ACCIDENT

Aircraft Type and Registration:	Enstrom 280FX, G-MHCK
No & Type of Engines:	1 Lycoming HIO-360-F1AD piston engine
Category:	2.3
Year of Manufacture:	1985
Date & Time (UTC):	21 May 2005 at 1015 hrs
Location:	Barton Airfield, Manchester
Type of Flight:	Trial Lesson
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Fire damage to aircraft skin and engine area
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	67 years
Commander's Flying Experience:	20,000 hours (of which 12,000 were on type) Last 90 days - 5 hours Last 28 days - 2 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and metallurgical examination of exhaust system component

Following a normal start-up, the pilot had lifted the helicopter into a hover when he noticed a burning smell and saw smoke coming from the area around the engine. He reported that the helicopter then lost power and he landed back on the helipad. The pilot was informed by ATC that the aircraft was on fire and he shut off the fuel and electrics. Both the pilot and passenger exited the aircraft without injury. The fire was extinguished by the Airport Fire Services.

After the fire had been extinguished the pilot looked inside the engine bay and found the exhaust pipe from the turbocharger had become detached. He concluded that the flames were as a result of the paint being heated by the exhaust exiting the turbocharger.

The exhaust pipe had been fitted to this helicopter for a significant period of time; it was maintained 'on-condition' and was required to be visually inspected every 50 hours in accordance with the maintenance checklist. The last such inspection was carried out one and a half hours flying prior to the accident.

Metallurgical examination of the exhaust system

The exhaust from the turbocharger outlet passed via a short pipe through an aperture in the skin to overboard.

Subsequent examination revealed that this pipe had failed, allowing exhaust gases to heat the aircraft skin, leading to the smoke and fire. The location of the detached exhaust pipe and the damage to the engine cover is shown in Figures 1 and 2. The exhaust pipe was returned to the AAIB for examination and is shown in Figure 3. The pipe had failed circumferentially around the weld attaching the flange to the main tube (see Figure 4). The material of the main tube and the flange was specified to be 321 grade stainless steel and the filler weld material was specified as AMS5680 (347 grade stainless steel).

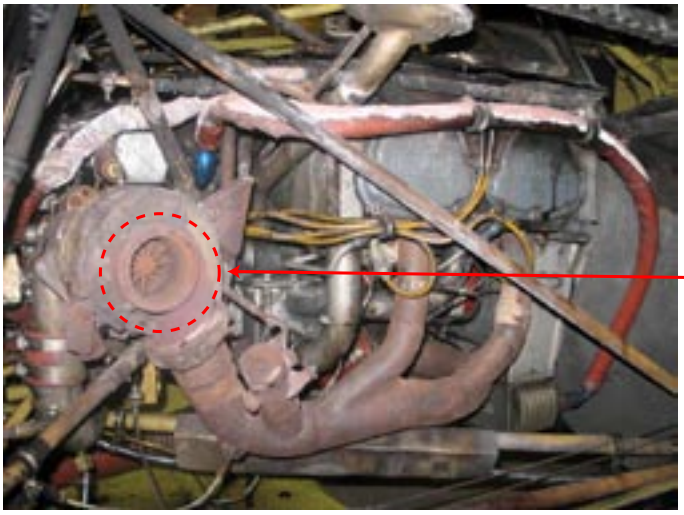

Figure 1

Figure 2

Photographs courtsey QinetiQ

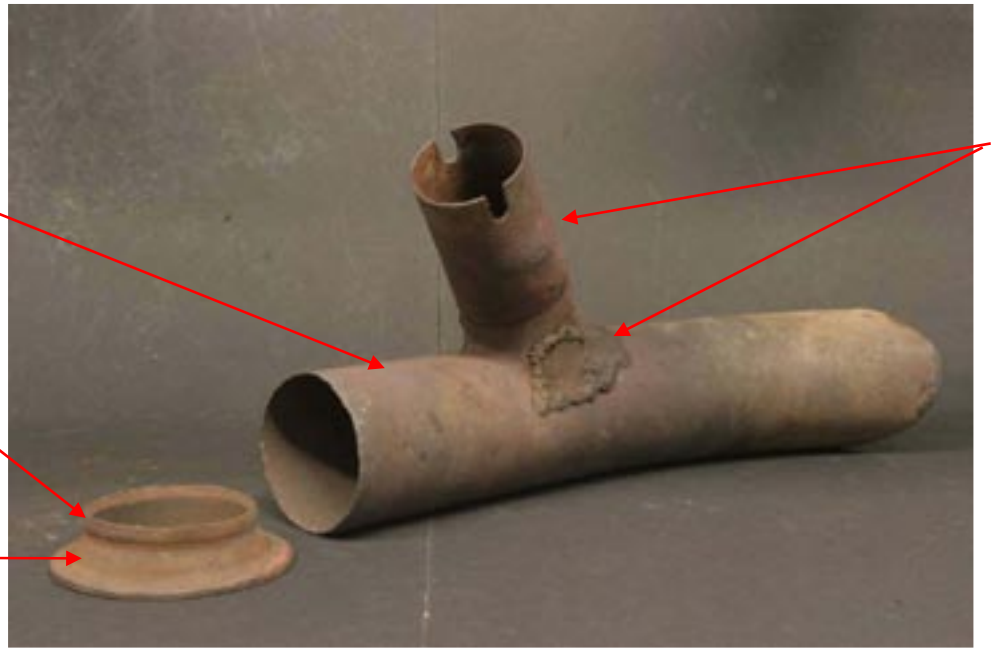

Figure 3

Exhaust pipe 'as found'

