Tipsy Nipper T.66 RA45 Series 3, G-TEDZ

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Aircraft Type and Registration:	Tipsy Nipper T.66 RA45 Series 3, G-TEDZ
No & Type of Engines:	1 Jabiru 2200A piston engine
Year of Manufacture:	1998
Date & Time (UTC):	16 July 2000 at 1515 hrs
Location:	Near Upper Cumberworth, West Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 - Passengers - None
Injuries:	Crew - 1 - Passengers - N/A
Nature of Damage:	Extensive
Commander's Licence:	Private Pilot's Licence
Commander's Age:	59 years
Commander's Flying Experience:	372 hours (of which 275 were on type) Last 90 days - 4 hours Last 28 days - Less than one
Information Source:	AAIB Field Investigation

History of the flight

On the day of the accident, the pilot had been carrying out some maintenance work on the engine of G-TEDZ, which was based at Huddersfield Crosland Moor Airfield. The pilot had replaced the oil temperature sensor, oil filter and replenished the oil with 2.5 litres of W100 grade aircraft engine oil. He carried out some taxiing checks then parked the aircraft while he took some light refreshment.

The aircraft then taxied for departure from Runway 07 at about 1510 hrs. The take off was filmed on video by an observer at the airfield. The aircraft left the airfield circuit to the south. An eyewitness observed the aircraft about five minutes later, at an altitude of about 2,000 feet amsl (1,000 feet above local ground level), flying straight and level in an easterly direction to the south of Holmfirth. The eyewitness, who also held a pilot's licence, indicated that the aircraft appeared to be flying at a faster than usual cruise speed. The eyewitness lost sight of the aircraft before

anything unusual occurred. Another witness saw the aircraft slightly further east of this location but noticed that the engine sounded as though it was running roughly and misfiring occasionally.

Two more eyewitnesses observed the aircraft flying low in an easterly or north easterly direction. They heard the engine noise stop, then restart with an apparent misfiring or rough running, before finally stopping once again. The aircraft made a sharp left turn just prior to disappearing from view over the brow of a hill. Perceiving that the aircraft was in distress, the witnesses then drove towards the aircraft's location to render assistance.

A farmer working in an adjacent field observed the aircraft approaching, maintaining its height initially. It then made a rapid left turn through 45° and began a steep descent. The aircraft made its final approach at a high rate of descent and was observed to touchdown apparently nose first. The nose landing gear collapsed and the aircraft nosed over, coming to rest inverted in an open field, about 100 metres short of a dry stone wall. The farmer went to summon assistance and proceeded to the accident site with several other people. Those first at the site turned the aircraft upright to assist the pilot who was still strapped in his harness, but the pilot died at the scene from severe head and neck injuries.

Meteorological conditions

An aftercast from the Meteorological Office indicated that, at the time of the accident, there was an area of high pressure over the North Sea, with a moderate south-southwesterly airstream covering the area. The visibility was around 20 km, with scattered stratocumulus cloud base 2,500 feet. The mean sea level pressure was 1019 mb. The surface wind was from 020° at 6 kt, temperature +15°C, dew point +8°C, relative humidity 63%. The upper wind at 1,000 feet amsl was from 360° at 12 kt, temperature +8°C, with a relative humidity of 81%. At 2,000 feet amsl, the wind was from 360° at 15 kt, temperature +5°C, relative humidity 87%.

Given these ambient conditions, the CAA General Aviation Safety Sense leaflet 14A, Piston Engine Icing, indicated that there was a high probability of moderate or serious carburettor icing occurrence at any power setting although, of course, no evidence of icing presence remained after the accident.

Pathology and medical information

The pilot had renewed his medical certificate, obtaining a JAA Class 2 Medical Certificate in January 2000, which was valid for a 12 month period. However, during April 2000, the pilot experienced a medical condition which resulted in a series of consultations with his General Practitioner and hospital specialist Consultants. The pilot did not consult his (aviation) Authorised Medical Examiner (AME) over the condition nor did he classify himself as 'temporarily unfit' under the conditions of the JAA Medical Certificate.

The post-mortem examination did not find any evidence of medical factors which may have contributed to the accident. However, because of the pilot's recent history of medical anomalies and the continuing investigation thereof, the pathologist considered that the pilot should have classified himself as temporarily unfit for flying and should have contacted the CAA Medical Branch or his own AME. The pathologist has written to the CAA to recommend that the CAA Medical Branch consider emphasising to pilots the appropriate portion of JAR-FCL3.040 - Decrease in medical fitness - possibly by means of an Aeronautical Information Circular (AIC).

