AAIU Report No: 1998/016
AAIU File No: 1997/0056

Aircraft Type and Registration:	Bell 206 BII, Jet Ranger, EI-BYJ
No. and Type of Engines:	1 Allison 250-C20 Turboshaft engine
Aircraft Serial Number:	1897
Year of Manufacture:	1976
Date and Time (UTC):	10th. November 1997, 1430 hrs
Location:	North of Balbriggan, Co. Dublin
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Severe damage to airframe
Commanders Licence:	Commercial Pilots Licence
Commanders Age:	32 years
Commanders Flying Experience:	2050 hrs (including 175 hrs on type)
Information Source:	Notification by IAA on 20th. November 1997 and subsequent Aircraft Incident Report Form submitted by the pilot.

Background

On 10th. November 1997, the pilot, having completed a commercial flight earlier that morning, was requested by a member of the operators maintenance staff to carry out a local test flight on EI-BYJ, to confirm that the maximum and minimum autorotation RPM was set correctly, among other requirements.

His passenger, a qualified helicopter engineer, was on board to record various readings laid down in a document of eleven pages, entitled "Flight Test Schedule Ref. 125 Iss. 1 April 1991". The pilot and the engineer discussed the contents of this document in detail prior to take-off.

This particular flight was carried out prior to the commencement of the helicopters annual inspection, which was necessary for the renewal of its Certificate of Airworthiness (C of A). It was intended that any collective pitch control or cyclic control rigging adjustment would be carried out during this annual inspection.

The Flight

The pilot stated that he entered an autorotation at 2,000 ft to observe rotor RPM by lowering the collective lever and closing the throttle to idle. He observed the N_R (Rotor RPM) rising sharply towards 107% (maximum RPM Rotor) and applied collective pitch to stop this rise. While descending at 60 mph IAS he observed a sharp reduction in the N_R, followed by the Rotor Low RPM warning cautions (audio and light), as the N_R decayed towards 80% (minimum is 90% Rotor RPM). He estimated that the time from applying collective to the sharp reduction in N_R was 2 -3 seconds.

While initiating recovery he felt two severe aircraft vibrations in quick succession. N_1 and N_R stabilised at 100% and the helicopter flew normally as he routed back to his base, where he carried out some ground work prior to landing.

The pilot commented that he believed the incident occurred due to an over-application of collective pitch and was accentuated by the aircraft being close to MAUW (Maximum All Up Weight).

Forecast obtained from the Met Office at Dublin Airport on the day was as follows:-

Wind	260/20 Kts
Vis	10+ Km
Cloud base	3,000 ft
Temp	+11ºC

Damage

A post flight inspection by the operator showed that the tail boom upper skin was wrinkled, the aft fuselage skin also showed signs of wrinkling, and that there were indications that the engine to transmission driveshaft had contacted the isolation mount. While there was no other visual evidence of damage to components the manufacturer recommended that a comprehensive series of checks and repairs be carried out including:-

- replace tailboom upper skin, torque check all four attachment bolts prior to removal of tailboom;
- replace isolation mount;
- overhaul main driveshaft;
- overhaul freewheeling unit;
- NDT inspection on drag pin and drag pin retaining studs;
- inspect main/tailrotor blades, hub and pylon assembly
- replace all affected aft fuselage skins and inspect internal fuselage structure for evidence of damage;
- inspect tailboom attachment fittings for damage;
- inspect cabin roof shell.

The operator complied with these recommendations and the aircraft received its C of A renewal on 29th. April 1998

Analysis

In carrying out flights such as occurred on 10th.November 1997, the operator utilises part of a UK CAA derived document which, under the operators logo is entitled "Flight Test Schedule Ref. 125 Iss. 1 April 1991", to record various technical parameters. In particular, Paragraph 2 of that document states that *"the aircraft is to be loaded to its gross weight of 3,200 lbs (206 B Models)"*, while Paragraph 9.3 specifies various recordings to be noted while undertaking the actual autorotative flight. However, the manufacturer's Maintenance and Overhaul Instructions Manual, dated 1 June 1974 and incorporating Revision 41 dated 21 November 1995, states as follows:-

> "Test fly the helicopter throughout the speed range to ensure that vibration level and autorotation RPM is satisfactory. It is recommended that autorotation RPM be checked at *low gross weights*. Determine autorotation RPM at 60 mph airspeed. Autorotation RPM should be 90% with minimum safe fuel load, one pilot (170 pounds) and with collective fully down. Autorotation RPM should be 107% RPM at maximum gross weight, and should not exceed 107%".

The manufacturer's explanation for the recommendation to use low gross weights is that low RPM is the most critical end of the spectrum. If RPM were set too low the autorotation could be compromised, whereas if the RPM is set too high then the pilot need only raise the collective pitch lever.

In this regard, neither the manufacturer's Flight Manual nor the manufacturer's Maintenance and Overhaul Instructions Manual contained any "Main Rotor Autorotation RPM Adjustment Chart", applicable to the Jet Ranger BII, as none was ever issued by the manufacturer, up to and including the time of the incident.
Subsequently, however, on 7th. January 1998, the manufacturer issued a series of amendments to the Maintenance and Overhaul Instructions Manual, which included an RPM adjustment chart, applicable to the BII model.

Additional Information

Enquiries made to two other operators of Jet Rangers Helicopters in Ireland showed that they were also using UK CAA derived documents for their annual Renewal of Certificate of Airworthiness flights, one version from 1989, and one version pre 1989.

Findings

1. It is evident from the pilot's report and the aircraft damage report that an irreversible control loss was only narrowly avoided by the pilot's subsequent positive reaction.

2. The operator used a document on 10 November 1997, entitled "Flight Test Schedule Ref. 125 Iss. 1 April 1991", which required the aircraft to be flown at maximum gross weight.

3. The precise source of the document title being used by the operator is not known. The document currently in use in the UK CAA Airworthiness Flight Test Schedule, is entitled AFTS No. 125 Iss. 3, April 1989. It states, inter alia, *"The aircraft is to be loaded with full fuel and any necessary ballast to achieve a take-off weight of 3000 lb (206A models) or 3200 lb (206B models)".*

4. The manufacturer's Maintenance and Overhaul Instructions Manual recommends that autorotation RPM be checked at low gross weights, (exact weight not specified), which was not complied with by the operator on this flight.

5. The IAA Aeronautical Notice No. A4, dated 8th. April 1998, "Renewal of Certificate of Airworthiness", Para 7 states:- *"The aircraft shall be tested in flight to an approved Flight Test Programme as required. Results of the test flight shall be submitted to the Authority".*

6. The operator was not in possession of an approved Flight Test Programme, as none had been produced by the manufacturer or the IAA.

7. The manufacturer's Flight Manual does not contain the same recommendation regarding weights for autorotation RPM checks as is contained in their Maintenance and Overhaul Instructions Manual.

Safety Recommendations (SR)

1. It is recommended that the manufacturer issue guidelines for the conduct of Flight Tests for Jet Ranger helicopter operators. **(SR 20 of 1998)**

2. It is recommended that the IAA review the process implied in Paragraph 7, Test Flight, of their Renewal of Certificate of Airworthiness document. **(SR 21 of 1998)**

3. Pending clarification for the requirements for an approved Flight Test Programme, it is recommended that the operator adheres to the recommendations and charts specifically for autorotation RPM checks, as issued by the manufacturer in January 1998. **(SR 22 of 1998)**