



Accident to the Dyn'aero MCR01 ULC identified 21ABU

on 24 February 2018
at Trignac (Loire-Atlantique)

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

Time	14:51 ⁽¹⁾
Operator	Private
Type of flight	Local flight
Persons on board	Pilot
Consequences and damage	Pilot fatally injured, microlight destroyed
This is a courtesy translation by the BEA of the Final Report on the Safety Investigation published in May 2020. As accurate as the translation may be, the original text in French is the work of reference.	

Asymmetric flap extension on final, loss of control and collision with ground

1 - HISTORY OF THE FLIGHT

Note: the following information is based mainly on statements and radio communications recordings.

The pilot took off at 14:34 from Saint-Nazaire Montoir aerodrome (Loire-Atlantique) to conduct circuit patterns in the MCR01 ULC, which he co-owned. The first aerodrome circuit was completed without incident. At 14:51, at the end of his second circuit, the pilot announced that he was on final to runway 07. The controller cleared the pilot to land after receiving confirmation from the pilot that he would be doing a full-stop landing. Thirty seconds later, the pilot radioed in "Fox Uniform Papa, in danger"⁽²⁾ his radio continued broadcasting, and he then repeated "MAYDAY" three times. A witness onboard an aircraft at the holding point saw the MCR01 turning with a very steep bank angle at an estimated height of 50 m. The aircraft collided with the ground.

⁽²⁾ His radio call-sign
was F-JFUP.

2 - ADDITIONAL INFORMATION

2.1 Pilot information

The 57-year-old pilot had held a microlight pilot licence since November 2017. He had been trained on Bristell XL8s and had jointly purchased the MCR01 ULC registered 21ABU during the summer of 2017. He had logged about 10 flight hours on the MCR since December 2017, including three one-hour flights with the co-owner to familiarise himself with the microlight.

⁽³⁾ The holder of the eligibility certificate for an aircraft type is, among other things, responsible for overseeing the airworthiness of that aircraft type.

⁽⁴⁾ A cross type universal joint is a mechanical device for coupling two rotation axes. On the aircraft involved in the accident, the cross type universal joints present on each side of the aircraft served to connect the pulley axis (rotated by the electric motor/toothed belt system) to the worm screw axis and absorbed the relative angular movements of the two axes caused mainly by the vibrations inherent in aircraft operation and any flap deflection.

2.2 Meteorological conditions

The METARs for Saint-Nazaire aerodrome at 14:30 and 15:00 reported winds of 10 kt varying between 020° and 090°, visibility 7,000 m and no significant cloud cover.

2.3 Aircraft information

The MCR 01 ULC is a microlight designed and manufactured by Dyn'Aero. Dyn'Aero ceased operations in 2017. SE Aviation now holds the eligibility certificate⁽³⁾ for the MCRs.

21ABU was brought into service in 2001. It was purchased in 2013 by three co-owners. In 2017, two of the co-owners sold their shares and the pilot involved in the accident purchased half of the aircraft. The microlight had logged about 328 flight hours on the day of the accident.

2.4 Examinations

2.4.1 Examination of the wreckage and accident site

The main findings of the on-site examination were as follows:

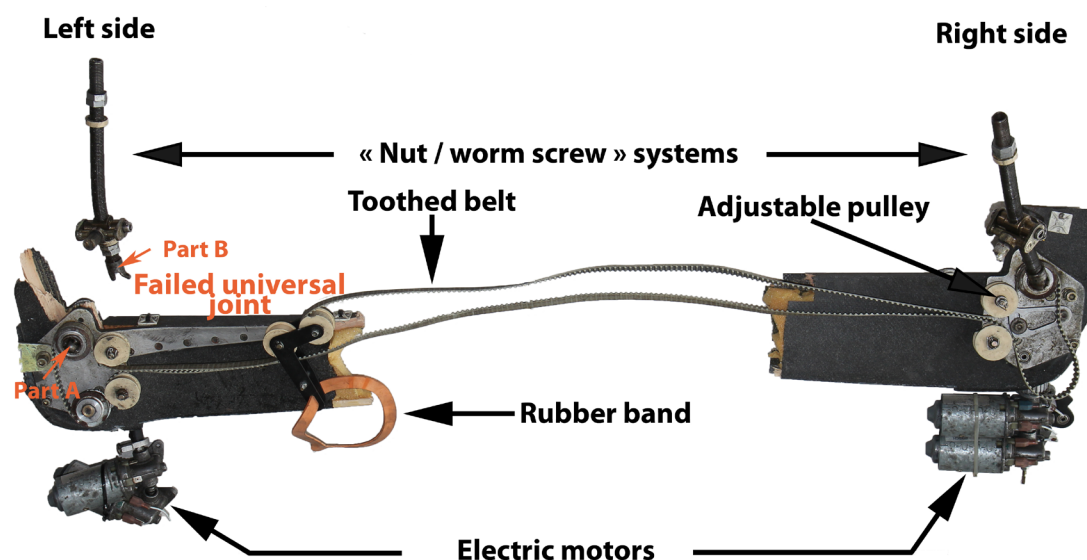
- ☐ the aircraft severed electrical cables, hit the ground in an inverted position with a shallow nose-down attitude and a slight right bank (left wing) before coming to rest against a wall;
- ☐ the aircraft was intact at the time of the impact with the ground;
- ☐ the flight controls were all continuous prior to impact;
- ☐ the position of the flap control mechanism indicates that the left flap was in the "up" position and the right flap was in the intermediate position;
- ☐ the flap control was found in the "up" position.

