

Factual Report

The Investigation Report was written in accordance with para 18 of the Law Relating to the Investigation into Accidents and Incidents Associated with the Operation of Civil Aircraft stating facts only.

Identification

| | |
|-----------------------|---|
| Type of Occurrence: | Accident |
| Date: | 16 November 2019 |
| Location: | Frankfurt/Main Airport |
| Aircraft: | Airplane |
| Manufacturer / Model: | Airbus Industries / A330-200 The Boeing Company / B777-300ER |
| Injuries to Persons: | No injuries |
| Damage: | A330-200 slightly damaged B777-300ER substantially damaged |
| Other Damage: | None |
| State File Number: | BFU19-1564-AX |

Factual Information

History of the Flight

At the day of the accident at 0530 UTC, the Boeing 777-300ER took off from Seoul Airport, South Korea, to a flight to Frankfurt/Main Airport, Germany. On board were 261 persons. At 1737 hrs¹ it landed at Frankfurt. After the landing, the flight crew received the instruction from Tower Frankfurt: "[...] vacate right Mike, Mike eight, category two holding point runway two five centre". At about 1743 hrs the Boeing stopped prior to the holding position at the intersection of taxiway M with taxiway M8. The fuselage longitudinal axis was at approximately 45° to the holding position. According to the flight crew's statement, they had approached the holding position as usual.

At 0714 UTC, the Airbus A330-200 had departed Windhoek Airport, Namibia, for a flight to Frankfurt/Main Airport, Germany. There were 229 persons on board. At 1739 hrs the airplane landed at Frankfurt. After the landing, the flight crew received the instruction from Tower Frankfurt: "[...] taxi right, Mike, Tango, hold short Tango four".

The Airbus taxied along taxiway M. Shortly before reaching the intersection with taxiway M8 taxi speed was reduced. At about 1744 hrs when passing the intersection, the left winglet of the Airbus collided with the elevator of the Boeing. The elevator was substantially damaged. According to the CVR recordings, the Airbus flight crew had seen the Boeing and was aware that it could be a tight fit.

After the accident had been documented on scene, the two aircraft were towed to their respective stands and the passengers could disembark. Nobody was injured during the collision.

Personnel Information

Airbus A330-200 Crew

The 59-year-old Pilot in Command (PIC) held an Airline Transport Pilot's License (ATPL) with the commensurate valid type rating for A330/350, issued by the French aeronautical authority. He held a valid class 1 medical certificate.

¹ All times local, unless otherwise stated.

The 39-year-old co-pilot held an ATPL with the commensurate valid type rating for A330 as co-pilot, issued by the Namibian aeronautical authority. She held a valid class 1 medical certificate.

The second, 51-year-old, co-pilot held an ATPL with the commensurate valid type rating for A330 as co-pilot, issued by the Namibian aeronautical authority. She held a valid class 1 medical certificate.

Boeing B777-300ER Crew

The 54-year-old PIC held an ATPL with the commensurate type rating for B777 issued by the Korean aeronautical authority. He held a valid class 1 medical certificate.

The 40-year-old co-pilot held an ATPL with the commensurate type rating for B737 and B777 issued by the Korean aeronautical authority. He held a valid class 1 medical certificate.

Aircraft Information

Airbus A330-200

The A330-200 is a low-wing transport aircraft with a conventional empennage and equipped with two fan jet engines.

| | |
|-------------------------------------|--------------------------|
| Manufacturer: | Airbus Industries |
| Year of Manufacture: | 2013 |
| Manufacturer's Serial Number (MSN): | 1451 |
| Engines: | 2 Rolls-Royce Trent 772B |
| Operating time: | About 20,467 hours |
| Wing Span: | 60.3 m |
| Fuselage Length: | 58.98 m |

The aircraft was registered in the Republic of Namibia and operated by a Namibian operator.

