CIVIL AVIATION AUTHORITY OF NEW ZEALAND

AIRCRAFT ACCIDENT REPORT

OCCURRENCE NUMBER 12/218

AEROSTAR YAK-52TW

ZK-YTW

ELEVATOR CONTROL RESTRICTION

TIMONA PARK, FEILDING

23 JANUARY 2012

Foreword

As a signatory to the Convention on International Civil Aviation 1944 ("the Chicago Convention") New Zealand has international obligations in respect of the investigation of accidents and incidents. Pursuant to Articles 26 and 37 of the Chicago Convention, the International Civil Aviation Organisation ("ICAO") issued Annex 13 to the Convention setting out International Standards and Recommended Practices in respect of the investigation of aircraft accidents and incidents.

New Zealand's international obligations are reflected in the Civil Aviation Act 1990 ("the Act") and the Transport Accident Investigation Commission Act 1990 ("the TAIC Act").

Section 72B(2)(d) and (e) of the Civil Aviation Act 1990 Act also provides:

> **72B Functions of Authority**
>
> (2) The Authority has the following functions:
>
> (d) To investigate and review civil aviation accidents and incidents in its capacity as the responsible safety and security authority, subject to the limitations set out in section 14(3) of the Transport Accident Investigation Commission Act 1990:
>
> (e) To notify the Transport Accident Investigation Commission in accordance with section 27 of this Act of accidents and incidents notified to the Authority:

In the case of a fatal aviation accident, the final CAA investigation report will generally be highly relevant to an inquiry, and in some circumstances, an inquest, conducted by a Coroner. CAA investigations are not however done for, or on behalf of, a Coroner.

Following notification to the Transport Accident Investigation Commission ("the Commission") of any accident or incident which is notified to the Authority, an investigation may be conducted by the Commission in accordance with the TAIC Act. CAA may also investigate subject to the requirements of the TAIC Act.

The purpose of an investigation by the Commission is to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future, rather than to ascribe blame to any person.

CAA however investigates aviation accidents and incidents for a range of purposes under the Act. Investigations are primarily conducted for the purpose of preventing future accidents by determining the contributing factors or causes and then implementing appropriate preventive measures - in other words to restore safety margins to provide an acceptable level of risk. The focus of CAA safety investigations is therefore to establish the causes of the accident on the balance of probability.

Accident investigations do not always identify one dominant or 'proximate' cause. Often, an aviation accident is the last event in a chain of several events or factors, each of which may contribute to a greater or lesser degree, to the final outcome.

CAA investigations may also inform other regulatory-safety decision making or enforcement action by the Director.

In the case of a fatal aviation accident, the final CAA investigation report will generally be highly relevant to an inquiry, and in some circumstances, an inquest, conducted by a Coroner.

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Glossary of abbreviations:

AAIB	Air Accident Investigation Board
amsl	above mean sea level
ATC	Air Traffic Control
BFR	Biennial Flight Review
CAA	Civil Aviation Authority (New Zealand)
CASA	Civil Aviation Safety Authority of Australia
C of G	centre of gravity
FAA	Federal Aviation Administration (US)
FOD	Foreign Object Damage/Debris
ft	foot or feet
G	acceleration of gravity
hp	horse power
hPa	hectapascals
kt	knots
METAR	Aviation routine weather report
MHz	megahertz
mm	millimetres
MPD	Mandatory Permit Directive
NTSB	National Transportation Safety Board (US)
NZDT	New Zealand Daylight Time
QNH	Barometric pressure setting adjusted to sea level
RNZAF	Royal New Zealand Airforce
UK	United Kingdom
UKCAA	Civil Aviation Authority (United Kingdom)
UTC	Coordinated Universal Time
WGS 84	World Geodetic System 1984