The flap control mechanism was removed for examination at the BEA Materials and Failure Analysis Laboratory to determine the cause of the asymmetric flap position.

2.4.2 Examination of the flap control mechanism

Details of the examinations conducted on the flap control mechanism at the BEA Materials and Failure Analysis Laboratory are available in the appendix to this report.

The flaps are retracted and extended via an electromechanical control system. Four electric motors drive a set of pulleys and a toothed belt. Rotation of the pulleys causes two worm screws, located on each side of the aircraft close to the wing root in the fuselage, to rotate through two cross type universal joints⁽⁴⁾. The rotation of each worm screw causes the translation of a bronze nut that controls the retraction or extension of the corresponding flap. Thus, the position of these nuts on the worm screws is directly linked to the position of the flaps on the microlight. Synchronisation of the extension of the right and left flaps is ensured by the toothed belt. This toothed belt is tensioned by adjusting the position of one of the pulleys. The system also has an emergency rubber band tensioner to compensate for a slight loss of belt tension.



Source: BEA

Figure 1: flap control system taken for examination at the BEA Materials and Failure Analysis Laboratory

Both worm screws were found to be bent. The position of the nuts on these screws indicates that the right and left flaps were in an asymmetrical position when the aircraft hit the ground. The right flap was in the 1/3 down position while the left flap was in the retracted position.

Examinations of the belt tensioning system (adjustable pulley position, toothed belt and emergency tensioner) did not reveal any faults with the system at the time of the accident, other than the use of a rubber band as an emergency tensioner that was not the one recommended by the manufacturer⁽⁵⁾. It was not possible to assess the effectiveness of this rubber band. However, SE Aviation states that the emergency tensioner is not required if the pulleys are properly adjusted.

On the right and left sides of the aircraft, the bronze nuts did not display any excessive wear that could jeopardise their functionality.

On the left side of the aircraft, the examinations of the universal joint pin showed that it probably failed due to fatigue as a result of the alternating torsional stresses caused by the jamming of the pin in its crosspiece⁽⁶⁾. This jamming was due to abnormal friction (lubrication problem, pollution, etc.) between these two parts and the inability of the system to evacuate the wear debris generated (see Figure 2). A longitudinal metallographic section showed that the fatigue failure occurred in a heat-affected zone (HAZ). This is because the pin is welded into its flange.

On the right side of the aircraft, the cross type universal joint pin showed slight wear, but could still rotate freely within its crosspiece. A longitudinal metallographic section (see Figure 3) of the pin revealed the presence of cracks in the zone affected thermally (HAZ) by the weld.

The intergranular profile of some of the cracks observed on the right-hand side and of certain areas of the fracture face observed on the left-hand side may be indicative of the presence of cracks as early as the manufacture of the universal joints, which were generated during the welding process.

⁽⁵⁾ The P/N of the rubber band recommended by the manufacturer is: ZMAWC2P00.

⁽⁶⁾ Internal component of the universal joint, for more details refer to the attached report.



Source : BEA

Figure 2: examination of the left-side universal joint

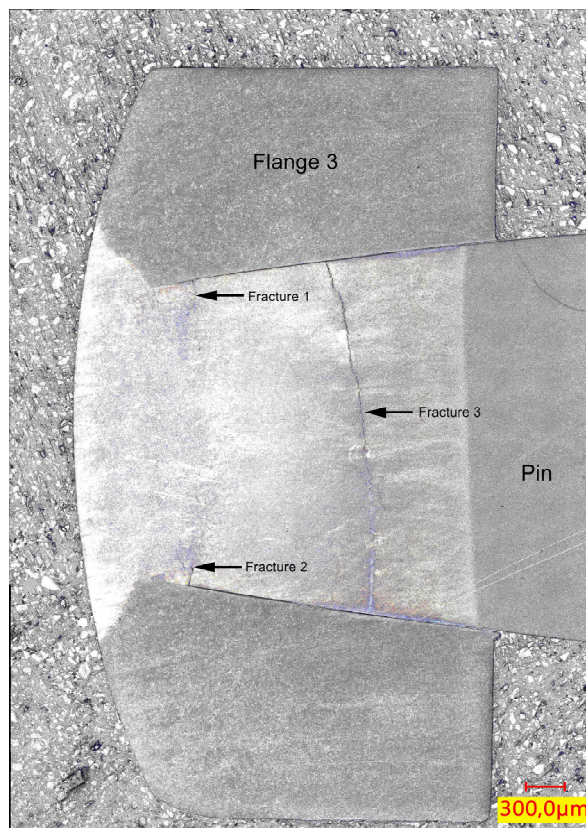


Figure 3: longitudinal metallographic section of the right-side pin after 4 % Nital etching
Note the presence of cracks in the HAZ

⁽⁷⁾ Four universal joints with approximately 1,000 hours of operation provided by SE Aviation and a new universal joint purchased unmounted on its screw from SE Aviation.

