Australian Government
Australian Transport Safety Bureau

Flight control event involving Embraer E190, VH-UZD

29 km south-east of Launceston Airport, Tasmania, on 15 April 2025

ATSB Transport Safety Report
Aviation Occurrence Investigation (Short)
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Acknowledgement of Country and Traditional Owners

The Australian Transport Safety Bureau acknowledges the traditional owners of country throughout Australia, and their continuing connection to land, sea and community. We pay our respects to them and their cultures, and to elders both past and present.

Investigation summary

What happened

On 15 April 2025, an Embraer ERJ 190-100, registered VH-UZD, was conducting a passenger transport flight from Sydney, New South Wales, to Launceston, Tasmania. After commencing approach to Launceston, the flight crew received multiple caution messages including a SLAT FAIL caution. The flight crew discontinued their approach and after completing the relevant checklists elected to divert to Melbourne, Victoria, as it was the longest available runway in the region. The remainder of the flight was uneventful, and the aircraft landed safely.

Post-flight troubleshooting determined that a torque tube in the left wing slat drive system had disconnected as it had been incorrectly assembled when it was last refitted.

What the ATSB found

The ATSB identified a similar occurrence with another of the operator's Embraer ERJ 190-100 aircraft, VH-UYB, where a torque tube in the left wing flap drive system had disconnected as it had been incorrectly assembled when it was last refitted.

The occurrences were similar in that the locking bolts that secured the torque tubes to their actuators had not been fitted correctly into the holes of the splined shafts, since the torque tubes had been incorrectly positioned during installation.

In both occurrences, those carrying out and certifying for the torque tube installations did not identify that they had been incorrectly assembled.

These errors occurred at different maintenance providers, and reportedly from January 2005–August 2011 in the worldwide fleet of Embraer 170, 175, and 190 aircraft (all sharing similar componentry), there have been 5 similar occurrences related to incorrect torque tube installation.

What has been done as a result

The operator, Alliance Airlines, issued a maintenance notice that detailed the flap torque tube disconnect affecting VH-UYB and the slat torque tube disconnect affecting VH-UZD. This notice reiterated the aircraft maintenance manual information for the correct installation of flap and slat torque tubes.

The maintenance organisation added an additional task card that is automatically issued when work is scheduled on the E190 slat system torque tubes that provides guidance in addition to the aircraft maintenance manual to mitigate the incorrect assembly of torque tubes on their splines. A similar additional task card was being developed for the E190 flap system torque tubes.

Safety message

Historical occurrence and technical information provide an opportunity to review known errors prior to commencing particular maintenance activities, thereby reducing the possibility of further errors occurring. When an error does occur, this information also provides a means to bolster the actions taken to prevent re-occurrences.

This information can be available from multiple sources including the manufacturer, national aviation authorities (such as CASA or the FAA), accident investigation authorities, and the safety management systems of operators and maintenance organisations.

The investigation

The ATSB scopes its investigations based on many factors, including the level of safety benefit likely to be obtained from an investigation and the associated resources required. For this occurrence, the ATSB conducted a limited-scope investigation in order to produce a short investigation report, and allow for greater industry awareness of findings that affect safety and potential learning opportunities.

The occurrence

Previous maintenance

In November 2024, an Embraer ERJ 190-100 aircraft, registered VH-UZD and operated by Alliance Airlines, commenced a heavy maintenance[1] check by Rockhampton Aviation Maintenance in Rockhampton, Queensland. A team comprising 2 aircraft maintenance engineers (AMEs) was tasked with inspecting and lubricating the leading-edge slat drive system (see *Embraer E190 slats and flaps*). This involved removing, cleaning, lubricating, and refitting each slat torque tube in turn. A licensed aircraft maintenance engineer (LAME) briefed the AMEs on what was required.[2] The LAME was familiar with the task but was unaware of any historical issues with the task (see *Maintenance requirements*). The work was carried out in a new facility with good lighting. Access to the components was good, and a purpose-built platform allowed the work to be carried out with the relevant components at eye level.

Prior to commencing work, brakes internal to the power drive units (PDUs) (which drive the flap and slat torque tubes) were electrically released as required by the aircraft maintenance manual (AMM) procedure. The AMEs printed a copy of the relevant AMM procedure, and worked together on the torque tube driving the left-wing outboard actuator for slat number 4. The PDU brakes were also required to be released prior to installing the torque tubes, however, it could not be established whether this took place (the PDU brakes reapply when power is removed). After refitting the outboard actuator torque tube, a push-pull check was carried out to ensure it was locked in place, as required by the AMM. Unknown to the AMEs, when this torque tube was refitted, it had not been positioned far enough onto the actuator's splined shaft for the locking bolt to secure it (Figure 1, lower right). The locking bolt was inadvertently installed beyond the end of the spline (shown in grey) rather than through the hole as required.

One AME then continued work on the left wing and the other moved to the right wing slat drive system to work alone. The remaining slat torque tubes were correctly fitted.

