

**DATA SUMMARY**

**LOCATION**

Date and time	<b>Wednesday, 12 May 2004; 19:30 h</b>
Site	<b>Cuatro Vientos Airport (Madrid)</b>

**AIRCRAFT**

Registration	<b>EC-CTO</b>
Type and model	<b>ROCKWELL COMMANDER 680-F</b>
Operator	<b>ARE Aviación</b>

**Engines**

Type and model	<b>LYCOMING IGSO-540B1A</b>
Number	<b>2</b>

**CREW**

**Pilot in command**

Age	<b>38 years</b>
Licence	<b>Commercial pilot</b>
Total flight hours	<b>7,000 hours</b>
Flight hours on the type	<b>500 hours</b>

**INJURIES**

	Fatal	Serious	Minor/None
Crew			<b>1</b>
Passengers			<b>1</b>
Third persons			

**DAMAGES**

Aircraft	<b>Important</b>
Third parties	<b>None</b>

**FLIGHT DATA**

Operation	<b>General aviation – Non commercial – Private</b>
Phase of flight	<b>Landing roll</b>

## 1. FACTUAL INFORMATION

### 1.1. History of the flight

The aircraft took off from Cuatro Vientos airport on 12th May 2004 at 19:17 local time. It carried out a 12-minute flight and then started to approach runway 28. It was down the landing gear and the pilot checked that the indicator in the cockpit showed that it was down and locked. He also visually checked that the landing gear was lowered.

When the aircraft touched down, the pilot lightly touched the brakes and the right-hand gear started to retract. The pilot cut off power and fuel mix and tried to keep the aircraft on the runway. The aircraft gradually shifted to the right and the lower part of the fuselage made contact with the runway. It then came off the runway and stopped approximately 990 meters from the threshold and 26 meters from the edge of the runway.

Neither the pilot nor the passenger suffered any injury.

The aircraft suffered damaged to the lower part of the fuselage, the end of the right wing and the right propeller.

It was lifted up off the ground with a crane. On being raised, the right main landing gear was lowered and blocked. It was then moved to the parking apron.

### 1.2. Personnel information

Information concerning the aircraft's pilot is summarized below:

Information on the pilot	
Age	38 years
Nationality	Spanish
Licence	Commercial pilot (since 27-02-1992)
<i>Type rating (validity)</i>	Single-engine (up to 02-02-2004)
	Multi-engine (up to 29-08-2004)
	Instrumental flight (up to 22-09-2003)
	Flight instructor (up to 02-02-2005)
	Instrumental flight instructor (up to 02-02-2005)

Information on the pilot		
<i>Experience</i>	Total	7,000 hours
	On the type	500 hours
	Last 90 days	200 hours
	Last 30 days	75 hours
	Last 24 hours	4 hours
<i>Activity</i>	Activity period start time	19:00 hours
	Previous rest	20 hours
<i>Medical certificate</i>	Type	Medical check
	Date	16-04-2004

### 1.3. Aircraft information

Specific information relating to this aircraft is given below:

General information		
Registration	EC-CTO	
Manufacturer	Aerocommander	
Model	Aerocommander 680F	
Serial number	1195-100	
Year of manufacture	1962	
<i>Engine 1</i>	Manufacturer	Lycoming
	Model	IGSO-540B1A
	Serial number	L-2495-50
<i>Engine 2</i>	Manufacturer	Lycoming
	Model	IGSO-540B1A
	Serial number	L-311-50
<i>Propeller 1</i>	Make	Hartzell
	Model	HC-B3Z-2B/9349-6
<i>Propeller 2</i>	Make	Hartzell
	Model	HC-B3Z-2B/9349-6

General information		
<i>Airworthiness certificate</i>	Class	Normal
	<i>Usage</i>	Category: Aerial work
		Service: Normal. Ideal aircraft for any environmental condition
		Type: School
	Number	1740
	Issued	27-06-1999
	Validity	01-10-2004
	Last renewal	01-10-2003

Technical features		
<i>Dimensions</i>	Span	15.09 m
	Height	4.42 m
	Length	10.07 m
<i>Limitations</i>	Maximum takeoff weight	3,629 kg
	Minimum crew	1 pilot

