturer: Piper Aircraft Corp
Aircraft Model: PA-25-235
Aircraft Registration: VH-AYB **Serial Number:** 25-7556036
Type of Operation: Miscellaneous Glider Towing
Damage to Aircraft: Destroyed
Departure Point: Benalla VIC
Departure Time: 1625 ESuT
Destination: Benalla VIC

Crew Details:

Role	Class of Licence	Hours on Type	Hours Total
Pilot-In-Command	Commercial	30.0	221

Aircraft Manufacturer: Glasflugel Gmbh & Co Kg
Aircraft Model: Mosquito
Aircraft Registration: VH-GMN **Serial Number:**
Type of Operation: Non-commercial Pleasure/Travel
Damage to Aircraft: Destroyed
Departure Point: Benalla VIC
Departure Time: 1330 ESuT
Destination: Benalla VIC

Crew Details:

Role	Class of Licence	Hours on Type	Hours Total
Pilot-In-Command	Private	5.5	407

Approved for Release: Wednesday, September 4, 1996

FACTUAL INFORMATION

At 1640 hours ESuT, a Piper Pawnee glider tug and a Glasflugel Mosquito glider collided in the Benalla circuit area. The pilot of the tug was fatally injured. The glider pilot received serious injuries. Both aircraft were destroyed.

Sequence of events

The glider departed Benalla for a cross country flight at approximately 1330, almost three hours before the accident. The wind was from the east and the glider was towed from airstrip 08. Benalla has two gliding airstrips 08/26 and 17/35, and two general aviation runways 08/26 and 17/35.

During the hour after the glider departed, the wind changed direction to a westerly and operations were changed to airstrip 26. A radio broadcast was made on the Benalla common traffic advisory frequency announcing the change.

Approximately 20 minutes before the accident, the glider pilot was heard on the Benalla common traffic advisory frequency informing traffic that the glider was at Wangaratta at 5,000 ft and returning to Benalla. The transmission was acknowledged by Benalla Ground. The pilot did not request and was not given airfield information. This was the last broadcast received from the glider pilot.

Six minutes before the collision, the tug towed a glider from strip 26 and subsequently released the glider to the west of the airfield. Very shortly before the collision the tug pilot made a radio broadcast on the Benalla common traffic advisory frequency informing that he was downwind for runway 26. The tug was observed descending downwind on a track essentially parallel to and displaced to the north of the 08/26 strip.

Immediately before the accident, the glider was seen approaching the airfield from the north-east flying on a westerly track almost parallel to and displaced to the north of the 08/26 airstrip. The glider was entering the circuit in conflict with the established circuit pattern.

Witnesses reported seeing the glider and the tug approaching each other almost head on. The aircraft collided approximately 750 ft above ground level, at a point where the tug would have been expected to turn onto a base leg for landing. It may have just commenced the base turn.

The right wings of both aircraft were severely damaged in the impact rendering them uncontrollable. The tug impacted the ground in a nose-down attitude. The impact was not survivable. The glider entered a flat spin to the right and impacted the ground in a level attitude. The glider pilot sustained serious injuries. Due to the effects of trauma sustained in the accident, he had no recall of events between the morning of the accident and 19 December, a period of 26 days.

Wreckage examination

The major components of both aircraft were destroyed.

Examination of the glider wreckage indicated that the initial impact occurred when its right wing collided with the tug's right main landing gear strut. The glider's right wing was severed during the impact. The lower surface of the glider's right wing was imprinted with a tyre tread mark. There was no evidence of propeller slash marks on the upper surface of the wing, and the forward fuselage was not damaged during the collision.

The initial point of impact on both aircraft was outboard of their respective centres of gravity resulting in the aircraft rotating about their respective vertical axes. Consequently damage to the aircraft after the initial impact could not be used to determine the pre impact position of the aircraft.

The main landing wheel of the glider was found to be down and locked.

The examination of both aircraft and their records did not disclose any defects which may have contributed to the accident.

Determination of relative bank

The maximum and minimum relative bank angles between the glider and tug prior to impact were determined from the collision impact marks on the aircraft to be within the range of 36 and 67 degrees. There was insufficient information to determine whether both aircraft were banking at the time of impact.

The relative bank angle between the tug and glider could have resulted from the tug having commenced its base turn or as a result of avoidance manoeuvres by either or both aircraft.

Determination of relative heading

Using the measured angle of the initial cut in the right wing of the glider and an estimate of the airspeed of each aircraft, the relative headings could be determined. However, due to the inaccuracies of measuring the cut angle on the glider's wing, relative headings are expressed as ranges. The glider was situated at an angle between 7 and 11 degrees to the left of the heading of the tug. The tug was situated at an angle between 12 and 16 degrees to the right of the heading of the glider.