After this work was completed, the LAME inspected the installation of the torque tubes and their locking bolts, and a second LAME carried out an independent inspection[3] of the

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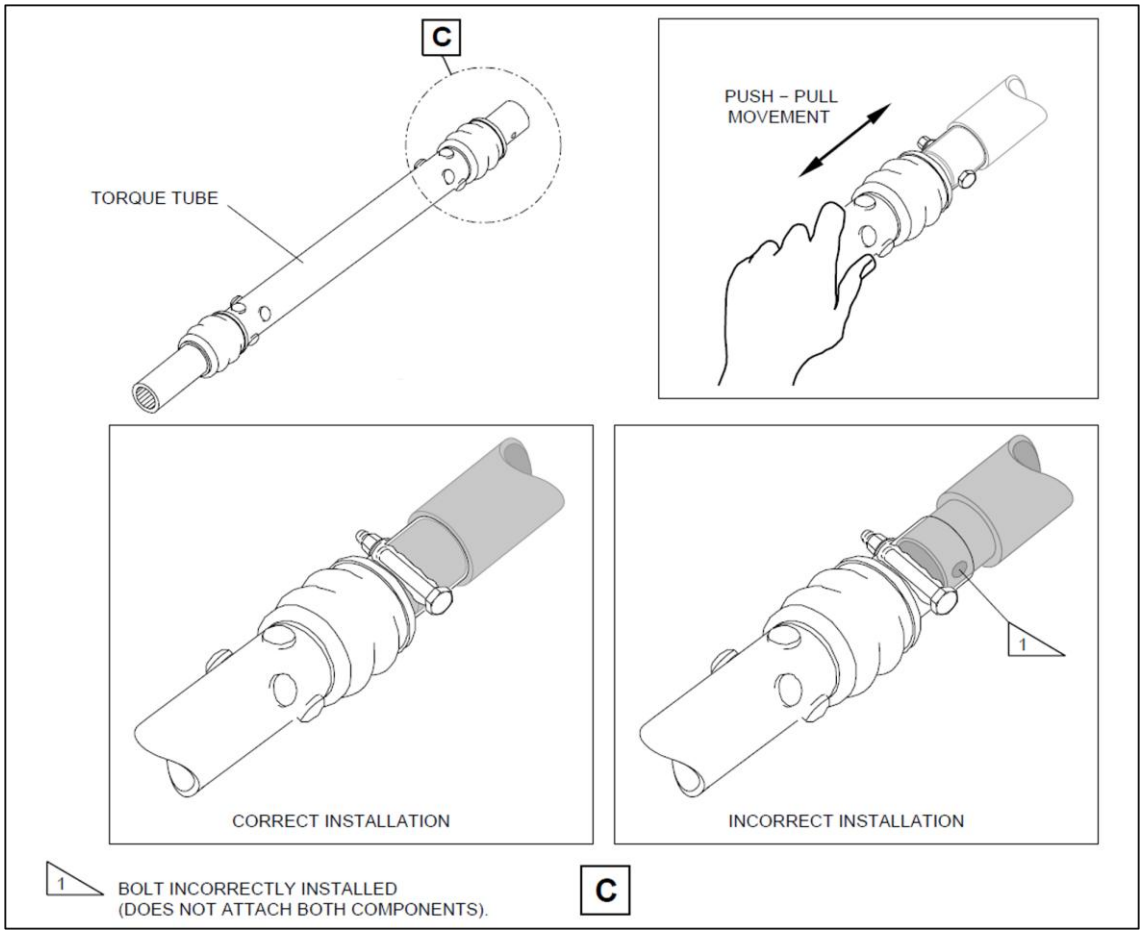
1 Heavy maintenance is typically when an aircraft is removed from service for a period of time for more extensive inspections, checks, servicing, and modifications to be carried out.

2 One of the AMEs had carried out this task previously. The other had experience maintaining E190s including slat and flap drive systems however had they had not previously removed and installed slat and flap torque tubes.

3 Civil Aviation Regulation (CAR) 42G required independent inspections to be carried out on flight control systems when they were disturbed during maintenance.

work. The heavy maintenance check was completed in March 2025, and the aircraft was returned to service.

Figure 1: Aircraft maintenance manual torque tube installation illustration



Source: Embraer

Flight control event

On 15 April 2025, 50 flights after returning to service from heavy maintenance, the aircraft was being operated on a passenger transport flight from Sydney, New South Wales, to Launceston, Tasmania, by Alliance Airlines for QantasLink. After commencing approach to Launceston, the flight crew received multiple caution messages[4] on the aircraft's engine indicating and crew alerting system (EICAS) including a SLAT FAIL caution. The flight crew discontinued the approach and requested clearance from air traffic control for vectors[5] so they could action the relevant quick reference handbook (QRH) checklists for the caution messages.

The flight crew completed the QRH checklist. As the slat failure would require landing with the slats and flaps up, the flight crew elected to divert to Melbourne Airport, Victoria, as it had the longest available runway in the region. The flight crew declared a PAN PAN[6] and commenced the diversion to Melbourne. After climbing to 19,000 ft the aircraft

[4] The caution messages presented were SLAT FAIL, SHAKER ANTICIPATED, and AOA [angle of attack] LIMIT FAIL.

[5] In this context, a vector is a heading given by air traffic control to a flight crew for navigation guidance.