Data summary

Aircraft type, serial number and registration:	Aerostar Yak-52TW, s/n 1312502, ZK-YTW
Number and type of engines:	One, Aeromotors SA M14PF-XSDK Radial Piston
Year of manufacture:	2003
Date and time of accident:	23 January 2012, 1045 hours[1] (approximately)
Location:	Timona Park, Feilding Latitude[2]: S 40° 13' 28.4" Longitude: E 175° 34' 57.6"
Type of flight:	Private
Persons on board:	Crew: 1 Passengers: 1
Injuries:	Crew: 1 Fatal Passengers: 1 Fatal
Nature of damage:	Aircraft destroyed
Pilot-in-command's licence:	Private Pilot Licence (Aeroplane)
Pilot-in-command's age:	51 years
Pilot-in-command's total flying experience:	2900 hours (approximately) 52 hours on type (approximately)
Information sources:	Civil Aviation Authority field investigation
Investigator in Charge:	Mr A M Moselen

[1] All times in this report are NZDT (UTC + 13 hours unless otherwise specified)

[2] WGS 84 co-ordinates

Synopsis

At approximately 1035 hours on 23 January 2012, the pilot and a colleague took off from Feilding Aerodrome in ZK-YTW, for the purpose of carrying out an aerobatic flight. A number of local residents observed the aircraft complete a slow roll then enter a steep dive. The aircraft continued descending steeply and at approximately 1045 hours, struck the ground in Timona Park, Feilding. The aircraft was destroyed and the pilot and passenger received fatal injuries.

The New Zealand Civil Aviation Authority (CAA) was notified of the accident on 23 January 2012. The Transport Accident Investigation Commission was in turn notified, but declined to investigate. A CAA field investigation was commenced the next day.

1. Factual information

1.1 History of the flight

1.1.1 On the day of the accident, at approximately 1000 hours, the pilot who was a part owner of ZK-YTW prepared the aircraft for an aerobatic flight from Feilding Aerodrome. The flight was to include the carriage of a passenger and as part of the preparation all loose items from the pilot and passenger's personal clothing were removed and stored in the pilot's hangar.

1.1.2 To assist the pilot in his pre-flight, he used a small stubby type screwdriver to open numerous access panels on the aircraft. The screwdriver was found in the pilot's hangar after the accident occurred.

1.1.3 A number of witnesses that were present at the aerodrome reported nothing unusual in the pilot's pre-flight activity or with events leading up to the take-off. At approximately 1035 hours the pilot and passenger departed in the aircraft from Feilding Aerodrome Grass Runway 28 and climbed, initially in a westerly direction.

1.1.4 At 1037 hours, the pilot made radio contact with Ohakea ATC. Included in the transmission was a request to conduct aerobatic manoeuvres for 10 minutes at 3000 feet[3]. Ohakea ATC provided a transponder code and after confirming the transponder setting, the pilot received a clearance to conduct aerobatics.

1.1.5 A review of radar plots of the flight showed that after receiving his clearance the pilot climbed to 3000 feet in a clockwise orbit over Feilding Aerodrome. Upon reaching 3000 feet, the aircraft entered a loop.

1.1.6 On completion of the loop, the pilot requested, and was subsequently cleared for, further climb to 3500 feet. At this point the aircraft was observed to perform another loop or as some witnesses commented, a 'stall turn'[4].

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[3] All heights in this document are amsl (above mean seal level).

[4] Stall turn also known as a hammerhead turn. During a vertical climb, the aircraft is rotated about its vertical axis and the nose falls through the horizon and points towards the ground. The term stall turn is a misnomer in that the aircraft never actually stalls. The stall turn is often mistaken for a loop but unlike a loop which starts and ends in one direction, the stall turn ends with the aircraft heading in the opposite direction.

