

MEMORANDUM FOR RECORD

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Subject: ERA24LA208

Contact: Michael Derderian, Engineering and Design Manager, DUC Helices
Propellers

As part of the investigation, Mr. Michael Derderian, Engineering and Design Manager, DUC Helices Propellers (technical advisor to BEA) was sent a DRAFT of the Wreckage Examination Summary & Maintenance Records Review and also a list of questions for clarification. The following questions and complete responses received on June 17, 2024 are included below:

“1) Who from DUC helped the pilot install the propellers and Beta and Reverse system components onto N848HP.

During a visit of the French team in the subsidiary in February 2024, we assisted Mr. Pier for the mounting of the propellers. But the initial mounting of the propellers was already done before our coming.

The electric actuators were installed and wired by Mr. Pier previously to our coming. We assist him to make adjustment on the wiring and on the setting of the pitch.

Mr. Romain Duqueine and me, Mr. Michaël Derderian, were involved.

But later, the propellers and actuators were disassembled by Mr. Pier to make other changes on the installation (replacement of blades following damage by the customer during a theft, modification of the actuator range, and other reason that we don't know...).

Those modification of the installation were managed by Mr. Pier himself.

The final assembly and wiring were not done by anyone from DUC.

2) How the reverse red guarded switches and reverse control switches were wired and operated/controlled.

Please refer to the diagram "4-VP_Reverse_Diagram.jpeg"

To summarize the use of the control of the propeller:

- there is a ON/ON switch (with 3 channel) to choose the mode Cruise or Reverse
- when Cruise mode is activated, the Flybox PR1P is controlling the propeller actuator between the fine pitch stop (present on the lever) and the coarse pitch stop (present in the actuator, extended position)

- when Reverse mode is activated, the Flybox PR1P is disconnected from the actuator and then a second switch (on)-off-(on) (2 channel) is used to control the pitch (increase or decrease).

This is a manual control of the pitch to reach the reverse position. In that mode, the switch is controlling the propeller actuator between the reverse pitch stop (present in the actuator, retracted position) and the coarse pitch stop (present in the actuator, extended position)

- to be able to control the actuator like this, there is a PCB integrated to the actuator with diodes to manage the direction of the current.

3) How when operating in reverse the FlyBox propeller controller was bypassed, if at all.

Please refer to the specific instruction "DUC-4-VP_Reverse.pdf"

In page 9, we can see the diagram of the PCB. The Reverse switch (on)-off-(on) (2 channel) control directly the actuator.

But this Reverse switch is powered only if the Mode switch ON/ON switch (3 channel) active the Reverse mode.

4) Whether there was any system protection to prevent movement of one or both propellers into Beta or Reverse in-flight.

The protection is the microswitches present of the actuator level. There are 2 units to define the fine pitch position, to have redundancy.

You can see them physically on the pictures P1200486.JPG (Left propeller) and P1200540.JPG (Right propeller).

Also, in the document "DUC-4-VP_Reverse.pdf", page 9, there are indicated as Microswitch #1 and #2. Indeed, those microswitch are connected to the PCB.

5) Whether there is any single point failure of the Reverse system that could cause uncommanded movement of one or both propellers into Beta or Reverse.

- if both of the microswitch present of the actuator lever failed
- if there are incorrect position of the microswitch and the contactor which does not activate the microswitches
- if there is false electrical contact on the switches

6) Based on the pilot's interview saying one propeller went uncommanded in-flight into reverse, what does DUC feel could have happened.

When the pilot reduced throttle to prepare the landing, the variable pitch propeller is moving to the fine pitch position. And it seems that the position was over-passed, so probably the microswitches didn't detect the propeller.

We can clearly see that on the pictures P1200486.JPG (Left propeller) and P1200540.JPG (Right propeller).

But we have a major comment:

The pilot seems to indicate a failure of the right propeller. But based on all the elements shared, the failure occurred on the left propeller, not the right.