Maintenance information		
<i>Aircraft</i>	Hours	2,017 hours
<i>Engine 1</i>	Hours	1,542 hours
<i>Engine 2</i>	Hours	2,019 hours
<i>Last inspections</i>	Aircraft	— Date: 19-08-2003 — Aircraft time: 1,989 hours — Type: basic inspection (100 hours)
	Engine 1	— Date: 19-08-2003 — Engine 1 time: 1,515 hours — Type: basic inspection (100 hours)
	Engine 2	— Date: 19-08-2003 — Engine 2 time: 1,990 hours — Type: basic inspection (100 hours)

### 1.3.1. *Aircraft history*

The aircraft was manufactured in 1962. It was imported in 1976. In 1987 it was sold to a second company and, finally, in 1996 it was purchased by the company which is

its current owner. A general overhaul was carried out on 12<sup>th</sup> July 1999 in order to obtain the Airworthiness Certificate.

The following maintenance tasks have been carried out on the aircraft since 12<sup>th</sup> July 1999:

Date	Aircraft hours	Type of inspection (hourly interval)
12-07-1999	1,702 hours	General overhaul (1,000 hours)
04-08-2000	1,745 hours	Line inspection (50 hours)
08-06-2001	1,796 hours	Basic inspection (100 hours)
10-08-2001	1,845 hours	Line inspection (50 hours)
16-11-2001	1,895 hours	Basic inspection (100 hours)
28-02-2002	1,945 hours	Line inspection (50 hours)
Repairs after incident on 22-04-2002 with 1,964 aircraft hours		
09-08-2002	1,964 hours	Basic inspection (100 hours)
Repairs after incident on 06-02-2003 with 1,989 aircraft hours		
19-08-2003	1,989 hours	Basic inspection (100 hours)
Incident on 12th May 2004 with 2,017 flight hours		

Since 2001, the aircraft has suffered three incidents and accidents:

- The first incident occurred in April 2002. On this occasion the retract cylinder clevis that joins one of the actuators to the landing gear truss broke. After this breakage, the main landing gear retracted. This would not have happened if the landing gear had been blocked (see Report IN-019/2002).
- The second accident occurred in February 2003. The aircraft had flown 24 hours and had carried out 21 cycles since the previous incident. On this occasion, a hydraulic fluid hose broke, leaving the aircraft without hydraulic pressure. There was also an erroneous indication in the cockpit: although the indicator in the cockpit showed that the right main landing gear was locked (green light), in fact it had retracted (see Report A-006/2003).
- The incident being reported here occurred in May 2004 when the aircraft had flown 28 hours and carried out 26 cycles since the previous accident.

On the three occasions, retraction of the right main landing gear occurred without being commanded.

### 1.3.2. *Maintenance program*

Two types of inspection are included in the aircraft's maintenance program, which was approved in June 1999:

1. Line inspection, every 50 hours.
2. Basic inspection, every 100 hours or 12 months.

The 100-hour inspection sheet shows the following tasks relative to the landing gear:

- Check wheels.
- Check condition of following elements:
  - i. Strut.
  - ii. Scissors.
  - iii. Drag links.
  - iv. Cord bungees.
  - v. Switches.
  - vi. Retract cylinder.
  - vii. Yoke.
  - viii. Main landing gear truss.
  - ix. Air cylinder for pressure 300 psi.
- Lubricate all zerk fittings.
- Perform landing gear retraction test.

According to information provided by maintenance staff, when the landing gear position indication switch is inspected, a check is made to ensure that the pin correctly activates the switch and that the pin slides correctly in its housing. If any pin sliding resistance is observed, the pin is removed and the pin plus the orifice in which it is housed are checked.

#### **1.4. Aerodrome information**

Cuatro Vientos airport has a runway with 10/28 bearing and an asphalt surface. The aircraft approached runway 28. This runway is 1,500 meters long and 30 meters wide.

#### **1.5. Wreckage and impact information**

The aircraft touched down on the runway and a few seconds later the right main landing gear started to retract. The first marks caused by the fuselage appear 650 meters from the threshold. The marks indicating that the aircraft came off the runway appear at approximately 900 meters from the threshold and the aircraft finally stopped 994 meters from the threshold and 26.50 meters from the edge of the runway. The trajectory followed by the aircraft can be seen in Figure 1. The final position is shown in Figure 2.