Pilot's experience

The pilot had been flying the Tipsy Nipper aircraft type since June 1992. Most of his flying experience was gained in his own machine, registration G-ATUH, which was powered by a Volkswagen 1,600 cc piston engine. The pilot purchased G-TEDZ from its builder (initially as a second aircraft) in August 1999. The original aircraft, G-ATUH, was then sold in May 2000. At the time of the accident, the pilot had flown G-TEDZ on a total of six occasions, for a total of 2.2 hours.

Since the pilot gained his Private Pilot's Licence in 1991, he had regularly updated its currency by ensuring that the required Certificate of Experience was signed in his flying log book, demonstrating that he had completed in excess of five hours flying within the preceding thirteen month period. However, the renewal Certificate of Experience which should have been entered during December 1999 was not present, although the pilot had completed almost 17 hours during the preceding thirteen months. The pilot had continued to fly since December 1999 without any valid Certificate of Experience, completing a further 10 hours flying by the time of the accident. Revised and extended JAA Flight Crew Licensing requirements for licence currency were introduced in January 2000.

The administrative oversight with regard to the Certificate of Experience serves to highlight the need for pilots to be fully aware of the status and currency of their licences and ratings. They also need to keep themselves fully briefed on the latest changes to the licencing system, promulgated by CAA AICs, as the CAA licensing system changes to become more aligned with the new European JAA FCL system. There was no record available to indicate when the pilot had last practiced the engine failure/forced landing procedure. The ability to perform a successful forced landing is highly dependent on being well practiced in this procedure.

Aircraft fuel system

The fuel tank configuration in G-ATUH (the previously owned aircraft) was a single fuel tank mounted in the forward fuselage, with a simple on/off selector. That aircraft was operated using Mogas.

The fuel tank configuration in G-TEDZ consisted of a main fuel tank of 24.5 litres capacity mounted in the forward fuselage, plus two inboard wing tanks, each of 15 litres capacity, in the wing roots. The three tanks were independent of each other, with no provision for cross-feeding fuel from one tank to another. Each of the three tanks could be independently selected to feed fuel to the carburettor via a rotary four position fuel selector. This fuel tank configuration is somewhat unusual for the Nipper, as most Nippers have either a single fuel tank in the forward fuselage, or a main tank in the forward fuselage and a small auxiliary tank on each wing tip. The fuel selector on G-TEDZ had been mounted below the main fuel tank such that it was below and well forward of the instrument panel and out of sight of the pilot. There was one position to feed from each corresponding fuel tank plus an 'off' position. The fuel system as configured in this aircraft would require the pilot to manage his fuel selections based on a knowledge of the amount of fuel available in each tank.

Fuel level indication for the main tank was by means of a clear plastic sight tube attached to the rear of the wing spar. Small cut-outs in the inboard wing ribs allowed the fuel level in the wing tanks to be seen through the fibreglass inboard wall of each tank.

Avgas 100LL was used exclusively in G-TEDZ. Only one fuel purchase had been made by the pilot from the refuelling facility at Huddersfield Crosland Moor airfield. This occurred during 10 or 11 June 2000, when 5.5 gallons (25 litres) of Avgas was uplifted. Given that the main fuel tank capacity was 24.5 litres, and that it was unlikely that the main tank was completely empty prior to the commencement of refuelling, then it is most likely that some fuel was put into either one or both of the wing tanks at that time.

After this refuelling, the aircraft did not then fly again until the accident flight. The flight time was about 5 minutes duration and several engine ground runs were apparently completed before the flight took place. It is not known which fuel tank(s) were selected for these.

Wreckage information

The wreckage was found to be intact with relatively little damage to the aircraft structure. The nose landing gear and right main landing gear had collapsed and been forced backwards by the initial impact. The canopy had shattered on impact with the ground as the aircraft nosed over, however there was minimal distortion of the fuselage frame behind the cockpit and the cockpit area itself was undamaged. There was minor damage to the left wing tip and one propeller blade tip had broken off. Ground marks from the nosewheel and right main wheel showed that the aircraft had made a steep descent into the field and had contacted the ground in a nose down and right wing slightly low orientation, on a heading of approximately 300° magnetic. The aircraft travelled forward approximately four metres with the nose ploughing into the grass, before pitching over onto its back and coming to rest. There was no fire.