On picture 20240502_203241000_iOS.jpg, we see clearly the intrados of the Right propeller, and the Leading edge close to the wing, it was well ahead. And if we look on the Left propeller, we can see the extrados side and the leading edge pointing on the back.

On picture 20240505_132059000_iOS.jpg and even 20240505_140142000_iOS.jpg, we see the right propeller placing at the correct pitch for Cruise.

On picture 20240505_131932000_iOS.jpg, it is more complex to see but if we look on the tip, we can see that this is the one in Reverse. And we can also see the actuator completely retracted. This is the Reverse position.

So, if the reaction of the pilot was to apply full throttle on the Left engine which was in Reverse, this could have amplified the problem and caused the accident.

7) How many aircraft in the US are flying with DUC reversible propellers installed?

Only this aircraft. It was a development requested by the customer for his experimental airplane. This request started by Mr. Pier in April 2023.

8) How many aircraft in the world are flying with DUC reversible propellers installed?

Here also, only on the Mr. Pier aircraft.

9) Of the aircraft in the US and World with DUC reversible propellers installed, have there been any previous reported issues of one or both propellers going uncommanded in-flight into reverse.

No other aircraft uses this system.

10) if yes to 9, what was the root cause. Explain in detail.

N/A.

11) Confirm with DUC propellers if they were notified of the propeller discrepancy of April 30, 2024.

The 29 of April, me, Mr. Derderian was informed by Mr. Pier about some trouble about the synchronization of both Flybox, following the addition he made.

As we can see on the picture MACX8542.JPG, between the 2 units of Flybox PR1P controller, Mr. Pier installed a potentiometer to synchronized the RPM setting of both unit when he adjusts them. Indeed, following the request of Mr. Pier, Flybox advices the diagram "Flybox Diagram - Synchronise two PR1-P.png" to implement a potentiometer which control both unit at the same time.

But no other notification by Mr. Pier, even the days after.

12) If yes to 11, who exactly was notified and what was done specifically. Explain in explicit detail.

See answer in 11)

13) From DUC whether there were any failures or malfunctions after the installation of the propellers and reverse systems onto N848HP found during ground testing.

During the tests that we conducted together in February, we have never encountered this type of failure on ground.

14) If yes to 13, explain in very explicit detail.

N/A.

15) What actives the LH Beta Prop and RH Beta Prop Annunciator lights on the instrument panel.

Mr. Pier had wanted to have a visual indicator on the dashboard. So, he added diodes to the Mode switch ON/ON (3 channels).

But I don't know in detail how it was wired.

16) Are the LH Beta Prop and RH Beta Prop Annunciator lights on the instrument panel incandescent or light-emitting diode (LED)?

According what I saw in February, it was a LED.

17) What type Is the propeller actuator near the gearbox? Can the position change on impact?

This is DC Electric Linear Actuator. The position change should not have impact.

On the actuator lever, there is the contactor of the microswitch. So, the change of the position of the contactor could have an impact.

In addition, here are some comments that we have:

- About the installation, on numerous occasions, there was the disassembly/reassembly of the entire system by the customer (controllers and propellers) (See answer 1)
Therefore, DUC cannot guarantee that the assembly complies with what was carried out in February 2024.
- About the operation in flight, we need to confirm, probably thanks to the Garmin data, about the inversion of the problem by the pilot.
If full throttle was applied on the left propeller, which was the failed unit, that's could be the main amplifier of the cause.
- Also, the initial installation of the propellers was done more 2 months prior the accident, not 1 week before.
But the last main change done by the customer was to install floats on the aircraft. This could have been part of the aggravating consequences because the finesse and behavior of the aircraft had changed.
- Otherwise, we read that Mr. Pier encountered a ground problem during exercises with his instructor on April 30. But no problems were reported to us and he did not stop flying despite being aware of the risk this could represent.

Remaining to your disposal,

Kind regards.

Michaël DERDERIAN”