Field of view from the Cockpit:

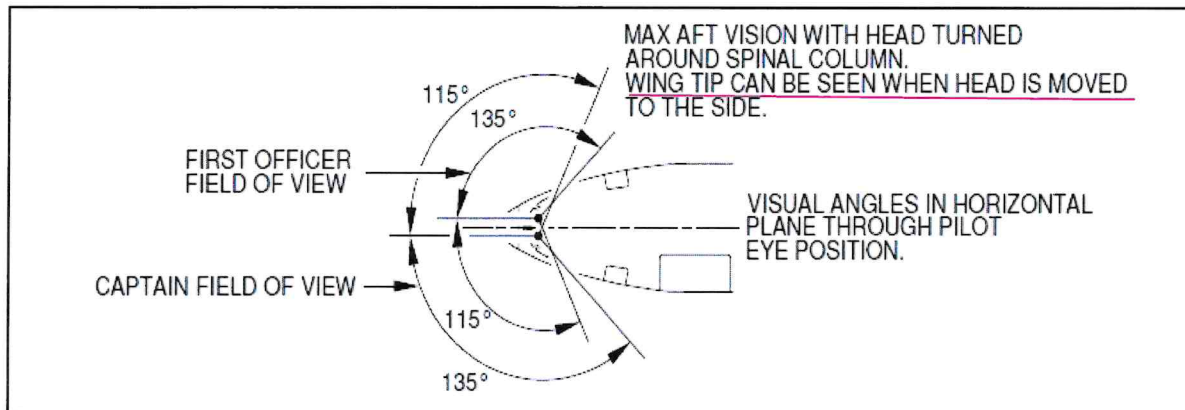


Fig. 1: Field of view to the left wing tip

Source: Airbus

Boeing 777-300ER

The Boeing 777-300ER is a low-wing transport aircraft with a conventional empennage and equipped with two fan jet engines.

| | |
|----------------------|-------------------------------|
| Manufacturer: | The Boeing Company |
| Year of Manufacture: | 2018 |
| MSN: | 60380 |
| Engines: | 2 General Electric GE90-115BL |
| Operating time: | approx. 7,974 hours |
| Landings: | 1,111 |
| Wing Span: | 64.8 m |
| Fuselage Length: | 73.9 m |

The distance between nose wheel and the field of view ahead of the aircraft from the pilot's eye position is 19.03 m.

The aircraft was registered in the Republic of Korea and operated by a Korean operator.

Field of view from the Cockpit:

