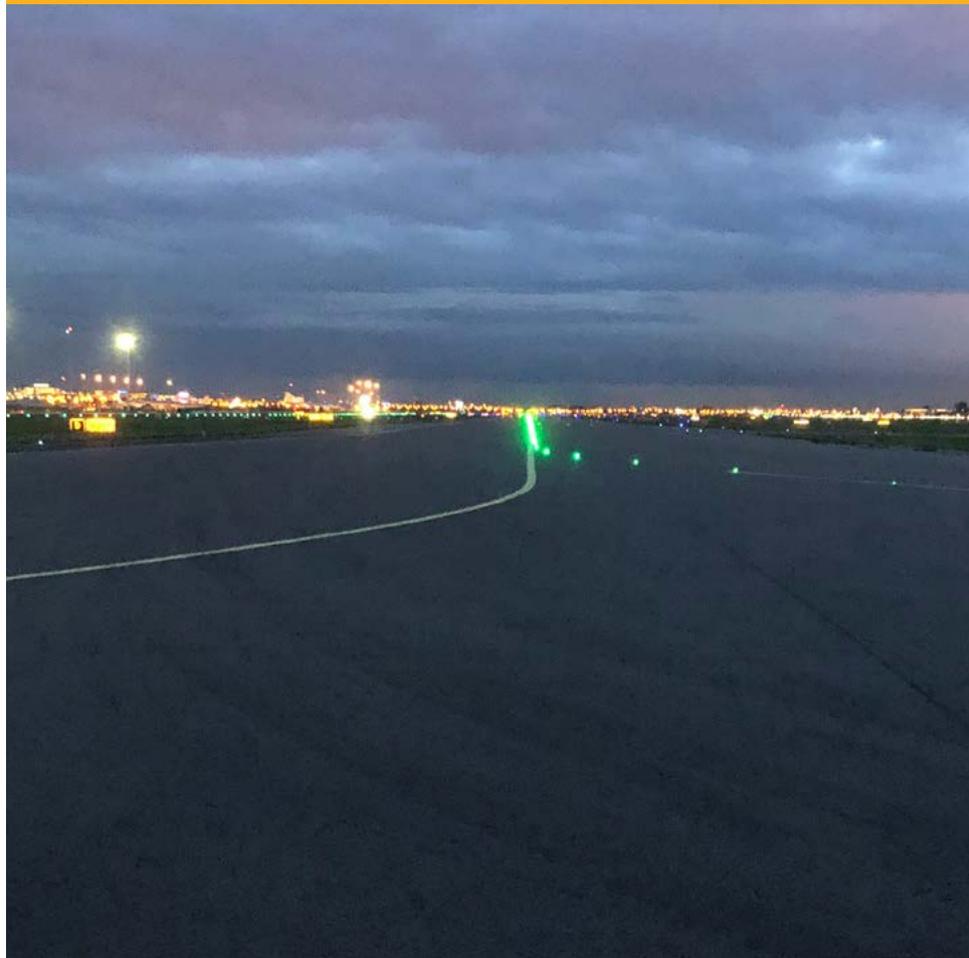




DUTCH
SAFETY BOARD

Aborted takeoff from taxiway, Boeing 737-800, Amsterdam Airport Schiphol



Aborted takeoff from taxiway, Boeing 737-800, Amsterdam Airport Schiphol

The Hague, May 2022

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N.B: This report is published in the English language, with a separate summary in the Dutch language. If there is a difference in interpretation between the Dutch and English texts, the English text will prevail.

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On 6 September 2019, the Boeing 737-800 was scheduled for a passenger flight from Amsterdam Airport Schiphol to Chania, Greece. It taxied in the dark at Amsterdam Airport Schiphol in northerly direction on Taxiway C to Runway 18C when it received takeoff clearance for Runway 18C. The flight crew then turned left twice, lined up on Taxiway D in a southerly direction and commenced the takeoff. Air traffic control noticed that the aeroplane started to accelerate on a taxiway and instructed the crew to stop immediately. At the moment the Boeing 737 initiated the takeoff, no other aeroplanes or vehicles were present on Taxiway D. The crew rejected the takeoff and taxied back to the beginning of Runway 18C, after which the aeroplane took off uneventfully. The flight crew continued the flight to Chania and contact with the company about the occurrence was established after landing.

This type of occurrence is hazardous, because the aeroplane initiates the takeoff from a location that is not intended to be used for takeoff. There is a danger of collision with other aeroplanes, vehicles or obstacles. Also the aeroplane could overrun the end of the taxiway if it is not long enough to get airborne or if the takeoff is rejected.

The Dutch Safety Board conducted a safety investigation into the cause of this serious incident. The investigation answers the following three questions: (1) How could it happen that the flight crew initiated a takeoff from a taxiway without noticing it? (2) Why did the flight crew continue the flight, instead of reporting the occurrence to the company immediately, and was cockpit voice recorder data not secured after the occurrence? (3) In which way did factors related to the layout and design or the operational concept of Schiphol contribute to the occurrence?

Cause of the serious incident

Cues such as the yellow, thin and continuous centre line marking and green centre line lights, were not recognised by the flight crew as cues of being on a taxiway. Environmental cues, such as signs indicating Runway 18C, enhanced the perception of the crew that they were lined up on Runway 18C, instead of on Taxiway D. The taxiway centre line markings did not provide continuous guidance to the holding position of Runway 18C, as the design of these markings was focused on preventing runway incursions during low visibility operations.

Air traffic control used Taxiway C for the aeroplane to taxi to the holding point of Runway 18C, because the inner parallel Taxiway D was used for incoming traffic that had crossed Runway 18C/36C. The use of outer Taxiway C in combination with the early issuance of the takeoff clearance, introduced a risk of taxiing the wrong route.

After the runway controller had issued the takeoff clearance, he shifted his attention to other traffic and did not observe the line-up of the aeroplane on Taxiway D. Based upon the operational situation and his expert judgement, the runway controller did not perceive his reduced focus on the Boeing 737 as a risk, especially because it concerned a home based carrier.

While taxiing on Taxiway C, the crew was not fully aware of their exact position. The yellow taxi line at C1, which is uninterrupted towards Taxiway D and interrupted towards Runway 18C, became clearly visible when the crew switched on the landing lights. So following the only taxiway guidance that was clearly visible to them, i.e. the yellow line from C1, the crew were led onto Taxiway D.

Consequences of continuing the flight after rejected takeoff

The flight crew's decision to continue the flight after the occurrence had several consequences regarding communication and the investigation process. First, because the decision was made to depart soon after the occurrence, no contact was made with the company for consultation about the occurrence before departure; such a dialogue may increase understanding of the safety implications of the event and may provide sound options for follow-up actions. After a serious incident, the Dutch Safety Board expects the captain to consult the company for further actions, even though s/he has the final responsibility to ensure the safe execution of the flight.

Furthermore, the decision to continue the flight led to a situation in which it was not possible to secure the cockpit voice recorder data. Upon arrival at the destination airport, the recording of the cockpit voice recorder was overwritten and therefore the cockpit voice recorder data covering the event was not available for the investigation. This investigation revealed that the airline's procedures were not effective to have flight crews timely notify the airline about the occurrence and preserve the recordings of the cockpit voice recorder.

Cockpit voice recorder data is crucial to support investigations into the decision making processes of flight crews and to reconstruct the sequence of events. In the present case, to understand why the flight crew believed they were entering the runway. Further, to understand how the decision was made to continue the flight without reporting the serious incident to the company first. Not having the cockpit voice recorder data available, hampered the Dutch Safety Board in its investigation and restricted learning from this occurrence for all parties involved.

The Dutch Safety Board previously investigated an occurrence that took place at Amsterdam Airport Schiphol on 10 February 2010, when a Boeing 737 took off from a taxiway. Corresponding causal factors, as in the present occurrence, played a role in the 2010 occurrence. The actions taken by Air Traffic Control the Netherlands and Amsterdam Airport Schiphol in response to the recommendations of the Dutch Safety Board regarding this investigation did not prevent reoccurrence.

Measures taken by sector parties at Schiphol

The three sector parties involved in the present occurrence conducted a joint investigation into this serious incident within the framework of the Integral Safety Management System in 2019. The findings of this investigation led to measures being implemented, such as designating the standard taxi routing for outbound traffic to Runway 18C via Taxiway D outside the uniform daylight period and applying continuous taxi way centre line markings from Taxiway C to Runway 18C.

Shared risk management at Schiphol Airport

During abnormal situations, like a rejected takeoff from a taxiway, all involved parties should be in a position to directly address each other about deviations that affect safety. Challenging each other may improve safety in a broader sense. Therefore, the Dutch Safety Board appeals to the relevant parties at Schiphol to foster a work environment where challenging each other about safety decisions in abnormal situations is accepted. This fits well within the thought of broader risk identification and mitigation of Schiphol's Integral Safety Management System as the overarching system that complements risk management of the individual companies.

RECOMMENDATIONS

This investigation revealed that the airline's procedures were not effective to have flight crews timely notify the airline about the occurrence. Consequently, the crew continued the flight without discussing the safety implications of the occurrence and the follow-up actions with the airline. Furthermore, continuing the flight also prevented that the cockpit voice recorder recordings were preserved.

The lack of cockpit voice recorder data hampered the investigation into the decision making process of the flight crew. In this case, to understand why the flight crew believed they were entering the runway and, thereafter, how the decision was made to continue the flight after the rejected takeoff.

The Dutch Safety Board has conducted other investigations, where the cockpit voice recorder recordings were not available.¹ The Board emphasises the importance of cockpit voice recorder data to determine the facts as part of an air safety investigation into the cause of an occurrence and learn from it.

The European regulations regarding the duration of the cockpit voice recorder recordings have been amended to ensure that cockpit voice recorders will be capable of recording the preceding 25 hours instead of 2 hours. This requirement only applies to aeroplanes with a certificate of airworthiness issued on or after 1 January 2022.

The Dutch Safety Board therefore issues the following recommendations to:

Transavia

Develop new procedures, or clarify existing procedures, that guide flight crews to consult with their airline at the earliest convenient moment, about abnormal situations that have had or may have significant flight safety implications, such as an aborted takeoff from a taxiway. Communicate to flight crews what range of occurrences are meant by these situations.

All Dutch airlines

Replace or upgrade existing cockpit voice recorders currently in use to accommodate for a storage capacity of at least 25 hours on aeroplanes with a certified maximum takeoff mass of more than 27,000 kg and with a certificate of airworthiness issued after 31 December 2001, before 2028.

¹ Investigations: Takeoff with erroneous takeoff data, Boeing 737-800, Amsterdam Airport Schiphol, 10 June 2018; Ground collision during pushback, Boeing 747-400, Boeing 787-9, Amsterdam Airport Schiphol, 13 February 2019; Takeoff with erroneous data, ERJ 190-400, Berlin Brandenburg Airport (Germany), 12 September 2021.

The International Air Transport Association

Encourage the members of IATA to replace or upgrade their existing cockpit voice recorders currently in use to accommodate for a storage capacity of at least 25 hours on aeroplanes with a certified maximum takeoff mass of more than 27,000 kg and with a certificate of airworthiness issued after 31 December 2001.

The European Union Aviation Safety Agency

Mandate that EU registered commercial air transport aeroplanes, with a certified maximum certificated takeoff mass of more than 27,000 kg, and with a certificate of airworthiness issued after 31 December 2001, to be equipped with a cockpit voice recorder capable of retaining recorded data for at least 25 hours; implement this requirement as of 1 January 2028.

