ACCIDENT

Aircraft Type and Registration:	Jabiru J430, G-RCST, amateur-built
No & Type of Engines:	1 Jabiru Aircraft PTY 3300A piston engine
Year of Manufacture:	2006
Date & Time (UTC):	5 June 2011 at 1704 hrs
Location:	Gloucester Lodge Farm, Northumberland
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to engine, nose landing gear, firewall
Commander's Licence:	Private Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	885 hours (of which 495 were on type) Last 90 days - 26 hours Last 28 days - 13 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and additional AAIB investigation

Synopsis

Whilst flying in the Newcastle area, the pilot reported smoke and fumes in the cockpit and noted that the engine oil pressure was dropping rapidly. He conducted a successful forced landing, although the aircraft sustained some damage. The problem was found to be a loss of oil via a split in a seam in the engine oil cooler; this component had been fitted immediately prior to the accident flight, the previously fitted unit having developed a 'weep'. It was found that a manufacturing fault had led to the oil cooler splitting as a result of being subjected to the normal engine oil pressure.

History of the flight

The aircraft took off from Eshott in Northumberland for an intended flight to a farm strip in Norfolk. The engine temperature and pressure indications were all normal as the aircraft entered the eastern part of Newcastle Control Area at an altitude of 1,200 ft. Whilst overhead Blyth wind farm Visual Reporting Point, smoke suddenly appeared inside the cockpit and the pilot noticed that the engine oil pressure was dropping rapidly. He made a MAYDAY call to Newcastle ATC, who were able to monitor the aircraft on radar and subsequently alerted the emergency services. The pilot turned the aircraft towards the west and prepared to conduct a forced landing. However, during the approach to his chosen field, the pilot noted a number of people were in the

landing area. Consequently, he was forced to land, with a tail wind component, in an adjacent field where the surface consisted of a series of ridges and furrows. The landing was successful although the rough nature of the field resulted in some damage to the nose landing gear and the firewall to which it was attached.

Investigation

Upon investigation, it was immediately apparent that a large quantity of oil had been lost via a split along a seam at the rear of the engine oil cooler. In fact this was a new component that had only just been fitted following a 'weep' that had been discovered in the previously fitted unit. Some of the oil had dropped onto the exhaust system, thus generating the smoke that had entered the cockpit.

The owner/pilot noted that the lower plate of the oil cooler had developed a "bulge" since being fitted to the aircraft and the leak appeared to be associated with this.

Both the incident oil cooler (see Figure 1) and the previously fitted component were examined by a metallurgist. After cleaning, an air pressure test revealed that there was a leak along an approximate 40 mm length of the lower plate, on the aft side as fitted to the aircraft. Both coolers were sectioned, (Figure 2) and the bulging in the lower plate of the incident unit could be seen. The cooling channels in the lower chamber were formed from corrugated sheet metal sandwiched between horizontal plates. However, it was apparent that there was an absence of solder between the lower plate and the corrugated channels, meaning that the plate had remained attached only around the periphery. As a result, the oil pressure within the chamber had caused the lower plate to bulge and had overloaded the sheet metal sidewalls of the chamber. The leak was due to a longitudinal fracture of the sheet metal sidewall, immediately adjacent to the soldered joint between it and the lower plate; this can be seen in Figure 3.

