



# A340 Thrust Reverser Unlocked



**By: Vincent SWIDERSKI**  
*A340 Propulsion System Engineer CFM56-5C*  
**Per-Oliver GUENZEL**  
*A330/A340 Flight Safety Coordinator*

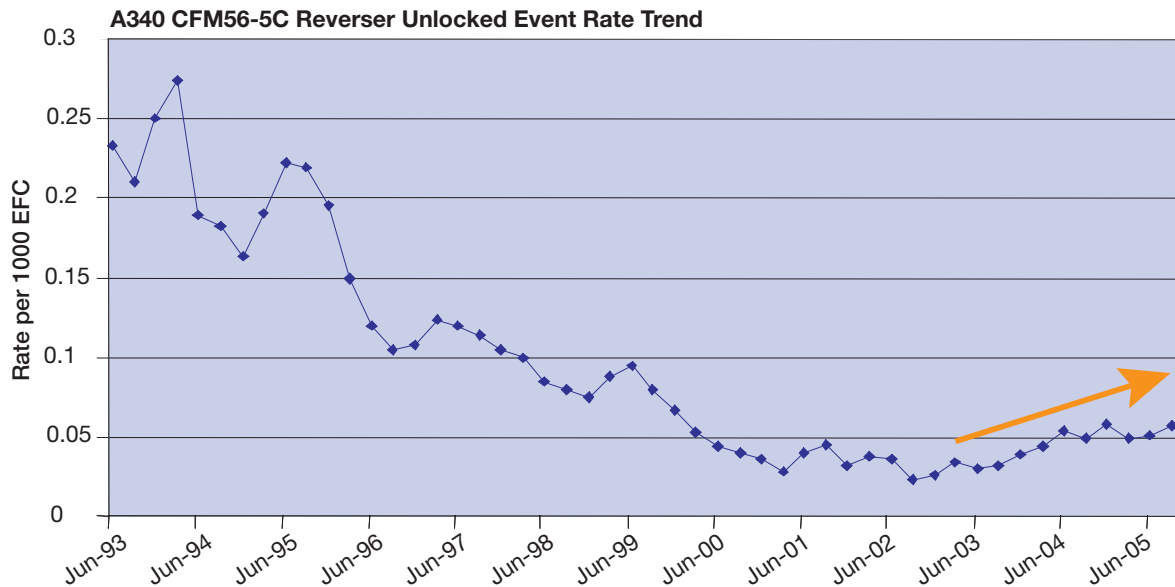


Fig 1: Trend of the “Rev Unlock” event rate since Entry Into Service

## 1 | Introduction

The CFM56-5C engine (fitted on A340-200 and 300) has a Thrust Reverser with 4 pivoting doors. As soon as one incorrectly locked thrust reverser door is detected, an “**ENG X REV UNLOCKED**” warning comes up on the ECAM warning display.

In the past, most “**ENG X REV UNLOCKED**” warnings were spurious. This is not the case any more, as this phenomenon has been understood and cured.

Today, most of the events are actual ones and the repetitive occurrences are due to a lack of troubleshooting as detailed hereafter.

## 2 | History

Since Entry Into Service, various operators are impacted by Rev Unlocked warnings. Airbus, CFM, Goodrich and Aircelle are carrying out a continuous improvement of the system. It began in August 1996 with issuance of the “ATO package” Service Bulletin (Ref A). This SB provided a first answer to the Rev Unlock phenomenon knowledge at that time. It has been followed by several other SB and led to decrease the Rev Unlock rate to under 0.05 events per 1000 Engine Flight Cycles.

However, this rate has been rising again in the last 2 years, as highlighted on Figure 1.

### 3 | Thrust Reverser system description

The CFM56-5C Thrust Reverser is hydraulically commanded. Each pivoting door is motioned by an actuator and secured in closed position by a locking system.

The selection of the Thrust Reverse mode sends hydraulic pressure, which opens the locking system and deploys the pivoting doors actuators.

The locking system is composed of 2 mechanical retention means (Fig 2):