The Integral Safety Management System Schiphol

Foster a work environment at Amsterdam Airport Schiphol that encourages the stakeholders of the Integral Safety Management System to challenge each other about decisions that have had or may have significant safety implications.



J.R.V.A. Dijsselbloem



C.A.J.F. Verheij

LIST OF ABBREVIATIONS

AD	Aerodromes
ADR-DSN	Aerodromes design
AIP	Aeronautical Information Publication
ALCMS	Airfield Lighting Control and Monitoring System
ATC	Air traffic control
ATSB	Australian Transport Safety Bureau
CS	Certification specifications
CVR	Cockpit voice recorder
DAAD	Deviation Acceptance and Action Document
EASA	European Union Aviation Safety Agency
EHAM	Amsterdam Airport Schiphol
FCTM	Flight Crew Training Manual
GMC	Ground movement chart
ICAO	International Civil Aviation Organization
ILS	Instrument Landing System
ILT	Human Environment and Transport Inspectorate
ISMS	Integral Safety Management System
KNMI	Royal Netherlands Meteorological Institute
LGKP	Karpathos Island National Airport
LGSA	Chania International Airport
METAR	Meteorological Aerodrome Report
NLR	Royal Netherlands Aerospace Centre
OM	Operations Manual
SC	Special Condition
TA/RA	Traffic Advisory/Resolution Advisory
TOP SAG	Top Safety Action Group
UTC	Coordinated Universal Time
VpS	Veiligheidsplatform Schiphol (Schiphol Safety Platform)

GENERAL OVERVIEW

Reference number:	2019074
Classification:	Serious incident
Date, time of occurrence:	6 September 2019, 06.10 hours ²
Location of occurrence:	Amsterdam Airport Schiphol
Airline	Transavia
Aircraft registration:	PH-HSJ
Aircraft type:	Boeing 737-800
Aircraft category:	Commercial airliner
Type of flight:	Commercial air transport (passenger)
Phase of flight:	Takeoff
Damage to aircraft:	None
Number of flight crew:	Two
Injuries:	None
Other damage:	None
Light conditions:	Darkness

² All times in this report are local times (UTC + 2 hours), unless otherwise specified.

1 INTRODUCTION

On 6 September 2019 at 06.08 hours, the Boeing 737-800 taxied during darkness via Taxiway³ C towards Runway⁴ 18C of Amsterdam Airport Schiphol (hereafter Schiphol) in order to take off. The flight crew turned left twice at Intersection C1 and lined up on Taxiway D, located parallel to Runway 18C. The crew started a rolling takeoff⁵ on Taxiway D in southerly direction: see Figure 1. Via radar, air traffic control detected that the aeroplane was attempting a takeoff from the taxiway and instructed the crew to stop immediately. The crew rejected the takeoff and taxied back via Taxiway C to Runway 18C, where it took off uneventfully several minutes later.

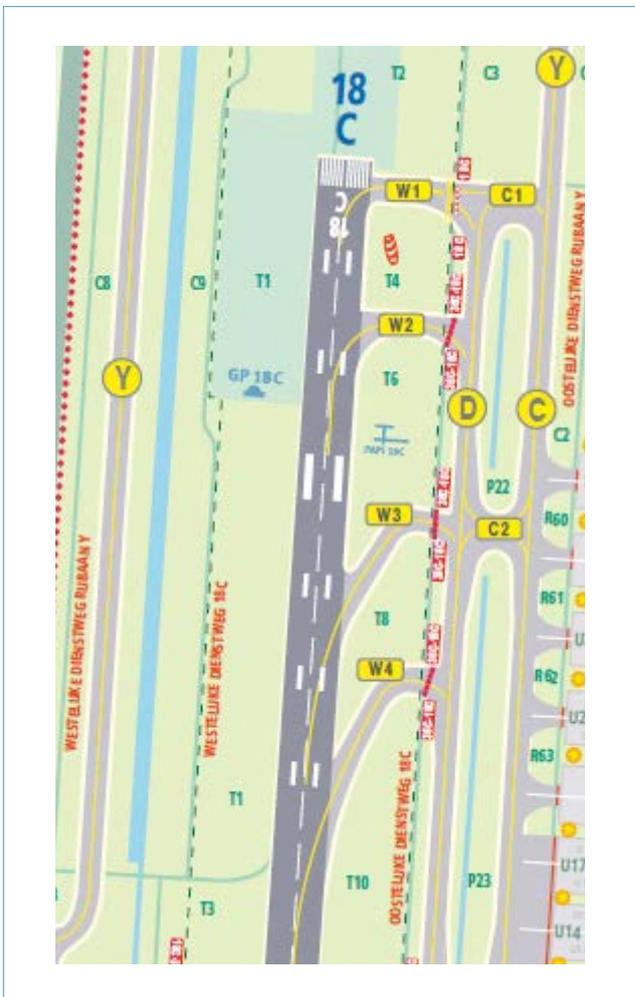


Figure 1: Lay-out of the infrastructure, surrounding the location of the occurrence. (Source: Amsterdam Airport Schiphol)

- 3 'Taxiway': a defined path on a land aerodrome established for the taxiing of aeroplanes and intended to provide a link between one part of the aerodrome and another, including: aeroplane stand taxilane, apron taxiway and rapid exit taxiway.
- 4 'Runway': a defined rectangular area on a land aerodrome prepared for the landing and takeoff of aeroplanes.
- 5 During a rolling takeoff, the aeroplane taxies out to the runway and takes off in one continuous movement.

This type of occurrence is hazardous because the aeroplane initiated its takeoff roll from a location that is not intended to be used for takeoff. There can be a danger of collision with other aeroplanes, vehicles or obstacles. Also the aeroplane could overrun off the taxiway if it is not long enough to get airborne or if the takeoff is rejected. The Dutch Safety Board classified the occurrence as a serious incident. Annex 13⁶ to the Convention on International Civil Aviation and Regulation (EU) No 996/2010⁷ both list an aborted takeoff on a taxiway as an example of an incident that is likely to be a serious incident.

On behalf of the state of occurrence, the Dutch Safety Board was responsible for conducting the investigation and instituted an investigation into the circumstances of the occurrence.

The investigation into the occurrence answers the following three questions:

1. How could it happen that the flight crew initiated a takeoff from a taxiway without noticing it?
2. Why did the flight crew continue the flight, instead of reporting the occurrence to the company immediately, and was cockpit voice recorder data not secured after the occurrence?
3. In which way did factors related to the layout and design or the operational concept of Schiphol contribute to the occurrence?

The sector parties⁸ conducted a joint investigation in the context of the Integral Safety Management System.⁹ The investigation report¹⁰, which is the product of this joint investigation, and a risk evaluation report of the occurrence¹¹, were shared with the Dutch Safety Board.

In Chapter 2 of this report, the factual information, gathered and considered relevant, is provided according to the ICAO Annex 13 standard. In Chapter 3, the occurrence is analysed and in Chapter 4 the findings and conclusions from the previous chapter are combined and listed. Chapter 5 lists a series of recommendations.

⁶ Aircraft Accident and Incident Investigation.

⁷ On the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC.

⁸ Transavia, Air Traffic Control the Netherlands and Amsterdam Airport Schiphol.

⁹ <https://integralsafetyschiphol.com/>

¹⁰ Joint sector ISMS, Occurrence September 6th 2019, Taxiway Take-Off Attempt, Schiphol Airport (EHAM), ISMS 6Sep19; version 1.1, 2020.

¹¹ NLR – Royal Netherlands Aerospace Centre, Risk evaluation attempted taxiway take-off Schiphol, NLR-CR-2020-158, 2020.

2 FACTUAL INFORMATION

2.1 History of the flight

2.1.1 Flight execution

The flight crew, consisting of two pilots, was scheduled to fly the Boeing 737-800 from Schiphol to Chania International Airport (LGSA) and Karpathos Island National Airport (LGKP) in Greece and back to Schiphol. During flight preparation, the flight crew planned and discussed the taxi route to and the takeoff from Schiphol's Runway 18C. They made a performance calculation for a takeoff from Intersection W3; see Figure 2.

The first officer was the pilot flying during the first flight (with destination Chania). The pilots had flown together before. The flight had a slot time; the crew however was ready for taxi well on time and were not in a rush.

The aeroplane was pushed back from Gate D51 at 05.57 hours. At 06.03 hours, the ground controller issued the taxi clearance via Taxiways B and C to the holding point of Runway 18C. The captain read back the clearance. The flight crew stated that there were no particularities during taxi. The flight crew had programmed the Flight Management System in advance and did not change it during taxi. The pilots both had selected the aerodrome chart, including the taxiways, on their Electronic Flight Bags. According to their statement, both pilots looked outside and occasionally said something to each other. It was busy on the radio frequency with other traffic.

When the Boeing 737-800 entered Taxiway C, there were no other aeroplanes in front of it. The before takeoff checklist was partly accomplished. The captain stated that on Taxiways C and D the taxiway centre line lights were not lit, except in the turn from Taxiway C to D, and that the taxiway edge lights were not lit.

At 06.08 hours the aeroplane taxied north on Taxiway C abeam W4, as the captain informed ground control they were approaching Runway 18C and ready for departure. See Figure 2. The ground controller instructed the crew to contact the tower (runway controller). Because it was busy on the tower frequency, the captain could not immediately contact the runway controller and request the intersection takeoff from W3, which they had planned. The captain contacted the runway controller when the aeroplane was near C2 at 06.09 hours and reported ready for departure.

The aeroplane's position was then between W2 and W3. The captain took over the controls and initiated the procedure for a rejected takeoff. The aeroplane came to a stop on the taxiway just south of W5: see Figure 2.

Only after the runway controller had informed the pilots that they started their takeoff roll from the taxiway, the pilots realised what they had done. They were both completely astounded by what had just happened. The flight crew informed the cabin crew and passengers that they had rejected the takeoff due to a warning in the cockpit. The runway controller asked if they needed the fire brigade or something because of the temperature of the brakes. The captain replied that this was not necessary. Thereafter, the runway controller asked if they were able to move, which was answered with "affirm." The pilots discussed what just had happened and judged that they were able to continue the flight despite the rejected takeoff. The captain stated that he had tried twice, without result, to contact the airline. He mentioned to the runway controller that they wanted to go to the departure runway again, whereupon the runway controller instructed them to take the first opportunity to turn and return to W1. The flight crew then taxied back via Taxiway C to the holding point of Runway 18C. Runway control issued the line-up¹² clearance and the aeroplane entered the runway. Thereafter, the flight crew received the takeoff clearance for Runway 18C and the aeroplane took off from the runway. The remainder of the flight was reported uneventful.

2.1.2 Tower occupation and runways in use

The on duty air traffic control personnel were the runway controller, who also fulfilled the role of supervisor, a ground controller and a tower assistant. The runway controller was responsible for handling traffic departing from Runway 18C, landing on Runway 18R and flying in the control zone. The runway controller, in his function of supervisor, had decided to use Intersection W5 for traffic to cross Runway 18C/36C after they landed on Runway 18R. By doing this, those aeroplanes could avoid the longer route to the terminal via Taxiway Y (north of Runway 18C/36C). Runway 06/24 and several (sections of) taxiways, including Taxiway Q, were not in use due to maintenance.