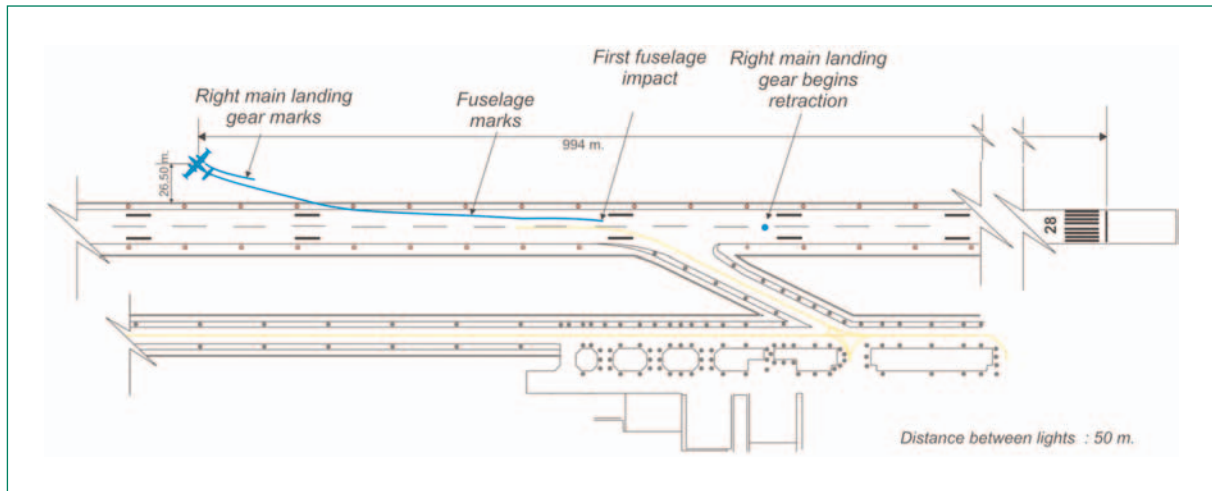


Figure 1. Aircraft path



Figure 2. Final position of the aircraft

The aircraft's right propeller was damaged. It was noted that the tips of the three blades were bent and worn due to friction with the runway and the grass verge (see Figure 3). When the right main landing gear retracted, the lower right-hand part of the fuselage touched the runway and then the earth and grass verge, with that whole area of the fuselage suffering deterioration due to friction (see Figure 4). The right-hand edge showed a slight crack probably due to the final contact of this wing with the ground when the aircraft came to a halt.



Figure 3. Propeller damages



Figure 4. Fuselage damages

## 1.6. Survival aspects

According to information provided by eye witnesses of the incident, the people on board suffered no injuries and were able to leave the aircraft without assistance.

Firemen arrived immediately and on observing that fuel was coming out of the aircraft's wing ventilation orifices, they covered them over. They did not use any fire extinguishing agents.

## 1.7. Tests and research

### 1.7.1. *Landing gear operational tests*

No malfunction of the landing gear was observed in this check, except that there was no indication of the right main landing gear extended and locked. It was found that the pin that creates pressure to actuate the switch when the drag braces are extended was not there and for that reason there was no indication.

### 1.7.2. *Disassembly of right main landing gear*

During disassembly of the right main landing gear, the drag brace assembly was stripped to check the length of the braces. Once stripped, marks were noted on the lower drag brace produced by pin head P/N ED12439. These marks indicated that it had been mounted incorrectly (see Figure 5).

After checking the mounting of pin P/N ED12439 in the left main landing gear it was also found to be incorrectly mounted.





Figure 5.

## 1.8. Additional information

### 1.8.1. *Landing gear operation and position indication*

#### Landing gear operation

- The main landing gear retracts by hydraulic system pressure. When the landing gear lever is placed in the GEAR UP position, the landing gear valve directs fluid under pressure to the corresponding port of each landing gear's «normal» and «emergency» actuators.
- In the case of extension, the operation is not only hydraulic, as in the case of retraction, but is both pneumatic and hydraulic. When the GEAR DOWN position is selected in the cockpit, the landing gear valve directs hydraulic fluid under pressure to the corresponding ports of each landing gear's «normal» cylinders, whilst pressurized air is injected into the «emergency» actuators through the corresponding port.
- When the main landing gear is fully extended, the center hinge point of the drag brace assembly is forced overcenter by the landing gear actuating cylinders to form a positive gear downlock. When no hydraulic pressure on the system, the drag brace is forced overcenter by action of the air pressure in the landing gear emergency actuating cylinder assisted by the bungees. The landing gear actuating cylinders are factory adjusted to have a slight amount of overtravel in order to preload the drag

brace; preload adjustment will be necessary only after some part of the landing gear has been removed and reinstalled or replaced. For maximum safety however, drag brace overtravel should be inspected periodically.