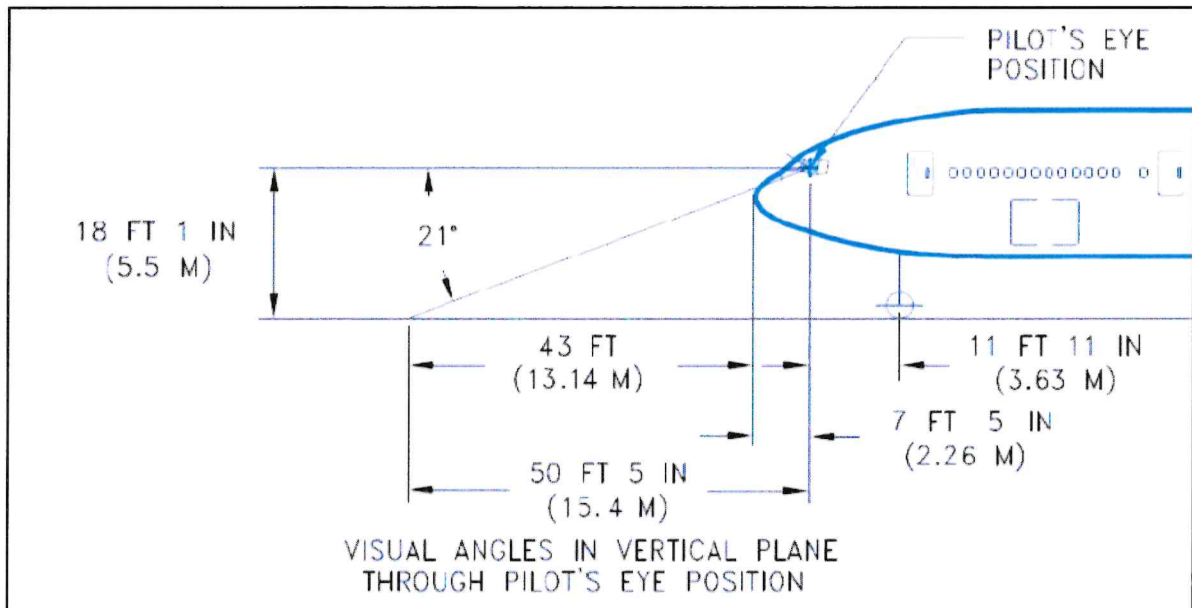


Fig. 2: Visual options from the cockpit down

Source: Boeing

Meteorological Information

The aviation routine weather report (METAR) of 1650 hrs of Frankfurt/Main Airport read:

Wind: 080°, 4 kt (varies between 030° and 110°)

Visibility: More than 10 km

Clouds: 1-2 octas at 2,500 ft AGL

Temperature: 3°C

Dewpoint: 2°C

QNH: 1,012 hPa

At the time of the collision it was dark.

Radio Communications

During landing and taxiing each of the two aircraft was in radio contact with Frankfurt Tower on frequency 119.905 MHz. Radio communications were recorded. The transcripts have been made available to the BFU for evaluation purposes.

Aerodrome Information

Frankfurt/Main Airport (EDDF) is located 6.5 NM south-west of Frankfurt City. The airport elevation is 364 ft AMSL. It was equipped with three parallel runways with the directions 068°/248° and one runway with the direction 178°.

Taxiway M, where the accident took place at the intersection with taxiway M8, runs parallel between runways 25L and 25C. Taxiway M8 is located in the eastern area. For taxiway M8, the Aerodrome Ground Movement Chart included the note: *Explicit clearance required for crossing RWY 07C/25C. Stop at CAT II/III holding point, stop-bar is illuminated under all weather conditions.*