2.2 Personnel information

The flight crew consisted of a captain and a first officer. Both were fully qualified to fly the Boeing 737-800.

¹² After issuing the line-up clearance the runway controller was relieved by a colleague, because his shift had ended.

2.3 Aircraft Information

General	
Manufacturer	Boeing Commercial Airplanes
Model	737-800
Year of manufacture	2014
Serial number	42150
Registration	PH-HSJ
Engine model	CFM56-7B26E (turbofan)

2.4 Meteorological information

The Royal Netherlands Meteorological Institute (KNMI) reported at the time of the occurrence that a southwesterly current was supplying maritime polar air. The wind on the ground was from direction 210° with a speed of 11 knots, at a temperature of 12 degrees Celsius. There was no significant weather. Ground visibility was more than 10 kilometres. It was dark; the sun had not risen yet and was 8 degrees below the horizon. A few clouds were present at 3,400 feet.

2.5 Aerodrome information

2.5.1 Infrastructure near Runway 18C

Runway 18C/36C, which is 3,300 metres long and has a width of 45 metres, is surrounded by three parallel taxiways, i.e. one taxiway west of the runway and two taxiways on the east side of the runway (see Figure 1). The latter two are called C and D north of the junction with Taxiway B (see Figure 3). The easternmost taxiway is connected with the taxiway west of the runway via Taxiway Y on the north side and Taxiway Z on the south side of the runway, respectively. In total, Runway 18C/36C features twelve entries to/exits from the runway (W1-W12). The taxiways have a width of 23 metres.

Taxiway C is connected with entry W1 via C1, with the holding point at the beginning of Runway 18C.

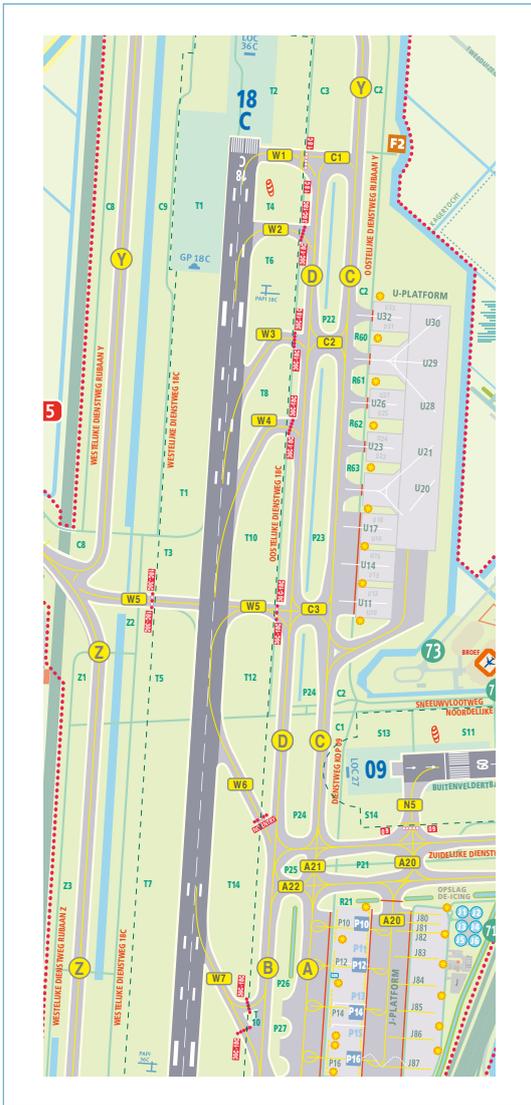


Figure 3: Lay-out of the infrastructure, east of Runway 18C/36C. (Source: Amsterdam Airport Schiphol)

2.5.2 Mandatory direction of travel on taxiways

The Aeronautical Information Publication (AIP) states that aircraft shall comply with standard taxi routings to and from the stands, as depicted on the Schiphol ground movement chart.¹³ Ground Control will timely pass on deviations from the standard taxi routings to the flight crew.¹⁴

The ground movement chart of Schiphol indicates that the standard routing for Taxiway B is counter clockwise, unless otherwise instructed by air traffic control. Taxiways C and D may be used two-way, at air traffic control's discretion. There are no standard routings for these taxiways except during low visibility operations.

¹³ Air Traffic Control the Netherlands, *AIP the Netherlands*, EHAM AD 2.EHAM-GMC.

¹⁴ Air Traffic Control the Netherlands, *AIP the Netherlands*, EHAM AD 2.20 LOCAL AERODROME REGULATIONS, 2 GROUND CONTROL AT SCHIPHOL AIRPORT, 2.1 General.

2.5.3 Markings and lighting infrastructure at Schiphol

General

Runway 18C has a thick, white and broken line marking the centre of the runway. White lights indicate the centre and edges of the runway.

Taxiways C and D have a yellow, thin and continuous centre line marking and green centre line lights.¹⁵ The edges of the taxiways are marked by blue reflective edge markers along the straight sections and blue edge lights in the curves.

The lighting is designed as to provide flight crews with guidance during low visibility conditions. Then, aeroplanes taxiing to the beginning of Runway 18C follow the green taxiway centre line lighting on Taxiway D. Aeroplanes taxiing around the north of Runway 18C-36C follow the green centre line lighting on Taxiway C. The consequence of this design is that there is no taxiway centre line lighting present at C1 between Taxiway C and the CAT III holding point¹⁶ at W1: see Figures 4 and 6.



Figure 4: Signs and marking, designating the CAT III holding point of Runway 18C. (Source: Dutch Safety Board)

¹⁵ At airports equipped for low visibility operations, like Schiphol, taxiways have green centre line lighting. At other airports blue edge lighting or blue reflectors are provided. If green centre line lighting is provided, blue taxiway lights may also be installed as additional guidance.

¹⁶ CAT III stands for a category of an instrument landing system (ILS), which enables a precision instrument approach and landing. An ILS is a system that works by sending radio waves downrange from the runway end, with aeroplanes that intercept it using the radio waves to guide them onto the runway. The CAT III holding point is situated far enough from the runway in order to protect the ILS sensitive area and will be used during low visibility operation.

Situation at intersection C1 and entry W1

At the junction of Taxiway C and Intersection C1, the taxiway continues northbound as Taxiway Y. At that point, the green centre line lights continue northbound. Turning to the west, there are no green centre line lights towards C1. There is an interruption of the yellow centre line marking towards W1. The yellow line continues in a turn to the south onto Taxiway D (see Figures 5 and 6). At C1, another yellow centre line marking starts towards W1. This line is not connected to the curved line towards Taxiway D (see Figures 5 and 6). Taxiway D has green centre line lights that continue northbound towards W1 (see Figure 7).



Figure 5: Interruption of the yellow centre line marking (from C1 towards W1) and continuing turn of the line to the left towards Taxiway D. (Source: Dutch Safety Board)



Figure 6: Broken taxiway centre line markings. (Source: Google Maps, modified by the Dutch Safety Board)

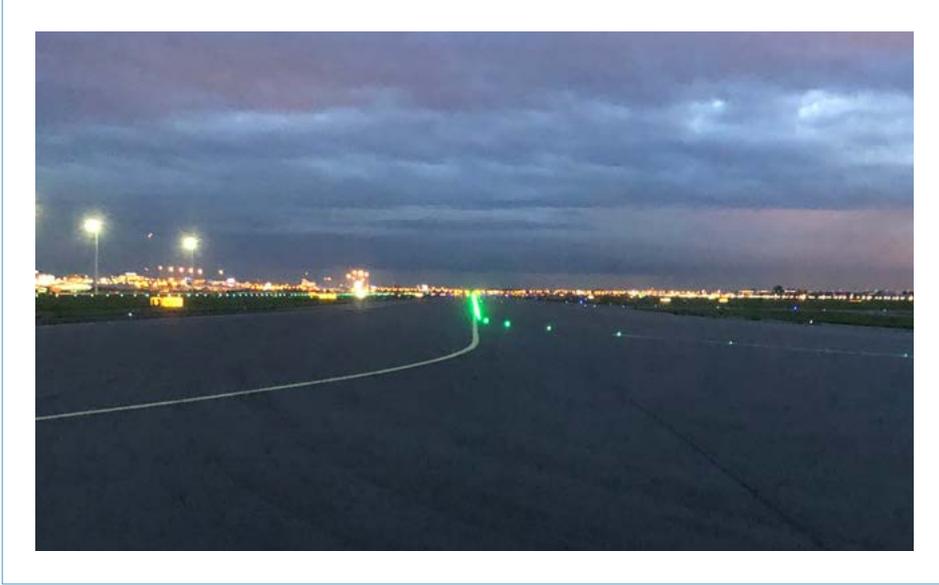


Figure 7: Looking south on taxiway D with its green centre line lights that continue in the northwest towards W1. (Source: Dutch Safety Board)

There are signs on and near the location indicating that intersection W1 leads to a runway. These include the signs designating the runway, the runway entry and the runway holding position marking on the tarmac (see Figure 4).

Lighting settings

The Airfield Lighting Control and Monitoring System (ALCMS) allows air traffic control to control the various airfield lighting systems such as runway, approach, taxiway, stop bars, apron etc. With one switch in the control tower, the taxi lights may be switched on and off manually. The recommended intensity setting for taxiway lighting between sunset and sunrise, when the runway visual range is more than 1,500 metres, is 10%.¹⁷ Table 1 shows the set intensity of the controller of the different lighting systems, as logged for Taxiways C and D and Runway 18C/36C at the time of the occurrence. The logging does not represent the actual intensity of the lighting systems; the systems do not have a feedback signal.¹⁸ The air traffic controllers, who were on duty at the time of the occurrence, did not report any particularities regarding the lighting.

¹⁷ Air Traffic Control the Netherlands, *OM SPL TWR-APP 4.03*, page 5, March 2019.

¹⁸ See 2.7 Tests and research.

Table 1: The intensity of lighting systems during the occurrence. (Source: Amsterdam Airport Schiphol)

Lighting	Intensity
All taxiway lights	10%
Taxiway signs	30%
Stop bars	10%
Runway signs	30%
Runway edge lights	0,3%
Runway centre line lights	0,3%

2.6 Flight recorders

Airliners are equipped with a cockpit voice recorder (CVR) that records communications and sounds in the cockpit. This information contained in the CVR is valuable for the reconstruction of occurrences. In the event of a serious incident, the captain is responsible to deactivate the flight recorders immediately after the flight is completed. This is a requirement according to CAT.GEN.MPA.105¹⁹ of Regulation (EU) No 965/2012 on Air Operations.

The regulation also states that the operator should establish procedures to ensure that flight recorder recordings are preserved for the investigating authority. The procedures should include instructions for flight crew members to deactivate the flight recorders immediately after completion of the flight and inform relevant personnel that the recording of the flight recorders should be preserved. These instructions should be readily available on board.²⁰

The Operational Manual²¹ of the airline involved in the occurrence stated as a guideline that flight crew not erase the CVR after an incident/accident, inhibit it immediately to avoid erasure and only stop the CVR in flight when deemed necessary to secure data.

Upon arrival at the destination airport the CVR recording, which had a duration of two hours, was overwritten and therefore the CVR data covering the event was not available for the investigation.

¹⁹ Responsibilities of the commander.

²⁰ AMC1 CAT.GEN.MPA.195(a) Handling of flight recorder recordings: preservation, production, protection and use.

