AAIB Bulletin No: 7/94 **Ref: EW/G94/04/20** **Category: 1.3**

INCIDENT

Aircraft Type and Registration:	Cessna F150H, G-AWPJ	
No & Type of Engines:	1 Rolls-Royce Continental O-200-A piston engine	
Year of Manufacture:	1968	
Date & Time (UTC):	28 April 1994 at 1332 hrs	
Location:	Near Humberside International Airport	
Type of Flight:	Private (Training)	
Persons on Board:	Crew - 2	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Damage to engine only	
Commander's Licence:	Basic Commercial Pilot's Licence with IMC, Night and Flying Instructor Ratings	
Commander's Age:	28 years	
Commander's Flying Experience:	450 hours (of which 180 were on type) Last 90 days - 57 hours Last 28 days - 26 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

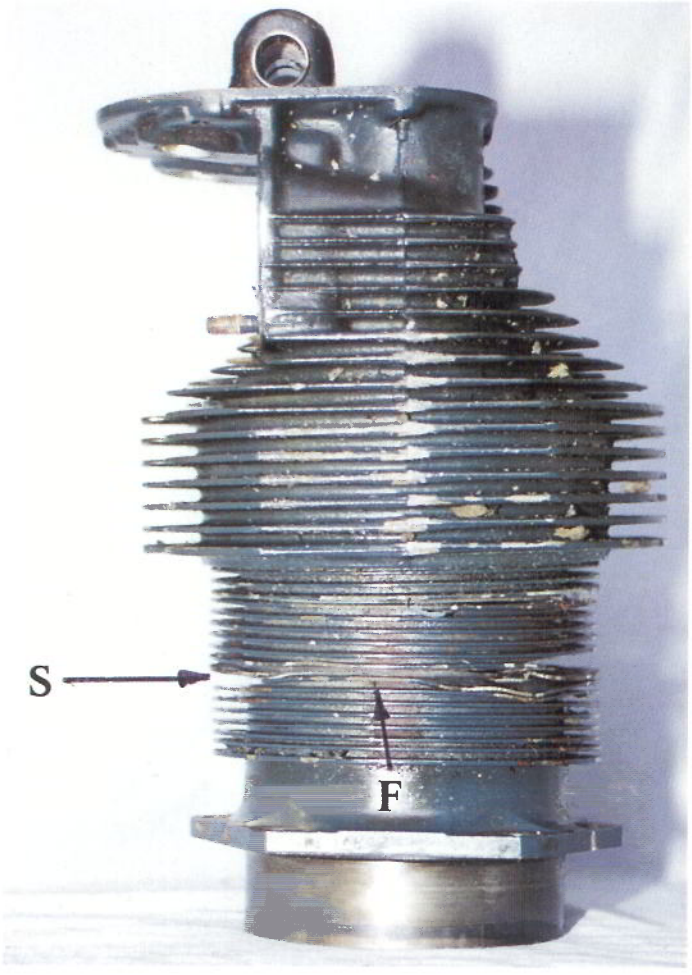
During the second training flight of the day from Humberside International Airport, with an instructor and pupil on board, a 'pop' sound was heard from the engine following which a light vibration developed. After the instructor had informed Air Traffic Control and turned the aircraft downwind, it was apparent that engine power was available between 1,300 and 1,700 RPM with light vibration, but at other speeds moderate to severe vibration was experienced. At this time the aircraft was some 6 nm to the north west of the airport at just below 3,000 feet altitude and, as the wind was approximately 270°/30 kt, the instructor decided to return to Humberside. During the shallow descent, a large puff of smoke came from the cowling which prompted the pilot to transmit a 'PAN' call, a second puff being seen just before turning finals for Runway 21. With the engine still running the aircraft landed safely and, with the emergency services in attendance, was taxied to its normal parking slot. However, just as the engine was to be shut down mechanical noises were heard, oil was ejected over the windscreen, cowling and nosewheel; and the engine stopped.

An initial examination of the engine revealed that the No 4 cylinder had failed. The upper half of this cylinder had separated and its piston had vacated the stub barrel, precipitating further damage to the cylinder, piston, associated rings and connecting rod.

The two sections of the cylinder were subjected to a detailed metallurgical examination by the AAIB. Initial examination revealed that it had failed across the mid point of the lower parallel finned section of the cylinder and that the fracture surfaces had been mechanically damaged after separation. Despite this damage it was clear that separation had occurred by a low stress high cycle fatigue mechanism, initiation being in the region shown in 'Figure 1'. Detailed examination of the initiation region, 'Figure 2', showed that separation had started in the outer surface of the cylinder wall, between two of the integral cooling fins, and that the adjacent fins had been extensively damaged by pre-existing corrosion.