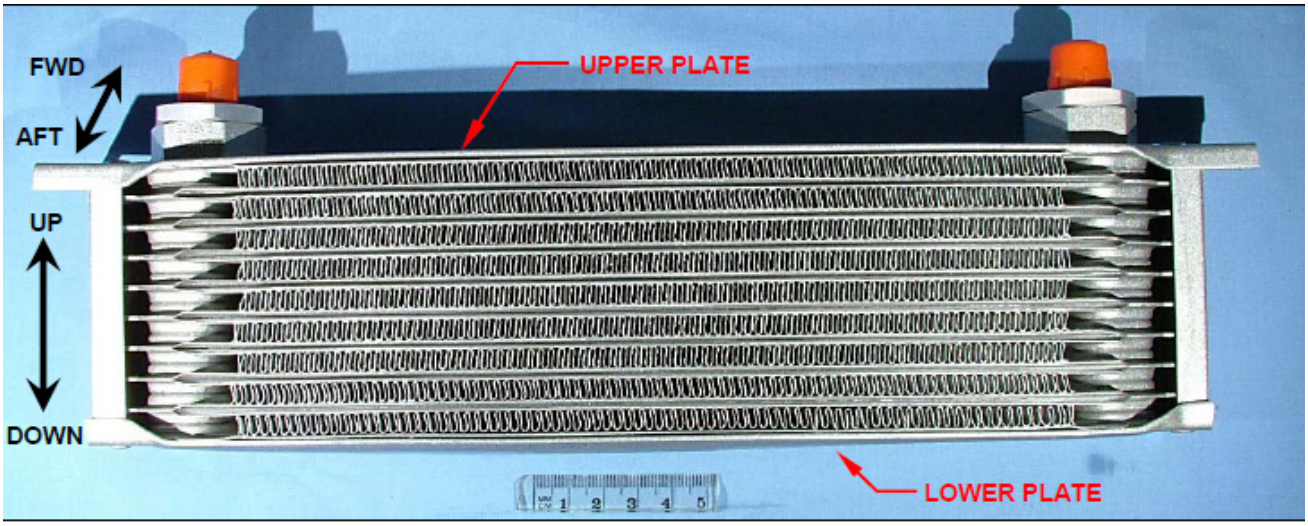
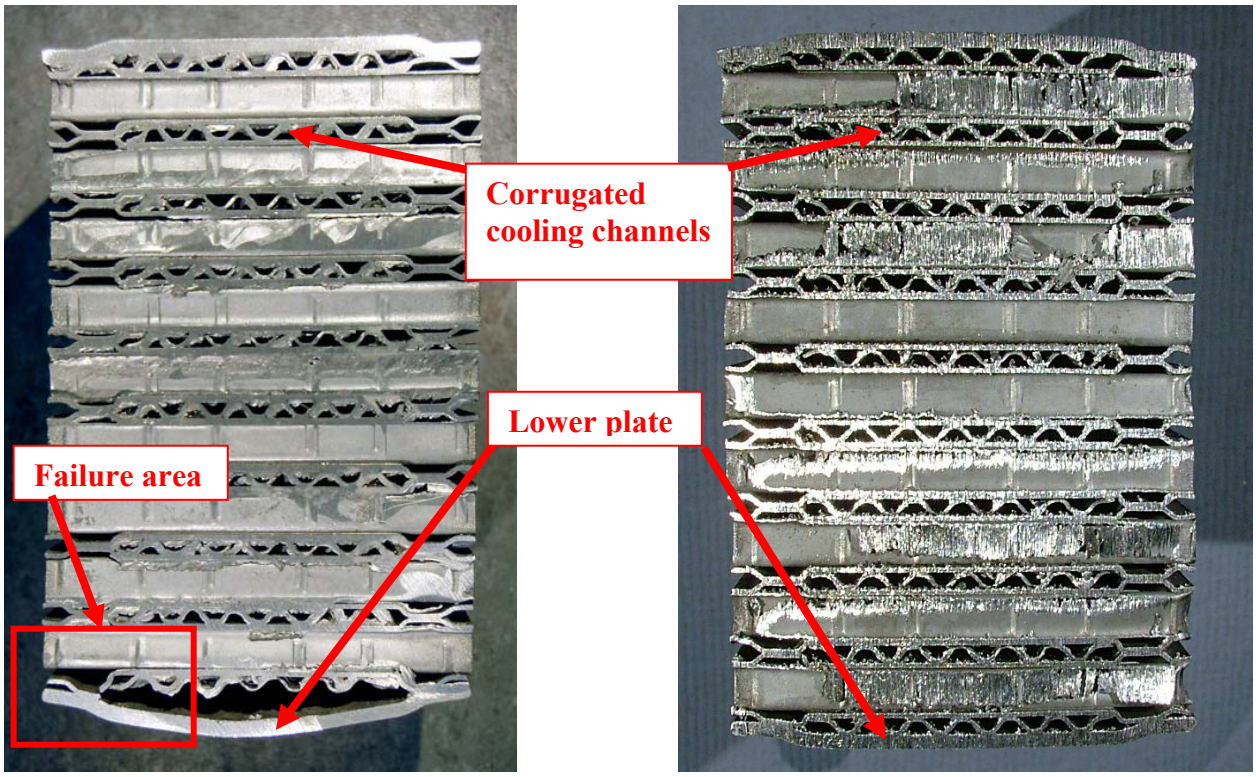


Photo: ms4i

Figure 1

View of the incident oil cooler, as received



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Incident oil cooler Previously fitted oil cooler

Figure 2

Oil coolers after being sectioned. Bulge in lower plate of incident unit is clearly visible