1.1.7 At the end of the manoeuvre, the aircraft maintained 3000 feet and flew in a north westerly direction toward Feilding Township. During this part of the flight, the aircraft was seen to complete a slow roll. One witness, an experienced RNZAF aerobatic pilot, described what he saw:

> *"I live in Aorangi Rd, which lies between Feilding Airfield and Feilding Township. On the day of the crash, I was working outside, and noticed the Yak commence aerobatics (estimated height about 3000ft).*
>
> *At the point prior to the crash, I looked up to see what looked like the last half of a slow roll. This looked "standard" i.e. the height was being maintained by inverted push, and the aircraft rolled out slowly. Immediately on roll out however it went into a steep (45/50 degree) dive. Throughout this, the power remained on. This dive really attracted my attention, because it looked more aggressive and prolonged than anything I had seen the pilot do previously. I thought: maybe he is getting the speed up for a spectacular aerobatic - but this soon changed to concern as it continued in a straight line towards the ground."*

1.1.8 The last recorded radar plot was timed at 1044 hours, two minutes and 16 seconds after the last clearance given to the pilot by Ohakea ATC. The radar plot depicted the aircraft at 2700 feet, heading in a north-westerly direction at a ground speed of 150 knots and at a distance of approximately 320 metres from Timona Park, Feilding.

1.1.9 In the vicinity of Timona Park, a number of witnesses observed the aircraft in a high speed dive, which appeared to be banking to the right at the time. Three of the witnesses were flying model aircraft at the park when the aircraft passed within approximately 50 metres of them moments before ground impact.

1.1.10 The accident occurred in daylight, at approximately 1045 hours, in Timona Park Feilding, at an elevation of 232 feet, latitude S 40° 13' 28.4" longitude E 175° 34' 57.6".

1.2 Injuries to persons

Injuries	*Crew*	*Passengers*	*Other*
Fatal	1	1	0
Serious	0	0	0
Minor/None	0	0	

1.3 Damage to aircraft

1.3.1 The aircraft was destroyed.

1.4 Other damage

1.4.1 Ground damage to Timona Park.

1.5 Personnel information

1.5.1 The pilot, aged 51 years, held a Private Pilot's licence (Aeroplane), a current Class 2 Medical Certificate and a current BFR. An endorsement on the licence required the pilot to wear trifocal spectacles.

1.5.2 The pilot was rated on a wide range of single engine aircraft and held a current instrument and aerobatic rating. His total flying time amounted to approximately 2900 hours with 52 of those hours flown in ZK-YTW.

1.5.3 The pilot was a member of Warbirds[5] and was the nominated Maintenance Controller of his aircraft having completed a CAA Maintenance Controllers Course in 2008.

1.5.4 On the day of the accident the pilot was described by family and colleagues as being in good health and good spirits.

1.6 Aircraft information

1.6.1 The Aerostar Yak-52TW, is a tail-wheel version of the Yak 52 that was originally designed as a military trainer for Russia during the 1970's. Production of the aircraft was carried out in Romania until 1991, and then resumed in 1998.

1.6.2 The aircraft is a tandem seat, fully aerobatic aircraft of all metal construction and is powered by a; 400 hp nine cylinder radial engine, driving a counter clockwise rotating three bladed constant speed propeller.

1.6.3 Split flaps are fitted and the retractable main landing gear are pneumatically operated. The flying controls are all configured conventionally using a combination of cables, pushrods and bell-cranks.

1.6.4 ZK-YTW was manufactured in 2003 in Romania, and exported to the USA where it was registered in the Experimental Category. In 2008, the aircraft was imported into New Zealand where it was registered as ZK-YTW. In 2010, ownership of ZK-YTW transferred to a trust which the pilot was a member. At the time of the accident, the aircraft had a Non Terminating Airworthiness Certificate under the Special Category (limited) provision.

1.6.5 ZK-YTW was similar to all other Yak variants in that being based on military requirements, there is little use for cabin trim and there are no bulkheads fitted in the fuselage behind the cockpit firewall. Therefore, all controls, cables, pushrods and bell-cranks are exposed to the entry of loose articles (FOD).

