



OPERATIONAL SAFETY RECOMMENDATIONS

Reference: REC 12/21, REC 13/21, REC 14/21 y REC 15/21

Date: 26 May 2021

Background

On Monday, 19 April 2021, the aircraft Diamond DA-20-C1, registration EC-LAO, operated by the Rego Foundation, took off from Reus Airport with a student pilot on board to carry out a local instruction flight under visual flight rules.

After take-off, the aircraft headed towards the Reus Airport CTR departure point E. Shortly after passing this point, the pilot radioed the air traffic control unit to declare an emergency due to an engine failure.

The pilot made an emergency landing in a vineyard located in the municipality of Sant Jaume dels Domenys (Tarragona).

The aircraft sustained significant damage during the landing roll-out, predominantly to its landing gear, propeller and forward part of the fuselage.

The pilot was unharmed.

Investigation A-011/2021, opened by the Civil Aviation Accident and Incident Investigation Commission, has found that:

The engine installed on the aircraft was manufactured by Continental, model IO240B32, with serial number 1036308. It had been rebuilt in November 2018 (TCM 8130-3 Track no. 537278) by Continental Motors, Inc. at its facilities in Mobile, state of Alabama (United States).

At the time of the accident, the engine had accumulated 893 operating hours.

The exhaust valve rocker arm in engine cylinder no. 4 was found completely detached.

Two retainers hold the rocker arm shafts at each end (retainer-r/arm thrust), p/n 631996, fixed by two stud bolts (stud. 25-20-28x1.41 #401850) threaded to the cylinder head. The stud bolts are fastened with two nuts (nut-plain) and secured with lock washers (washer-tab) to prevent them from coming loose.

We recovered all the elements that make up the rocker arm assembly when the rocker arm cover was removed. They were found as follows:

- The shaft remained assembled in the rocker arm housing. The two washers on each side of the rocker arm were also in position.
- The retainers were loose but showed no signs of significant damage.
- The two stud bolts that hold the retainers had fractured at the point where they enter the cylinder head (figure 1 – left photograph).



- One of them had its threaded nut, and the other did not.
- The threads on the stud bolt that did not have the threaded nut showed no significant damage. Its missing nut was found entirely separated from the stud with its threads in good condition.
- The two lock washers were also found detached, intact, and with no appreciable damage.

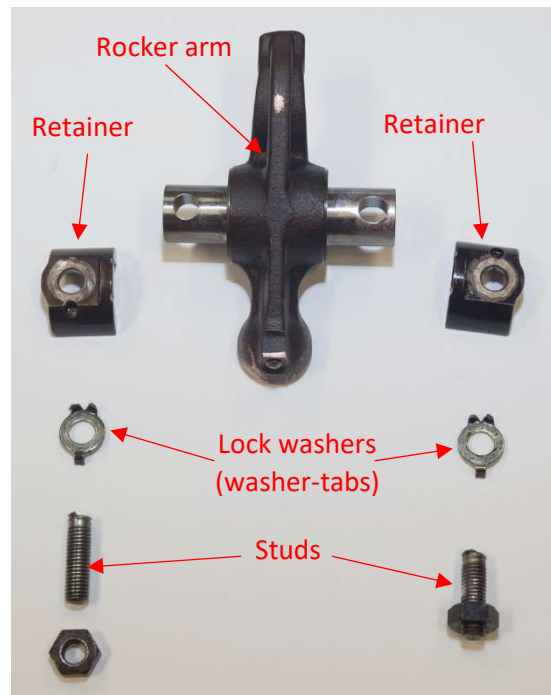
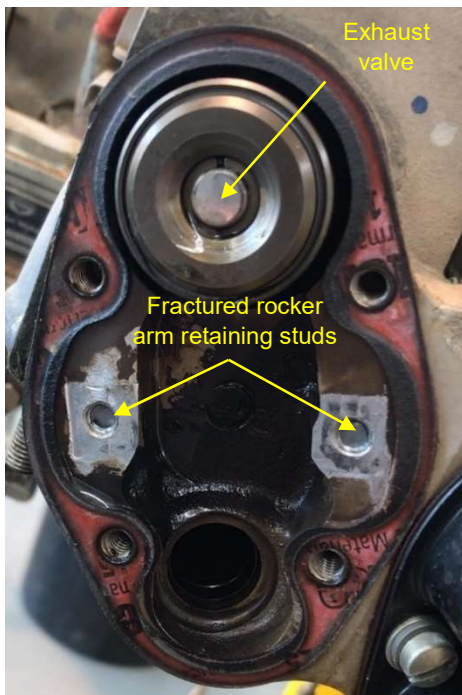


Figure 1. Photographs of the exhaust area of cylinder no. 4 (left) and of the elements that were found loose (right)

Discussion

The fact that a loose, unscrewed nut was found without damage to the threads of either the stud or the nut suggests it gradually unscrewed itself.