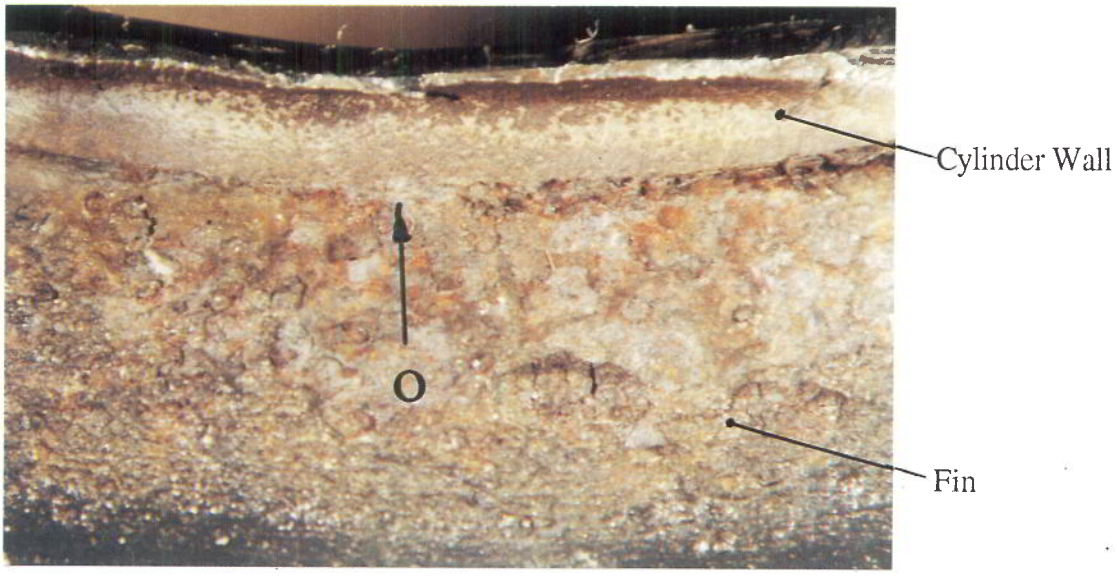
A micro cross-section prepared of the fatigue initiation region, 'Figure 3', confirmed the above corrosion but also that some was present on the fracture surface itself. Measurement of the fin thickness indicated that the cylinder wall thickness in this area had decreased by at least 17% due to corrosive attack. Paint was present over the external corrosion, within a corrosion pit in the fracture initiation region and on the initial part of the fracture surface, thus indicating that the initial part of the crack was present when the cylinder was last painted. The general characteristic of the paint finish on this cylinder did not suggest that it had been 'touched up' by local application of paint but rather that the complete unit had been painted at some time.

The engine of this aircraft was first fitted in December 1975 and removed in July 1987, at 1949 hours, for overhaul. During this rebuild to a zero hour 'new parts specification', corrosion was removed from the crankcase and cylinder fins following which reprotection was applied. This overhaul was completed in May 1992. The most recent inspection was an Annual check at 582:20 engine hours, some ten hours prior to the cylinder failure.