1.6.6 The elevator control functionality on ZK-YTW consisted of a pushrod to connect together the fore and aft control columns. A bell-crank assembly transferred the means of control from pushrod to cables which ran aft to a quadrant mounted inside the aft fuselage. The elevator control surfaces and a mass balance weight were bolted to the quadrant and there was an aperture (see Figure 1), cut into the

[5] New Zealand Warbirds Association (Inc). A society formed in 1978 for the preservation of classic service aircraft.

top of the aft fuselage to allow the quadrant to pass through thereby providing a full range of elevator travel.

1.6.7 Inspection of the aft section of the empennage was achieved from the rear seat in the cockpit, however, rearward viewing would have been compromised by equipment mounted in the rear fuselage. An inspection panel was also provided under the left horizontal stabiliser. However, owing to the tail-wheel installation, a strengthening sub frame is fitted approximately 75mm forward of the end of the fuselage. This would make inspection of the area behind the subframe impossible without a boroscope type tool. (see Figure 1).

1.6.8 As Maintenance Controller, the pilot was responsible for providing a maintenance program for the aircraft. The most recent CAA approved maintenance program for ZK-YTW was dated November 2011 and included provision for the Maintenance Controller to monitor service information. The service information recommended the websites of 'Russianaeros.com' and the UKCAA's website for continued airworthiness guidance.

1.6.9 In terms of continued airworthiness guidance, the Russianaeros website makes no mention of Airworthiness Directives (AD's) or any Mandatory Permit Directives (MPD's). However, the UKCAA website does, via a link to an airworthiness information section.

1.6.10 An additional means for information on continuing airworthiness is the Yak-UK website where a document link directs the user to AD's and MPD's specifically for the Yak 52.

1.6.11 A review of the Aircraft and Engine Logbook's revealed that the maintenance provider carried out an annual inspection which included 100 and 200 hour inspection requirements in November 2011. The airframe and engine had, at the time, accumulated 266.5 hours total time in service. There were no deferred maintenance inspections or defects recorded that may have been a factor in the accident.

1.6.12 It was reported that, between the annual inspection and some time prior to the accident, the aircraft received damage to the tail wheel assembly and required field repairs. No maintenance records could be found relating to the repairs.

1.6.13 Normal servicing, refuelling and the checking of the engine oil during pre-flight were facilitated by opening quick release access panels. Pilots often use a flat bladed stubby screwdriver, a multi tool or a Swiss Army type pocket-knife to accomplish the task.