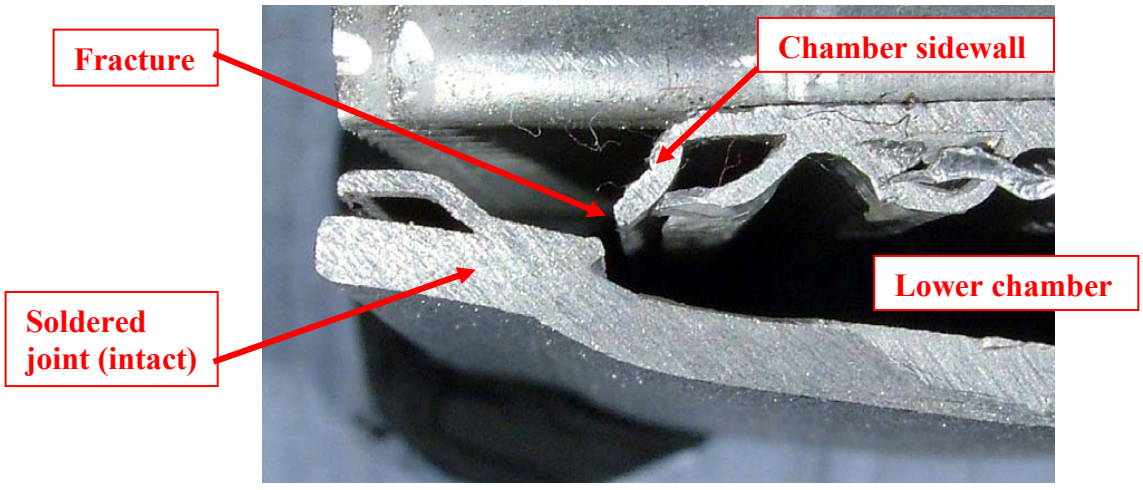

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Figure 3

Enlarged view of area of failure

Examination of the fracture surface indicated that the failure was consistent with overload; there was no evidence of slow crack growth mechanisms, such as fatigue.

As part of the investigation, the lower plate of one half of the previously fitted oil cooler was deliberately torn from the matrix. In contrast to the incident unit, the corrugated cooling channels were found to be securely joined to the lower plate such that the removal process caused the channel material to fail (Figures 4 and 5).

It was therefore concluded that the oil cooler failed as a result of the corrugated channels not being joined to the lower plate. This was in turn due to the omission of solder that should have been applied during the manufacturing process.

Previously fitted oil cooler

The 'weep' in the previously fitted cooler, which had achieved 94 hours since fitment, was also investigated, and it was found that two fatigue cracks had developed in the corners of the lower plate sidewall. The remaining half of the lower plate was deliberately torn off in order to expose and examine these features, which are indicated in Figure 4 (note: a conventional leak test could not be conducted due to the cooler having already been sectioned).

Both the fatigue cracks were approximately 25 mm in length and had penetrated through the full thickness of the chamber sidewall. These are shown on a photograph of the lower plate at Figure 5. The fatigue cracks were visually distinguishable from the deliberate

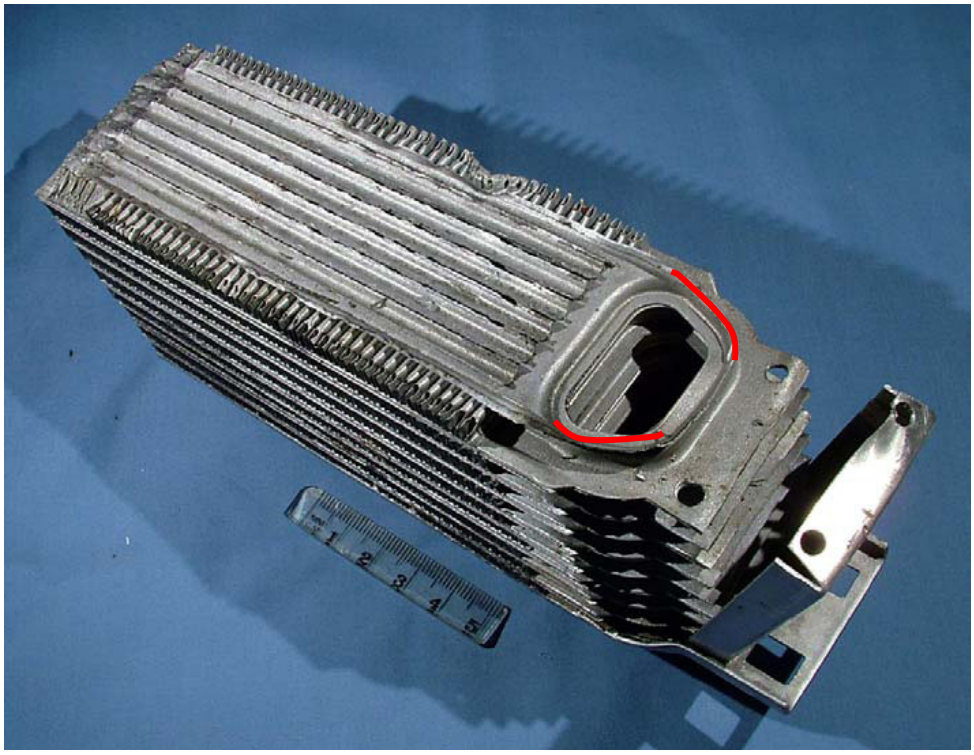

Photo: ms4i

Figure 4

View of underside of previously fitted oil cooler, with lower plate torn off. Remains of channels can be seen; fatigue crack regions are highlighted

