BEA
Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile

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REPORT
SERIOUS INCIDENT

Emergency landing gear extension, nose landing gear collapse during landing roll

Aircraft	Beech-200 King Air registered EC-KNP
Date and time	10 May 2012 at 16 h 12[(1)]
Operator	Air Taxi et Charter International
Place	Paris le Bourget (93) Airport
Type of flight	Public transportation, non-commercial, ferry flight
Persons on board	Captain (PF); Co-pilot (PNF)
Consequences and damage	Propellers and fuselage damaged

[(1)] Unless otherwise specified, the times in this report are expressed in Universal Time Coordinated (UTC).

This is a courtesy translation by the BEA of the Final Report on the Safety Investigation. As accurate as the translation may be, the original text in French is the work of reference.

1 - HISTORY OF THE FLIGHT

The crew took off from Blois aerodrome bound for Paris Le Bourget. A maintenance operation, which did not involve the nose landing gear, had just been carried out by the Blois Aéro Services maintenance workshop.

When the landing gear was extended during the initial ILS 27 approach procedure, the crew heard an unusual noise and noticed that the red landing gear indicator light was on and the green down-and-locked light was off. The controller reported that the nose landing gear was extended. The crew performed a go-around and retracted the landing gear. Since the red landing gear indicator light was still illuminated, they applied the emergency landing gear extension procedure and found the same symptoms as during the initial approach. They carried out an approach to runway 21 to take advantage of the headwind and in order not to block the main runway 27 in the event of a problem.

During the landing roll, the nose landing gear collapsed. The aeroplane stopped on the runway.

Damage was observed on the lower forward section of the aeroplane and the propellers on both engines.

2 - ADDITIONAL INFORMATION

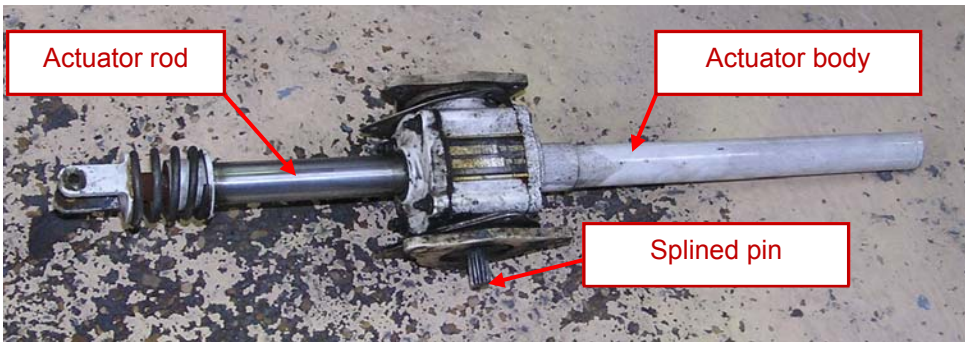
The examination of the kinematics of the nose landing gear brought to light a malfunction of the actuator.

2.1 Examination of the Actuator

2.1.1 Description of the Actuator

The actuator comprises:

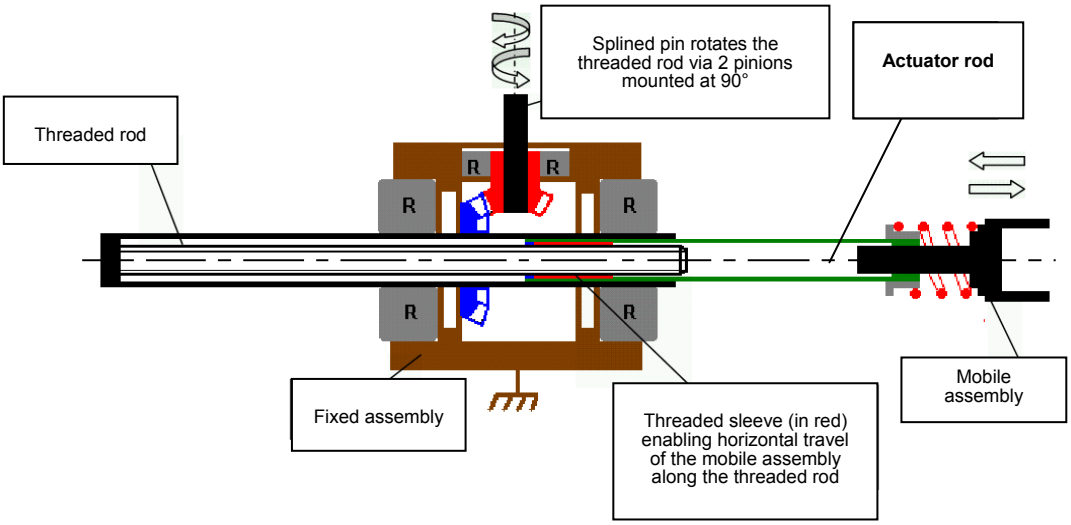
- The actuator body with a threaded rod inside it;
- The actuator rod which has a threaded sleeve on its inside and end.



2.1.2 Operating Principle

In normal operation, the electric motor that extends and retracts the landing gear drives an accessory gearbox which rotates the mechanisms of the main landing gear and the nose landing gear. The mechanism of the nose landing gear is coupled to its actuator via a splined pin.