Examination of the propeller blades showed no evidence of rotation at impact, indicating that the engine was stopped. The flight controls were checked and found to operate correctly.

The main fuel tank was visually estimated to be between two thirds and three quarters full. The fuel filler cap had popped off the right wing tank during the impact, but there was little evidence of fuel staining on the grass, which suggests there was little or no fuel in the tank. The left wing tank filler cap was still in place and the left wing tank was found to be empty. The fuel selector was selected to the right wing tank. The main tank was fitted with a fuel indication system which comprised a clear plastic sight-tube attached to the wing spar below the instrument panel. Adjacent to this had been loosely taped a small piece of paper with graduations labelled '1' to '6' marked on it in ball-point pen. The fuel level in the sight tube was noted to be level with the '4' mark. It is not known whether the markings had been calibrated by the pilot.

Inspection of the cockpit settings showed that the magneto switches were 'ON'. The throttle plunger was two thirds open and operated smoothly and correctly when checked. The carburettor heat selector was set to the 'COLD' position and was also found to operate correctly. The choke was set to the 'OFF' position and operated correctly when tested.

External examination of the engine at the accident site did not reveal any obvious defects. Minor damage was noted on the faces of a few of the flywheel ring gear teeth, which may have been caused by the pilot attempting to restart the engine whilst the propeller was windmilling, although this could not be established for certain. There was sufficient oil in the engine and there was no evidence of mechanical or electrical failure. The propeller found fitted was of the same type listed in the aircraft's Permit to Fly and was correct for the type of aircraft.

The aircraft

The aircraft was a home-built aircraft of a well established design which dates back to the 1950's. It was of simple construction with a fabric covered tubular steel fuselage and a mid-mounted wing of wood and fabric construction. The wings were not fitted with landing flaps. The landing gear was fixed and of tricycle configuration. The main spar of the wing ran through the front of the cockpit and served as a platform on top of which was mounted the instrument panel. The aircraft was powered by an air-cooled, 80 horsepower Jabiru 2200A four-stroke engine, directly driving a two-bladed wooden propeller. The engine was equipped with an electric starter and dual ignition system. Fuel was supplied via a single carburettor and there was provision for supplying warm air to the carburettor to protect against carburettor icing. The aircraft had been built from a kit acquired by the previous owner, but was missing its wings and so these were constructed separately. Inboard fuel tanks were incorporated in the wings during construction. The aircraft was built between 1996 and 1998 and obtained it's initial Permit to Fly in July 1999 after completion of an engineering inspection and flight test. The aircraft had performed as expected during its flight test and no abnormal characteristics were noted.

The aircraft's initial Permit to Fly was valid until 29 July 2000 and so it was shortly due for its first permit renewal. (The Permit is valid for twelve months and is renewable subject to the aircraft passing an engineering inspection and a flight test). The engineering inspection for the permit renewal was completed on 10 July 2000 by a Popular Flying Association (PFA) approved inspector, with no significant defects recorded. The flight test had not yet been performed, but it is possible that the pilot was intending to do this himself, being sufficiently experienced to do so under PFA rules.

Acquaintances of the pilot commented that after purchasing the aircraft in August 1999, he had carried out a considerable amount of work on the aircraft and engine in order to confirm their serviceability, as rumours suggested that the engine may not have been run-in correctly. They also commented that the pilot had perceived that the engine was not developing the maximum available power, which he believed to be due to a restrictive air intake system. This prompted him to fabricate a new carburettor air inlet system, consisting of an air inlet box containing a BMW motor cycle air filter, drawing air externally through a 60 x 40 millimetre rectangular cut-out on the left side of the lower engine cowling. (On the standard Nipper air inlet system, air is drawn from within the engine compartment into a small air box via a conical air filter mounted on the air box). The new system was not part of the original design of the aircraft and PFA approval for the modification had not been sought. It could not be established when the pilot had incorporated this modification nor if it was present at the time of the permit renewal inspection on 10 July.