²¹ Part A, 11 Handling of accidents & occurrences, revision number 13, date 1 August 2018.

An extension of the regulatory requirement regarding the minimum recording duration of the CVR has been recognised internationally by aviation regulators as a necessary safety improvement. Current European legislation requires that for commercial air transport operations with aeroplanes with a maximum certificated take-off weight of more than 27,000 kg and first issued with an individual certificate of airworthiness on or after 1 January 2022, the CVR shall be capable of retaining the data recorded during at least the preceding 25 hours.²²

Flight data from the Quick Access Recorder was read out and made available to the Dutch Safety Board.

2.7 Tests and research

The Integral Safety Management System (ISMS) investigation team reconstructed the incident under comparable conditions for visibility, darkness, weather and the set intensity of the lights on Runway 18C and the taxiways. The airline provided a Boeing 737 for this. During the reconstruction, film recordings were made from the cockpit. An air safety investigator from the Dutch Safety Board took part in this reconstruction. The ISMS investigation team shared the images with the Dutch Safety Board.

The logging system at Schiphol records the outgoing signal of the controller(s) to the runway, taxiway and sign lights. This logging system does not include a feedback signal from the various lights in the field itself, whether a group of lights or lights have failed or do not illuminate due to another reason (i.e. no power supplied). The stop bar light system is an exception, as it does provide a feedback signal that is logged.

2.8 Organisational and management information

2.8.1 Air traffic control procedures

General

Air traffic control selects the combination of runways in use at Schiphol according to a preferential runway system.

Area of responsibility

Ground controllers and runway controllers have designated areas of responsibility. The ground controller's area of responsibility includes the manoeuvring area, excluding the available and not usable runways.²³ The area of responsibility of the runway controller includes the available runways and the Schiphol control zones. The air traffic controller

²² Commission Implementing Regulation (EU) 2020/2036 of 9 December 2020.

²³ A runway is called available if it is made available by the airport authorities. A runway can be not usable due to maintenance work.

accomplishes transfer of communication before transfer of control takes place.²⁴ Transfer of control takes place on the boundary of the area of responsibility.

Use of ground radar²⁵

The ground controller and runway controller may use ground radar information to supplement and/or replace the visual observation of traffic in the manoeuvring area when they perform the following tasks:

- Checking that aeroplanes and vehicles are moving according to given clearances and instructions.
- Determining positions of aeroplanes and vehicles in the manoeuvring area.

The view on the area near the threshold of Runway 18C from the main tower is limited in the dark. The exact position of aeroplanes in this area is difficult to determine between all the lights. Therefore, the ground radar is helpful for this. At night, flights arriving on Runway 18R are monitored via video screens in the main tower.

2.8.2 Airline procedures

Guidelines and procedures

The Flight Crew Training Manual²⁶ (FCTM) of the operator contained guidelines to enhance situational awareness and safety during ground operations. Relating to the phase prior to taxi, these guidelines include: ensure that both flight crew members understand the expected taxi route, write down the taxi clearance when received and have an airport diagram readily available for each crew member during taxi. Guidelines relating to the taxi phase include:

- follow the aeroplane position during taxi progressively on the airport diagram;
- use standard radio phraseology;
- use all appropriate aeroplane lighting at night;
- ensure that the exterior lights, specified in the Flight Crew Operating Manual, are illuminated when an aeroplane is entering any active runway.

The FCTM²⁷ also stated that a rolling takeoff is recommended for setting takeoff thrust. It expedites the takeoff and reduces the risk of foreign object damage or engine surge/stall due to tailwind or crosswind.

The Operations Manual²⁸ described, as part of the takeoff procedures, that before entering the departure runway, it should be verified that the runway and runway entry point are correct. When entering the departure runway, the strobe light should be switched to ON. Other lights should be used as needed and the transponder mode selector should be set to TA/RA.²⁹ When cleared for takeoff, the landing light switches have to be set to ON.

²⁴ Air Traffic Control the Netherlands, *Operations Manual (OM) SPL TWR-APP 3.03*, page 5, February 2019.

²⁵ Air Traffic Control the Netherlands, *OM SPL TWR-APP 3.05*, page 2, June 2019.

²⁶ Chapter 2, Ground Operations

²⁷ Chapter 3, Takeoff and Initial Climb.

²⁸ B – Normal Procedures.

²⁹ TA stand for Traffic Advisory and RA for Resolution Advisory.

2.9 Additional information

2.9.1 Previous departures from Runway 18C

A total of 23 flights departed from Runway 18C in the period between 22.45 hours at 5 September and the rejected takeoff from Taxiway D, which took place at 06.10 hours the next morning. Twelve of those flights taxied to the runway via Taxiway D, the remaining eleven via Taxiway C. The seven flights before the occurrence took place all used Taxiway C, departing between 05.22 hour and 05.58 hours. None of the pilots of the above flights reported irregularities to air traffic control regarding the taxiway's and runway's infrastructure and/or lighting.

2.9.2 Other taxiing traffic

At the moment the Boeing 737-800 was taxiing on Taxiway C towards C1, another aeroplane had landed on Runway 18R. This aeroplane was cleared by the ground controller to taxi to Gate G3 via W5 and to hold short of Runway 18C at W5. In the meantime, the Boeing 737-800 started the takeoff roll from Taxiway D and subsequently rejected the takeoff. After the runway controller had cleared the Boeing 737-800 to taxi back to the holding position of Runway 18C, the ground controller cleared the other aeroplane, which was waiting at the holding point of W5 West, to cross Runway 18C and then turn right onto Taxiway D. Another Boeing 737 was taxiing on Taxiway C towards the holding position of Runway 18C, when the Boeing 737-800 started the takeoff roll on Taxiway D

2.9.3 Certification specifications for aerodromes design

Amsterdam Airport Schiphol falls within the scope of Regulation (EC) No 2018/1139 (Basic Regulation). Therefore, it must be certified in accordance with the EASA certification specifications and the related guidance material for aerodromes design (CS-ADR-DSN).³⁰

CS-ADR-DSN.L.555 Taxiway centre line marking

Taxiway centre line marking should be provided on a taxiway, de-icing/anti-icing facility and apron in such a way as to provide continuous guidance between the runway centre line and aircraft stands.

CS-ADR-DSN.M.710 Taxiway centre line lights

The safety objective of taxiway centre line lights is to provide guidance for the safe taxi of aircraft on a taxiway in reduced visibility conditions and at night.

Taxiway centre line lights

Taxiway centre line lights should be provided on an exit taxiway, taxiway, de-icing/anti-icing facility, and apron intended for use in runway visual range conditions less than a value of 350 metres in such a manner as to provide continuous guidance between the runway centre line and aircraft stands, except that these lights need

³⁰ EASA, *Certification Specifications and Guidance Material for Aerodromes Design (CS-ADR-DSN)*, Issue 4, December 2017.

not be provided where the traffic density is light and taxiway edge lights, and centre line marking provide adequate guidance.

2.9.4 Issuance of takeoff clearance

ICAO Document 4444 *Procedures for air navigation service, Air Traffic Management*³¹, states that the takeoff clearance shall be issued when the aeroplane is ready for takeoff and at or approaching the departure runway, and the traffic situation permits. To reduce the risk for misunderstanding, the takeoff clearance shall include the designator of the departure runway.

2.9.5 Future development on taxiway guidance

Amsterdam Airport Schiphol and Air Traffic Control the Netherlands are investigating the application of the 'Follow-the-Greens' concept³² on Schiphol's taxiways. This concept provides pilots with guidance while taxiing, by automatically switching on the green centre line illumination of taxiways in front of the aeroplane. It also automatically turns off lights in areas where they are not needed. This project is still in a research phase. Depending on the results, switchable lighting will be installed at Schiphol's hot spots from June 2026 onwards.³³

2.9.6 Previous incidents and investigations

The Dutch Safety Board investigated two previous occurrences at Schiphol, which have similarities to the present occurrence: a taxiway takeoff from Runway 36C in 2010³⁴ and a misaligned takeoff from Runway 24 in 2016.³⁵ Also, in 2017 the Dutch Safety Board finished its investigation into air traffic safety at Schiphol; some of the findings are also relevant for the present investigation.³⁶

Taxiway takeoff, 2010

On 10 February 2010 at 20.30 hours, a Boeing 737 took off in the dark from Taxiway B northbound at Schiphol. Here it was planned that the aeroplane would depart from Runway 36C. The runway controller issued the takeoff clearance before the aeroplane had crossed Taxiway B. During climb, air traffic control informed the crew of the occurrence. The crew replied that they did not know that they had taken off from a taxiway.

The investigation revealed that the flight crew was not sufficiently aware of the aeroplane's position at the airport. Contributing factors were the increased workload due to accepting a shortened route, not using a ground movement chart, the discontinuation of green taxiway centre line lighting towards the runway entry and distraction caused by

³¹ ICAO, *Document 4444, Procedures for air navigation service, Air Traffic Management*, 7.9.3 Take-off clearance, Sixteenth Edition, 2016.

³² This is an Advanced-Surface Movement Guidance and Control System Service.

³³ <https://integralsafetyschiphol.nl/project/follow-the-greens/> (consulted on 13 August 2021).

³⁴ Dutch Safety Board, *Take-off from Taxiway, Amsterdam Airport Schiphol*, 2011.

³⁵ Dutch Safety Board, *Misaligned take-off from Runway 24, Amsterdam Airport Schiphol*, 2018.

³⁶ Dutch Safety Board, *Schiphol air traffic safety*, 2017.

communication between the air traffic controller and the crew of an aeroplane that taxied in the wrong direction.

Air traffic control did not prevent the serious incident, because the air traffic controller had to shift his attention to another aeroplane and assumed that the crew would follow his instructions correctly. In addition, after the issuance of the takeoff clearance, the aeroplane was no longer monitored until someone in the tower observed the takeoff from the taxiway. The underlying causes of the incident were the design of the infrastructure at the airport and its use. Schiphol has a relatively complex taxiway system; it is therefore essential that pilots keep track of their position while taxiing.

The CVR data, which records the cockpit sounds, is important for the reconstruction of an event. The information from the CVR was not available because the recording capacity of the CVR is limited in duration and the pilots had not secured the data in a timely manner.

The follow up of the recommendations of this investigation is described in paragraph 3.8.

Misaligned takeoff, 2016

On 18 January 2016 at 18.25 hours, an EMB 120 made a misaligned takeoff in the dark from Runway 24 at Schiphol. During the takeoff, the crew interpreted the right-hand side runway edge lights as the runway centre line lights. Evidently, visual cues provided in the form of taxiway markings and lighting, turned out to be insufficient for a correct guidance of the aeroplane from the taxiway to the runway centre line. The large turning angle, required to align the aeroplane with the runway centre line, in combination with the discontinuity of the taxiway S5 centre line and absence of the taxiway centre line lighting have contributed to the misaligned takeoff. In addition, the air traffic control clearance during the turn from Taxiway B onto S5 and Runway 24 might have distracted the flight crew.

The Dutch Safety Board recommended to International Civil Aviation Organization (ICAO) to initiate the process to develop, within Annex 14 Volume 1 'Aerodrome Design and Operations', a standard for runway edge lights that would allow pilots to identify them, specifically, without reference to other lights or other airfield features. In line with the above recommendation to ICAO, Amsterdam Airport Schiphol was recommended to proactively take measures, which prevent pilots from interpreting the runway edge lights as the runway centre line lights. The Dutch Safety Board recommended to Air Traffic Control the Netherlands to allow air traffic access to the runway for takeoff only, outside the uniform daylight period, when intersections are used that are equipped with centre line lighting.