Rate and angle of descent.

It was not possible to determine the relative angle of pitch between the two aircraft. It is probable that the tug had a nose-down attitude and was still descending. The flight profile of the glider could not be determined.

Pilot information

The tug pilot had been flying for 4 years and held an Australian commercial pilot licence and a valid Class 1 medical certificate. His total flying experience was 221 hours. He had completed approximately 90 aero tows at Benalla during the three months prior to the accident. During that period he had also flown 36 glider flights.

The glider pilot was a visitor from England. He held valid power and gliding licences issued by the British authorities. He had flown gliders since 1952 and had accumulated 180 hours over 494 flights. He commenced flying powered aircraft in 1987 and had flown approximately 227 hours in powered aircraft prior to the accident. His medical certificate was valid and specified that vision correction was required while flying. He complied by wearing corrective lens of CR 39 resin plastic on which were fitted clip-on amber-tinted sunglasses. His visual acuity met the requirements for the issue of a private pilot licence. However, there were scratches on his glasses which, when coupled with the presence of clip-on sunglasses, would have degraded his vision while looking into the sun.

Weather

The weather was fine, there was a light wind from the west and no cloud in the immediate area. The temperature was 26 degrees Celsius and the visibility was in excess of 40 km. The sun had descended to approximately 40 degrees above the horizon. The glider was flying into the sun and the sun was behind the descending tug.

Operational procedures

The operational information pertaining to Benalla was contained in the Enroute Supplement Australia issued by the Civil Aviation Authority. The Enroute Supplement Australia stated that when gliding operations are conducted on the 08/26 airstrip at Benalla all glider and tug circuit patterns must be flown to the north of the airstrip. When operations are from 26 the circuit is to the right and when from 08 the circuit is to the left. All other aircraft operations must be conducted to the south of the airfield. This circuit arrangement of gliders and tugs to the north, and other aircraft to the south, is referred to as a contra-circuit operation.

Prior to commencing flying at Benalla, the glider pilot had been briefed by the operations manager of the Gliding Club of Victoria. The purpose of this briefing was to explain local operations at Benalla, Australian regulatory requirements, and to assess the pilot's capabilities.

The briefing included a requirement for the pilot to certify that he had read the club's Operations Handbook. The handbook was last revised in 1988 and, due in part to changes to the administration of aviation in Australia, it was out of date in many respects. The handbook was not made available to the pilot and he had not read it, even though he had signed that he had. Some parts of the handbook were relevant to the flight. Requirements for the briefing of visiting foreign pilots were not specified in the handbook, nor were the duties and responsibilities of the operations manager.

The pilot received a Visiting Pilot Information Package which contained the following statement concerning circuit joining procedures:

"When joining the circuit pilots must avoid flying in opposition to the established circuit pattern, and must join in such a way as to avoid potential conflict with existing traffic. This is especially vital when returning from a cross country flight. In this circumstance the pilot should contact the pie cart (Benalla Ground) to ascertain the runway in use"

There was no evidence that the glider pilot involved in the accident made contact with Benalla Ground to ascertain the runway in use.

The information package also contained an airfield layout diagram which detailed the requirements for ground and air movements on the same page. This made the page cluttered confusing and difficult to decipher. The package did not contain the pages of the Enroute Supplement Australia pertinent to Benalla. The package did not adequately explain the radio broadcast requirements detailed in the Aeronautical Information Publication.

The Gliding Federation of Australia's handbook, Airways and Radio Procedures for Glider Pilots, did not adequately address the positions at which the inbound and circuit joining broadcasts were to be made. The Gliding Federation of Australia advised that the handbook had been prepared during the time Civil Aviation Authority procedures were being discussed with industry. Changes emanating from those discussions were not able to be included in the handbook prior to publication. Similarly, the Manual of Standard Procedures did not address common traffic advisory frequency area entry requirements.

Although this information was detailed in the Aeronautical Information Publication, it was a discretionary, purchasable document and may not have been available at clubs and appropriate sections may not have been included in Gliding Federation of Australia documents. Therefore, the operational and regulatory information contained in such documents may not have reached all users of the airspace system.

The Gliding Club of Victoria was required to comply with the Gliding Federation of Australia's Manual of Standard Procedures. This manual did not contain any details on briefing visiting foreign pilots.

