



## Accident to the MOONEY - M20J registered F-GNGG

on 8 November 2013

at Cholet le Pontreau aerodrome (Maine-et-Loire)

<sup>(1)</sup> Unless otherwise stated, all times given in this report are in local time.

<b>Time</b>	Around 12:30 <sup>(1)</sup>
<b>Operator</b>	Aéroclub du Pontreau
<b>Type of flight</b>	Local flight
<b>Persons on board</b>	Instructor and student pilot
<b>Consequences and damage</b>	Aircraft damaged
<b>This is a courtesy translation by the BEA of the Final Report on the Safety Investigation published in June 2020. As accurate as the translation may be, the original text in French is the work of reference.</b>	

## Nose gear collapse on landing during instruction flight

### 1 - HISTORY OF THE FLIGHT

During a circuit flying training session from Cholet le Pontreau aerodrome, the instructor reported to the AFIS officer, while on a downwind leg, that he had no indication that the landing gear was locked. He decided to make a low pass in front of the control tower so that the officer could visually confirm the position of the landing gear. The AFIS officer announced that the landing gear was fully extended. The instructor decided to land. The nose gear collapsed on touchdown and the aircraft slid on the runway for about 150 m before coming to rest.

### 2 - ADDITIONAL INFORMATION

#### 2.1 Landing gear information

The three landing gear are controlled by an electro-mechanical actuator which is electrically powered according to the position of the control on the instrument panel in front of the pilot. Landing gear retraction and extension are controlled by limit switches. The emergency system allows for manual extension of the landing gear using a control located between the two front seats, which mechanically drives the same actuator via a tension spring.

The aircraft is equipped with a visual and audio warning system linked to the landing gear position sensors.

## 2.2 Damage to aircraft

The tips of both propeller blades were bent. This was caused by the rotating blades coming into contact with the runway when the nose gear collapsed on landing. There were marks on the left and right nose gear doors, which were caused by these doors rubbing on the runway during landing.

The threaded part of the rod of the nose gear actuator, which controls the extension or retraction of the nose gear, was fractured inside the gearbox (Figure 1).

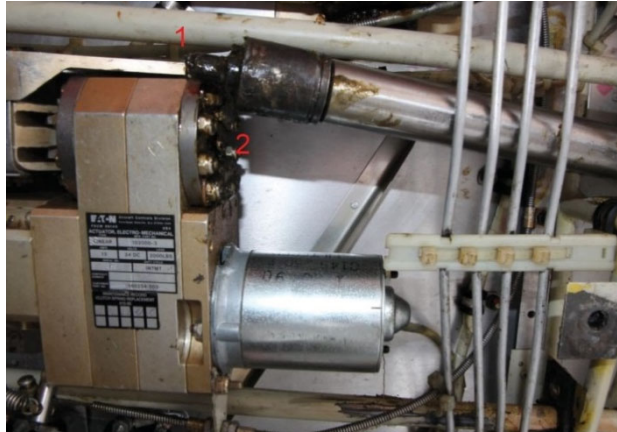


Figure 1: Photo of the actuator with the threaded part of the rod (1) separated from the gearbox (2)

The position of the limit switch indicated that the nose gear had not locked during the accident flight.

The round nut on the actuator rod could be rotated freely (Fig. 2).

Circular marks (figure 3) could be seen on the mechanical down stop shims at the gearbox input. According to the maintenance manual, the mechanical down stops are adjusted with the landing gear extended subject to the tolerances in respect of the shoulder of the round nut (Figure 4).

