

No: 1/89

Ref: EW/C1055

Category: 1c

**Aircraft Type and Registration:** Enstrom 280C-UK, G-CTSI

**No & Type of Engines:** 1 Lycoming HIO-360-EIBD piston engine

**Year of Manufacture:** 1980

**Date and Time (UTC):** 14 January 1988 at 1145 hrs

**Location:** Shoreham Airport

**Type of Flight:** Test flight

**Persons on Board:** Crew - 1                      Passengers - 1

**Injuries:** Crew - 1 (Minor)              Passengers - None

**Nature of Damage:** Lefthand skid collapsed, cross-tube bent and tail-boom distorted

**Commander's Licence:** Private Pilot's Licence

**Commander's Age:** 31 years

**Commander's Total Flying Experience:** 86 hours fixed wing, 55 hours rotary wing (all on type)

**Information Source:** Aircraft Accident Report Form submitted by the pilot and AAIB examination of failed gearbox

The helicopter had undergone an annual maintenance check at the main distributor for Enstrom in the UK. A Company pilot was assigned the task of delivering it back to its owner and he received a request from Engineering to perform a short flight test prior to his departure. The purpose of this test was to check the "feel" of the yaw controls in order to compare G-CTSI with another aircraft which had a pilot report of "snatchy" pedal forces.

Accordingly, the pilot and an engineer boarded the aircraft and commenced a series of spot turns to the left and right, initially at hover taxi height and then at 30 feet. The latter turns were at a higher rate and involved two turns to the left and right. However, as left pedal was applied to arrest the swing to the right on the last turn the pilot felt the helicopter start to respond but then heard a loud buzz from the back. At this point, the response ceased and the aircraft continued to rotate to the right. The pilot immediately closed the throttle and lowered the collective pitch control slightly until the aircraft was about to strike the ground with slight forward motion, whence he raised it fully to cushion the landing. With the application of pitch, the aircraft yawed to the right again and the aircraft landed heavily on its left skid which collapsed. Fortunately, neither the main nor tail rotors struck the ground. The occupants completed the emergency checklist and evacuated without injury.

Inspection of the aircraft after the accident revealed that the tail rotor could be turned freely and independently of its driveshaft, indicating a disconnection within the tail rotor gearbox. Strip examination of the gearbox showed that the input gear had become completely stripped of its teeth.

The mating output gear, whilst heavily damaged by debris, remained intact. Metallurgical examination of the failed gear indicated that all the teeth bore evidence of fatigue cracking, ranging from almost 100% fatigue failure to a small percentage. The fatigue originated at the heel of each tooth and appeared to be associated with abnormal wear grooves on the tooth flank at this position. This wear indicated a breakdown of the lubrication film between the mating gear surfaces and led to "dig-in" by the driven tooth which increased the stresses at the input gear tooth roots. Evidence of misalignment between the meshing gears and a poor surface finish of the gear faces were also considered to have been likely contributory factors to the eventual failure.

Examination of the aircraft's log books showed that, some months before the accident, the owner discovered a broken tail rotor gearbox oil sight glass during a pre-flight inspection. Following various checks (which did not include strip or other visual inspection of the gears) and an assurance from the owner that the sight glass could not have failed during earlier flights, the engineer concluded that the gearbox had not incurred damage due to lack of lubrication. Accordingly, the sight glass was replaced, the gearbox refilled and the aircraft returned to service.

The Manufacturer intends to issue a Service Directive Bulletin to all Enstrom Operators calling for periodic visual inspection of the tail rotor gear wheels for mechanical damage and abnormal wear. Limits for metallic debris found on the magnetic chip detector will also be included in this letter.