



AIR ACCIDENTS INVESTIGATION INSTITUTE
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CZ-19-0317

FINAL REPORT

**Investigation of a serious incident
a collision of two airplanes
Boeing B737-800 registration OK-TVW
and Boeing B737-8CX registration N277EA,
at Praha/Ruzyně airport, 17. 5. 2019**

Prague
June 2020

This investigation was carried pursuant to Regulation (EU) of the European Parliament and of the Council No. 996/2010, Act No. 49/1997 Coll., on civil aviation, and Annex 13 to the Convention on International Civil Aviation. The sole and only objective of this report is the prevention of potential future accidents and incidents free of determining the guilt or responsibility. The final report, findings, and conclusions stated therein pertaining to aircraft accidents and incidents, or possible system deficiencies endangering operational safety shall be solely of informative nature and cannot be used in any other form than advisory material for bringing about steps that would prevent further aircraft accidents and incidents with similar causes. The author of the present Final Report states explicitly that the said Final Report cannot be used as grounds for holding anybody liable or responsible as regards the causes of the air accident or incident or for filing insurance claims.

The report has been translated and published by the Air Accidents Investigation Institute to make its reading easier for English-speaking people. As accurate as the translation may be, the original text in Czech is the work of reference.

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Glossary of abbreviations

A-SMGCS	Advanced Surface Movement Guidance and Control System
ACAS	Airborne Collision Avoidance System
ADC	Aerodrome Chart
AIP	Aeronautical Information Publication
AIRAC	Aeronautical Information Regulation and Control
AOC	Aerodrome Obstacle Chart
ATC	Air Traffic Control
ATFM	Air Traffic Flow Management
ATPL	Airline Transport Pilot Licence
ATIS	Automatic Terminal Information Service
ATS	Air Traffic Services
BKN	Broken
CAT I (II/III)	Instrument Landing Category
CPT	Captain
CRM	Crew Resource Management
CTOT	Calculated Take-Off Time
CVR	Cockpit Voice Recorder
DTMB	International Airport Monastir – Tunis
EASA	European Union Aviation Safety Agency
EGLL	International Airport Heathrow
FCOM	Flight Crew Operating Manual
FDR	Flight Data Recorder
FO	First Officer
G	Maximum Wind Gust Speed Indicator
HP	Holding Point
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
IR	Instrument Rating
LKPR	Public International Aerodrome Prague Ruzyně
LPMA	International Aerodrome Madeira
LRST	Local Runway Safety Team
METAR	Aviation Routine Weather Report
NIL	None
NOSIG	No Significant Change
Q	Altimeter sub-scale setting to obtain elevation when on the ground
RFFS	Rescue and Fire Fighting Service
RWY	Runway
SCT	Scattered
SERA	Standardised European Rules of the Air

SOP	Standard Operating Procedure
SSR	Secondary Surveillance Radar
TAF	Terminal Aerodrome Forecast
THR	Threshold
TORA	Takeoff Run Available
TRI	Type Rating Instructor
TWR	Tower
TWR-GEC	Tower - Ground executive controller
TWR-TEC	Tower - Tower executive controller
TWY	Taxiway
UTC	Co-ordinated Universal Time
ÚZPLN	Air Accidents Investigation Institute
Z	Zulu time indicator

Used unites

h	Hour (s)
kg	Kilogram (s)
km	Kilometre (s)
KT(kt)	Knot (1,852 km.h-1)
m	Metre (s)
MHz	Megahertz
min	Minute (s)
mm	Milimetre (s)
s	Second

A) Introduction

Boeing B737-800 aircraft

Operator: Smartwings, a.s.
Aircraft manufacturer and type: Boeing, B737-800
Identification mark: OK-TVW
Call sign: TVS 5FI

Boeing B737-8CX aircraft

Operator: Smartwings, a.s.
Aircraft manufacturer and type: Boeing, B737-8CX
Identification mark: N277EA
Call sign: TVS 2858A
Location: LKPR, intersection of TWY E and F
Date and time: 17. May 2019, 10:38:46 (all times are UTC)

B) Synopsis

On 17 May 2019, while taxiing on TWY F to the place of take-off from RWY 06 at LKPR, the B737-800 aircraft, registration OK-TVW, hit with the end arch of the right half of its wing (winglet) the B737-8CX aircraft, registration N277EA, in the second holding position in the queue on TWY E. During the collision, the edge of the N277EA aircraft stabiliser and the winglet leading edge of the OK-TVW aircraft were mechanically damaged. Neither aircraft was airworthy without being repaired. The operator reported the serious incident to the AAll through the mandatory occurrence reporting system. Based on the decision regarding authorisation with ref. No. 35/P-18/2/2016, on 20 May 2019, the AAll delegated the investigation of causes to the Safety Department of Smartwings, a.s. On 21 June 2019, with regards to international standards and recommended practices, the AAll decided to investigate the causes of the serious incident using its own commission consisting of:

Investigator-in-charge: Ing. Stanislav Suchý
Commission member: Ing. Zdeněk FORMÁNEK
Ing. Ivo Bartoň – consultant

The Final Report was issued by:

AIR ACCIDENTS INVESTIGATION INSTITUTE
Beranových 130
199 01 PRAGUE 9

On 8 June 2020

This Final Report consists of the following main parts:

- 1 Factual Information
- 2 Analyses
- 3 Conclusions
- 4 Safety Recommendations

5 Annexes

1 Factual Information

1.1 History of the Flight

At LKPR, there was morning peak time traffic. RWY 06 was in use. The N277EA aircraft was assigned for flight No. TVS 2858 from LKPR to DTMB.