Engineering investigation

The wreckage was recovered to the AAIB hangar at Farnborough for more detailed engineering investigation. The engine was inspected closely, taking care to preserve it as far as possible in the 'as found' condition, but no obvious defects were noted. The engine was then test run statically, using the original fuel from the main tank. The test runs were conducted satisfactorily, with the engine starting immediately on the first attempt, running smoothly and responding satisfactorily to changes in throttle setting. A maximum engine speed of 2,700 RPM was obtained at full throttle, as indicated on the tachometer fitted to the aircraft. This fell slightly short of figure of 3,000 RPM noted during a climb performance check during the aircraft's initial Permit-to-Fly flight test on 11 August 1998. A frequency analysis was conducted on the sound channel from the video of the take off. This indicated that the engine had been developing some 2,680 RPM just after lift-off. Whilst such a shortfall in the maximum engine rpm could have accounted for the pilot's complaints of the

aircraft's poor performance, it could not be attributed to the cause of the sudden failure of the engine which led to the accident.

A laboratory analysis was conducted on a fuel sample from the main tank. This was found to conform to the specifications for Avgas 100LL and was free from significant contamination. The fuel was therefore proved to be fit for aircraft use. The fuel system was checked for debris and signs of blockage. No significant debris was found, however a thin strip of PTFE thread tape was found stretched across and partially blocking the fuel selector inlet port from the main fuel tank. It was estimated that between 20 to 30 percent of the cross sectional area of the port was obstructed. The tape had the appearance of having been present for some time. The engine runs however, confirmed that it did not significantly restrict the flow of fuel to the engine, although it may have accounted for the engine falling short of the expected 3,000 RPM at full throttle. It was therefore possible to rule this out as a possible contributory factor to the accident.

During the wreckage examination, an anomaly was found in the positioning of the fuel selector. Tests showed that the pilot, who was 1.73 metres tall and of stocky build, would not have been able to reach the fuel selector to operate it when strapped in for flight. Furthermore, it was mounted in such a position that the pilot could not see it when seated in the aircraft. The pilot would only have been able to reach the fuel selector by loosening his shoulder harness and reaching well forward under the main fuel tank. It is believed that even with the shoulder harness loosened, the cramped cockpit conditions would have made it difficult to reach the fuel selector whilst maintaining adequate control of the aircraft under engine failure/forced landing conditions. A check of the Tipsy Nipper build instructions showed that an extension rod should have been fitted to the fuel selector to bring the selector knob aft, level with the instrument panel and within sight and reach of the pilot. The extension rod was not fitted on G-TEDZ at build and so the aircraft deviated from the original design in this respect. If the pilot had inadvertently taken off with the wrong fuel tank selected, it would therefore not have been immediately obvious to him, and had it occurred to him, he would only have been able to change the fuel selector position after loosening his shoulder straps and reaching forward under the main fuel tank.

It was noted that there is no requirement to check the operation of the fuel selector in the PFA engineering inspection and flight test schedules for the initial Permit to Fly. The discrepancy with the fuel selector would therefore not have been identified prior to the aircraft receiving its Permit. Whilst not covered in the engineering inspection for permit renewal, there is however, a specific item in the flight test schedule for permit renewal which requires the fuel selector to be operated. Permit renewal Flight Test Schedule Item 11 states '...fuel shall be selected from all fitted tanks for a period of not less than three minutes each.' The flight test for G-TEDZs first permit renewal had not yet been completed, but as this may have been done by the pilot himself, he might not have identified the poorly located fuel selector as being a problem. It is believed that had there been a similar check in the initial Permit to Fly flight test or engineering inspection schedules, which must be performed by a PFA approved test pilot and engineering inspector, the problem could have been highlighted and corrected prior to issue of the initial Permit.

It is not known what effect the non-standard air intake system fitted to G-TEDZ would have had on the engine performance, however it is likely that by drawing in cold air from outside the cowling rather than warm air from within the engine compartment as originally designed, it may have increased the probability of carburettor icing. It also possible that the general performance of the engine could have been impaired, as the cut-out in the cowling may have exposed the carburettor to air inlet pressures for which it was not calibrated, which could in turn have caused variations in the air/fuel mixture to the engine. This effect could have been dependent on the airspeed and attitude of

the aircraft. The type of carburettor fitted to the aircraft required little (if any) pressure differential from ambient for normal operation.

