

AAIB Bulletin No: 7/94

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Category: 1.3

**Aircraft Type and Registration:** Yak-52, RA 01337

**No & Type of Engines:** 1 Vedeneyev (Ivchenko) M-14P radial piston engine

**Year of Manufacture:** 1981

**Date & Time (UTC):** 20 March 1994 at approximately 1455 hrs

**Location:** Lighthorne, near Gaydon, Warwickshire

**Type of Flight:** Private

**Persons on Board:** Crew - 1 Passengers - 1

**Injuries:** Crew - Fatal Passengers - Fatal

**Nature of Damage:** Aircraft destroyed

**Commander's Licence:** Private Pilot's Licence (United Kingdom)

**Commander's Age:** 36 years

**Commander's Flying Experience:** 406 hours (of which 24 hours were on type)  
Last 90 days - 10 hours  
Last 28 days - 6 hours

**Information Source:** AAIB Field Investigation

### History of the Flight

The pilot in the front seat at the time of the accident was the owner of the aircraft. He had completed a course of aerobatic instruction in a Beagle Pup aircraft during 1990. Following this he purchased a Topsy Nipper aircraft and continued to improve his aerobatic skills on that until it was sold during 1993. He then purchased the Yak-52 in August 1993, and operated it as a flying group with seven other pilots.

During the day prior to the accident, four members of the group received instruction in competition style aerobatic manoeuvres from an aerobatics specialist. The owner received one flight of some 32 minutes duration, during which some advanced manoeuvres were practised. Other members of the group indicated that it was the pilot's intention to enter aerobatic competitions at the beginners level later in the year, once proficiency had been gained on the Yak-52. On the morning of the accident, the aircraft was flown by two other group members without any adverse comment, and with no unserviceabilities noted. The owner had also flown one sortie of 21 minutes duration earlier that day. That flight, and the accident flight, were demonstrations to pilots who were considering the purchase of a similar type of aircraft.

The rear seat occupant held a Commercial Pilot's Licence, with Flying Instructor Rating. His total flying experience was 936 hours. During 1993, he had undertaken a five hour course in order to remove the restriction on aerobatic training on his Flying Instructor Rating. That course was conducted on a Cessna 152 Aerobat. He had since conducted occasional instruction in aerobatic manoeuvres in a Fuji FA-200 aircraft. His logbook indicated that he had some 26 hours of flying which included aerobatics in that type, some 22 of these giving instruction to others. In August 1993, he flew the Yak-52 for 40 minutes during a demonstration flight. He then spent a week in Russia in September 1993, during which some 5.2 hours experience was gained in the Yak-52, including some 2.8 hours of aerobatics. It was his intention to form a syndicate in order to purchase and operate another Yak-52 aircraft, imported from Russia. The purpose of this short flight was to allow him to experience and assess the operation of the aircraft from the rear seat, which is the instructor's usual position.

There were no indications that either occupant had performed low level aerobatics during the course of their previous flying experience.

The aircraft departed from Wellesbourne Mountford Airfield at 1437 hrs. It was observed by the pilot of another light aircraft, himself a flying instructor of considerable experience, while climbing out towards the disused airfield at Gaydon. The observing pilot noted that the Yak-52 carried out several aerobatic manoeuvres at medium levels in the vicinity of Gaydon, including loops, rolls and an attempted stall turn. The pilot commented that the aircraft appeared to be conducting very sharp vertical pull-throughs, and considered that high g-forces would have been applied at those times. He also noted that the aircraft attempted a stall turn to the left, but appeared to fall over onto its back, rolling through 180° during the vertical dive before recovery. He finally lost sight of the Yak-52 just north of Gaydon Airfield, and continued heading south to vacate the area.