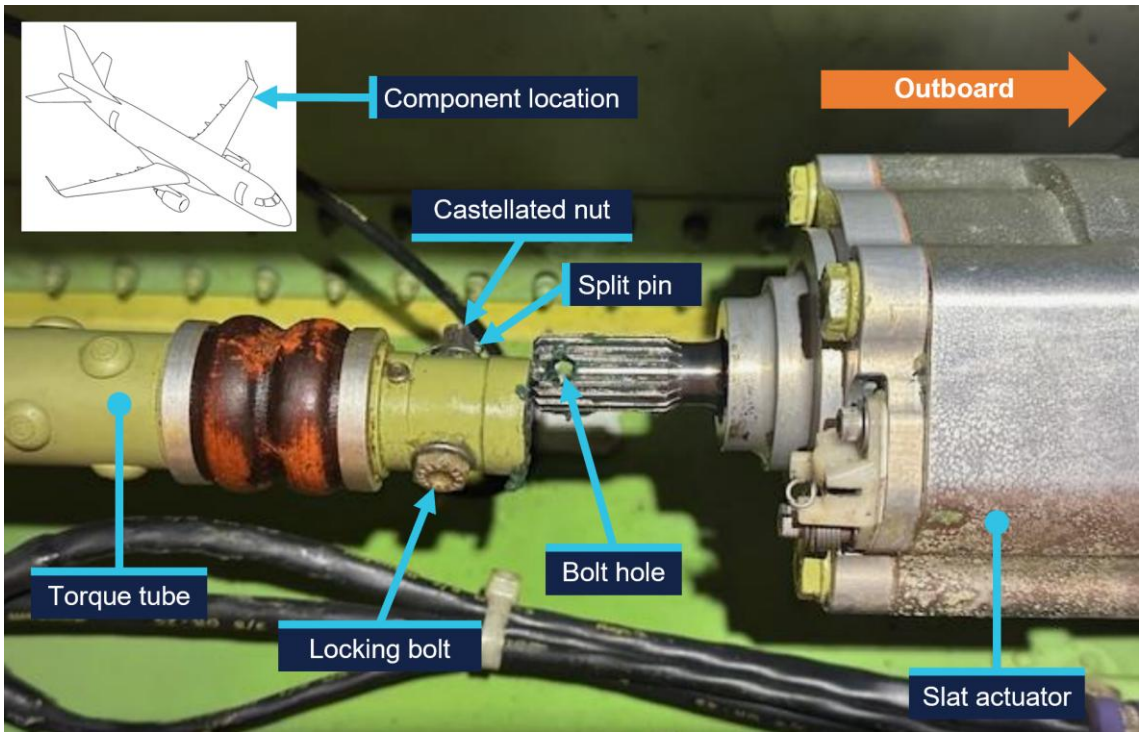
[6] PAN PAN: an internationally recognised radio call announcing an urgency condition which concerns the safety of an aircraft or its occupants but where the flight crew does not require immediate assistance.

was flown to Melbourne at 220 kt as required by the QRH because of the slat failure. The aircraft landed at Melbourne without further incident.

Post-flight inspection

Post-flight inspection determined that the torque tube for the left wing slat number 4 outboard actuator had disconnected as the locking bolt fitted to the torque tube had not passed through the corresponding hole in the actuator's splined shaft when it was last refitted (Figure 2).

Figure 2: VH-UZD left wing outboard actuator for slat number 4 and torque tube, shown disconnected after the occurrence flight



Source: Alliance Airlines, annotated by the ATSB

Context

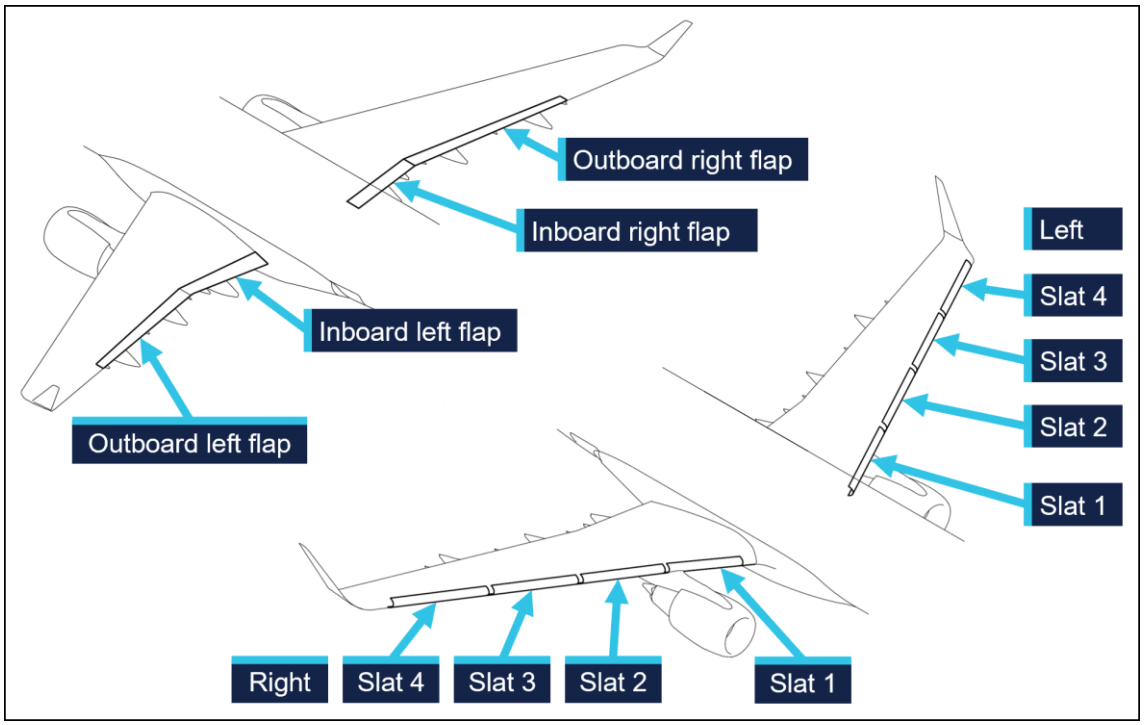
Aircraft information

The Embraer ERJ 190-100 IGW (E190) is a narrow-body aircraft used for air transport operations and powered by 2 General Electric CF34-10E5 turbofan engines. VH-UZD was manufactured in Brazil in 2008 and registered in Australia on 31 January 2022.