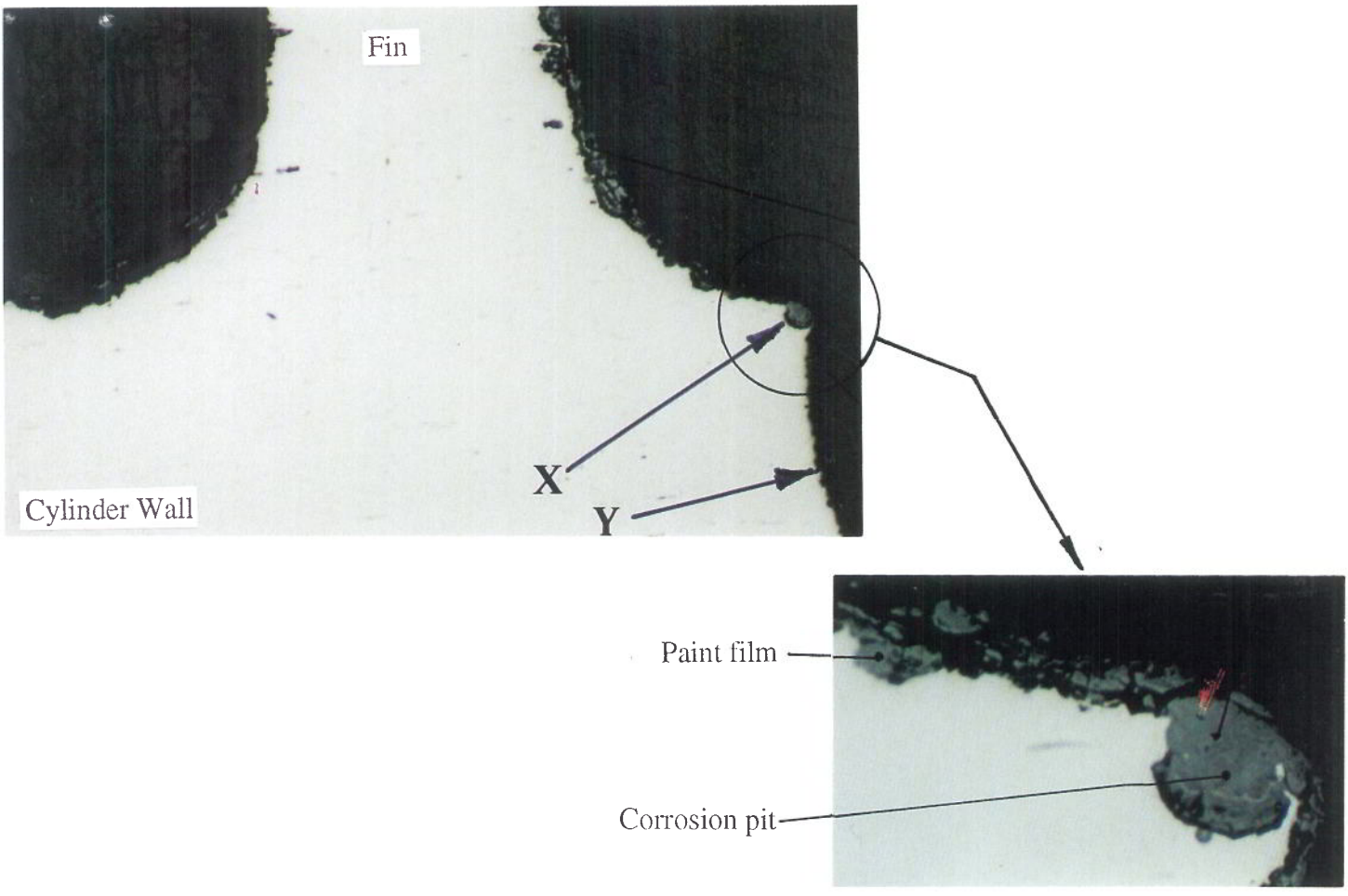
General view of No 4 cylinder. Separation occurred across diameter at arrow S, fatigue initiation region centered at arrow F

Figure 1



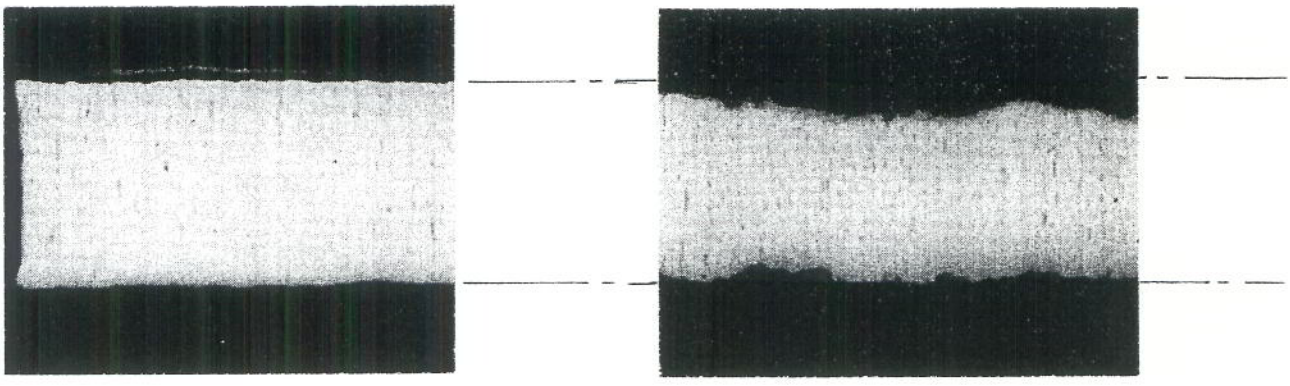
Close up of fatigue initiation region, centered on O showing corrosive attack at base of fin

Figure 2



Edge containing fatigue initiations arrowed X, fatigue separation arrowed Y

Figure 3



Typical outer and inner sections of corroded, paint covered, cooling fin

Figure 4