In October 2020, ICAO informed the Dutch Safety Board that the safety recommendation was referred to the Aerodrome Design and Operations Panel for further study during its Visual Aids Working Group meeting in November 2019. The meeting considered the safety recommendation and concluded that, in the absence of a cost benefit study at a global level, changing the characteristics of the runway edge lights might not be the

most practicable solution. Furthermore, introducing changes to the provisions for runway edge lights in Annex 14 — Aerodromes, Volume I — Aerodrome Design and Operations, would have the potential to create additional hazards and unintended consequences. ICAO mentioned that work is in progress to develop appropriate specifications in Annex 14 related to the provision of continuous taxiway centre line marking into the runway centre line, since it was noted that, at some airports, the taxiway centre line marking terminates at the edge of the runway.

Amsterdam Airport Schiphol and Air Traffic Control the Netherlands have jointly investigated the occurrence. Based on the results of that investigation, they have extended the taxiway centre line to the middle of Runway 24. No further measures had been taken, because both organisations are of the opinion that a situation of non-compliance with ICAO and EASA standards would arise. First, new standards must be drawn up.

Air Traffic Control the Netherlands is of the opinion that, based on the ISMS investigation, the introduction of centre line lighting for intersections that are used to allow air traffic access to the runway for takeoff, would negatively affect capacity³⁷ and possibly a correct line-up (due to following the wrong light row).

Air traffic safety at Schiphol, 2017

In April 2017, the Dutch Safety Board published the report *Schiphol air traffic safety*. Following a number of incidents (some of which repeatedly), the Dutch Safety Board carried out an investigation to identify any vulnerabilities in the safety system around Schiphol. The investigation found no evidence to suggest that safety at Schiphol is inadequate. However, the investigation did reveal a number of safety risks that need to be tackled integrally and systematically in order to guarantee safety both now and in the future.

The report states that Runway 18C/36C is frequently crossed at W5 when the runway is not in use. Air Traffic Control the Netherlands applies an internal rule that air traffic controllers do not allow the runway to be structurally crossed when it is in use. Crossing saves aeroplanes taxi time, because they do not have to taxi around the runway via a taxiway.

The report concludes that Schiphol is a complex airport, both in terms of its infrastructure (amongst which numerous taxiways, runway exits and entries) and in terms of how air traffic is handled. This complexity entails certain risks for air traffic. Additional risks are, for example, posed by the large number of daily runway configuration changes, traffic crossing the takeoff and landing runways each day, deviations from procedures to handle the traffic, and capacity shortages at air traffic control. This leads to an accumulation of risk mitigation measures, which in turn creates new risks.

³⁷ Because determining an efficient order for the aeroplanes becomes more difficult, possibly clogging the taxiway.

2.9.7 Investigation of present occurrence by Integral Safety Management System

The three sector organisations involved in the present occurrence conducted a joint investigation within the framework of the joint sector Integral Safety Management System (ISMS).³⁸

Based on the analysis, the following potential risk reduction actions were identified:

- Review the infrastructural situation on and near runway entries.
- Review the (standard operating) procedures with respect to taxiing to and taking off from runways.
- Review the procedure to secure CVR data for investigation purposes.
- Improve the balance between safety and efficiency with regard to room for expert judgement of air traffic control with respect to takeoffs.
- Improve the awareness of ground controllers and runway controllers by sharing this event.
- Evaluate the effectiveness of the current process with respect to the follow up of recommendations of the Dutch Safety Board.
- Improve overall awareness with respect to deviating locations.

This list is non-exhaustive and only served as a broad and initial exploration of potential actions.

On 15 April 2020 in the Top Safety Action Group (TOP SAG) meeting a temporary taskforce was initiated to further reduce the risk of a taxiway takeoff.³⁹ An additional analysis of this risk was discussed in the TOP SAG meeting of 20 May 2020.

To determine the risk, the ISMS common risk matrix was used to plot the common risk acceptability for operations at Schiphol. It was concluded that the likelihood of a scenario where an aircraft taxis outside Uniform Daylight Period (UDP) on a taxiway not adjacent to the runway, lines up on the taxiway adjacent to the runway, initiates its takeoff and collides with another aircraft or vehicle on the taxiway is once in 700 years.^{40,41}

The taskforce put forward several measures, which have now been implemented, to reduce the likelihood such that the risk is no longer in the unacceptable region.

- Standard taxi routing for outbound traffic to Runway 18C via Taxiway D with the following preconditions:
 - outside the uniform daylight period;
 - deviations from this standard remain possible, but only in exceptional circumstances (taxiway damage, work in progress, other incidents or obstructions);
 - no publication in Aeronautical Information Publication (change in air traffic control procedures only).
- Continuous centre line markings from Taxiway C to Runway 18C (see Figure 8);
- Directional marking on Taxiway C1 to Runway 18C, Intersection W1;

³⁸ The three organisations referred to are Air Traffic Control the Netherlands, Amsterdam Airport Schiphol and Transavia.

³⁹ In ISMS the follow-up of joint incident investigations is controlled by the Top Safety Action Group (TOP SAG).

⁴⁰ Severity assessment: major damage or hull loss of aircraft and severe injuries to people or multiple fatalities.

⁴¹ Determined by Netherlands Aerospace Center (report NLR-CR-2020-158).

- Appointment of C1 as a hotspot⁴² and publication of it in the AIP;
- Awareness program for flight crew;
- Awareness program for air traffic controllers.

Air Traffic Control the Netherlands has published a leaflet highlighting hotspot C1 (see Appendix B) and sent this leaflet to all airlines flying to Schiphol.

In short time⁴³, runway guard lights will be installed on various takeoff intersections at Schiphol, amongst others at Runway 18C, Intersection W1.

The TOP SAG considered the above measures sufficient mitigation for the short term (such that the risk is no longer in the 'red' region) and supported that the taskforce continues work on the structural solution.

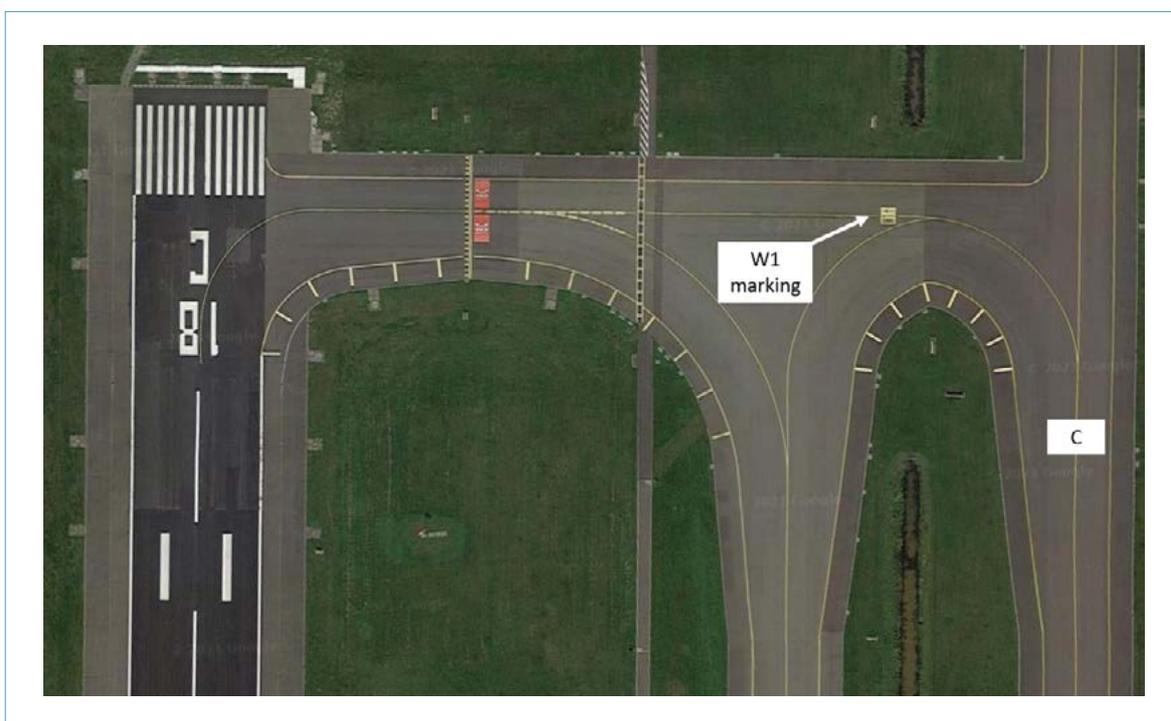


Figure 8: Continuous centre line markings from Taxiway C to Runway 18C and W1 marking at C1. (Source: Google Maps, modified by Dutch Safety Board)

⁴² A hot spot is defined as a location on an aerodrome movement area with a history of potential risk of collision or runway incursion, and where heightened attention by pilots/drivers is necessary (ICAO Doc 9870, Manual on the Prevention of Runway Incursions).

⁴³ Will be implemented in short time (according to ISMS on 26 August 2021).



Figure 9: W1 marking at C1. (Source: Amsterdam Airport Schiphol)

2.9.8 ATSB study

Between 2009 and 2010, the Australian Transport Safety Bureau (ATSB) conducted a study into risk factors influencing misaligned takeoff occurrences at night.⁴⁴ The factors included were:

- distraction or divided attention of the flight crew;
- confusing runway layout;
- displaced threshold or intersection departure;
- poor visibility or weather;
- air traffic control clearance(s) issued during runway entry;
- no runway centre line lighting;
- flight crew fatigue;
- recessed runway edge lighting.

44 ATSB, *Factors Influencing Misaligned Takeoff Occurrences at Night*, June 2010.

3.1 Introduction

In this chapter, the rejected takeoff from a taxiway is analysed. The results of the reconstruction of the event will be used, in combination with interviews with employees of the organisations involved. Furthermore, the decision making process of the flight crew that led to continuation of the flight after the occurrence will be examined. Finally, the measures taken by the parties involved to prevent a similar occurrence are examined.

3.2 Selection of runways and taxiways

On 6 September 2019, maintenance was carried out on the infrastructure of the airport. As a result, Runway 06/24 and Taxiway Q were not in use. Given the wind conditions that night and the preferential runway system, normally Runway 24 would have been used for departing traffic. As this runway was not available and due to environmental regulations, Runway 18C was used for departing traffic. This had consequences for the handling by air traffic control of traffic flows that night and morning. Runway 18R was used for landing traffic. Aeroplanes that had landed on this runway, were instructed to cross Runway 18C/36C via W5 and then proceed via Taxiway D. By using Taxiway D for this purpose, it could not be used all the time for traffic taxiing out to Runway 18C for departure. Air traffic control instructed this traffic to use Taxiway C in order to keep it separated from traffic taxiing in after arrival (and using Taxiway D at that time).

When Runway 18C is used for departing traffic, Runway 18R is generally used for arriving traffic. If the incoming traffic is routed via Taxiway Y (north of Runway 18C/36C) and C, this traffic encounters the outgoing traffic at A21 (see Figure 3), which is then routed via D to Runway 18C. By using W5, these encounters are avoided.