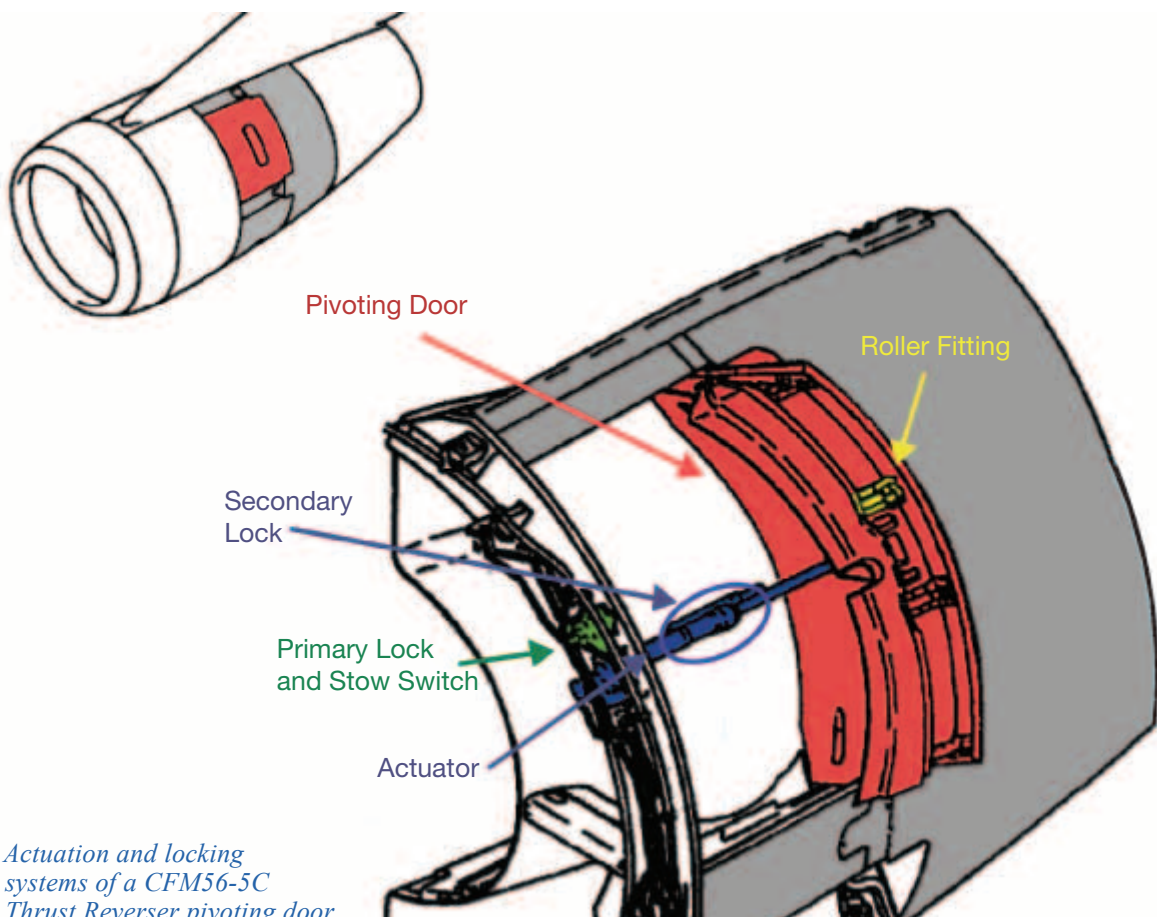
#### *The primary lock*

It is the main locking element. It consists of a rotating cam located on the Thrust Reverser's forward frame, which hooks on a roller fitting fixed on the pivoting door.

#### *The secondary lock*

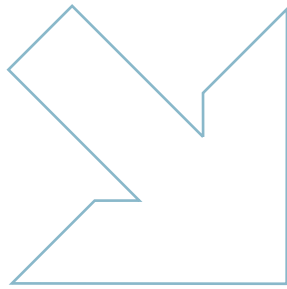
It ensures that the door stays closed in case the primary lock fails.

It is composed of 4 integrated "locking fingers" located in the pivoting door actuator body.



*Fig 2: Actuation and locking systems of a CFM56-5C Thrust Reverser pivoting door*





## 4 | “ENG X Rev Unlocked” root causes

When the locking system is not pressurized, the secondary lock is engaged, ready to retain the actuator in its almost full-retracted position. If the primary lock fails, the door will extend slightly above the flush position before the secondary lock engages. In that case, the stow switch sensor is released (Fig 3), which leads to the generation of an “**ENG X REV UNLOCKED**” warning on the ECAM.

