Yak 52, G-BXJB

AAIB Bulletin No: 2/99 Ref: EW/G98/11/20 Category: 1.3

Aircraft Type and Registration:	Yak 52, G-BXJB
No & Type of Engines:	1 Ivchenko Vedeneyev M-14P piston engine
Year of Manufacture:	1987
Date & Time (UTC):	17 November 1998 at 1115 hrs
Location:	In-flight near Raydon Airfield, Suffolk
Type of Flight:	Private
Persons on Board:	Crew - 1 - Passengers - 1
Injuries:	Crew - None - Passengers - None
Nature of Damage:	Break-up of right elevator
Commander's Licence:	Private Pilot's Licence
Commander's Age:	50 years
Commander's Flying Experience:	382 hours (of which 158 were on type) Last 90 days - 35 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

After performing an aerobatic detail with a passenger on board, the pilot descended the aircraft at an indicated airspeed of 350 kph to join the circuit. However, on reaching a height of approximately 1500 feet agl the control stick suddenly jerked forward and the aircraft pitched down, accompanied by severe vibration of the stick. A 'second or so' later a loud report was heard from the rear of the aircraft. The pilot closed the throttle and was able to recover the aircraft to level flight at a height of approximately 400 feet agl. Whilst flying at a minimum safe speed, an emergency call was made and the aircraft returned to its departure airfield where an uneventful landing was made. During this transit the rear seat occupant confirmed to the pilot that a section of the right elevator was missing.

The framework for each of the fabric covered elevators on this aircraft is constructed from aluminium alloy and consists of ribs (numbered 1 to 5 from the inner rib - outboard in this report) attached to a tubular spar. The ribs are attached to a folded sheet section trailing edge, most attachments being accomplished by the use of rivets, with a formed sheet aluminium leading edge. The framework is covered with fabric secured to the ribs by stitching.

Examination of the failed elevator, Figure 1, revealed the following:-

Cotton fabric had been used to cover the framework.

Mould was growing on the fabric, particularly near the tip, and was also found on the fabric used on other surfaces on this aircraft.

The elevator upper surface fabric had torn chordwise in eleven places, but only one tear had occurred at a rib position. Subsequently the aft edges of the upper and lower fabric had been 'feathered' by flapping in the slipstream.

Trailing edge rib No 1 had bent outward and No 2 inward. The flanges on these ribs had fractured first, followed by anticlockwise (viewed from the rear) torsional fracture of the webs. A very low cycle fatigue mechanism was involved with the web fracture on rib No 1.

Ribs 3 and 4 had fractured in a similar manner to ribs 1 and 2, except that their webs had failed in a clockwise direction.

The tip rib had been crushed just forward of the trailing edge and one flange had fractured. The trailing edge section had also fractured, adjacent to the tip fairing, by forward bending. A fatigue crack was present in the lower skin of the fairing running into one of the trailing edge attachment rivet holes.

From these findings it was concluded that the break-up of the elevator had been initiated by a chordwise tear in the upper surface fabric at the No 2 rib position, due to in-service degradation of the cotton, and that 'ballooning' of the fabric under airloads had been involved in the structural failures. All of these failures were associated with very low cycle fatigue mechanisms. Information gained from another maintenance organisation supported this view, since they had seen examples of fabric on Yak-52 elevators having become detached in-flight from the structure along the trailing edge. This was reportedly associated with a forward motion of the control stick.

As a result of this accident, the CAA have issued Mandatory Permit Directive (MPD) No. 1998-020 which requires that it is established from the records of such imported aircraft if the control surface fabric has been inspected and, if necessary, replaced in accordance with paragraph 1 of MPD 1997-019 R1. This MPD requires the fabric to meet listed specifications, but excludes the type of cotton fabric used on this particular aircraft. The maintenance organisation responsible for this aircraft reported that prior to its importation into the UK, less than three years before this accident, they had shipped a quantity of suitable fabric to the manufacturer, to obviate the need to re-cover the control surfaces after the aircraft arrived in the UK, and they had believed that this had been done. In addition, the aircraft had been repainted by the manufacturer before export, which precluded direct examination of the type of fabric used.