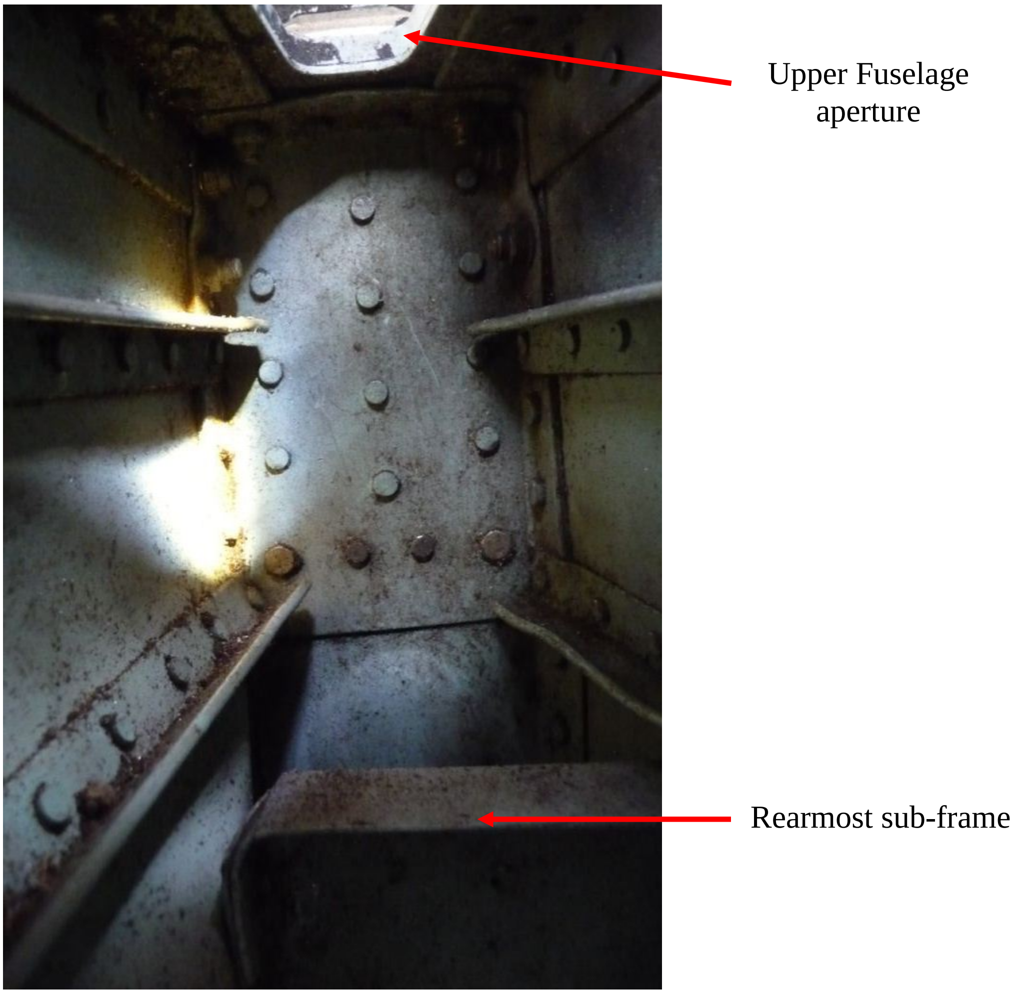

Figure 1: Aperture and Sub-frame illustration ZK-YTW

1.6.13 A weight and balance calculation placed the centre of gravity for the aircraft within the limits specified for aerobatic flight.

1.7 Meteorological information

1.7.1 A southerly air flow was affecting the area at the time of the accident. The area forecast was for partly cloudy conditions, occasional light showers, and wind speeds of up to 10 knots. The actual weather (METAR), reported at Palmerston North Aerodrome at 1030 hours was a light south-westerly breeze, a temperature of 15 degrees Celsius and a QNH of 1016 hPa.

1.7.2 Witnesses described the weather as mostly clear skies and a light southerly wind. Weather was not a factor in the accident.

1.8 Aids to navigation

1.8.1 Not applicable.

1.9 Communications

1.9.1 Other than standard radio calls on the Feilding Aerodrome frequency 121.4 MHz and communications with Ohakea Control on 125.1 MHz, no other calls were heard from ZK-YTW.

1.10 Aerodrome information

1.10.1 Not applicable.

1.11 Flight recorders

1.11.1 Not Applicable.

1.12 Wreckage and impact information

1.12.1 The aircraft struck the grassed surface of Timona Park in a north-westerly direction, while banked approximately 25 degrees to the right and with a nose down attitude of approximately 50 degrees.

1.12.2 The forces involved in the impact sequence were such that the aircraft nose section, engine and wings created deep ground scars then virtually disintegrated. The majority of the remaining sections of the aircraft bounced and came to rest 10 metres along the wreckage trail. The furthest piece of wreckage located at the site was the tail-wheel assembly which was 100 metres forward of the initial impact point.

1.12.3 Propeller slash marks had under-cut the grassed surface in a manner that indicated rotation on impact. However, the engine, its accessories, cockpit instruments, switches and controls were damaged to such an extent that no useful information could be obtained.

1.12.4 All components of the aircraft were located at the accident site and control continuity was established as far as possible. The flaps were examined and it was established they had been selected fully down prior to impact.