Embraer E190 slats and flaps

The E190 is fitted with devices to increase the lift produced by its wings during take-off and landing. On the leading edges of the wings there are 8 slat panels and on the trailing edges of the wings there are 4 flap panels (Figure 3), where each set (slats/flaps) extends and retracts together.

Figure 3: Embraer E190 slats and flaps



Source: Embraer, annotated by the ATSB

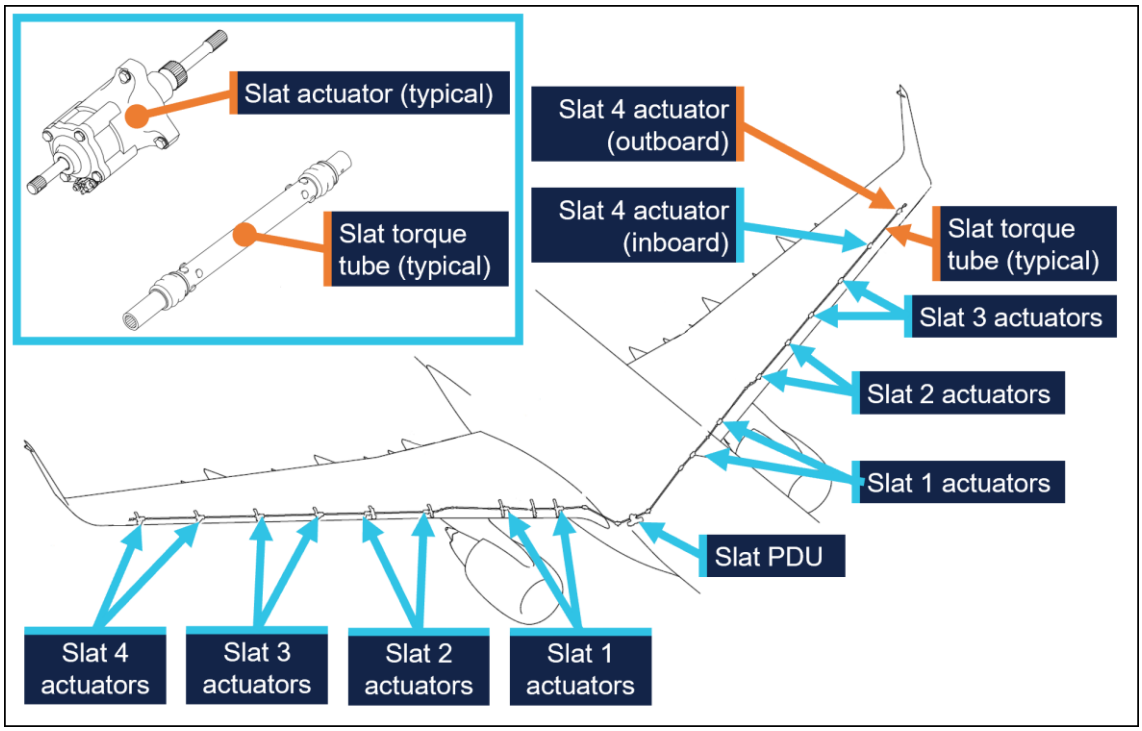
Slat and flap extension and retraction is controlled from the cockpit by using the slat/flap control lever (SFCL). When the SFCL is moved from its 0 (up) position,[7] the flap and slat power drive units (PDUs) drive torque tubes which in turn drive actuators, transferring the rotary motion of the torque tubes to linear motion that extends the slats and flaps (Figure 4 and Figure 5).

Each PDU has 2 internal brakes that are engaged under spring force and released electrically, such that the brakes would re-engage when power is removed. There are 26 torque tubes in the slat drive system and 22 torque tubes in the flap drive system.

In the event of a slat or flap failure, redundant detection and protection systems prevent them operating in such a way that may compromise safety of flight.