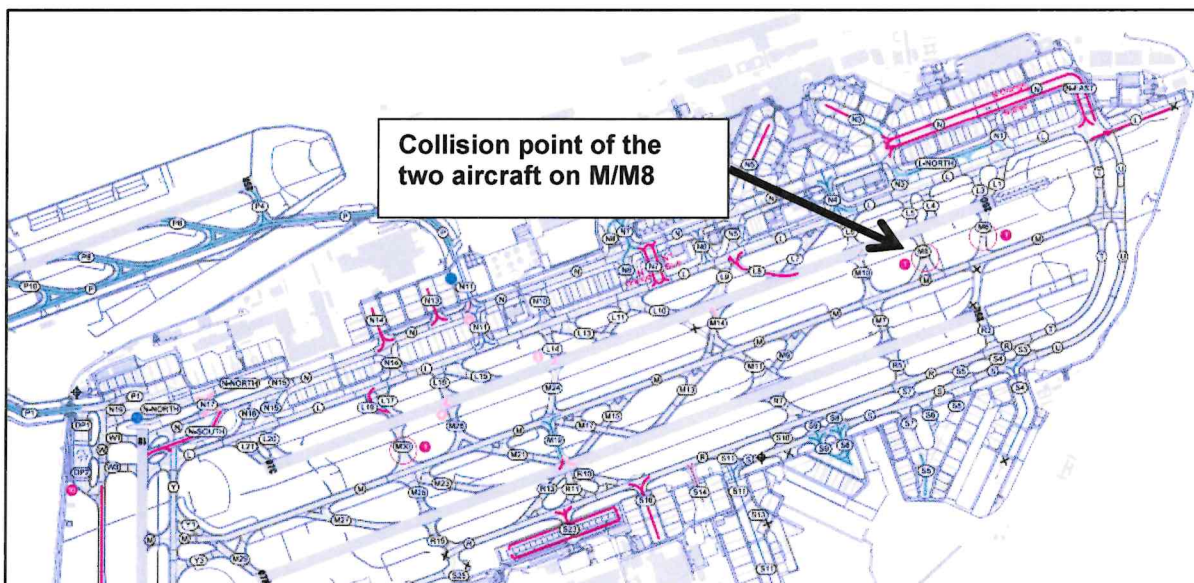


Fig. 3: Aerodrome chart Frankfurt/Main Airport

Source: AIP

According to the Aeronautical Information Publication (AIP) Item 4.4.6 Holding procedures at runway holding positions *"Pilots are requested to stop and hold as close to the holding point as possible to enable other aircraft to taxi by. This does not relieve the taxiing pilots of their responsibility to ensure a safe distance from the holding aircraft."*

Flight Recorders

The FDR and the CVR of both aircraft were seized by the BFU and analysed.

The FDR data was used for the description in the chapter History of the Flight. The FDR data showed that the B777-300ER stood still and the A330-200 was decelerat-

ed prior to reaching the intersection and then taxied slowly farther until the collision (Fig. 4 and Fig. 5).

Recorder A330-200

FDR

Manufacturer: L-3COM
Type: FA 2 100
Part number: 2100-4045-00
Serial Number: 702014

The data of the last 109.83 hours was recorded.

CVR

Manufacturer: L-3COM
Type: FA 2 100
Part number: 2100-1026-02
Serial Number: 954704

A total of 120 minutes of audio data were recorded. The recording included the taxiing, the collision, and ended with the shutting down of the engines on taxiway M.

Recorder B777-300ER

FDR

Manufacturer: L-3COM
Type: FA 2 100
Part number: 2100-4945-022
Serial Number: 1248139

The data of the last 71.28 hours was recorded.

CVR

Manufacturer: L-3COM
Type: FA 2 100
Part number: 2100-1925-022
Serial Number: 1248947

A total of 120 minutes of audio data were recorded. The recording started after the collision and ended at the parking position.