1.12.5 A “stubby” type screwdriver was located approximately 15 metres from the main impact site and it’s position aligned with the tail wheel 100 metres away and the tail section in the wreckage. The screwdriver had rust on the blade and on the tang of the blade inside the handle. A number of fresh looking abrasions were apparent on several areas of the handle (see Figure 2).

Figure 2: Screwdriver from accident site

1.12.6 Further on-site investigation determined that the screwdriver had ejected from the aircrafts tail section during the accident sequence. However, the origin of the screwdriver could not be immediately established.

1.12.7 After moving the tail section from the inverted position, improved access was gained and closer inspection of a cable end fitting on the elevator control quadrant revealed small flakes of an opaque substance attached to the cable end. A sample was retrieved into a specimen jar and along with the screwdriver these were sent for laboratory testing.

1.12.8 Inspection of the left elevator attachment fitting revealed gouges not consistent with damage caused during the impact. The entire wreckage was removed from the accident site and taken to a secure facility for further examination.

1.13 Medical and pathological information

1.13.1 Post-mortem examination determined that the cause of death to the occupants was from injuries consistent with a high energy impact.

1.13.2 The limited toxicological tests for the pilot and passenger found no alcohol or drugs.

1.14 Fire

1.14.1 Fire did not occur.

1.15 Survival aspects

1.15.1 The impact forces were not survivable.

1.16 Tests and research

1.16.1 Examination of the screwdriver and the sample from the elevator quadrant cable end were conducted in a laboratory. The analysis was undertaken using a spectrometer.

1.16.2 Comparison of the spectra of the screwdriver and of the fragment showed that all features of the screwdriver handle spectrum were present in the fragment spectrum. It was deemed that the screwdriver handle was the most likely source of the fragment taken from the elevator quadrant cable end fitting.

1.16.3 Research undertaken to determine how the screwdriver became restricted required the tail section and the area immediately surrounding the quadrant to be cut away from the rear fuselage. Once exposed, gouging and crush marks on the structure, quadrant, and screwdriver were identified and matched.

1.16.4 It was determined that the screw driver had entered the tail section via the aperture in the top of the rear fuselage. In order for that to have occurred, the aircraft needed to have been subjected to negative G or inverted flight, coupled with an elevator down input by the pilot.

1.16.5 The gouges on the elevator attachment flange showed that the screwdriver blade had been resting against it. The screwdriver had then been rotated by the elevator quadrant in response to an elevator up control input. As a consequence, the screwdriver had then jammed the elevator control mechanism in three places:

- the handle had jammed against the rear of the aperture
- the handle was pinned by the cable end fitting on the other side of the handle; and
- the screwdriver blade had jammed against the elevator attachment flange (see Figures 4 and 5). Figure 5 is shown with the elevator removed for clarity.

Figure 3: Marks on the left elevator attachment assembly made by the screwdriver.

Figure 4: Screw driver pinned in aperture (approximation only)

1.16.6 Tests were carried out to try and reproduce the accident flight situation. On the majority of occasions, the screwdriver missed the aperture altogether. It was also observed that the screwdriver would on many occasions, remain wedged between the rearmost stringers and not move at all.

1.16.7 The only time the screwdriver had opportunity to pass through the aperture was when the elevator was commanded to an elevator down position. When this occurred the elevator control quadrant assembly was at a lower position which opened up the aperture and therefore allowed sufficient clearance for the screwdriver to enter the elevator control mechanism.

1.16.8 The multiple abrasions on the screwdriver handle indicated that the pilot had made a number of attempts to free the control restriction. Various combinations in the positioning of the elevator control quadrant and the screwdriver were then tested. It was found that once the screwdriver had become pinned at the waist of the handle and forced against the narrowest section of the upper rear fuselage aperture, the effects of continued negative G during the exit from the slow roll and the shape of the screwdriver handle may have prevented the screwdriver from becoming dislodged.