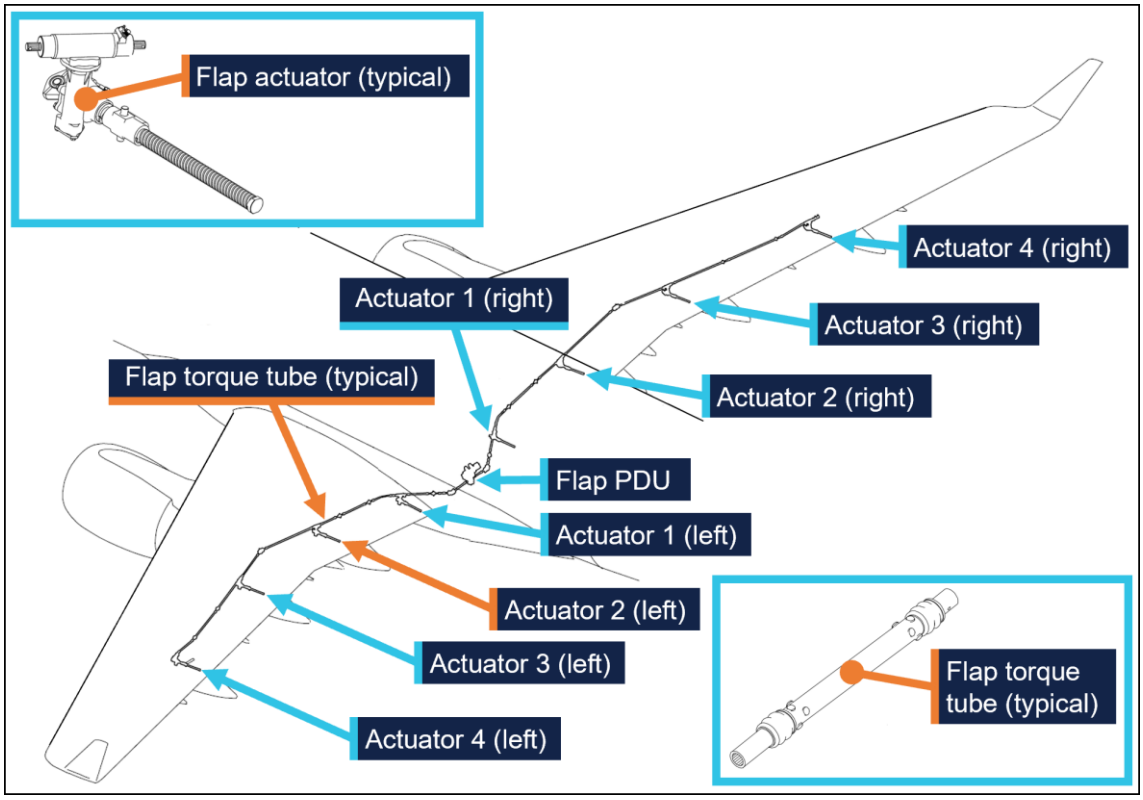
[7] The SFCL has 7 positions ranging from up (retracted) to fully extended slats and flaps.

Figure 4: Embraer E190 slat drive system



Source: Embraer, annotated by the ATSB

Figure 5: Embraer E190 flap drive system



Source: Embraer, annotated by the ATSB

Maintenance requirements

The slat and flap torque tubes are removed periodically for the actuator splines to be lubricated with grease. They may also need to be removed to replace associated

components. A detailed visual inspection of the slat and flap drive system is also carried out periodically and includes a requirement to check that the torque tubes are correctly secured in place by their locking bolts. No detailed visual inspections of the slat system had been required between the heavy maintenance in November 2024 and the occurrence flight.

The procedure to remove and install the slat and flap torque tubes is detailed in the aircraft maintenance manual (AMM). As part of this procedure, the slat or flap PDU brakes are disengaged electrically to eliminate any residual torque in the system that may impede (through friction) the removal of the torque tubes. For the same reason, the brakes must also be disengaged for their installation.[8] Embraer advised the ATSB of the importance of removing residual torque for the installation.

Rockhampton Aviation Maintenance noted during its investigation into the occurrence that excessive amounts of grease on the actuator splines can produce hydraulic resistance to re-assembly of the torque tube and therefore no more than what is required to lubricate the splines should be applied. It could not be determined whether this occurred during the maintenance of VH-UZD. The installation procedures for torque tubes in the AMM requires the old grease to be removed, new grease to be applied, and any unwanted grease to be removed prior to assembly.

The torque tubes interface with other components via splined shafts and are secured by locking bolts in conjunction with castellated nuts and split pins to prevent their inadvertent disconnection. There are 24 locking bolts in the slat drive system and 18 locking bolts in the flap drive system, all with this configuration.

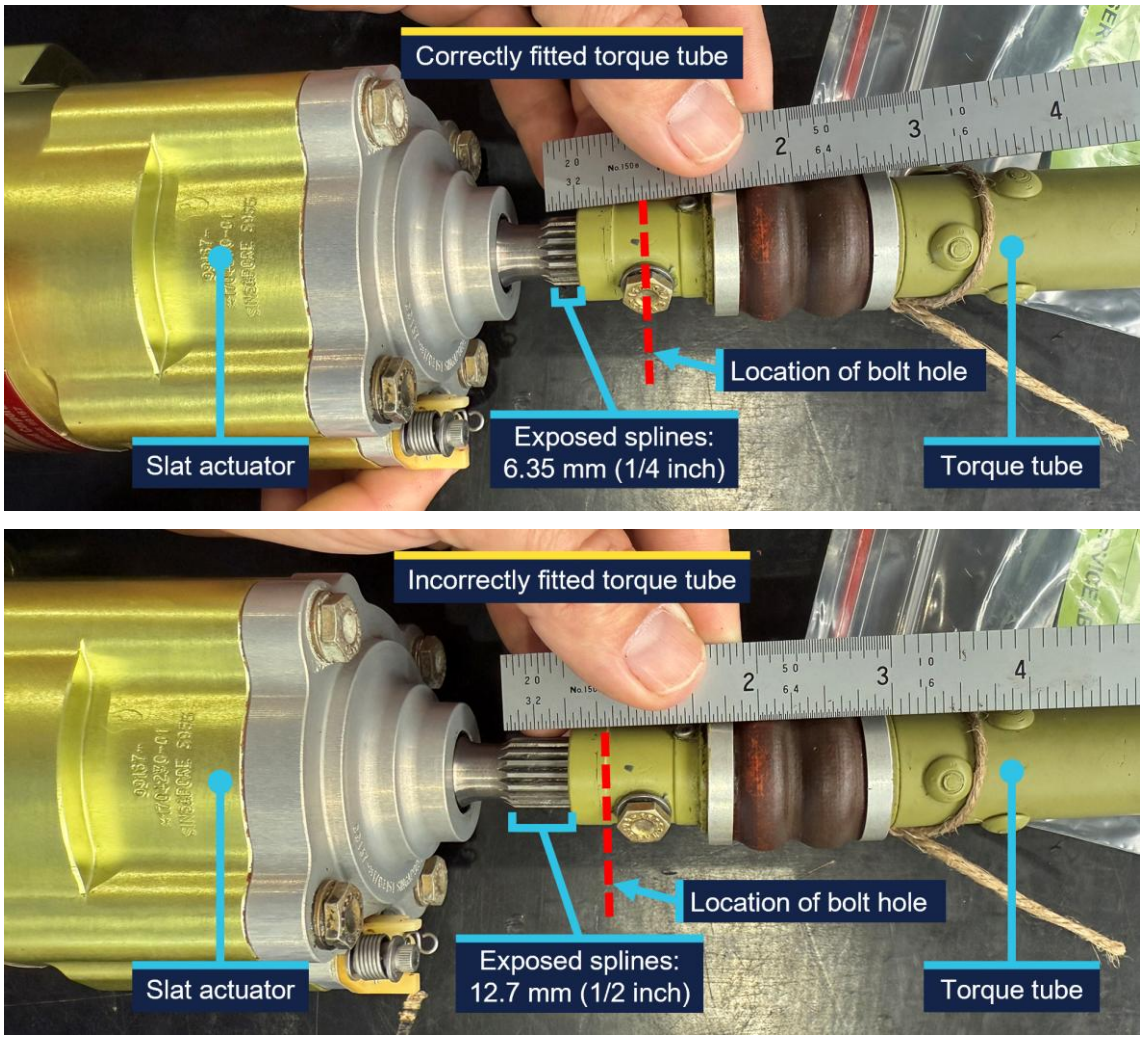
The AMM describes and illustrates a ‘push-pull’ check to determine the locking bolt has been correctly installed and had showed representative examples of correct and incorrect installation (Figure 1).