In this way, it will ensure adequate overtravel of the cylinder piston, drag brace preload, and positive locking of the gear when in the down and locked position. Preloading of the drag brace also ensures sufficient clearance between the end of the actuating cylinder and piston when fully extended.

### Landing gear position indication

— There are four indicator lights in the cockpit which give information on the landing gear's status: three green lights and one red light (see Figure 7).

— Green lights:

- They provide information on the status of each one of the three landing gears separately.
- When a green light lights up it indicates that the corresponding landing gear is in the down and locked position.
- Each green light has a down and locked switch associated with it (see Figure 6) situated in the connection area between the gear's upper and lower drag braces.
- Each switch has a pin which presses the switch, closing or opening some contacts which will give rise to the indicator light in the cockpit being turned on or off, respectively. In addition to the pin and contacts, there are some adjusting jabs that allow the gear's lower drag brace switch assembly to be brought closer or taken further away, thereby guaranteeing contact.
- The correct position of the pin is with the head upwards exerting pressure on the switch.
- In order to be able to change the pin's position from the correct one, with the head upwards, to the wrong one, with the head downwards, the gear down and blocked indicator switch has to be disassembled (see Figures 8 and 9).
- According to information made available by an authorized Aerocommander maintenance centre, there is no specific maintenance for pin P/N ED12439. The aircraft's maintenance manual does not specify the correct position of the pin. Only one figure appears which shows the switch-pin assembly in detail, as can be seen in Figure 6.

### 1.8.2. *Statements*

#### Statements of pilot and the passenger

In his statement the pilot indicated that the indicator in the cockpit showed landing gear down and locked.