There were several eyewitnesses on the ground around the Gaydon disused airfield who had seen the aircraft performing aerobatics during the previous day, and also around the time of the accident flight. Witnesses also noted the aircraft making what were described as low passes over farmland to the south of Gaydon Airfield, before flying off towards the village of Lighthorne, a northerly direction from Gaydon. An eyewitness in the village of Lighthorne observed the aircraft at a fairly low altitude flying straight and level, heading north-west, with the engine noise described as loud and misfiring, but with no smoke coming from it. He heard a loud crunch sound some 30 seconds later. Another witness saw the aircraft pull up and go over onto its left side. It then went nose down, the engine noise ceased, and the aircraft fell from view behind some trees. The aircraft was observed by a car driver descending, apparently with some sideslip, before yawing sharply. He too did not observe the final impact but, believing that the aircraft had not recovered, stopped on the road adjacent to the accident site to telephone the emergency services.

An aftercast from the Met Office indicated that, at the time of the accident, there was a weak ridge of high pressure over the area, giving a visibility of 20 km or more, with no significant weather. There was scattered cumulus/stratocumulus cloud with a base of 3,000 to 4,000 feet. The surface wind was variable in direction, less than 10 kt, and the wind at 2,000 feet was from 290° at 15 to 20 kt. The mean sea level pressure was 1014 mb.

### **Impact Parameters**

The aircraft had crashed into a narrow flat uncultivated field, bounded by trees, whilst on a track of 153°M. At the moment of impact it had been erect, but in approximately a 25° right wing low attitude and was following a flight path angle of, at least, 11° down. Following this initial impact with the ground the right outer wing broke off, the propeller blades shattered and the engine tore free from its mountings. Analysis of the ground scars and propeller fragments indicated that the engine had been running, probably at a high power setting, and slash marks from the blades in the ground (assuming the usual engine setting for this aircraft of 2,400 RPM - 82%) suggested that the aircraft's forward speed had been in the region of 200 kt. This relatively high speed resulted in most of the wreckage sustaining severe further damage as it passed through a line of mature trees bordering the field; the fuselage, with the left wing still attached, coming to rest some 600 feet from the initial point of impact in the adjoining field. The aircraft's configuration was determined as being with flaps and undercarriage retracted. Evidence of fuel was found within the wreckage but there had been no fire.

### **Wreckage Examination**

The wreckage was recovered to the AAIB facility at Farnborough where a detailed examination was carried out. This, together with an assessment of the impact site, revealed that the aircraft had been structurally complete before impact, and that all failures and defects in the manually operated flying control systems were as a result of impact forces. No evidence was found to show that any control had been jammed. Due to the relatively shallow impact with the ground, little reliable information was obtained from the instruments or warning lights in the cockpits.

This aircraft was fitted with a five point harness in each cockpit, and it was determined that all five straps were being worn by both occupants at the time of the accident. The crotch strap of these harnesses is connected to the floor of each cockpit by a metal link, which is free to pivot in the fore-and-aft direction from a point just aft of each control column. Any slackness in the crotch strap could allow this link to rotate either forward, to make contact with the rear of the column, or aft, under the base of the seat. In the rear cockpit this link had rotated aft and had failed in compression induced bending after being trapped by the downwards deformation of the seat, probably during the initial

impact. Failures had also occurred in both upper torso restraints. The right strap had been released by failure of one side of the common attachment fitting (crank link), a fitting designed such that the loads from both straps are fed to a single attachment point on a crossbeam located at the top of, and behind, the seat. This crossbeam had remained intact and securely attached to the fuselage sides. The left strap itself had suffered a failure, probably as a result of additional loading following failure of the right strap, at a point where it passed around its adjustment buckle. These failures, the upper torso ones in particular, had allowed the rear seat pilot to jack-knife about the intact lap strap and strike his head on the coaming. In the front cockpit, the crossbeam had broken and become detached as a result of the general disruption of the forward fuselage, although the upper torso attachment fitting remained intact. In addition, the link attached to the crotch strap had pulled free from the fuselage complete with a section of floor structure, but the lap straps had remained intact. Figure 1 details the above failures. The post mortem examination revealed that both occupants received fatal injuries as a direct result of the accident and that their chances of survival, the rear seat pilot in particular, would have been greatly enhanced had the harnesses/attachments not failed and head protection been worn. Information from the manufacturer stated that 'all belts and crank links are calculated for a load of 1.5 tonnes'.