The torque tube locking bolts pass through holes close to the end of each actuator’s splined shaft. A correctly installed torque tube is visually apparent by less exposed splines (Figure 6). If a slat torque tube is incorrectly positioned[9] on a slat actuator the locking bolt will not capture the splined shaft and can lead to the torque tube disconnecting and slat failures.

[8] Embraer advised the ATSB that in a scenario where the PDU brakes had been released, and power was subsequently removed from the aircraft (thus reapplying the PDU brakes) this would not be expected to generate any residual torque in the slat or flap drive system. However, Embraer reiterated the importance of the PDU brakes being released when carrying out these tasks.

[9] These dimensions are for the slat actuator and torque tube interface. Dimensions vary for other components in the slat and flap systems.

Figure 6: Exemplar slat torque tube correctly fitted (upper image) and incorrectly fitted (lower image) to a slat actuator



A slat actuator and torque tube were correctly and incorrectly assembled on a workbench to create these images.
Source: The maintenance organisation, annotated by the ATSB

Actions taken to prevent installation errors

In 2010 the AMM was amended to include the previously mentioned illustration (Figure 1) showing the correct and incorrect installation of slat and flap torque tubes along with the push-pull test. This revision also added the requirement to release the PDU brakes.

Embraer communicated these changes by publishing a service newsletter SNL 190-27-0050 noting reports of incorrect slat or flap torque tube installation, advising that the AMM had been revised to mitigate future occurrences, and provided an overview of the revisions. This information was also published in Embraer's safety magazine[10] (available to operators of E190s) and was contained in a document[11] published by the National Civil Aviation Agency of Brazil.

In October 2017 Embraer published an update on the issue in a document[12] that reiterated the previous actions taken to mitigate these occurrences. This document noted that from January 2005–August 2011 in the worldwide fleet of Embraer ERJ170, 175,

[10] Embraer E-Jet news issue 42, May 2010.
[11] Flight Alert AV Nº 11/2011.
[12] Follow Up Item F190-27-012.

190, and 195 aircraft[13] there were 483 reports of slat or flap system failures. Of these, 5 were occurrences related to incorrect torque tube installation. Additionally, the document stated that the subject of incorrect torque tube installation was presented to civil aviation authorities in Europe and the Americas. It was concluded that no additional actions were required, as there were a small number of exposed aircraft, and there had been no reported events since the AMM was revised in 2010, and the manufacturer considered the issue closed.