Some senior instructors and administrators in the gliding movement were not aware of the implications of the regulatory requirements in relation to circuit entry and radio procedures. The Gliding Club of Victoria operations manager believed that there was no requirement for a glider to make a broadcast when entering the circuit pattern, and because radios were not mandatory in gliders, he thought that there was no requirement for gliders to announce entry to a common traffic advisory frequency area. This belief conflicted with the recommendations contained in the Aeronautical Information Publication.

The Gliding Federation of Australia's director of operations believed that gliders could join directly onto the downwind or base legs of the circuit. This was not correct in relation to joining on base leg. Approval for aircraft to join the circuit on base was restricted to emergency procedures. Civil Aviation Regulation 145, emergency authority, provided the authority for a pilot to depart from the rules of circuit entry, contained in Civil Aviation Regulation 166, to avoid immediate danger. There was no evidence that the glider was operating other than normally, and no evidence that immediate danger or an emergency existed that would have necessitated joining on base.

The Civil Aviation Authority had approved a procedure within the Gliding Federation of Australia's Operational Regulations which allowed gliders to make two turns in a circuit prior to landing. This had been interpreted as allowing a glider to join base with one turn, and final with the second. This had been further interpreted as allowing a left turn onto base and right turn onto final, or vice versa. Such a manoeuvre would allow a glider to approach head on, to traffic conforming to a normal circuit pattern.

The tug's descent profile and circuit flying procedure were different to those flown by other powered aircraft. After releasing a glider, a tug was permitted to join the circuit downwind while in a high rate of descent, which was maintained until after turning base. The tug pilot should conduct clearing turns during the descent. These turns are designed to improve the tug pilots visual acquisition of other aircraft in the circuit. The investigation was unable to determine if clearing turns had been carried out on this flight.

The Gliding Club of Victoria was responsible for the training of the tug pilot in accordance with the club's Operations Manual, the Gliding Federation of Australia's Manual of Standard Procedures, and the Civil Aviation Authority's Flying Operations Instruction 21 4. None of these documents adequately addressed the issues of pilot workload and responsibilities.

Tug pilot training

The requirements for the control of gliding operations were monitored by procedures administered by the Gliding Federation of Australia. The monitoring of tug pilot training and operations was shared between the Civil Aviation Authority and the Gliding Federation of Australia.

The guidance pertaining to tug pilot training and tug pilot approvals contained within manuals and instructions was found to be diverse and unclear. There was inadequate emphasis placed on:

- the tug pilot's responsibilities in relation to traffic avoidance;

- the limitations of the see and avoid principle of collision avoidance;

- an awareness of the dangers inherent in the tug's descent profile;

- the need to continually clear the tug's blind spots during descent; and

- the obligation to fly the aircraft in a manner that would minimise any hazard to other traffic.

Discussions between the Civil Aviation Authority and the Gliding Federation of Australia concluded that it may be appropriate for the Gliding Federation of Australia to take a more active role and take over the responsibility for establishing and monitoring tug pilot training standards.

System surveillance and audit

At the time of the accident the Civil Aviation Authority employed one Sport Aviation Inspector, based in Canberra, to administer sport aviation which included gliding, ballooning, hang gliding, parachuting, gyroplanes, and model aircraft.

Control of much of the gliding activity was vested in the Gliding Federation of Australia by delegation. It had a small full-time staff, only one of whom was employed in the operational standards area. Much of the audit function was carried out by experienced volunteers in each state. The systemic failures highlighted by this accident indicate that the audits conducted by the Civil Aviation Authority and the Gliding Federation were not effective. There were more than 4000 glider pilots, 700 gliders and 80 gliding clubs in Australia. Neither the Gliding Federation of Australia nor the Civil Aviation Authority had the capacity to carry out effective audit activities that might have shown up the systemic failures pertinent to this accident.

Since the accident, the Civil Aviation Safety Authority has appointed a sport aviation inspector in the north east region and one in the western region.

ANALYSIS

Glider pilot briefing

An analysis of the glider pilot's understanding of operations at Benalla and his intentions in relation to his entry into the circuit on this flight had to be made without the benefit of his recollections.

Evidence obtained during the investigation indicated that the glider pilot may not have been conversant with some of the procedures applicable to the flight, including radio broadcast and circuit joining procedures.

Although the Gliding Club of Victoria's Operations Handbook did not detail a briefing to visiting pilots, the Visiting Pilot Information Package statement in regard to circuit joining was clear and concise. The reason the pilot flew contrary to this instruction could not be determined. Post-accident interviews with the pilot and people who knew him indicated that he could be expected to follow regulatory requirements. A lack of appreciation of the dangers of not making prescribed radio broadcasts and of entering a circuit contrary to the established direction may have been as a result of inadequate briefing or as a result of his relatively low recent flight time.