Taxi routing

The flight of the Boeing 737-800 started at Gate D51, which is connected to the centrally located passenger terminal. The flight crew was aware that Runway 18C was in use for departing traffic and used Intersection W3 of this runway for the performance calculation for the takeoff during the flight preparation. The expected taxi route was also included in this preparation.

After push back and engines start, the ground controller issued the clearance to taxi via Taxiways B and C to the holding point of Runway 18C. Taxiway B is located on the outside of the double ring of taxiways around the terminal building and its standard routing is counter clockwise.

By taxiing on Taxiway B towards C, the flight crew followed the standard routing. At the junction between Taxiways B and C, the flight crew turned right and followed Taxiway C northbound. Visibility was good.

Prior to the rejected takeoff from the taxiway, the taxi instructions as provided by air traffic control were conform the applicable regulations.

3.3 The flight crew

Both pilots arrived at Schiphol around 05.00 hours for flight preparation. They both stated that they were fit to fly.

The captain had operated from Schiphol since 2000 and the first officer for about three years. They were both familiar with the infrastructure of the airport. Nevertheless, the assigned taxi route was unusual for the crew. The first officer stated that he had never taken off from Runway 18C before. The captain had previously taken off a few times from this runway.

Both pilots stated that they had not been distracted while taxiing. There was a relaxed atmosphere in the cockpit; visibility was good, even though it was dark. Both pilots stated they felt no reason to be extra alert when taxiing.

Although the crew had performed a takeoff performance calculation for W3, they did not ask to use this intersection to line up on the runway. The fact that the captain asked if they could depart via W2, while the aeroplane was near C2, suggests that he was unaware of their precise location at the time. This would have required the aeroplane to turn left at C2, the position where it already was. The first officer stated that he knew they were on Taxiway C but was unaware that they were on an outer parallel taxi track. While taxiing on Taxiway C, the crew was not fully aware of their exact position.

When pilots taxi and take off during daylight conditions, they normally have a wide range of visual cues by which they can navigate and verify their location. At night however, the amount of visual information available is markedly reduced. Pilots rely more on the taxiway and runway lighting patterns and what can be seen in the field of the aeroplane's taxi and landing lights.⁴⁵ So, at times of darkness and low visibility, flight crew members must take additional care to ensure accuracy in navigation on the ground.

Both pilots experienced the taxiway lighting near C1 as confusing. At the junction between Taxiway C and intersection C1, the green centre line lights continue north. The green lights the crew had been following on taxiways B and C did not continue towards the holding point of Runway 18C. In contrast, green centre line lights do continue south from the holding point (W1) towards taxiway D.

⁴⁵ ATSB, *Factors Influencing Misaligned Takeoff Occurrences at Night*, June 2010.

This might have given the pilots the impression that W1 was a western entry to Runway 18C. However, there is no such entry on the west side of the runway threshold. This impression was reinforced by the fact that both the centre line and edge lighting of Runway 18C are not clearly visible from the side. The runway edge lights of Runway 18C that were visible from C1, form visual patterns with the lights in the background and therefore these edge lights cannot be clearly distinguished. The stop bar at W1 was not lit at the moment the aeroplane taxied at C1. The pilots described the way to the runway, seen from C1, as a 'black hole' due to the lack of green centre line lights. The captain stated that the runway identifier signs were not lit.

When approaching C1, the flight crew, according to procedure, started their preparations and checks for the takeoff. Since takeoff clearance had been received when the aeroplane was taxiing near C2, around C1 the crew was not solely focusing on taxiing, but was also preparing for takeoff. The pilots selected the departure chart on their Electronic Flight Bags. The takeoff checklist requires the crew to verify that they are about to enter the correct runway and have clearance to do so. In the perception of the crew, this was the case. They noticed signs indicating Runway 18C, which to them was confirmation that they were entering the runway they were cleared to.

The airline's company procedure was to perform a rolling takeoff where possible.⁴⁶ To achieve this, takeoff preparations need to be completed when entering the runway, as this moment is immediately followed by the takeoff roll. The airline policy for a rolling takeoff requires the crew to perform multiple tasks (landing lights on, engine checks, switches etc.) simultaneously, thereby shifting their attention between inside and outside the cockpit during the line-up phase, instead of solely focusing on taxiing. This may have resulted in the crew missing visual clues in the 'black hole' of C1 that they were not entering a runway (like signs and markings designating the actual runway entry) and paying less attention to the verification of the correct runway.

Another point that the pilots had noticed, concerns the absence of a straight continuous yellow centre line from C1 towards the holding point of Runway 18C. When turning from Taxiway C to C1 there is an interruption of the yellow centre line marking. In contrast, the yellow line continues in a U-turn towards Taxiway D. This yellow taxi line, uninterrupted towards Taxiway D and interrupted towards Runway 18C (see Figure 5), became clearly visible at C1 when the crew switched on the landing lights.⁴⁷ So following the only taxiway guidance that was clearly visible to them, i.e. the yellow line from C1, the crew were led onto Taxiway D. This was a significant contributing factor in initiating the takeoff from the taxiway. Noted, a taxiway has green centre line lights and a runway has white centre line lights. The reconstruction of the occurrence showed that the bright beam of an aeroplane's taxi or landing lights can make it difficult to distinguish these colours under dark circumstances. The crew stated that they did not notice any difference in colours of the lighting.

⁴⁶ Boeing recommends conducting a rolling takeoff to decrease the takeoff distance and the risk of engine damage due to foreign object damage.

⁴⁷ The yellow taxi line on Taxiway C is poorly visible due to the bright green taxiway lighting, but when the green lighting stops on C1 and the landing lights are switched on, the yellow line becomes visible in the 'black hole'.

The width of C1 is approximately 40 meters, which resembles the width of a runway (45 meters), while a taxiway normally is 23 meters wide. This might also have been a cue of entering the beginning of a runway.

The design of taxiway centre line markings at Schiphol was focused on preventing runway incursions during low visibility circumstances. The lining on taxiways at some points of the aerodrome therefore lead to another taxiway instead of a runway.

After the aeroplane was lined up on Taxiway D and the landing lights were turned on, the first officer applied full thrust, selected the auto throttle and made a rolling takeoff. The 'runway' was clear from other traffic. Everything looked normal for both pilots. The captain stated he saw W2 to the right and a waiting aeroplane (at W5) during the takeoff roll. According to him, the situation was correct until the runway controller instructed them to stop immediately and hold position.

Environmental cues enhanced the perception of the crew that they were lined up on Runway 18C, instead of on Taxiway D. It likely attributed to a confirmation bias. Cues such as the yellow, thin and continuous centre line marking and green centre line lights, were not recognised by the flight crew as cues of being on a taxiway.

No changing environmental conditions took place in the period from 05.22 hours that might have contributed to the occurrence. Seven aeroplanes took off from Runway 18C from that time until the serious incident occurred, all using Taxiway C, without any problems. METAR data indicates that the visibility was more than 10 kilometres and did not change in this time period.

While taxiing on Taxiway C, the crew was not fully aware of the exact position of the aeroplane. The yellow taxi line at C1 was uninterrupted towards Taxiway D and interrupted towards Runway 18C. The line became clearly visible when the crew switched on the landing lights. Following the only taxiway guidance that was clearly visible to them, i.e. the yellow line from C1, the crew ended up on Taxiway D.

In the morning darkness the crew interpreted Taxiway D as the designated Runway 18C and started the takeoff roll. Environmental cues, such as signs indicating Runway 18C, enhanced the perception of the crew that they were lined up on Runway 18C, instead of on Taxiway D. Cues such as the yellow, thin and continuous centre line marking and green centre line lights, were not recognised by the flight crew as cues of being on a taxiway.

When taxiing from Taxiway C towards the holding position of Runway 18C, the taxiway centre line markings did not provide continuous guidance, as the design of these markings was focused on preventing runway incursions when low visibility procedures are in force.

3.4 Air traffic control

3.4.1 Room for expert judgement as an operating principle

Air Traffic Control the Netherlands uses procedures, working instructions and guidelines that leave room for expert judgment for the air traffic controllers. This operating principle enables them to react to unexpected situations and to base decisions on the specifics of the current operational situation. Examples of these decisions in the current case are the use of Taxiway C, the moment of transfer of communications and the issuing of the takeoff clearance, which will be discussed in the following paragraphs. The operating principle enables air traffic controllers to find a balance between efficiency and safety.

3.4.2 Use of Taxiway C

Air traffic control staff in the control tower was convinced that all taxiway routes are identical in providing the necessary guidance with respect to lighting and ground markings. Therefore, controllers did not have a preference in using either Taxiway C or D for taxiing traffic to Runway 18C. The air traffic controllers in the tower had decided to use Taxiway C for outbound taxi traffic because the parallel Taxiway D, also located on the east side of Runway 18C/36C, was used for traffic that had landed on Runway 18R and just crossed Runway 18C/36C. By doing this, the inbound and outbound taxiing traffic was separated from each other.

The air traffic controllers on duty did not realise that there is no continuous taxiway centre line lighting present between Taxiway C and the stop bar at the beginning of Runway 18C. Consequently, they did not provide the flight crew with additional guidance, as they had not done either with the other traffic that had used Taxiway C during the night. The air traffic controllers acted in accordance with the Operations Manual's procedures.

Air Traffic Control the Netherlands set the intensity of the taxiway lighting at 10%, which is conform procedures. No runway and taxiway lighting failures had been reported. As stated by the captain, only the green taxiway centre line lights in the turn from Taxiway C to D were on. Since the logging does not record a feedback signal from the light systems in the field (except the stop bars), the Dutch Safety Board cannot confirm that a part of the taxiway centre line lights on Taxiways C and D was not illuminated at the time of the occurrence, as stated by the captain. The stop bar was not visible because the flight had been cleared for takeoff and therefore it was off.

As was customary and according to the procedures in force, the air traffic controllers did not provide additional guidance to the flight crew, taxiing on Taxiway C towards the holding point of Runway 18C. They were convinced that the lighting and ground markings on all taxiways were identical.

Due to restrictions of the logging system, it cannot be confirmed that a part of the taxiway centre line lights was not illuminated.

3.4.3 Transfer of communication and issuance of takeoff clearance

Transfer of communication

When abeam W4, the captain informed the ground controller they were approaching Runway 18C and ready for departure. The ground controller transferred the flight to the runway controller, which is not uncommon at that location. As the captain had reported to be ready for departure, there was no reason for the ground controller to assume that the crew might take a wrong turn, and hence keep the flight on his frequency. The ground controller relied on the local knowledge of the pilots of an airline based at Schiphol and there were no indications that they would have problems finding the holding point of Runway 18C. In addition, the runway controller would keep an eye on the aeroplane, although it was still in the ground controller's area of control.

The Operations Manual states that an air traffic controller arranges transfer of communication before transfer of control. Transfer of control takes place on the boundary of the responsible area, so in this case at the moment the aeroplane enters the runway. So the ground controller acted in accordance with the Operations Manual.

The use of a runway and a parallel outer taxiway, for departing traffic from that runway, introduces the risk of assuming the inner taxiway as the runway. This risk may be elevated if both the transfer of communication and the issuance of the takeoff clearance take place early and especially during darkness. In such a case, the aeroplane is in the ground controller's area of control, but in communication with the runway controller. In the context of an efficient traffic flow, a flight is transferred early to the runway controller so as not to incur unnecessary delays.