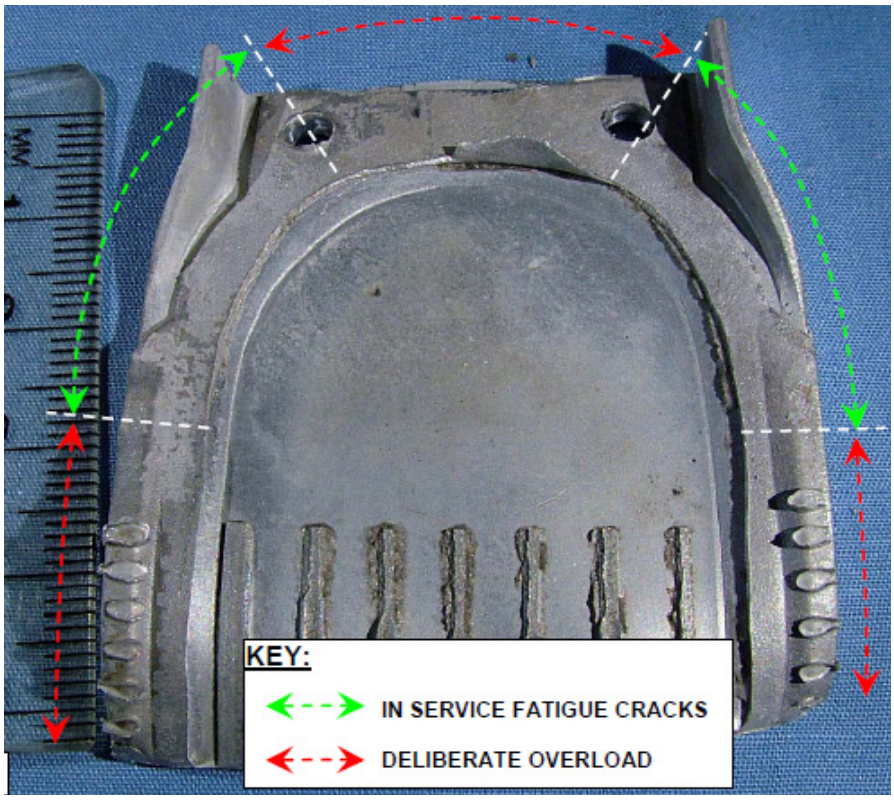

Photo: ms4i

Figure 5

View of lower plate after removal, with areas of pre-existing fatigue indicated. Note remains of oil channels, which had been attached to those seen in Figure 4

overloading of the sidewall, since they were darker in appearance, due to oxidation and staining during stable crack growth. The nature of the fracture surface indicated that the fatigue crack had initiated from multiple sites on the internal surface of the chamber sidewall. It was not possible to establish a figure for the amount of time taken for the crack to progress from initiation to failure.

Other information

This type of oil cooler, which is sold primarily into the automotive market, is used on a number of Jabiru J400/430 aircraft and the owner of G-RCST was aware of concerns among other owners over their continued use.

The manufacturer's data sheet for the oil cooler states that:

> *'Every cooler is pressure checked to 175 psi. Periodic samples are burst tested to 350 psi.'*

However, the aircraft owner stated that there was no documentation that accompanied this, or any other cooler, that indicated what checks had been conducted prior to release from the manufacturer.

The oil pressure generated by a Jabiru engine is reported to be typically around 45 psi, with the pressure sensor located immediately upstream of the oil cooler. As a result of the damage observed on the failed oil cooler from G-RCST, notably the bulge in the lower plate,

it seems unlikely that the unit would have been able to withstand the 175 psi test pressure applied after manufacture and it is thus possible that this test may have been omitted. The USA-based manufacturer has not been able to provide an explanation for lapses in the manufacturing process, although they did note that some coolers had developed leaks as a result of pressure spikes being generated by some types of oil pump.

The Light Aircraft Association (LAA), who provide airworthiness services and oversight for this aircraft type, are to conduct a survey of owners to establish the extent of oil cooler problems, whilst at the same time evaluating other available oil coolers.