SERIOUS INCIDENT

Aircraft Type and Registration:	Piper J3C-65 Cub, G-CGIY
No & Type of Engines:	1 Continental Motors Corp C90-12F piston engine
Year of Manufacture:	1943 (Serial no: 11535)
Date & Time (UTC):	12 May 2018 at 1300 hrs
Location:	En route from Gamston Airport to Leeds East Airport
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Upper rudder hinge pin missing, lower hinge lugs distorted and elevator ribs damaged
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	71 years
Commander's Flying Experience:	7,870 hours (of which 136 were on type) Last 90 days - 108 hours Last 28 days - 55 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and inquiries made by the AAIB

Synopsis

The aircraft was en route from Gamston Airport near Retford to Leeds East Airport when the pilot noticed a vibration on the rudder pedals. This was followed by an uncommanded yaw and a jolt through the pedals. Several seconds later the pilot heard a loud bang with a violent nose-down pitch. The pilot slowed the aircraft, regained control and, looking behind, observed that the rudder appeared to be displaced. He informed Leeds East of the problem and landed without further incident. The partial rudder detachment and the resultant handling difficulties were caused by the loss of the rudder upper hinge pin and bushes. It is not known how the pin and bushes worked loose but their loss would have been prevented had the specified upper washer been in place.

History of the flight

The pilot was carrying out a local flight between Gamston and Leeds East in good weather conditions. He had just changed radio frequency from Doncaster to Leeds East when he noticed a vibration through the rudder pedals. This was shortly followed by an uncommanded yaw and violent jolt through the pedals. A few seconds later there was a loud bang and the aircraft pitched nose down. The pilot regained control and level flight, but experienced heavy stick forces and had to maintain a constant pressure on the rudder pedals to arrest their movement back and forth. He glanced back and saw that the rudder appeared to be

displaced to the right and detached from its upper hinge. Nearing Leeds East, he informed ATC of the problem and was offered either Runway 16 or 24. There were obstacles in the undershoot and vicinity of Runway 16 so he chose Runway 24, accepting a slight crosswind of 180°/4kt. He landed the aircraft, taxied clear and shut down without further incident.

Engineering investigation

On inspection the pilot found that the rudder upper hinge pin and bearings were missing and the lower hinge lug (cylindrical portion through which the pivot pin passes) had detached from the leading edge of the rudder. The rudder was therefore held in position only by its control cables attached to the left and right control horns. There was distortion to the inboard edge frame of both elevators adjacent to the rudder. Despite this, the elevators functioned correctly, albeit with some restriction and an increased stick loading. Figure 1 is a general view of the aircraft and Figures 2 and 3 show the condition of the rudder upper hinge and elevators.

Figure 1
General view of G-CGIY

Figure 2
Upper rudder hinge separation, pin and bushes missing

Figure 3
Damage caused to the elevator inboard edge frames

Discussion

The damage to the elevator shows the rudder had been oscillating in the aircraft slipstream, hence the pilot describing how he had to physically restrain the rudder pedals from moving back and forth. Without the upper hinge support, the oscillation overloaded the lower hinge lug and caused it to part from the rudder leading edge frame. This left the rudder attached to the aircraft by its two control cables only. In this unusual state the rudder was not able to provide yaw control effectively. There was also a risk that the elevator could have been jammed by the loose rudder and pitch control lost as a result.

Rudder hinge assembly

The upper and lower rudder hinge assemblies consist of tubular lugs welded to the fin trailing edge tube and the rudder leading edge tube. Within the lugs there are non-ferrous interference-fit bushes through which the steel pivot pin is fitted, locked in place by a split pin. According to the illustrated parts catalogue, there should be a washer fitted directly under the head of the pivot pin and a second washer fitted between the split pin and hinge. The pin should always be fitted with its head uppermost. During the pre-flight walk around the pilot noticed nothing unusual about the rudder or its hinges. It is not known why the bushes worked loose.

Despite the damage to the lower hinge, the pin and bushes remained in place and it appears that there was no washer fitted directly under the head of the pivot pin. However, there was a correctly fitted washer at the lower end of the pin above the split pin as shown in Figure 4.

It is likely that the upper hinge had been assembled in the same way. However, the diameter of the pivot pin head is slightly less than that of the outer diameter of the bushes. Without the upper washer there would be nothing to stop the pin and bushes ‘working’ out of the rudder hinge as appears to have happened in this case.

Figure 4
Lower rudder hinge assembly

AAIB inquiries

During this investigation it was observed that from a random small sample of other J3 Cub and Cub derivatives, two aircraft were missing their upper washers from the hinge assemblies. This incident and the two random sample aircraft suggests that there may be an airworthiness issue concerning the correct assembly of the rudder hinges in the J3 Cub and derivative fleet.

Safety action

The CAA have been informed and are considering an appropriate safety action to inform owners and operators. In addition, the LAA has published a comprehensive article in the Safety Spot section in the association magazine with advice to Cub owners regarding the assembly and integrity of the rudder hinge pins.