Because of the operations manager's lack of understanding of the Aeronautical Information Publication and related documentation, it is unlikely that he would have stressed the importance of radio broadcasts as an integral part of the see and avoid principle of collision avoidance.

Instructor awareness

The glider pilot was instructed by the Gliding Club of Victoria's operations manager in the days prior to the accident. The tug pilot was instructed by the Gliding Club of Victoria's tug master during the previous three months. It is apparent that in both cases inadequate emphasis was placed on the regulatory requirements and on the procedures pilots should adopt to comply with these requirements. The documentation available to the instructors and the pilots was unclear and lacked emphasis and may have led to a lack of awareness of regulatory requirements by the instructors.

Radio broadcast requirements

The radio broadcast made by the glider pilot at Wangaratta, 16 NM from Benalla, approximately 20 minutes before the accident, indicated that the radio was operating satisfactorily at that time. Impact damage to the radio precluded post-impact analysis. Because the glider was fitted with a radio the pilot was required to monitor the common traffic advisory frequency and to make broadcasts on that frequency approaching the airfield. For this particular flight a broadcast should have been made before crossing the common traffic advisory frequency boundary, 10 NM from the airfield. However, the Aeronautical Information Publication cautions that it is the pilot's responsibility to determine an appropriate distance from which a broadcast is made. In determining an appropriate distance the aircraft's performance must be considered, to ensure that broadcast information is relevant to aircraft operating in, or about to operate in the common traffic advisory frequency area. Many powered aircraft, including glider tugs, operate in the common traffic advisory frequency area for less than five minutes.

The glider's broadcast at Wangaratta could not be considered to have occurred at an appropriate distance for a broadcast to be relevant to aircraft operating in, or about to operate within the common traffic advisory frequency area. Similarly, having regard to glider performance, a call at 10 NM, at the common traffic advisory frequency boundary, may not be an appropriate distance. It may be more appropriate to make another call when closer to the airfield.

It is not known why the glider pilot did not contact Benalla Ground as detailed in the visiting pilot's package.

Visual acuity and scanning considerations

The Bureau's 1991 research report into the limitations of the see and avoid principle of collision avoidance states that visual scanning involves moving the eyes in order to bring successive areas of the visual field onto the small area of sharp vision in the centre of the eye. This process is frequently unsystematic and may leave large areas of the field of view unsearched. However, a thorough, systematic search is not a solution as in most cases it would take an impractical amount of time. The report states that the human visual system is better at detecting moving targets than stationary targets, yet in most cases, an aircraft on a collision course appears as a stationary target in the pilot's visual field.

Civil Aviation Regulation 166(1) requires all pilots to observe other aerodrome traffic for the purposes of avoiding collision. While radio calls are a necessary part of traffic alerting and subsequent observation, the visual acquisition of traffic is still paramount.

Immediately before the collision the glider was observed heading west into the sun and the tug was observed heading east descending out of the sun.

It is probable that the glider pilot was looking ahead of his glider and looking into the sun. The consultant optometrist who assisted the investigation advised that when the glider pilot looked towards the sun wearing his scratched glasses his vision would have been reduced dramatically. The optometrist advised that the addition of clip-on sunglasses introduced two more surfaces which, if slightly dirty or scratched, would further degrade vision when looking into the sun. He stated "It could be postulated that if an aircraft was positioned between the sun and the glider...his vision may have been degraded by the multiple surfaces...to such an extent that it may not have been possible to see the approaching aircraft".

During the tugs descent the glider would have been essentially head on to the tug, may have been partially or totally hidden by the long nose and cowl of the tug, and would have been a diminutive target. The tug pilot should have been making clearing turns during the downwind leg. Under normal circumstances he would have been expected to look to the right to assess his position relative to the airfield. Had he commenced his turn onto base, he would probably have transferred his scanning away from the area of the approaching glider.

Circuit entry considerations

It was established that the tug pilot had made a position broadcast on the downwind leg for airstrip 26. The glider pilot did not respond to the broadcast by either announcing his intentions or manoeuvring the glider to remain clear of the established traffic pattern. He did not acknowledge the broadcast from the tug pilot, nor was he required to. It is possible that the glider pilot may not have heard the tug pilots broadcast, or he may not have understood it.