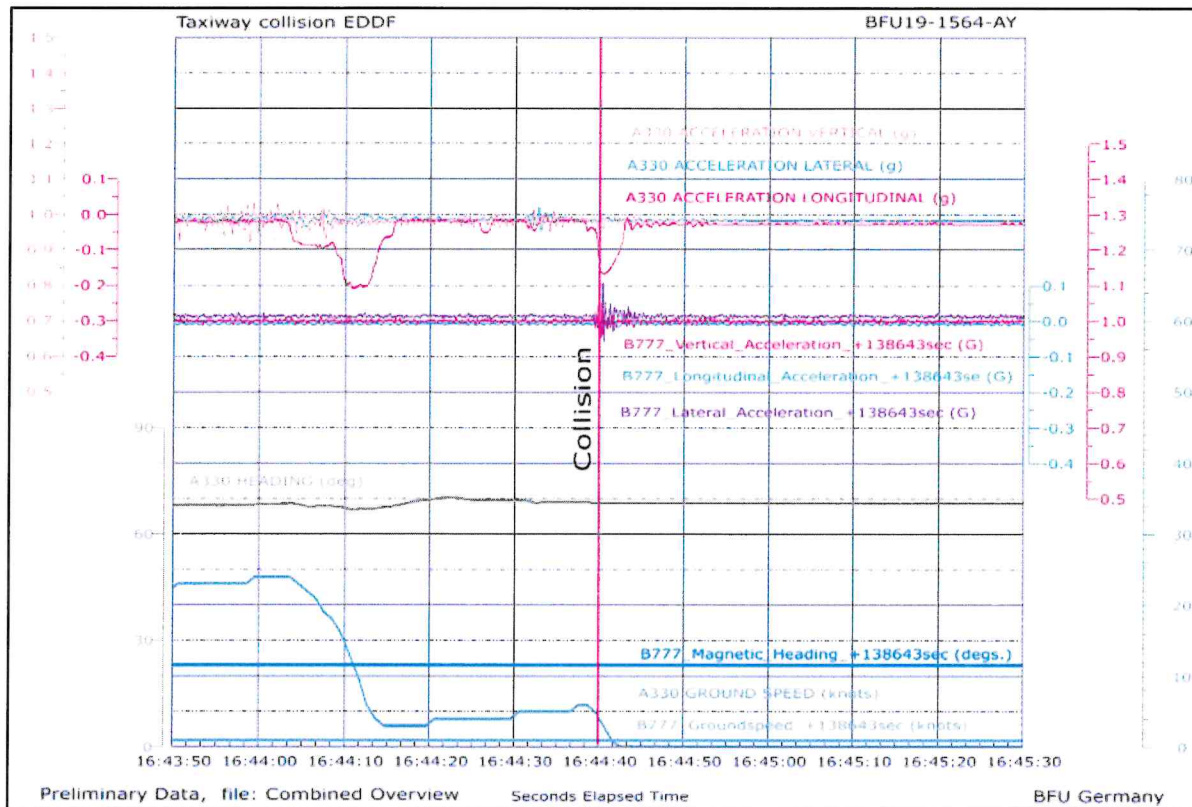


Fig. 4: Overview of the FDR data to determine the time of collision

Source: BFU

Wreckage and Impact Information

The collision occurred at the intersection with taxiway M to taxiway M8.