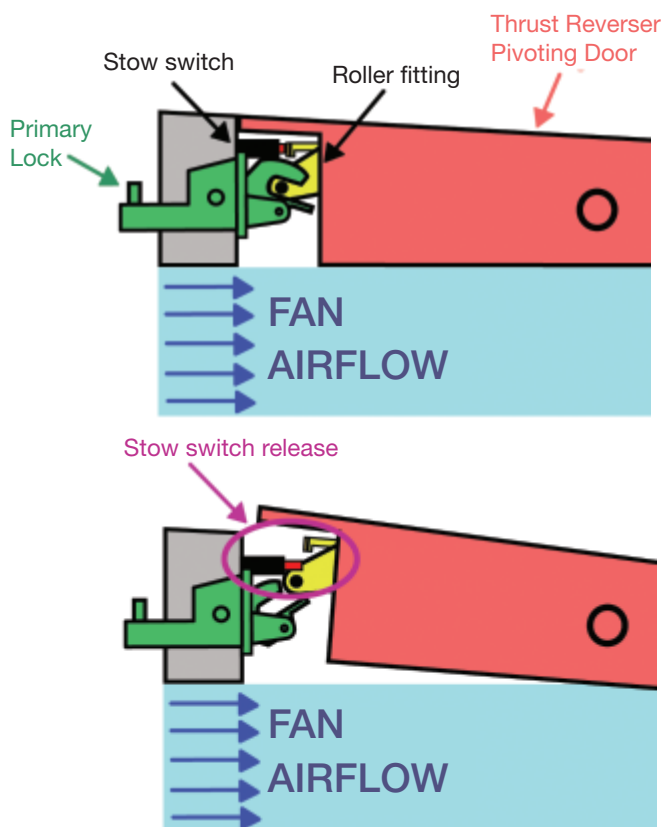


Fig 3: Release of the stow switch with Primary lock open

The continuous feedback from the operators allowed identifying that the primary lock rotating cam can fail to hook the roller-fitting due to:

- An insufficient actuator stroke;
- An incorrect rigging of the roller fitting;
- A primary lock contamination, which can prevent the rotating cam from moving freely;
- An undesirable hydraulic pressure spike in the actuation system, which can prevent the primary lock from hooking completely.

## 5 | Operational impact and maintenance actions

The above-described root causes usually lead to an unstable position of the primary lock between open and closed position. This unstable position switches to the open position (secondary lock activated) during the following flight due to engine acceleration/vibration. In most cases this happens during the takeoff run. An “**ENG X REV UNLOCKED**” warning is triggered and the crew performs a Rejected Take Off.

Maintenance will find a pivoting door ajar on the affected engine. Pushing the door back in its closed position will engage the primary lock and clear the issue for the next takeoff. But as the root cause has not been addressed it is likely that an “**ENG X REV UNLOCKED**” will appear after some thrust reverser actuations.

This is why troubleshooting has to be done in accordance with Ref. D or E in order to find the root cause and to apply the appropriate corrective action.

If the need to operate the aircraft does not allow any troubleshooting, the Thrust Reverser should be deactivated as per the MEL (Ref F).

## 6 | Preventive maintenance and permanent solution

The various investigations emphasized the importance of adhering to several maintenance practices in order to prevent the “Rev Unlocked” events.

CFM/Goodrich have released the Best Practices Manual (BPM) in January 2005.

It has proven to be very effective when applied at every C-check, but it was only applied by 25% of the operators.

To ensure a fleet-wide application, the BPM has been included in a Service Bulletin (Ref C) that is referenced as a scheduled maintenance task at each ‘C’ in the MPD (ref. H).

In addition to those practices, a final solution will introduce a set of improvements to the locking system by addressing the above root causes. See also ref. G for further information.

## 7 | Conclusion

Airbus permanent effort on the “Rev Unlocked” warning has eliminated the spurious triggering known from the early days of the A340-300.

Today, the majority of the events are due to actual Thrust Reverser door unlocks. Therefore:

- Adhere strictly to the ECAM procedure, which instructs to select idle on the affected engine, even if that engine has already been automatically reduced to idle by the FADEC;
- Apply proper troubleshooting before the next flight to avoid re-occurrence, or deactivate the Thrust Reverser if you can not complete the troubleshooting;
- Perform preventive maintenance, in the form of a MPD task every ‘C’ check, to minimize the operational interruptions due to “Rev Unlocked” events.

### REFERENCES

- A) SB RA34078-27
- B) SB RA340A78-56
- C) SB RA34078-88
- D) TSM tasks 78-31-00-810-967/968/969/970
- E) Goodrich AOL A340/CFM56-04-047 REVISION 1
- F) MEL 78-30-01
- G) TFU 78.30.00.052
- H) MPD task 783241-C4-1





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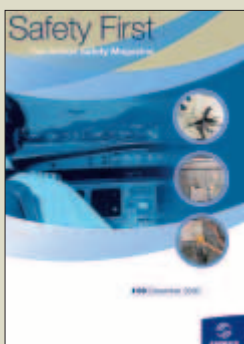
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**Airbus**  
Product Safety department (GS)  
1, rond point Maurice Bellonte  
31707 Blagnac Cedex - France  
Fax: +33(0)5 61 93 44 29  
[safetycommunication@airbus.com](mailto:safetycommunication@airbus.com)



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