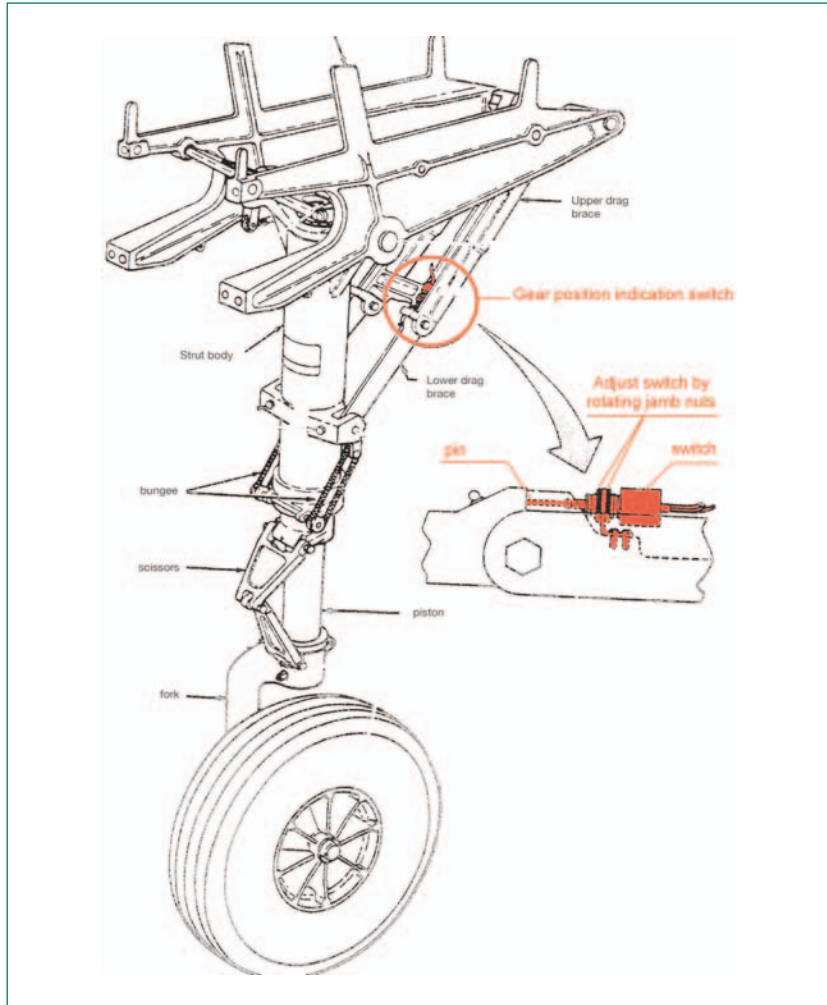


Figure 6. Main landing gear indication switch



Figure 7. Landing gear lever and gear position indication lights

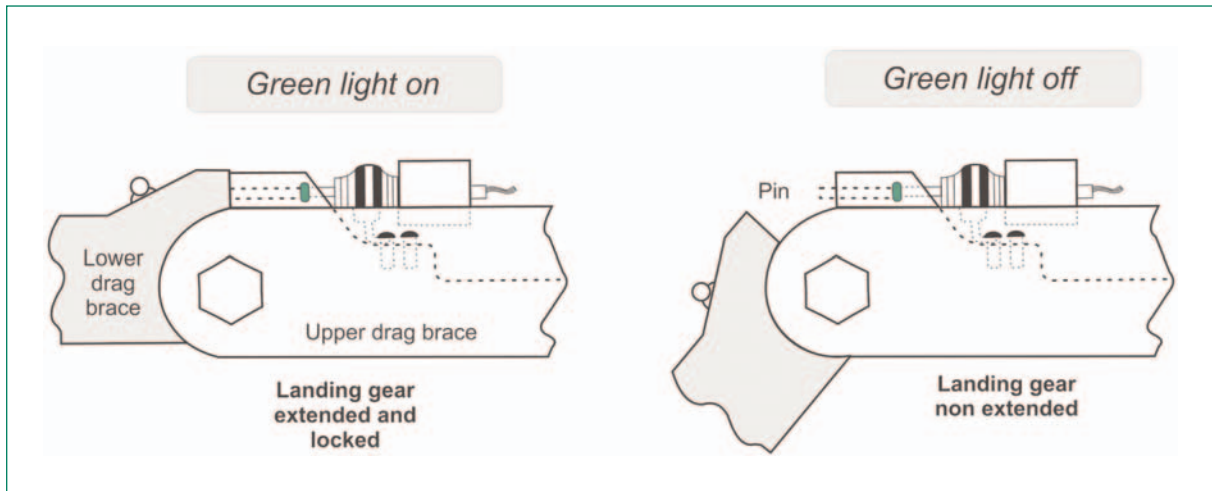


Figure 8. Right rigging of pin P/N ED12439

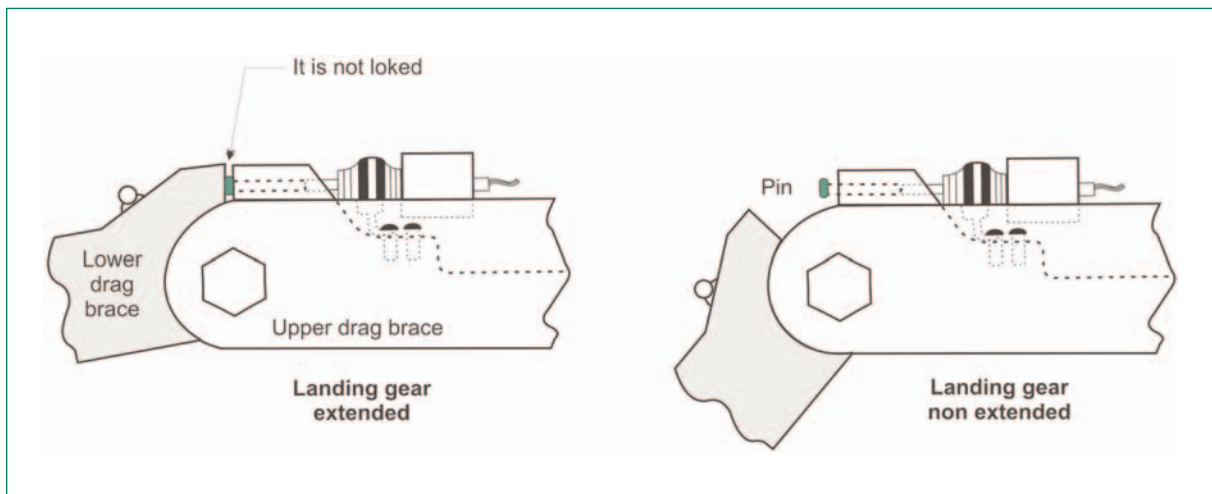


Figure 9. Wrong rigging of pin P/N ED12439

The other person on board also stated that the indication in the cockpit was of landing gear down and locked. He also visually checked that the right main landing gear was extended.