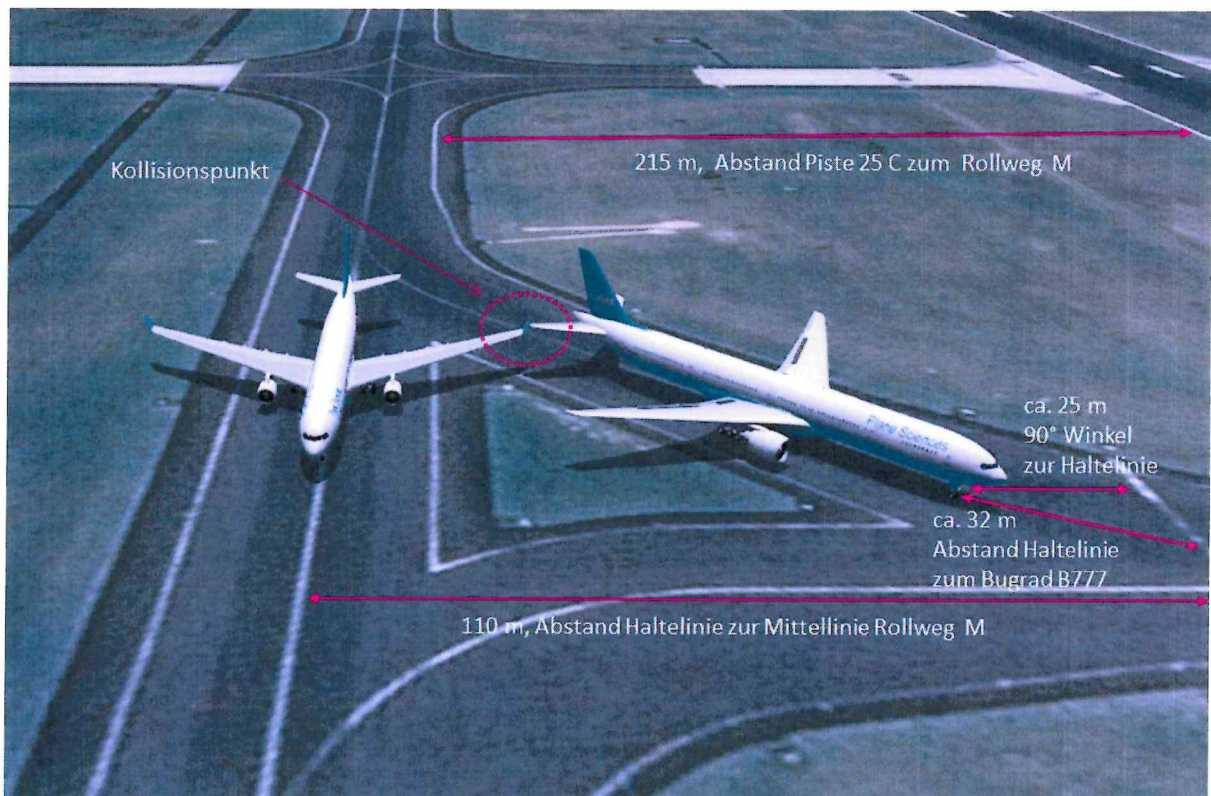


Fig. 5: Reconstruction of the aircraft positions during the collision

Source: BFU

The Boeing 777-300ER stood pointing about north in the direction of holding position CAT II/III at the intersection of taxiway M with taxiway M8. The right nose wheel stood on the yellow centre line. If measured along the yellow centre line, the distance between the nose wheel and the holding position of taxiway M8 was about 32 m. If measured at a 90° angle it was about 25 m.



Fig. 6: Distance of the Boeing 777-300ER to the holding position

Source: FRA Airport Security

The Airbus A330-200 stood on taxiway M pointing east with the left nose wheel just about on the yellow centre line.



Fig. 7: Position of both aircraft after the collision

Source: FRA Airport Security

During the collision the outer area of the right elevator of the Boeing 777-300ER was damaged. Parts of the elevator were lying about 28 m behind the Boeing on taxiway M. The upward pointing winglet of the left wing of the Airbus A330-200 was damaged.

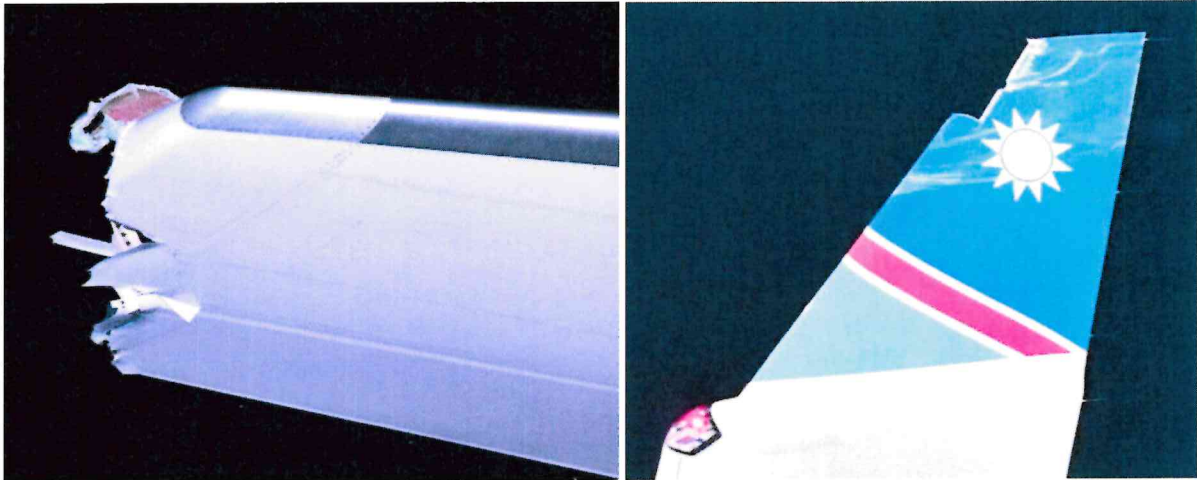


Fig. 8: Damage on the B777 elevator and the A330 winglet

Source: FRA Airport Security

Fire

There were no signs of fire.