⁽⁸⁾ SE Aviation's website states that the company has been the world leader in MCRs since October 2015 and the exclusive distributor of the MCR product range.

⁽⁹⁾ Reference: M EX NO 03 06 dated 10 April 2013.

⁽¹⁰⁾ Clean with WD-40 before applying new lubricant of the Aeroshell Grease 33 or standard type in tubes.

2.4.3 Examination of different MCR01 ULC universal joints

By way of comparison, other universal joints were examined⁽⁷⁾. Manufacturing discrepancies were identified in respect of the universal joint from the aircraft involved in the accident:

- ☐ embedding of the rod by crimping and not by welding;
- ☐ rounded shape of the jaws.

Both of these characteristics seem to be present on the most recent universal joints. During the investigation, it was not possible to trace the various modifications made to the manufacturing procedure that the universal joint under the same reference number may have undergone. SE Aviation⁽⁸⁾ indicated to the BEA that, to the best of its knowledge, the universal joints were always ordered under the same reference number and from the same manufacturer. These universal joints are common to the MCR ULC (pre- and post-2014 version), MCR Mini Cruiser, MCR Club, MCR ULC Oleo and MCR M.

It was not possible to establish whether universal joints with welded pins have any particular weakness compared to those with crimped pins.

The fatigue failure on the universal joint pin on the plane involved in the accident is the only such fracture that the BEA is aware of to date. SE Aviation also indicated to the BEA that it was not aware of any other fractures of this kind.

2.5 Maintenance

2.5.1 Maintenance scheduled in the service manual

According to the aircraft service manual⁽⁹⁾, during the 50-hour inspection, the 100-hour inspection (or annual inspection) and the 1,000-hour inspection, the worm screw joints on the flap control system⁽¹⁰⁾ should be lubricated and the flight controls (friction points and clearances) should be checked.

The 1,000 h and 5-year inspections are designated as detailed inspections in the maintenance manual. Only the 1,000-hour visit requires the removal and re-installation of the flight controls. The kinematics of the joints must be checked.

It also states that when a 5-year inspection is due, it is mandatory to combine it with either a 100-hour or a 1,000-hour inspection (depending on the flight hours of the aircraft).

2.5.2 Maintenance history of the microlight

The last 100-hour inspection of the microlight was in January 2017 and was carried out by the co-owner. The co-owner indicated that he had scheduled a 100-hour inspection for shortly after the date of the accident. Since the microlight had only logged 328 flight hours, it had never undergone a 1,000-hour inspection to the best of the co-owner's knowledge. Only a five-year inspection had been conducted when the microlight was purchased.

A shaft failure on one of the two flap control engines on the right side of the aircraft in May 2017 had led to post-repair maintenance that included lubrication of the universal joints. A visual inspection of the flap system was then carried out in July 2017. The microlight had logged about 10 flight hours since then.

The investigation was unable to find documentary evidence of the aircraft's maintenance and flight hours between 2007 and 2013. Given the aircraft's low number of flight hours relative to its age (16 years), it is possible that the aircraft may have been in storage or not used very much. Mismanagement of the storage may result in a lack of lubrication or pollution, which cannot be corrected through lubrication during routine maintenance.

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

An asymmetrical flap extension on final made the microlight difficult or even impossible to control. The low height did not give the pilot enough time to regain control of the aircraft before hitting the ground.

The asymmetrical flap extension was likely caused by fatigue failure resulting from the alternating torsional forces exerted on a component part of the flap control universal joint on the left side of the aircraft. These torsional forces were created by abnormal contact between internal parts in the universal joint, which may have been exacerbated by a lack of lubrication. The lack of aircraft maintenance documentation, particularly between 2007 and 2013, meant that it was not possible to determine whether the lack of lubrication may have been due to a maintenance shortcoming or mismanagement of the storage of the aircraft.

Safety measures taken following this accident

A jamming caused by a lack of lubrication on the microlight involved in the accident could only have been detected during a 1,000-hour inspection.

Following this accident, SE Aviation issued an update to the maintenance manual accompanied by a service bulletin requesting that the universal joints on the flap control systems on all relevant MCRs be checked every 50 hours. The DGAC issued a newsletter relating to this accident to notify owners of the changes made by SE Aviation⁽¹¹⁾.

SE Aviation also proposes that the flap control system be replaced with a more robust system.

⁽¹¹⁾ The newsletter is available at the following address:
[http://www.regles-osac.com/OSAC/br.nsf/c1bd7c9ce5ee2ec1256b8f00293f97/4f75f96e88377252c12584d4002a3ab7/\\$FILE/BI2019_06.pdf](http://www.regles-osac.com/OSAC/br.nsf/c1bd7c9ce5ee2ec1256b8f00293f97/4f75f96e88377252c12584d4002a3ab7/$FILE/BI2019_06.pdf)