The aircraft is fitted with a VHF radio and intercom system. To transmit, a button on the side of the throttle lever must be pressed; similarly if the pilots wish to talk to each other then a second button on the throttle lever must be pressed as it is not possible to speak directly due to the relatively high noise level in the cockpits. This requires the non-handling pilot to reach for, or keep his hand on, the throttle when he wishes to speak. Thus, free communication between the crew is not as effective as a system employing 'hot', or permanently live, microphones. The intercom system was examined in the wreckage, but wire failures and damage to the radio controller, one intercom box and one headset precluded a thorough functional check. The system was, however, reported as being functional on the previous flight.

### **Aircraft Description and History**

The Yak-52 was designed by the Yakovlev Design Bureau in Moscow and first flew in late 1978, but is manufactured in Romania. It is a derivative of the Yak-50 single seat aerobatic tailwheel aircraft, which itself first flew in 1975. Although primarily designed as a tandem two seat military basic training aircraft, it retains the full aerobatic capability of the Yak-50 and is cleared for repeated application of load factors upto +7g and -5g. It is fitted with a Vedeneyev (Ivchenko) M-14P nine cylinder radial piston engine and a constant-speed two bladed wooden propeller. Production of the Yak-52 started in 1979 and continues at a rate of approximately 100 per year, having peaked at around 150 per year.

This aircraft was released into Russian service in August 1981 but issued with a Certificate of Airworthiness by the Russian Federation of Aviation Amateurs in June 1993 just before being brought into the United Kingdom. At that time it was recorded as having flown for a total of 656 hours but a zero timed overhauled engine was fitted before delivery. Maintenance was carried out in the UK but certified by a visiting licensed engineer from Romania. RA 01337 had received a 100 hour check approximately one week before the accident. During this check detachable spring units, installed in the elevator and aileron flying control circuits, were removed. These units are designed to provide a simple form of artificial feel and are reportedly fitted to make the aircraft more stable and less prone to being over controlled when being flown by pilots of low experience, particularly during landing. In Russia the State Aviation Institute states that it approves the removal of these spring-loaded mechanisms for 'highly qualified pilots (with at least 30 hours flying time) in order to improve their piloting skills. Aircraft controllability is facilitated by removing the springs. The aircraft may more easily pass into transcritical states, which must be taken into account in accordance with Directive 2/6-944 of 25 March 1988 of the Central Committee of the All-Union Voluntary Society for Assistance to the Army, Air Force and Navy of the USSR'.

During the examination of the wreckage an area of crush damage, that had previously been repaired, was revealed at the inboard end of the left aileron. Although not a causal factor in this accident, the quality of this repair was extremely poor and was not detected without removal of the fabric covering the aileron structure. Photographs of this repair are shown at Figure 2.

At the time of the accident there were in excess of 20 Yak-52's in the UK, several of which had been placed on the UK register and issued with Permits to Fly by the CAA. Some of these are new build aircraft from Romania, others are used examples from Russia. Amongst, typically, eleven operating limitations on these Permits is one requiring a placard to be placed in full view of the occupants which states:

#### OCCUPANT WARNING

This aircraft has not been certificated to an International Requirement



**FRONT COCKPIT**

Upper Torso Attachment  
Showing Crossbeam Failure



**REAR COCKPIT**

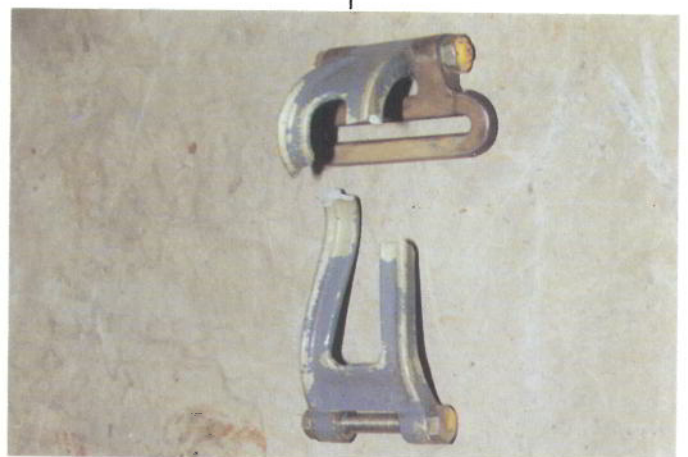
Upper Torso Attachment Showing  
Failure of Common Fitting