Organisational and Management Information

International guidelines and aeronautical regulations did not clearly define how close to a holding point or stop bar an aircraft should stop. It was stipulated that the holding point shall not be crossed without clearance and that aircraft shall remain clear of the holding point or holding position.

According to the pilots, it was common to taxi as far up to the holding position so that the line and the stop bar lighting could just be seen.

Excerpt ICAO Doc 4444 Air Traffic Management:

Definition Runway-holding position: A designated position intended to protect a runway, an obstacle limitation surface, or an ILS/MLS critical/sensitive area at which taxiing aircraft and vehicles shall stop and hold, unless otherwise authorized by the aerodrome control tower.

7.6.3.1.3.1 Except as provided in 7.6.3.1.3.2 or as prescribed by the appropriate ATS authority, aircraft shall not be held closer to a runway-in-use than at a runway-holding position.

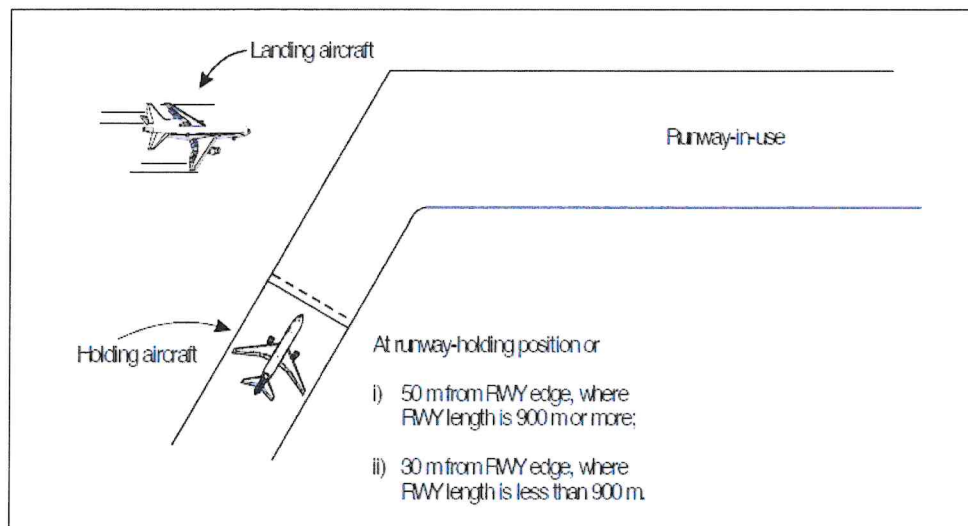


Figure 7-2. Method of holding aircraft (see 7.6.3.1.3.2)

7.12.1.1.1 At the intersection of taxiways, an aircraft or vehicle on a taxiway shall not be permitted to hold closer to the other taxiway than the holding position limit defined by a clearance bar, stop bar or taxiway intersection marking [...]

7.15.7 Stop bars

Stop bars shall be switched on to indicate that all traffic shall stop and switched off to indicate that traffic may proceed.

Note: Stop bars are located across taxiways at the point where it is desired that traffic stop, and consist of lights, showing red, spaced across the taxiway.

During taxiing, the pilot is responsible to avoid any collisions. According to ICAO Annex 2 Rules of the Air, 2.3.1 Responsibility of pilot-in-command: The pilot-in-command of an aircraft shall, [...] be responsible for the operation of the aircraft in accordance with the rules of the air, [...]. 3.2 Avoidance of collisions: Nothing in these rules shall relieve the pilot-in-command of an aircraft from the responsibility of taking such action, including collision avoidance manoeuvres [...]. It is important that vigilance for the purpose of detecting potential collisions be exercised on board an aircraft, regardless of the type of flight or the class of airspace in which the aircraft is operating, and while operating on the movement area of an aerodrome.