Survivability

The absence of significant damage to the cockpit structure and aircraft structure in general indicated that the forces experienced had been well within the limits of survivability. The fatal injuries experienced by the pilot were caused as a result of the aircraft nosing over and not as a result of the initial impact. In an accident to a Tipsy Nipper in February 1999 involving a forced landing, the aircraft experienced very similar damage to G-TEDZ, however in this instance the aircraft remained upright and the pilot escaped injury. A review of other forced landing incidents on Tipsy Nippers showed that the aircraft has a tendency to nose over during an engine-out forced landing due to its steep descent angle and relatively high approach speed. There were however, no reports of fatalities in any previous accidents in which the aircraft nosed over. With the limited clearance between the canopy and the top of the pilot's head, survivability in the event of the aircraft nosing over is highly dependent on the tightness of the pilot's harness. It is possible that the pilot's harness may not have been tightly done up in the first instance, or that he may have slackened it in an attempt to reach the fuel selector.

Analysis

Given that the engine ran satisfactorily and developed sufficient power for sustained flight when tested, and based on the other findings made, the engine failure is most likely to have occurred as a result of any combination of three possibilities;

Firstly, the presence of carburettor icing. This is generally rather insidious and is detectable only when icing presence results in a noticeable effect on engine performance (characteristically, the onset of 'rough running' and rpm loss for a fixed throttle position). The aircraft was not fitted with a carburettor temperature gauge, nor was it required to be. The pilot's previous aircraft/engine installation was also prone to this phenomenon. It is possible that the non-approved modification to the air intake system on G-TEDZ could have increased the probability of carburettor icing. Both this and the pilot's previous aircraft were fitted with carburettor heat systems which, when operated, would have melted any ice build up and restored normal engine operation if operated in a timely manner. It is likely that the pilot was fully aware of this possibility and should have taken the appropriate action in this event to restore power.

Secondly, the possibility of an interruption of the fuel supply to the engine as a result of the selected fuel tank running dry. The main fuselage fuel tank was approximately two thirds to three quarters full when inspected after the accident. However, the fuel selector was found selected to feed fuel from the right tank, which probably contained very little (if any) fuel prior to impact. From the refuelling record and known tank capacities, it is likely that at least some fuel was put into one (or both) inboard wing tanks during the previous refuelling. It is possible that the selected (right) tank ran dry and the engine consequently lost power, intermittently at first due to fuel 'sloshing'. The location of the fuel selector (well forward, under the main fuel tank) was out of sight from the pilot's viewpoint and also rendered it out of reach if the pilot's shoulder harness was correctly tightened. In view of the pilot's previous ownership of an aircraft with a single operating position fuel selector, the need for fuel tank selection may have been overlooked in the stress of the situation and he may not have been immediately aware of the problem as he could not see the fuel selector. If the pilot had loosened his harness in an attempt to reach the fuel selector to establish its position or reselect it to another tank, he would have had little time to re-tighten his harness whilst

attempting to restart the engine and then prepare the aircraft for a forced landing from such a low height above the ground.

Finally, the custom fabricated carburettor air inlet system. Because this design had not been submitted to and approved by the PFA, no previous testing of this type of installation had been carried out. It is known that the type of carburettor fitted to the aircraft required little (if any) pressure differential from ambient for normal operation. In the approved installation for this type of carburettor in this type of aircraft, air is entrained from within the engine compartment. The effect of the custom air intake hole in the side of the engine cowling was untested. It is possible that the installation may have increased the likelihood of carburettor ice formation. It is also possible that unforeseen dynamic pressure effects may have been present in fast forward flight, which could have produced fluctuations in the mixture flow to the engine, causing it to run erratically under certain conditions.

The pilot's recent medical history should have been notified to the CAA or his AME. Either notification would probably have resulted in the temporary suspension of the pilot's medical certificate, pending satisfactory outcome of the medical investigations. Although no medical condition was identified during the post-mortem which could have directly caused the accident, the possibility of some form of pilot distraction could not be totally dismissed.

Safety recommendation

Based on the above findings the following Safety Recommendations has been made to the Popular Flying Association.

Recommendation 2000-73

It is recommended that the PFA amend the engineering inspection schedule and the flight test schedule for both the initial Permit to Fly and annual renewal to include an operational check of all flight critical controls, including fuel selectors, to establish that these controls can be operated satisfactorily by the pilot when strapped correctly in his seat.

The Popular Flying Association subsequently stated that they accept the recommendation and will amend the engineering inspection schedule and the flight test schedule, as appropriate, at the earliest opportunity.