1.16.9 A number of accidents have occurred involving the Yak 52 that were attributed to restricted flight controls from the presence of FOD. In particular, an investigation of a fatal accident that occurred in the UK in 2003[6] located a stubby type screwdriver during the wreckage inspection, jammed between the rearmost section of the fuselage and the elevator quadrant.

1.16.10 In one section of its report, the AAIB referred to maintenance inspections via the inspection panel below the left horizontal stabiliser. The report stated that on 80 percent of occasions that the panel had been opened, loose articles were discovered. The items included: coins, sunglasses, pens, maps, fuel drain tools, keys, stones, batteries and in one case a five foot section of a broom handle.

1.16.11 The detection of FOD, including visual inspection and slapping the underside of the fuselage has been encouraged for Yak operators. However, the AAIB investigation proved that it is possible for loose articles to be present at the rear of the fuselage and not be heard even with the most vigorous slapping of the underside of the fuselage. This aspect has particular relevance to ZK-YTW, where slapping would prove difficult on a tail wheel model and therefore a totally ineffective means of detecting FOD in that immediate area.

1.16.12 The AAIB cited design of the Yak 52, as a contributing factor in the accident and as a consequence, the UK CAA accepted a recommendation made by the AAIB and issued a mandatory permit directive (MPD)[7], effective April 2004, for the fitting of a barrier into the fuselage of Yak 52's. ZK-YTW however, was initially imported into the USA as an experimental/exhibition aircraft. The FAA does not issue AD's or MPD's against the Yak series aircraft because their legal structure states the aircraft must have a type design. The Yak does not meet that criteria, therefore no barrier was required to be fitted into ZK-YTW. In New Zealand, regulatory oversight of the Yak series aircraft is similar to that of the FAA.

1.17 Organisational and management information

1.17.1 Not applicable.

1.18 Additional information

1.18.1 Research carried out on similar accidents involving the Yak 52 indicated numerous FOD related events[8].

- On June 18, 2002, near Antioch, California a Yakolev Yak 52 was destroyed when it struck terrain in a near vertical attitude following a loss of control after a loop. The NTSB discovered a screwdriver in the tail section and further research determined that it had jammed in the elevator bell-crank in a similar fashion to that which occurred on ZK-YTW.

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[6] AAIB Bulletin No: 10/2003 Ref: EW/C2003/01/01

[7] MPD Number 2008-005 R1Installtion of barrier on rear cockpit floor

[8] Information sourced from Aviation Safety Network, an exclusive service of the Flight Safety Foundation. http://aviation-safety.net/wikibase/dblist.php?AcType=YK52

- On 31 October 2004, at Essex in the UK, the pilot in a Yak 52 had completed a stall turn but felt a control restriction that gave the aircraft limited nose up authority. However, he managed to recover the situation and land the aircraft. Investigation found that a cell phone left in the aircraft two months earlier had penetrated a defective safety barrier and lodged in the elevator quadrant.

- The Yak departed from a slow roll and collided with the ground at an angle of 80 degrees. A camera lens cap had jammed in the elevator mass balance arm.

- Two non-fatal events occurred in Lithuania: In the first instance, the pilot rolled inverted and found the elevator inoperable. He managed to free the restriction when he rolled back wings level. In the second instance the pilot was forced to abandon the aircraft when a flight recorder frame jammed the elevator controls.

- In Colorado, a Yak 52 pilot was doing aerobatics when a radio knob came off and jammed the elevator control.

- In Utah, the aircraft was performing aerobatics when it departed controlled flight after completing a loop and struck the ground in a near vertical attitude. The NTSB found a brass nut had jammed in the elevator quadrant.

- A pilot survived a jammed elevator control after conducting a Cuban Eight aerobatic manoeuvre. After landing he inspected the inside of the rear fuselage and found a 7 inch pair of vice grips.