From the collision point, the glider would have had adequate height and been in a satisfactory position to have joined downwind for airstrip 08 or base leg for airstrip 26. If the glider pilot's intention was to join downwind and land on airstrip 08 then he would not have complied with the requirements of Civil Aviation Regulation 166(b) and (e) that a pilot shall conform with or avoid the pattern of traffic formed by other aircraft in operation, and shall as far as practicable land into wind.

If he was intending to turn left to join on base for airstrip 26, he would have been operating contrary to the requirement of Civil Aviation Regulation 166(c) that aircraft join the circuit on the upwind, crosswind or downwind legs.

The investigation was unable to determine why the main landing gear wheel of the glider was down and locked. It is possible that the pilot had completed a downwind check in preparation for turning left onto base for airstrip 26 or he may have completed an early downwind check for airstrip 08. It is also possible that the wheel may not have been retracted after take off.

The tug joined the circuit in accordance with procedures for tug operations.

Civil Aviation Regulation 162(1) requires that powered aircraft give way to unpowered aircraft. This can only be relevant when the powered aircraft is aware of the presence of an unpowered aircraft. The direction from which the glider entered the circuit would not have been expected by the tug pilot.

While there may have been some track displacement between the two aircraft, the pilot of the descending tug would have been faced with an almost head on perspective of the glider. The glider was sleek with a diminutive cross section. It would have been very difficult to see unless the tug pilot was alerted to the glider's presence.

The Bureau's data for mid-air collisions over the last 20 years listed 39 occurrences, 22 of which included gliders. Four involved collisions with tugs. Three of these accidents occurred within the circuit area, two at Benalla and one at Tocumwal. Although these accidents occurred in different circumstances, contra circuits were prescribed at each airfield at the time of the accident.

In each accident, if the tug had descended on the powered aircraft side of the contra circuit the accidents may have been avoided. All three accidents occurred while the tug was descending in the circuit.

CONCLUSIONS

Findings

1. Both pilots were medically fit, correctly licensed and qualified to undertake their flights.

2. Both aircraft were properly certificated and serviceable for the flights undertaken.

3. Formal requirements for the briefing of visiting pilots and the training of tug pilots were inadequate.

4. The documentation used to brief the glider pilot was confusing and deficient in detail.

5. The documentation detailing the requirements for tug pilot training lacked emphasis in safety considerations.

6. Gliding administrators did not have a clear understanding of the operational requirements in relation to radio broadcasts and circuit entry procedures.

7. The glider pilot did not respond to a radio broadcast from the tug.

8. The glider entered the circuit in a non-standard manner.

9. The glider pilot would have had difficulty sighting the tug approaching due to the angle of the sun and limitations of his visual acuity. He was wearing scratched corrective lenses and clip-on sunglasses.

10. The tug pilot would have had little opportunity to visually acquire an unalerted, small profile glider approaching from an unlikely area of conflict.

11. Neither the Civil Aviation Authority nor the Gliding Federation of Australia had the capacity to adequately audit the procedures in use.

Significant factors

The following factors were considered relevant to the development of the accident:

1. The glider pilot did not make a radio broadcast detailing his intentions in relation to circuit entry procedures.

2. The glider pilot did not follow established circuit entry procedures.

3. The tug would have been extremely difficult for the glider pilot to see because:

- the sun was behind the descending tug; and

- the glider pilot was wearing scratched corrective lenses and clip-on sunglasses.

SAFETY ACTION

As a result of this investigation the following safety actions were initiated:

1. The Gliding Federation of Australia submitted, and Civil Aviation Safety Authority approved, an amendment to the Gliding Federation of Australia's Operational Regulations. The amendment clarifies and verifies the requirement for gliders to track over the ground such that at least two turns, each of approximately 90 degrees in the circuit direction, are made prior to landing.

2 The Gliding Federation of Australia has revised its documentation to ensure that regulatory requirements are reflected accurately and completely.

3. The Gliding Federation of Australia amended the Manual of Standard Procedures to ensure that a minimum standard of briefing is specified for visiting glider pilots.

4. The Gliding Federation of Australia has promulgated instructional material detailing the circumstances under which non-standard approaches can be carried out, taking cognisance of the need to ensure a safe operation.

5. The Gliding Federation of Australia internal audit system has been updated and improved.

6. The Gliding Federation of Australia and the Civil Aviation Safety Authority are moving towards the Gliding Federation of Australia assuming responsibility for training and checking of tug pilots and tug pilot instructors.

7. The Gliding Club of Victoria is expediting the amendment of its Operations Manual to correctly reflect the Club's operating structure and to reflect Civil Aviation Safety Authority statutory requirements as they stand. Interim briefing material and handout notes have been produced for visiting pilots.