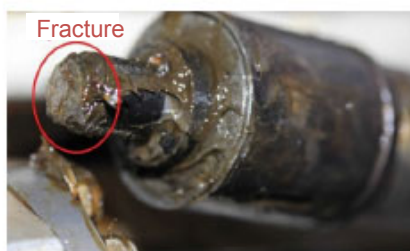


Figure 2: Fractured actuator rod and round nut

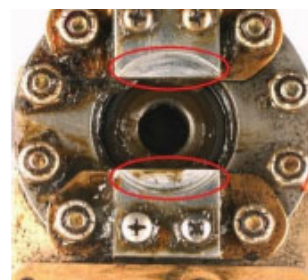


Figure 3: Marking on the shims at the gearbox input

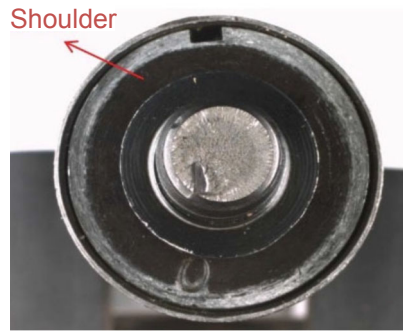


Figure 4: Fractured rod and shoulder of round nut

### 2.3 Examination of the electro-mechanical actuator

The actuator barrel and the round nut displayed marks (Figures 5 and 6) that resembled tool marks (possibly of the nose plier type).

Le corps du vérin ainsi que l'écrou cylindrique présentent des marques (figures 5 et 6) qui s'apparentent à des empreintes d'outil (possiblement de type pince à bec).



Figure 5: Marks on the tube and worm screw



Figure 6: Marks on the round nut

Two lock screws on the round nut are used to stop the round nut from rotating around the actuator rod. One of them was loose and was no longer performing its locking function on the round nut. The other one was marked and deformed, which prevented the use of the specific loosening tool.

After opening the actuator box, the inspections of the components (gears, bearings, drive rod) did not reveal any significant damage that could have caused the fracture of the threaded rod of the actuator.

However, scanning electron microscopy examinations revealed the presence of dimples over the entire surface of the fracture face (Figures 7 and 8). These dimples are characteristic of a ductile fracture<sup>(2)</sup>. The outer edges of the faces on the opposite side to the fracture displayed ridge lines and small dimples around their entire circumference, which were consistent with torsional stress. The cores of the fracture faces displayed non-oriented dimples, which were consistent with tensile stress.

<sup>(2)</sup> Fracture and deformation characteristic of a fast fracture (or overload).

During maintenance, disassembly operations to uncouple the round nut and the rod barrel tube may have led to damage to the lock screws on the round nut. As this nut was no longer held in place, it was free to rotate and move freely, thus distorting the adjustment of the mechanical down stops. When the landing gear was retracted, the abnormal tensile and torsional forces were transferred to the actuator rod, causing it to fracture due to overload.



Figure 7: Photo of the fractured face (nut side)

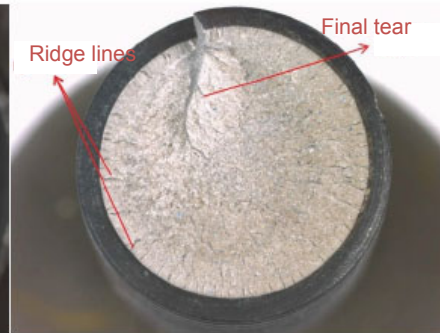


Figure 8: Photo of the fractured face (gear side)

## 2.4 Maintenance instructions

On 12 December 2013, the manufacturer informed owners of Mooney aircraft<sup>(3)</sup> about the importance of complying with annual or 100-hour inspections and, in particular, the importance of performing a full examination of the landing gear system and checks of the landing gear settings, as described in the maintenance manual for the aircraft type.

<sup>(3)</sup> Via Service Instruction M20-122, backed up by FAA Bulletin CE-14 12 of 14 March 2014.

## 3 - CONCLUSIONS

*The conclusions are solely based on the information which came to the knowledge of the BEA during the investigation. They are not intended to apportion blame or liability.*

### Scenario

The nose gear collapsed during landing due to the sudden fracture of the threaded rod of the landing gear's electro-mechanical actuator. Because the actuator rod was fractured, the landing gear could not be extended and locked by any means available to the pilot (control on the instrument panel and emergency control). The two main landing gear, unlike the nose gear, were able to lock down under gravity.

### Contributing factors

The following factors may have contributed to the fracture of the threaded rod of the landing gear electro-mechanical actuator:

- Use of unsuitable tools during landing gear system maintenance operations.