- In Aledo, Texas, the aircraft was performing aerobatics when it departed controlled flight after completing a loop. The NTSB found gouge marks on the elevator quadrant but did not recover any FOD.

- In New Zealand a roll of duct tape became jammed in the elevator control whilst in inverted flight. The pilot had limited nose up control but later managed to free the restriction and land the aircraft.

1.19 Useful or effective investigation techniques

1.19.1 Not applicable.

2. Analysis

2.1 The accident occurred as a result of a screwdriver restricting elevator control on the aircraft following a slow roll. The restriction did not allow sufficient nose up elevator authority and the pilot was unable to recover from a steep dive.

2.2 The fact that the pilot had completed two aerobatic manoeuvres and then flown in level flight for a period of time would tend to eliminate an inflight control restriction occurring at that part of the flight. However, the witness observations of the aircraft entering a steep dive following a slow roll would support a conclusion that the loose screwdriver penetrated the upper rear fuselage aperture during that manoeuvre.

2.3 From the tests and research, it is likely that the screwdriver lodged in the elevator control system after an elevator down input was made by the pilot. This would have provided sufficient clearance in the aperture for the screwdriver to pass through.

2.4 On completion of the slow roll and encountering the restriction, the pilot's initial thoughts may have been with the passenger handling the controls and when the realisation that that was not the case a further delay may have occurred with the pilot trying to overpower the elevator control.

2.5 These aspects and a factor of surprise may have created sufficient delay that once the aircraft became established in an accelerating dive, the pilot's predicament would have been overtaken by speed of events. The thought of then rolling back to inverted flight in an attempt to free the restriction would likely have been sub-consciously rejected by the pilot.

2.6 It would appear that the pilot lowered the flaps in an attempt to help slow the aircraft. However, the aircraft was accelerating owing to the elevators being jammed nose down. As such, the lowering of the flaps would have little effect on the speed.

2.7 The roll to the right moments before impact was likely to have been made in order to avoid a line of houses situated on the western side of the park.

2.8 The physical condition of the screw driver suggests it was exposed to moisture over some time. It is not inconceivable that the screwdriver had been in the rear of the aircraft for a long period. From the results of the post-accident research, ZK-YTW may have completed many aerobatic flights in New Zealand in the past with the screwdriver remaining out of sight behind the rearmost sub-frame.

2.9 It could not be determined why a barrier had not been fitted to ZK-YTW by the owners. Although the pilot had an excellent knowledge of his aircraft and always displayed good airmanship during his pre-flights, he may have simply been unaware of the UKCAA mandated MPD listed on their website or had assumed the barriers may have been mandated and fitted in the USA.

3. Conclusions

3.1 A screwdriver remained undetected in the rearmost section of the fuselage.

3.2 The screwdriver became lodged in the elevator controls during a slow roll.

3.3 Attempts by the pilot to free the elevator control restriction were unsuccessful and the situation quickly became unrecoverable.

3.4 The design of the aircraft contributed to the accident.

3.5 The only adequate means of defence against elevator control restriction caused by FOD in this type of aircraft is a physical barrier installed into the rear fuselage.

3.6 The UKCAA mandated barriers for Yak 52s in the UK via a MPD.

3.7 ZK-YTW did not have a barrier fitted to prevent migration of FOD into the elevator control system.

3.8 The accident was not survivable.

4. Safety actions

4.1 Immediately after the accident and finding the elevator controls had likely been restricted by FOD, the CAA notified all Yak 52 operators to carry out a thorough inspection for loose articles prior to further flight.

4.2 Given the frequency of accidents involving the Yak series aircraft worldwide, the CAA issued an AD in March 2012, mandating the fitment of a barrier into the rear fuselage of all Yak 52 models. The AD also includes the requirement to thoroughly inspect fore and aft of all fuselage frames for the presence of FOD prior to fitment of the barrier.

4.3 This report will be made freely available on the CAA website to all interested parties.

Report written by:	Authorised by:
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