Additional Information

On 25 July 1999, a similar collision occurred at Frankfurt/Main Airport resulting in damage to the elevator of a B737 and the left wing tip of an A310. The BFU published an investigation report with the File No. AX001-1/2/99.

Another accident occurred on 22 February 1998 at Frankfurt/Main Airport as an ATR72 taxied past behind a TU154. The BFU published an investigation report with the File No. 1X001-0/98.

The BFU addressed the Safety Recommendation 13/1999 to ICAO, because during both accidents the indetermination of the distance between stop point of the aircraft and the holding point was a contributory factor: *The phrase „HOLD SHORT OF (position)“ in accordance with ICAO Doc 4444, Part X, para 3.4.9d should be replaced by a more precise phrase or deleted.* This safety recommendation was not implemented.

On 9 September 2012 a minor collision occurred at the intersection of taxiway M with taxiway M8 at Frankfurt/Main Airport involving a B737-800 and an A340-300. The Boeing flight crew had attempted to taxi past the Airbus by utilising the entire taxiway width. The collision resulted in scratch marks at the Boeing winglet and at the Airbus wing (BFU12-012-PX-802).

The internet platform Skybrary wrote in regard to taxiway collisions in 2018:

[...] While most occurrences on airport aprons and taxiways do not have consequences in terms of loss of life, they are often associated with aircraft damage, delays to passengers and avoidable financial costs. [...]

Assuming that ATC maintains situational awareness and issues a correct taxi clearance — and the aircraft flight crew complies with clearances or standard routings — the highest risk of wing tip collision occurs when multiple aircraft are holding or taxiing in the manoeuvring area (e.g., near a runway entry point, changing the queuing order (especially at night) or moving without benefit of visible taxiway centrelines; Flight crews of swept-wing aircraft must stay alert to the physical clearance during a turn in which the wing tip describes an arc greater than the normal wingspan due to the geometry of the aircraft and the arrangement of the landing gear.

Prevention

Most taxiway accidents and incidents are preventable. This prevention is dependent upon appropriate training and testing, compliance with clearances, published proce-

dures and right-of-way rules, maintaining situational awareness and adapting speed of movement to suit the weather and surface conditions. Some specific accident prevention strategies are as follows: [...]

Controllers

- *The ground controller is responsible for the safe and efficient movement of aircraft and vehicle traffic on the taxiways and aprons. They should: °provide the appropriate clearance for the requested action*
- *ensure that the clearance readback is accurate*
- *to the extent possible, monitor the movement visually, via transponder or by use of multilateration equipment to ensure clearance compliance*

Pilots

- *In general, pilots are responsible for the ground movement of an aircraft from the runway to the gate and from the gate to the runway although they may also reposition aircraft from one point on the airfield to another. In all cases they should: request, readback and comply with an appropriate clearance*
- *maintain situational awareness*
- *taxi at a speed appropriate to the conditions and traffic situation*
- *maintain the centre of the taxi lane*
- *be vigilant for taxi lane compromise by another aircraft, vehicle or object*
- *not assume that vehicles will yield right-of-way*

Investigator in charge: Axel Rokohl
Assistance: Michel Buchwald, Berndt Dreyer
Braunschweig, 6 February 2020

This investigation is conducted in accordance with the regulation (EU) No. 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and the Federal German Law relating to the investigation of accidents and incidents associated with the operation of civil aircraft (*Flugunfall-Untersuchungs-Gesetz - FIUUG*) of 26 August 1998.

The sole objective of the investigation is to prevent future accidents and incidents. The investigation does not seek to ascertain blame or apportion legal liability for any claims that may arise.

This document is a translation of the German Investigation Report. Although every effort was made for the translation to be accurate, in the event of any discrepancies the original German document is the authentic version.

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