It is important that, after the transfer of communication to the runway controller has taken place, the ground controller remains aware that the aeroplane is under his responsibility until that responsibility is actually transferred to the runway controller when the aeroplane enters the runway.

Issuance of takeoff clearance

Abeam C2, the captain reported to the runway controller they were ready for departure, whereupon he received the clearance to line up and take off from Runway 18C. The runway controller had no indications that the crew would take a wrong turn. After a short conversation between the captain and the runway controller regarding a possible intersection takeoff from intersection W2, the runway controller turned around and shifted his attention to traffic at another part of the airport. The line-up of the aeroplane on Taxiway D was therefore not observed by the runway controller.

In principle, a takeoff clearance shall be issued when the aeroplane is ready for takeoff and at or approaching the departure runway, and if the traffic situation permits this.⁴⁸ The runway controller complied with this rule.

Between the time that a takeoff clearance is issued and the time the takeoff run actually takes place, circumstances may change and thus be different than originally thought. Therefore, especially when an early takeoff clearance is issued, runway controllers should continue to monitor an aeroplane to be sure it remains on taxiing the correct route. This did not happen in the present case because the runway controller directed his attention to other traffic, just like the ground controller. This is not remarkable since an air traffic controller cannot constantly visually monitor every aeroplane in his area of control and/or on his frequency. Based upon the operational situation and his expert judgement, the runway controller did not perceive his reduced focus on the Boeing 737-800 as a risk, especially because it concerned a home based carrier. However, the aeroplane had not passed the beginning of Taxiway D when the takeoff clearance was issued, so there was still a risk that the aeroplane would taxi incorrectly.

The severity of the occurrence

On the basis of the clearances issued, air traffic controllers have certain expectations with respect to the traffic they control. In the vast majority of cases, air traffic complies with the instructions. Nevertheless, the response of a flight crew could turn out differently from what air traffic control and other users had anticipated.

This also proved to be the case in the present occurrence. The flight crew on board the Boeing 737-800 initiated the takeoff from a taxiway instead of the designated runway. Air traffic control had not taken this possibility into account and did not notice it straight away. This meant that the situation was no longer under control. Shortly after the initiation of the takeoff, the ground controller observed the aeroplane on Taxiway D and immediately notified the runway controller about this.

The use of outer parallel Taxiway C in combination with an early issuance of the takeoff clearance introduced a risk of taxiing incorrectly.

The runway controller issued the takeoff clearance when prompted by the crew with a ready for departure notification. Thereafter he shifted his attention to other traffic and did not observe the line-up of the aeroplane on Taxiway D. Based upon the operational situation and his expert judgement, the runway controller did not perceive his reduced focus on the Boeing 737-800 as a risk, especially because it concerned a home based carrier.

At the moment the Boeing 737-800 initiated the takeoff from Taxiway D, no other aeroplanes or vehicles were present on that taxiway. A takeoff from a taxiway is a

⁴⁸ ICAO, Document 4444, Procedures for air navigation service, Air Traffic Management Chapter 7.6.2 Designated positions of aircraft in the aerodrome traffic and taxi circuits, 7.9.3 Take-off clearance, Sixteenth Edition, 2016.

hazardous situation, since a taxiway is not intended for takeoffs. In this case, a safety barrier worked as the flight crew was instructed by the runway controller to stop, so that the consequences of the serious incident were limited in time.

3.5 Consequences of the decision to continue the flight

3.5.1 Continuation of the flight

After the rejected takeoff, the pilots discussed the situation and decided to continue the flight to its destination. This decision was based on the fact that the aeroplane was still airworthy and both pilots assessed that they could continue the flight safely. After a short conversation with the runway controller, the pilots taxied the aeroplane back to Runway 18C and departed from there. The remainder of the flight was without reported particularities. After landing, the captain informed the airline about the occurrence that had taken place.

The operator's policy prescribes that the captain is responsible for the safe conduct of the flight, which is in line with European regulations.⁴⁹ Specifically, the company policy does not prescribe the actions to be taken by the captain after an abnormal situation, such as a rejected takeoff from a taxiway. After the takeoff had been rejected, the immediate hazard was subsided and no restrictions seemed to hinder the continuation of the flight. The captain stated that he tried to contact the company twice for consultation, however he did not succeed whereafter he decided to continue the flight. Even though the captain has the final responsibility to ensure a safe execution of the flight, the Board expects a captain, in such an abnormal situation, to first establish contact with the company and then mutually decide on further actions. Such consultation will allow for a thorough understanding of safety implications in relation to the situation at hand.

It is not one of the statutory tasks of Air Traffic Control the Netherlands to challenge the flight crew's decision to continue the flight after a serious incident, like the rejected takeoff from a taxiway. However, in such an abnormal situation, parties should be in a position to directly address each other about deviations that affect safety. Challenging each other may improve safety in a broader sense. Therefore the Dutch Safety Board appeals to Air Traffic Control the Netherlands and the operator, and other relevant parties at Schiphol to foster a work environment where challenging each other about safety decisions is normal. This thought fits well within the broader risk identification and mitigation of Schiphol's Integral Safety Management System as the overarching system that seeks to complement the risk management of the individual companies.

3.5.2 Availability of information for investigation

In the interest of the investigation, it is important for investigators to speak to the crew as soon as possible after such an incident rather than having them perform a flight first. By speaking to a crew immediately, their memories of the occurrence are still fresh and not mixed with experiences from a more recent flight. The discussion of the occurrence

⁴⁹ EASA, *Commission Regulation (EU) No 965/2012, CAT.GEN.MPA.105 (a), 2012.*

during a subsequent flight can adversely affect one's memory. In addition, such a discussion might distract them from their primary duties in flight. Procedures with regard to safeguarding relevant information for an investigation should be explicitly laid down within a company.

Securing cockpit voice recorder data

During the climb out, the two pilots discussed if they had to secure the CVR data. They consulted the Operations Manual where it is stated: 'Only stop the CVR in flight when deemed necessary to secure data.' This procedure leaves room for individual interpretation and is not corresponding with European regulation, which prescribe that flight recorders are not disabled or switched off during flight.⁵⁰ The pilots stated that their interpretation of the occurrence was such that the CVR data had no added value compared to the already by air traffic control recorded conversations between air traffic control and the flight crew. This is a worrying statement. It is common knowledge that Air Traffic Control data does not reveal communication between flight crew members. The flight crew therefore decided not to secure the CVR data. Upon arrival at the destination airport the CVR recording, which had a duration of two hours, was overwritten and therefore the CVR data covering the event was not available for the investigation.

Due to the unavailability of the CVR data, the investigation team was unable to determine the conversation between the pilots prior, during and after the occurrence. The Dutch Safety Board emphasises the importance of CVR data to establish facts as part of an air safety investigation into the cause of an occurrence; its availability is of value to be able to learn optimally from incidents.

In case of a serious incident, the operator and flight crew should act in accordance with Regulation (EU) No 965/2012 on Air Operations and do the utmost to ensure the CVR recordings are preserved for the purpose of the air safety investigation.

After an abnormal situation, that affects safety, the Board expects a captain to first consult the company for further actions. The flight crew's decision to immediately continue the flight resulted in a missed opportunity to confer the situation with the company. Also, this decision led to the circumstance that it was not possible to secure the cockpit voice recorder data. Due to this, the Dutch Safety Board lacked information and was therefore hampered in its investigation.

The airline's procedures were not effective to have flight crews timely notify the airline about the occurrence and preserve the cockpit voice recorder recordings.

Cockpit voice recorder data is crucial to support the investigation into the decision making process of the flight crew. In this case, to understand why the flight crew believed they were entering the runway and, thereafter, how the decision was made to depart without reporting the serious incident to the company first.

⁵⁰ EASA, Commission Regulation (EU) No 965/2012, CAT.GEN.MPA.105 (a.10), 2012.

3.6 EU regulations concerning CVR recording duration

The European regulations regarding the duration of the CVR recordings have been amended to ensure that CVRs will be capable of recording the preceding 25 hours instead of 2 hours. However, as this requirement only applies to aeroplanes with a certificate of airworthiness issued on or after 1 January 2022, it will take decades before this is implemented across the whole existing commercial air transport fleet. Therefore, to improve safety, the installation of the update of the memory of the existing cockpit voice recorders to a storage capacity of 25 hours, is deemed necessary the coming years.

3.7 Aerodrome design regulations

The centre line marking from C1 towards the beginning of Runway 18C was broken and therefore did not comply with CS ADR-DSN.L.555 (see Paragraph 2.9.3).

Broken taxiway centre line markings can be found at different locations at Schiphol, as a result of a 2006 Runway Safety Team evaluation of the runway system, focusing on runway incursions. One of the recommendations was to implement broken taxiway centre line markings near runways to prevent runway incursions from occurring, in case of low visibility circumstances. In 2014, EASA introduced certification specifications and the related guidance material for aerodromes design (CS ADR-DSN.L.555), to which the broken taxiway centre line markings from C1 towards the beginning of Runway 18C were not compliant. This deviation at Schiphol was included in the Deviation Acceptance and Action Document (DAAD) and accepted by the competent authority, the Dutch Human Environment and Transport Inspectorate (ILT).

The DAAD has been established to compile evidence provided to justify the acceptance of deviations from the EASA certification specifications. The DAAD items are current deviations which could not (yet) be classified as a case of Equivalent Level of Safety or Special Condition. The DAAD is a separate document, which is reviewed each year, meant to be used as a dynamic agreement between the aerodrome operator and the competent authority to 'track' the status of all deviations requiring further attention. The deviations listed in the DAAD are accepted by the ILT, but have not been dealt with by the aerodrome operator to the satisfaction of the ILT. Each item in the DAAD, by definition, comes with a future action by the aerodrome operator and an end date for the final classification into an Equivalent Level of Safety or Special Condition.

The broken centre line marking from C1 towards the beginning of Runway 18C did not comply with CS ADR-DSN.L.555, but it was included in the Deviation Acceptance and Action Document and therefore accepted by the Human Environment and Transport Inspectorate.

3.8 Follow-up on previous recommendations

The Dutch Safety Board previously investigated an occurrence that took place at Amsterdam Airport Schiphol on 10 February 2010, when a Boeing 737 took off from a taxiway. Corresponding causal factors, as in the present occurrence, played a role in the 2010 occurrence. The final report was published in December 2011. The report contains recommendations to Amsterdam Airport Schiphol, Air Traffic Control the Netherlands, European Union Aviation Safety Agency and the Federal Aviation Administration.

Amsterdam Airport Schiphol and Air Traffic Control the Netherlands were recommended to prepare a joint risk assessment of air traffic taxiing near takeoff and landing runways and adjust procedures in line with the findings. Amsterdam Airport Schiphol was also recommended to change the infrastructure so that all taxiways at air traffic control's disposal have green centre line lights indicating only the route(s) to be followed. Air Traffic Control the Netherlands was also recommended to ensure that entries without green centre line lights were no longer used during darkness if an aeroplane had to taxi across a taxiway, until the risk assessment had been completed and the resulting outcomes had been implemented.