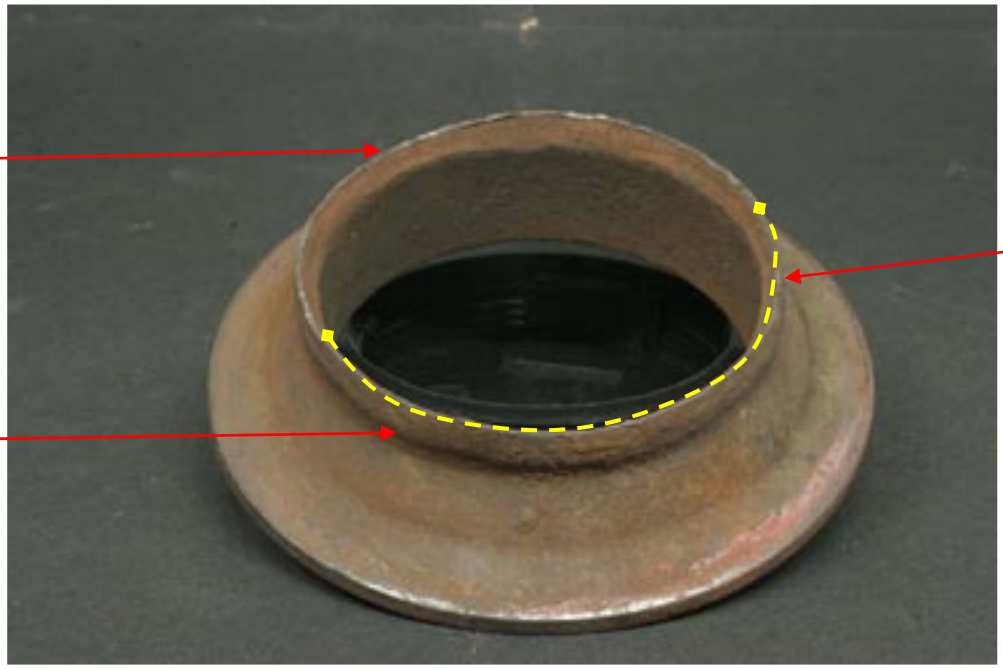

Figure 4

Exhaust pipe flange showing fracture surface and corrosion

Photographs courtsey QinetiQ

The exhaust pipe was sent for metallurgical examination. It was found that:

> *'Visual examination of the fracture surface revealed one half to be severely corroded and the other half exhibited blue/purple colours in the fracture surface (locations shown in figure 4); these colours may be indicative of heat tinting of the component.*

Scanning Electron microscopy (SEM) of the fracture surface on the flange revealed that:

> *'the coloured area from the visual examination exhibited intergranular cracking on the outer edges. In the centre of the intergranular cracking were areas of fatigue. Approximately 60% of the fracture surface was severely corroded, which had removed any fine detail in that area. The extent of the corrosion would indicate that the crack had been present for some length of time.'*

It was concluded that:

> *'The Enstrom 280FX turbo charger exhaust pipe failed due to intergranular cracking around the weld connecting the flange to the main tube. It is probable that the cause of the intergranular cracking was due to sensitisation of the austenitic 321 stainless steel during welding. Sensitisation occurs in some austenitic stainless steels in the temperature range of 500 – 850°C. The formation of chromium carbides at the grain boundaries lowers the corrosion resistance and thus is susceptible to attack in an environment the steel would usually resist. Hence, a result of sensitisation is that the component becomes more vulnerable to intergranular corrosion. The fatigue found in the fracture surface would have been a secondary failure mode initiated by cyclic loading on the reduced thickness of the tube caused by the intergranular cracking.*

Previous events

A previous incident to an Enstrom 280c G-BRPO where the clamp securing the exhaust pipe failed was reported in AAIB Bulletin 1/2005. The report stated that the turbocharger exhaust pipe:

> *'was detached from the turbocharger, allowing the exhaust to impinge directly on the inside of the skin, resulting in the local overheating previously mentioned. The pilot had assumed that this had been dislodged in the landing, however the clamp securing it had fractured in fatigue, allowing it to become dislodged in flight. This pipe also connected to a bypass pipe from the engine exhaust system, and once dislodged this allowed exhaust from close to the cylinders to be directed at the bulkhead immediately behind the pilot. The entire engine compartment would have filled with exhaust fumes, accounting for smoke in the cockpit.'*

The manufacturer's agent advised that fractures of this type of clamp are rare and there have been no reported incidents of the failure of the exhaust pipe.