The actuator rod enables horizontal travel of the threaded rod in the actuator body via its threaded sleeve.



2.1.3 Examination of the Actuator

When the actuator was removed, the actuator rod was found to drive freely into the body of the actuator, making a metallic sound. Disassembly of the actuator showed the presence of grease and metal shavings.

Examination of the actuator showed that:

- The stripping of the threads on the threaded sleeve made it impossible for it to drive the actuator rod;
- Prior to stripping, the threads of the sleeve were subject to gradual wear due to friction between the threads on the threaded sleeve and the threads on the threaded rod during nose landing gear extension and retraction phases. The period of time over which this wear took place could not be determined;
- The clearance between the threads on the threaded rod and the threads of the sleeve was measured at 0.6 mm (about 0.025 in);

- ❒ The actuator rod was not that referenced by the manufacturer but corresponded to an FAA-approved replacement part (*"FAA PMA"* part);
- ❒ The presence of grease was confirmed throughout the actuator.

2.1.4 Analysis of the Grease

Spectrometric analysis showed that the thickening agent in the grease recovered from the actuator differed from the Nyco GN17 Grease supplied by the workshop in charge of maintenance.

Note: The workshop indicated that it regularly used Nyco GN17 Grease for lubricating actuators in the case of intermediate maintenance operations.

It was concluded that the grease recovered from the actuator either corresponded to an older version of Nyco GN17Grease, the nature of the thickener having being modified in 2003, or to the grease of another manufacturer. Therefore it did not correspond to the grease regularly used by the workshop.

The amount of grease recovered for spectrometric analysis did not allow characterization tests to be carried out in order to precisely identify the grease.

No water was found in the grease.

2.2 Actuator Maintenance

2.2.1 Maintenance Programme

Between each overhaul (every 8,000 cycles or 6 years), the maintenance manual requires that the following operations be carried out every 1,000 cycles or 30 months[(2)]:

- ❒ Lubrication of the actuator;
- ❒ Check on the internal clearance between the thread of the piston rod and that of the sleeve if:
  - ■ the clearance is less than 0.40 mm, the actuator can be returned to service;
  - ■ the clearance is between 0.40 mm and 0.46 m, the actuator can be returned to service but a new check should be carried out every 200 cycles;
  - ■ the clearance is greater than 0.46 mm, the actuator must be overhauled or replaced.

Note: the maximum clearance tolerated during the final inspection after an overhaul is 0.25 mm.

[(2)]This period of time follows a safety recommendation issued by the AAIB following the accident to the Beech-200 registered G-BYCP.

2.2.2 Maintenance Operations Carried Out

The last check operation on the actuator was carried out on 19 November 2010. As of the date of the accident, there were 210 cycles remaining before the next internal clearance check.

When measured, internal clearances are not included in work files[(3)]. Nevertheless, the workshop noted that, for each check, the clearance was found to be less than 0.40 mm.

The lubrication associated with the check on internal clearance is not specified on the technical intervention sheet issued by the workshop. No information about lubrication is included in the *"work done"* section of the work files for previous maintenance operations.

[(3)]The manufacturer's maintenance documentation does not require reporting of internal clearances.

The tool used to measure the internal clearance is made locally. Its use is not listed in the Blois Aéro Services' Maintenance Organization Manual (MOM). For this reason, it has not been approved by the oversight authority.

A demonstration of the operation of the tool showed that it was difficult to perform the measurement. In addition, the precision of the tool is not compatible with the precision required for detection of the clearance.

2.3 Information from Hawker Beechcraft Corporation (HBC)

The HBC maintenance manual states that only original HBC parts must be used.

The equipment to be used to check internal clearance is detailed in the maintenance manual.

HBC has no statistics on the number of actuators rejected after a check of the internal clearance.

According to HBC, the possible contributory factors to actuator failure are:

- Unsuitable lubrication;
- A mixture of greases that can significantly reduce the effectiveness of the lubrication;
- Incorrect alignment of the actuator during assembly, raising the temperature of the actuator during operation and thus the wear on the threads and also reducing the lubricating performance of the grease;
- Use of *"FAA PMA"* type parts.

2.4 Similar Events

Five similar cases of stripped threads from the threaded sleeve of the actuator have been identified, including an event that was the subject of an investigation by the BEA.

Three cases had conclusive probable causes:

- C-GISH on 18 May 2002: *"lack of lubrication"*;
- G-BYCP on 24 March 2007: actuator of the *"FAA PMA"* type with grease contaminated by water;
- F-GFDJ on 9 May 2011: inadequate maintenance in terms of lubrication.

3 - LESSONS LEARNED AND CONCLUSION

3.1 Scenario for Actuator Damage

During both check operations of the internal clearance of the actuator, the maintenance workshop:

- Proceeded to lubricate with Nyco GN17 Grease manufactured prior to 2003 or used grease from another manufacturer

  Or
- Did not lubricate.

In the last check on the internal clearance on the actuator, it is possible that no excessive clearance was detected.

These issues resulted in acceleration of actuator degradation.

3.2 Causes

The serious incident was caused by improper maintenance of the actuator, leading to accelerated degradation of the threading on the piston rod sleeve.

Using a tool of non-approved local design may have contributed to the failure to detect excessive internal clearance.