Related occurrences

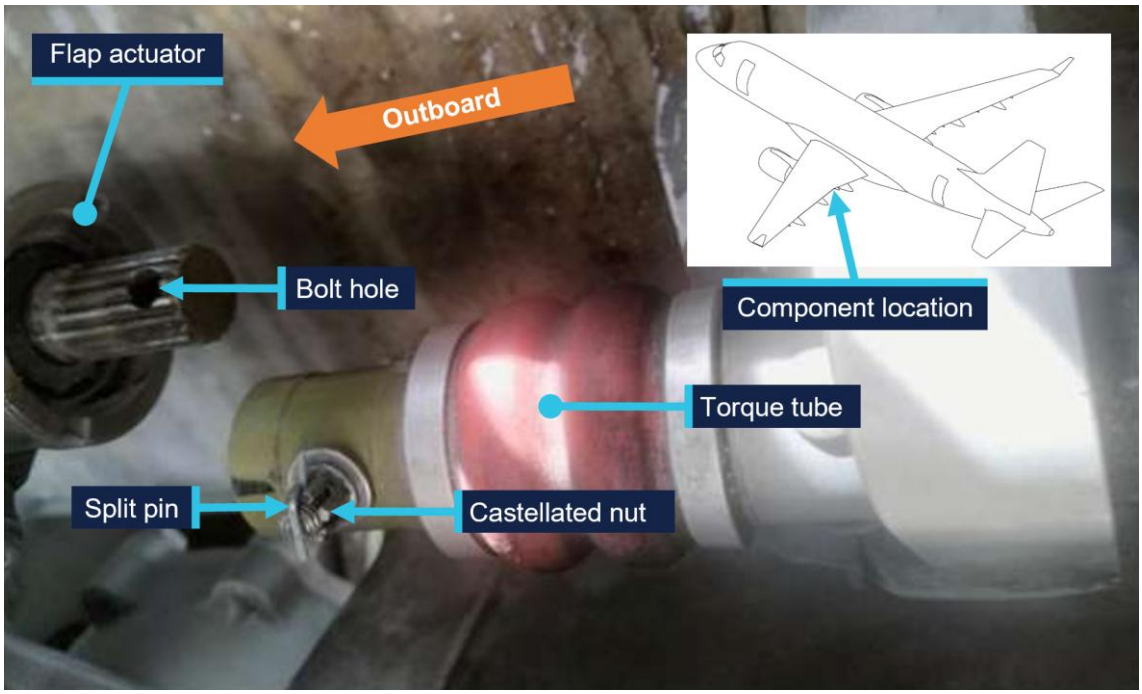
Incorrect flap torque tube installation

In late 2024, an Embraer ERJ 190-100 aircraft, registered VH-UYB and operated by Alliance Airlines for QantasLink, commenced a heavy maintenance check at a facility in Singapore. The torque tube driving the left wing flap actuator number 2 (see *Embraer E190 slats and flaps*) was removed to carry out flap actuator torque limiter checks. When fitted, the torque tube had not been positioned far enough onto the actuator's splined shaft for the locking bolt to secure it.

On 10 November 2024, 35 flights after returning to service from heavy maintenance, the aircraft departed for a passenger transport flight. After take-off, the flight crew received a FLAP FAIL caution on the EICAS as the flaps were retracting. The flight crew initiated a turnback and the aircraft landed safely.

Engineering personnel later found that the locking bolt for the left wing flap actuator number 2 torque tube had not passed through the corresponding hole in the actuator splined shaft when it was last refitted (Figure 7).

Figure 7: VH-UYB left wing flap actuator 2 and torque tube



Source: Alliance Airlines, annotated by the ATSB

[13] While there are differences in the wings for ERJ170, 175, 190, and 195 aircraft, the slat and flat torque tube systems are similar.

Other flight control event involving VH-UZD

On 18 April 2025, VH-UZD was operating from Adelaide, South Australia, to Canberra, Australian Capital Territory. When flaps were selected down, the slats began to extend but the flaps did not deploy, and the crew received multiple failure warnings. The flight crew diverted to Melbourne. Post-flight troubleshooting determined that the flap power drive unit (PDU) torque limiter had tripped, which is a problem unrelated to the investigation occurrence or the recent heavy maintenance check.

Safety analysis

Incorrect fitment of actuator torque tubes

When the torque tube for the left wing slat number 4 outboard actuator was refitted to VH-UZD in November 2024, it had not been positioned far enough onto the actuator's splined shaft for the locking bolt to secure it in place. After re-entering service and conducting 50 flights, the torque tube disengaged from the actuator, and the slat system failed. Protection systems ensured the safety of flight was minimally affected.

Similarly, when another E190, VH-UYB, was under heavy maintenance at a different facility at around the same time, the torque tube driving the left wing flap actuator number 2 was incorrectly assembled in that the locking bolt had not passed through the hole in the actuator's splined shaft. The torque tube disengaged 35 flights after the aircraft re-entered service and the flap system failed.

Non-detection of the error

The 2 AMEs who fitted the torque tube in VH-UZD did not identify that the torque tube had been incorrectly fitted. Further, the LAME checking this work and the second LAME carrying out the independent inspection of this work did not identify that it had been incorrectly assembled. The similar error affecting VH-UYB also apparently remained undetected by those carrying out and certifying for the work.

As far as could be established, there were no physical or environmental factors that may have influenced the incorrect assembly of the torque tube. The work on VH-UZD was carried out in a new facility with good lighting, and access to the work area was good and could be carried out with the relevant components at eye level.

Ultimately, it is likely that not knowing the subtle difference in appearance of an incorrectly assembled slat torque tube (that is, as little as about 6.35 mm more of the actuator spline visible) contributed to the error not being detected by the 2 AMEs and the 2 LAMEs involved. Further, the remaining torque tubes in the slat drive system were correctly assembled, however their subtly different appearance did not trigger recognition that the original torque tube had been incorrectly assembled.

Available relevant information

Installation of the slat and flap drive system torque tubes is a simple task, but errors have occurred. Embraer noted that from January 2005–August 2011 in the worldwide fleet of Embraer 170, 175, 190 aircraft (all sharing similar componentry) there were 5 occurrences related to incorrect torque tube installation. The Embraer 190 has 24 locking bolts in the slat drive system and 18 in the flap drive system representing a total of 42 opportunities to incorrectly secure the torque tubes.

In 2010, Embraer made amendments to the aircraft maintenance manual to reduce the possibility of assembly errors. These were intended to remove any residual torque loads during removal and installation (by releasing the PDU brake), highlight the possibility of error with an illustration, and through the addition of the push-pull check, provide a means to detect an installation error.