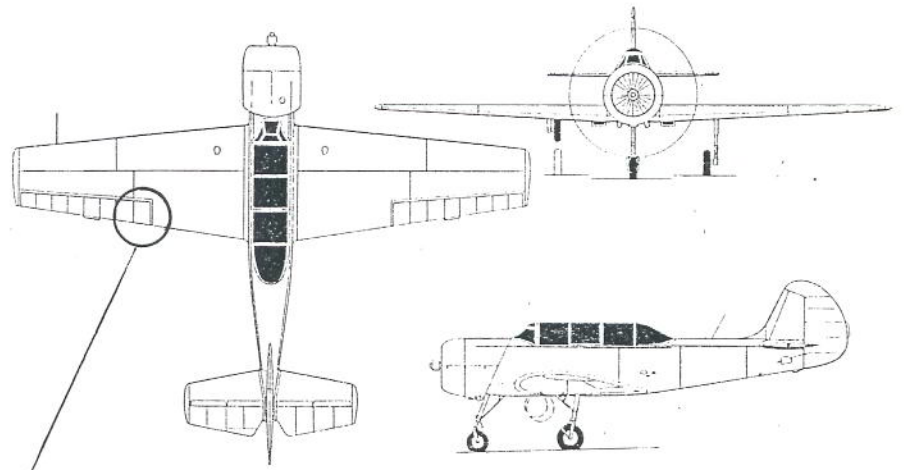
**Complete Harness Showing  
Failures of Structural Members**



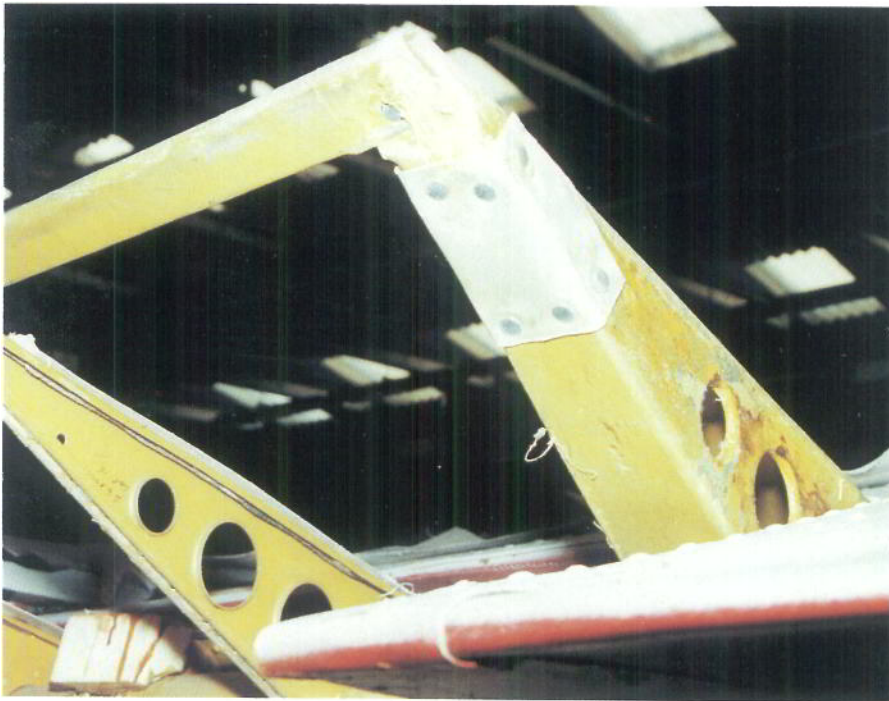
**Failure of Left Upper Torso Strap**



**Compression Failure of Crotch Strap Link**



Yakovlev Yak-52



Repaired area to inboard end of left aileron structure