The European Union Aviation Safety Agency (EASA) and the Federal Aviation Administration were recommended to increase the minimum recording time of the cockpit voice recorder (CVR) in order to better safeguard the availability of data for the purpose of incident and accident investigation.⁵¹

Responses

In cooperation with the partnership Schiphol Safety Platform⁵² (in Dutch: Veiligheidsplatform Schiphol (VpS)), both Air Traffic Control the Netherlands as well as Amsterdam Airport Schiphol started with the follow-up of the recommendations. However, over time focus and resources shifted to the risks involved in pushback operations. The commitment to act upon the risk of taxiway takeoffs was not followed neither challenged. As a consequence, potential mitigations that might have resulted from the follow-up of the occurrence in 2010 were not developed further and therefore could not help prevent reoccurrence of taxiway takeoffs.

On 21 December 2012 the VpS published the report resulting from the risk assessment.⁵³ This risk assessment did not provide clear guidance on how to mitigate the risk of taxiway takeoffs. Furthermore, a clear, structured and integral follow-up of the outcomes of this report did not take place. After the implementation of the Ground Movement Safety Team in 2016, solving the hazards involved in push-back operations were deemed more urgent; resources were diverted to mitigate those hazards.

⁵¹ As stated in 3.6, the European regulations regarding the duration of the CVR recordings have been amended to ensure that CVRs will be capable of recording the preceding 25 hours instead of 2 hours.

⁵² The Schiphol Safety Platform was a partnership of companies that play a role in the aviation process at Amsterdam Airport Schiphol. The objective of their collaboration was to guarantee safety at Schiphol and to continuously and integrally improve it.

⁵³ Veiligheidsplatform Schiphol, *Eindrapport, Risico-inventarisatie voor taxiënd verkeer nabij start- en landingsbanen op Schiphol, 12-RA-MD-060, version v1.00*, December 2012.

The occurrence in 2010 led, among other things, to awareness training regarding the phenomenon of transfer of communication in relation to transfer of control within Air Traffic Control the Netherlands. No procedural or infrastructure changes did take place.

The actions taken by Air Traffic Control the Netherlands and Amsterdam Airport Schiphol in response to the recommendations of the Dutch Safety Board regarding the investigation into the takeoff from a taxiway in 2010 did not prevent reoccurrence.

3.9 Relationship with the “Schiphol air traffic safety” investigation

In the report *Air traffic safety at Schiphol* the Dutch Safety Board concluded that Schiphol is a complex airport, both in terms of its infrastructure (such as numerous taxiways, runway exits and entries) and in terms of how air traffic is handled. This complexity entails risks for air traffic. The taxi route that the crew followed in this case cannot be described as complex. In hindsight, it can be stated that the use of a runway and a parallel outer taxiway (for departing traffic from that runway) involves the risk, although small, of assuming the inner taxiway is the runway.

As the above-mentioned report states, additional risks are posed by traffic crossing the takeoff and landing runways each day. In this case, air traffic control used Taxiway C for the aeroplane to taxi to the holding point of Runway 18C, because Taxiway D was used for incoming traffic that had crossed Runway 18C/36C at W5. Therefore, by using W5 the outer Taxiway C had to be used, which created the abovementioned risk.

4 CONCLUSIONS

In the morning darkness the flight crew interpreted Taxiway D as the designated Runway 18C and started the takeoff roll. They initiated the takeoff roll from a taxiway, because they had misinterpreted taxiway markings and environmental cues.

As Taxiway D was used for incoming traffic, air traffic control used parallel Taxiway C for the aeroplane to taxi to the holding point of Runway 18C. While taxiing on Taxiway C, the crew was not fully aware of the exact position of the aeroplane. The taxiway centre line markings did not provide continuous guidance; the yellow taxi line at C1 was uninterrupted towards Taxiway D and interrupted towards Runway 18C. The line became clearly visible when the crew switched on the landing lights. Following the only taxiway guidance that was clearly visible to the crew, i.e. the yellow line from C1, the aircraft ended up on Taxiway D. Cues such as the yellow, thin and continuous centre line marking and green centre line lights, were not recognised by the flight crew as cues of being on a taxiway. Environmental cues, such as signs indicating Runway 18C, enhanced the perception of the crew that they were lined up on Runway 18C, instead of on Taxiway D.

Several factors contributed to this serious incident.

- The use of outer Taxiway C in combination with an early issuance of the takeoff clearance, introduced a risk of taxiing incorrectly.
- The runway controller issued the takeoff clearance when prompted by the crew with a ready for departure notification. Thereafter he shifted his attention to other traffic and did not observe the line-up of the aeroplane on Taxiway D. Based upon the operational situation and his expert judgement, the runway controller did not perceive his reduced focus on the Boeing 737-800 as a risk, especially because it concerned a home based carrier.
- When taxiing from Taxiway C towards the holding position of Runway 18C, the taxiway centre line markings did not provide continuous guidance, as the design of these markings was focused on preventing runway incursions during low visibility operations.

In addition to the above main conclusion, the Dutch Safety Board draws the following conclusions.

A takeoff from a taxiway is a hazardous situation, since a taxiway is not intended for takeoffs. In this case, a safety barrier worked as the flight crew was instructed by the runway controller to stop. Furthermore at the moment the Boeing 737-800 initiated the takeoff from Taxiway D, no other aeroplanes or vehicles were present on that taxiway, so that the consequences of the serious incident were limited in time.

After an abnormal situation, that affects safety, the Dutch Safety Board expects from flight crew members to consult the company for further actions. The flight crew's decision to immediately continue the flight resulted in a missed opportunity to confer the situation with the company. Also, this decision led to the circumstance that it was not possible to secure the cockpit voice recorder data. Due to this, the Dutch Safety Board lacked information and because of this all parties involved were not able to learn optimally from this occurrence.

The airline's procedures were not effective to have flight crews timely notify the airline about the occurrence and preserve the cockpit voice recorder recordings. Cockpit voice recorder data is crucial to support the investigation into the decision making process of the flight crew. In this case, to understand why the flight crew believed they were entering the runway and, thereafter, how the decision was made to depart without reporting the serious incident to the company first.

The broken centre line marking from C1 towards the beginning of Runway 18C did not comply with CS ADR-DSN.L.555, but it was included in the Deviation Acceptance and Action Document and therefore accepted by the Human Environment and Transport Inspectorate.

Due to restrictions of the logging system, it cannot be confirmed that a part of the taxiway centre line lights was not illuminated.

The actions taken by Air Traffic Control the Netherlands and Amsterdam Airport Schiphol in response to the recommendations of the Dutch Safety Board regarding the investigation into the takeoff from a taxiway in 2010 did not prevent reoccurrence.

5 RECOMMENDATIONS

This investigation revealed that the airline's procedures were not effective to have flight crews timely notify the airline about the occurrence. Consequently, the crew continued the flight without discussing the safety implications of the occurrence and the follow up actions with the airline. Furthermore, continuing the flight also prevented that the cockpit voice recorder recordings were preserved.

The lack of cockpit voice recorder data hampered the investigation into the decision making process of the flight crew. In this case, to understand why the flight crew believed they were entering the runway and, thereafter, how the decision was made to continue the flight after the rejected takeoff.

The Dutch Safety Board has conducted other investigations, where the cockpit voice recorder recordings were not available. The Board emphasises the importance of cockpit voice recorder data to determine the facts as part of an air safety investigation into the cause of an occurrence and learn from it.

The European regulations regarding the duration of the cockpit voice recorder recordings have been amended to ensure that cockpit voice recorders will be capable of recording the preceding 25 hours instead of 2 hours. This requirement only applies to aeroplanes with a certificate of airworthiness issued on or after 1 January 2022.

The Dutch Safety Board therefore issues the following recommendations to:

Transavia

Develop new procedures, or clarify existing procedures, that guide flight crews to consult with their airline at the earliest convenient moment, about abnormal situations that have had or may have significant flight safety implications, such as an aborted takeoff from a taxiway. Communicate to flight crews what range of occurrences are meant by these situations.

All Dutch airlines

Replace or upgrade existing cockpit voice recorders currently in use to accommodate for a storage capacity of at least 25 hours on aeroplanes with a certified maximum takeoff mass of more than 27,000 kg and with a certificate of airworthiness issued after 31 December 2001, before 2028.

The International Air Transport Association

Encourage the members of IATA to replace or upgrade their existing cockpit voice recorders currently in use to accommodate for a storage capacity of at least 25 hours on aeroplanes with a certified maximum takeoff mass of more than 27,000 kg and with a certificate of airworthiness issued after 31 December 2001.

The European Union Aviation Safety Agency

Mandate that EU registered commercial air transport aeroplanes, with a certified maximum certificated takeoff mass of more than 27,000 kg, and with a certificate of airworthiness issued after 31 December 2001, to be equipped with a cockpit voice recorder capable of retaining recorded data for at least 25 hours; implement this requirement as of 1 January 2028.

The Integral Safety Management System Schiphol

Foster a work environment at Amsterdam Airport Schiphol that encourages the stakeholders of the Integral Safety Management System to challenge each other about decisions that have had or may have significant safety implications.

COMMENTS ON DRAFT REPORT

In accordance with the Dutch Safety Board Act, a draft version (without recommendations) of this report was submitted to the parties involved for review. The following parties have been requested to check the report for any factual inaccuracies and ambiguities:

- Air Traffic Control the Netherlands
- Amsterdam Airport Schiphol
- European Union Aviation Safety Agency
- Flight crew members
- Human Environment and Transport Inspectorate
- Ministry of Infrastructure and Water Management
- National Transportation Safety Board
- Transavia

The responses received, as well as the way in which they were processed, are set out in a table that can be found on the Dutch Safety Board's website (www.safetyboard.nl). Those responses can be divided into the following categories:

- Corrections and factual inaccuracies, additional details and editorial comments that were taken over by the Dutch Safety Board (insofar as correct and relevant). The relevant passages were amended in the final report.
- Not adopted responses; the reason for this decision is explained in the table.

LEAFLET HOTSPOT C1



Additional HOTSPOT information

In June 2020, an **extra hotspot (C1)** was defined near the beginning of runway 18C and taxiway W1.

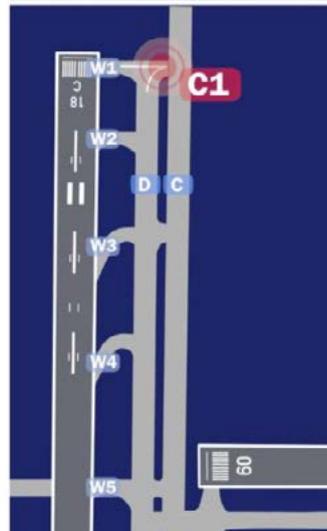
Main reason to incorporate this hotspot was creating awareness amongst flight crew **to prevent a taxiway takeoff from taxiway D.**

Other implemented measures to enhance awareness are:

- The use of taxiway D as standard taxi-route for outbound traffic for runway 18C;
- Continuous centreline marking from taxiway C via W1 to runway 18C and;
- Applying direction markings on taxiway C1, indicating the direction to runway 18C, intersection W1.

In the future, runway guard lights will be installed on various take-off intersections at Schiphol Airport, amongst others at runway 18C, intersection W1.

With all these measures, the risk of a taxiway takeoff will greatly be reduced.



This leaflet is initiated by ATC the Netherlands, and in cooperation with the Runway Safety Team Schiphol, because of the belief that there should be mutual exchange of information between organisations and airlines to assist in enhancing runway safety.

If you wish to receive or share further information regarding this topic, please don't hesitate to contact us via safety@lvnl.nl. Your feedback on this matter is highly appreciated.



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