The purpose of the lock washer is to prevent the nut from working its way loose during engine operation. The fact that the nut had done so suggests the washer did not serve its purpose. Given that there were no signs of any significant damage that might have affected its performance, the most probable hypothesis is that the washer was incorrectly installed.

These types of washers have three pins; one bent at a 90° angle to the plane of the washer and two that aren't. During installation, the angled pin is inserted into the retainer housing. The nut is then put on and tightened with the appropriate torque. When tightening the nut, care must be taken to ensure the pin doesn't slip out of the housing or become deformed. Once torque has been applied to the nut, the remaining two washer



pins are bent towards it. These bent pins must be touching the sides of the nut to allow an effective braking of the nut. They should be touching it for the braking to be effective.

The rocker arms for this engine were installed during the rebuild carried out by Continental Motors, Inc. in November 2018.

No maintenance tasks that would require the removal of the rocker arms have been carried out since.

Given that the incident aircraft's operator had another aircraft of the same model equipped with the same type of engine, IO-240-B32 s/n: 1035257, which had also been rebuilt in 2019 (TCM 8130-3 Track no. 530317) by Continental Motors, Inc. at its facilities in Mobile, Alabama, it was decided to inspect the condition of its rocker arms.

We found that one of the retainer nut lock washers in the exhaust valve of cylinder no.3 was incorrectly installed, as the pin had not been inserted into the retainer housing (see figure 2).

If the pin is not inserted into the housing, the washer doesn't brake the nut effectively and, therefore, it could come loose.

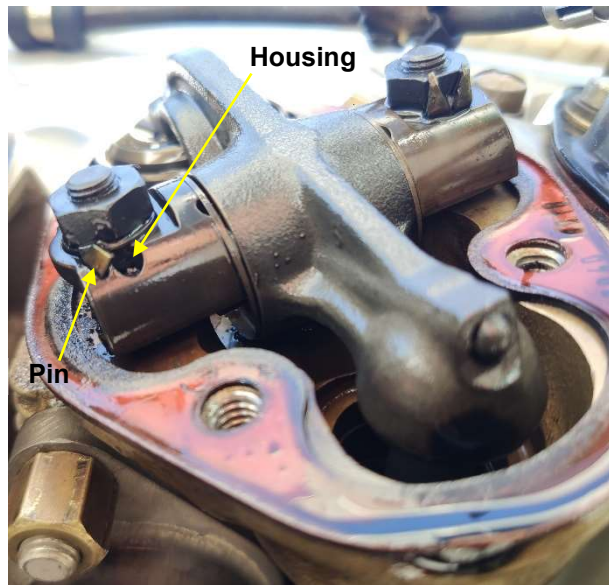


Figure 2. Photograph of exhaust valve rocker arm cylinder no. 3, engine IO-240-B32, s/n: 1035257.

Conclusions

As has been determined in the EC-LAO aircraft accident, an incorrectly fitted lock washer can allow the retaining nut to work its way loose and detach from the rocker shaft, causing an in-flight engine failure.

The fact that the lock washers for the rocker arm shaft retaining nuts were incorrectly installed in two engines that were both rebuilt at the same facility within a short time of one another suggests the problem is not an isolated issue.

In this scenario, it's likely that other engines rebuilt at the Continental Motors, Inc. plant in Mobile (Alabama) also have incorrectly installed lock washers, potentially constituting an operational safety hazard that could be affecting an unknown number of aircraft.

In the opinion of the CIAIAC, the cause or causes that led to the incorrect assembly of the lock washers must be urgently established, and the necessary actions implemented to correct the issue. It's also imperative the engine units potentially affected by this latent failure are identified, and the steps required to remedy it are initiated.



To this end, four (4) urgent safety recommendations are issued to Continental Motors, Inc.

REC 12/21: It is recommended that Continental Motors, Inc. should carry out the necessary actions and investigations to determine the cause and nature (isolated, organisational, etc.) of the circumstances that led to the faulty assembly of some of the rocker shaft lock washers at its facility in Mobile (Alabama).

REC 13/21: It is recommended that Continental Motors, Inc. should implement measures to ensure the correct installation of the lock washers.

REC 14/21: It is recommended that Continental Motors, Inc. should determine which engine units have potentially left its factory in Mobile (Alabama) with an incorrectly installed lock washer.

REC 15/21: It is recommended that Continental Motors, Inc. should contact all operators of aircraft equipped with engines potentially affected by this problem in order to verify the extent of the problem and, where necessary, replace the defective washers.