These changes were communicated in multiple documents, such as a service newsletter, that were available to operators and maintainers of E190s. Review of such documents can assist in highlighting known issues and thereby prevent reoccurrence.

Findings

ATSB investigation report findings focus on safety factors (that is, events and conditions that increase risk). Safety factors include 'contributing factors' and 'other factors that increased risk' (that is, factors that did not meet the definition of a contributing factor for this occurrence but were still considered important to include in the report for the purpose of increasing awareness and enhancing safety). In addition 'other findings' may be included to provide important information about topics other than safety factors.

These findings should not be read as apportioning blame or liability to any particular organisation or individual.

From the evidence available, the following findings are made with respect to the flight control event involving Embraer E190, VH-UZD, 29 km south-east of Launceston Airport, Tasmania, on 15 April 2025.

Contributing factors

- During scheduled maintenance, the locking bolt for the left outboard slat torque tube was not passed through the hole in the actuator's splined shaft as the torque tube had been incorrectly positioned. The aircraft was released from maintenance, and 50 flights later, the torque tube disconnected, causing the slat system to fail.
- Both licensed aircraft maintenance engineers inspecting the left outboard slat torque tube did not identify that it had been incorrectly assembled.

Safety actions

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

Safety action taken by Alliance Airlines

On 17 April 2025, Alliance Airlines issued a maintenance notice that detailed the flap torque tube disconnect affecting VH-UYB on 11 November 2024 and the slat torque tube disconnect affecting VH-UZD on 15 April 2025. This notice reiterated the aircraft maintenance manual information for the correct installation of flap and slat torque tubes.

Safety action taken by Rockhampton Aviation Maintenance

The maintenance organisation added an additional task card that is automatically issued when work is scheduled on the E190 slat system torque tubes. This task card provides guidance in addition to the aircraft maintenance manual to highlight the possibility of hydraulic lock caused by lubricant and the importance of releasing the PDU brake. Additionally, this task details a dimensional check to confirm the correct installation of torque tubes on their splined shafts. A similar additional task card was being developed for the E190 flap system torque tubes.

General details

Occurrence details

Date and time:	15 April 2025 – 1600 EST	
Occurrence class:	Incident	
Occurrence categories:	Flight controls, Missed approach / Go-around, Airframe overspeed, Diversion / Return	
Location:	29 km south-east of Launceston Airport, Tasmania	
	Latitude: 41.7006° S	Longitude: 147.4937° E

Aircraft details

Manufacturer and model:	EMBRAER - EMPRESA BRASILEIRA DE AERONAUTICA S.A. ERJ 190-100 IGW	
Registration:	VH-UZD	
Operator:	ALLIANCE AIRLINES PTY LIMITED	
Serial number:	19000152	
Type of operation:	Part 121 Australian air transport operations - Larger aeroplanes-Standard Part 121	
Activity:	Commercial air transport-Scheduled-Domestic	
Departure:	Sydney Airport, NSW	
Destination:	Launceston Airport, TAS	
Actual destination:	Melbourne Airport, VIC	
Persons on board:	Crew – 4	Passengers – 95
Injuries:	Crew – none	Passengers – none
Aircraft damage:	None	

Sources and submissions

Sources of information

The sources of information during the investigation included:

- Alliance Airlines
- Centro de Investigação e Prevenção de Acidentes Aeronáuticos (Brazil)
- Civil Aviation Safety Authority
- Embraer
- Rockhampton Aviation Maintenance
- licenced aircraft maintenance engineer that made the final certification of the work
- both aircraft maintenance engineers.

Submissions

Under section 26 of the *Transport Safety Investigation Act 2003*, the ATSB may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. That section allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the following directly involved parties:

- Alliance Airlines
- Centro de Investigação e Prevenção de Acidentes Aeronáuticos (Brazil)
- Civil Aviation Safety Authority
- Embraer
- Rockhampton Aviation Maintenance
- licenced aircraft maintenance engineer that made the final certification of the work
- both aircraft maintenance engineers.

Submissions were received from:

- Embraer
- Rockhampton Aviation Maintenance.

The submissions were reviewed and, where considered appropriate, the text of the report was amended accordingly.

About the ATSB

The **Australian Transport Safety Bureau** is the national transport safety investigator. Established by the *Transport Safety Investigation Act 2003* (TSI Act), the ATSB is an independent statutory agency of the Australian Government and is governed by a Commission. The ATSB is entirely separate from transport regulators, policy makers and service providers.

The ATSB's function is to improve transport safety in aviation, rail and shipping through:

- the independent investigation of transport accidents and other safety occurrences
- safety data recording, analysis, and research
- influencing safety action.

The ATSB prioritises investigations that have the potential to deliver the greatest public benefit through improvements to transport safety.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, international agreements.

Purpose of safety investigations

The objective of a safety investigation is to enhance transport safety. This is done through:

- identifying safety issues and facilitating safety action to address those issues
- providing information about occurrences and their associated safety factors to facilitate learning within the transport industry.

It is not a function of the ATSB to apportion blame or provide a means for determining liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings.

At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

The ATSB does not investigate for the purpose of taking administrative, regulatory or criminal action.

About ATSB reports

ATSB occurrence investigation reports are organised with regard to international standards or instruments, as applicable, and with ATSB procedures and guidelines.

An explanation of ATSB terminology used in this report is available on the ATSB website.