## 2. ANALYSIS AND CONCLUSIONS

As mentioned in the report, no commanded retraction of the right main landing gear has occurred three times, with an indication in the cockpit of gear down and locked.

### No commanded landing gear retraction

No commanded retraction of the landing gear can occur if the landing gear is not locked.

The investigation carried out demonstrated that pin with P/N ED12439 was incorrectly mounted and was preventing the right main landing gear from reaching the overcenter and, therefore, being locked. This would explain the three no commanded landing gear retractions that have occurred in the last three years.

The pin was also incorrectly mounted in the left main landing gear and yet it did not suffer any commanded retraction. It is possible that this landing gear's geometric configuration varies with respect to that of the right main landing gear, although this point has not been verified.

### Erroneous indication in the cockpit

Both the pilot and the passenger maintained that the indication in the cockpit was that of gear down and locked. This is explained by the fact that switch adjustment was carried out subsequent to the pin's incorrect mounting. Consequently, it was adjusted to indicate gear locked in spite of not being locked.

### Incorrect mounting of pins P/N ED12439

In the checks made it was noted that element with P/N ED12439 was incorrectly mounted in both the right and left landing gears. This gives the impression that this was not accidental but that for the maintenance staff the position they were in was the correct one.

The lack of information in the maintenance manual relative to the pin's position would have contributed to this error and would have prevented maintenance staff in subsequent inspections from noticing that the pin was not correctly mounted.

If the aircraft's history is studied, the maintenance activities that could have affected both main landing gears may have taken place either during the aircraft's initial assembly, after a general overhaul or in one of the 100-hour inspections. It is possible that the gear down and locked indication switches may have been serviced and the pin's position modified on any of these three occasions.

### *Initial aircraft assembly*

The aircraft was imported in 1976 and between then and 2002 there were no incidents with respect to the main landing gear, meaning that it seems highly unlikely that the aircraft was incorrectly mounted in the factory.

### *General and 100-hours inspections*

It is possible that when the general overhaul was carried out in 1999 the pins in both landing gears were incorrectly mounted, although the possibility also exists that this occurred during the 100-hour inspection when malfunctioning of the landing gear down and blocked indicator switches was detected.

### **Conclusions**

The final conclusion is that the probable cause of the right main landing gear's retraction in the landing roll was that it was not locked due to the incorrect mounting of the pin P/N ED12439 that exerts pressure on the gear down and locked indicator switch, which prevented the overcenter from being reached.

It has not been possible to establish when this element's incorrect mounting occurred.

A contributing factor to this incident is the lack of information in the aircraft's maintenance manual relative to the detailed mounting of pin P/N ED12439.

### **3. SAFETY RECOMMENDATIONS**

Due to the successive incidents and accidents suffered by the aircraft, preliminary recommendation REC 20/04 was issued on 14th June 2004, indicating the following:

*Before declaring aircraft Aerocommander 680F, registration EC-CTO, S/N 1195-100 suitable for flying, the Dirección General de Aviación Civil [Civil Aviation General Directorate] is recommended to*

- 1. Require of the operator that it define and implement, in collaboration with the aircraft's manufacturer, a specific and complete functional test for the landing gear system, including the pertinent in-flight trials; and*
- 2. Establish a stricter maintenance inspection schedule than the one currently included in the maintenance program for the landing gear system. This greater strictness should be reflected not only in the inspection repetition frequency but also in the specification of the tasks to be carried out in such inspections, thereby effectively guaranteeing the aircraft's continued airworthiness.*

After completing the investigation and detecting the reason of the non commanded retraction of the right main landing gear, it is considered that it is not necessary to establish a specific functional test or stricter specific inspection program for this aircraft, and therefore the safety recommendation must be cancelled.

However, because of the result of the investigation, it would be necessary to assure that the pin P/N ED12439 is mounted correctly and it is considered convenient to issue a new safety recommendation in this regard.

**REC 48/2004.** It is recommended to the aircraft's manufacturer that either the design of pin P/N ED12439 or the associated maintenance documentation is modified in order to preclude the possibility of it being incorrectly mounted.