The OK-TVH aircraft was originally assigned for flight No. TVS 5FI from LKPR to LPMA. While the flight crew were preparing for the flight, the operational control centre interchanged the aircraft for OK-TVW; the cabin crew were also changed, some members of the new crew were summoned from standby duty.

1.1.1 N277EA aircraft

N277EA started taxiing from stand No. 14 for take-off from RWY 06 at 10:30. As instructed by TWR-GEC, it was gradually taxiing on TWY H, L, D, F and E. At 10:34:20, it switched to the TWR-TEC frequency. At 10:37:40, it turned to TWY E where it then stopped at 10:38:15 (approx. 75 m behind B737-800/TVS 3BD, which was holding the position HP CAT I, and reported readiness to enter RWY 06) – see the situation in Fig. 1. It was standing approx. 8 m in front of the horizontal marking of the intermediate holding position on TWY E – see Fig. 2.

At 10:39:08, the N277EA aircraft crew reported on the TWR-TEC frequency that their tailplanes had been crashed into when another aircraft was passing by.

1.1.2 OK-TVW aircraft

OK-TVW was delayed on arrival from the previous destination. The crew were allocated a calculated take-off time (CTOT 10:35) for the flight from LKPR to LPMA. The aircraft started taxiing from stand No. 60 for take-off from RWY 06 at 10:33, as instructed by TWR-GEC to taxi on TWY D, F and E. At 10:36:40, it switched communication to the TWR-TEC frequency.

At 10:38:18, at the place immediately in front of the turn-off curve to TWY E, the crew asked TWR-TEC whether their take-off could be performed from the intersection of RWY 06 with TWY F.

At 10:38:21, TWR-TEC issued clearance and instructed the crew to continue on TWY F to the holding position on RWY 06. The crew continued taxiing at low speed on TWY F towards RWY 06, slightly to the right of the TWY F axis – see the situation in Fig. 1.

At 10:38:26, the crew noticed that B737-800 at HP CAT I obtained clearance to enter RWY 06 and started moving at 10:38:37.

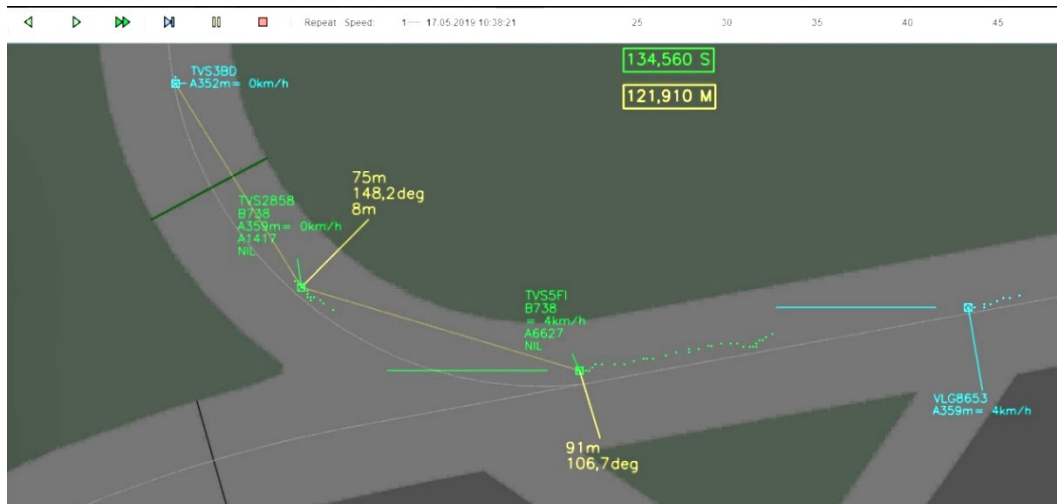


Fig. 1 – Situation at 10:38:21 – OK-TVW cleared to continue on TWY F.

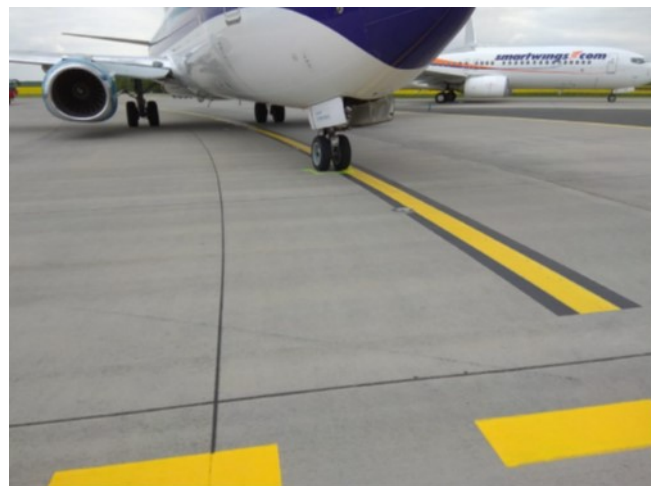


Fig. 2 – Position of N277EA standing 8 m in front of the horizontal marking of the intermediate holding position on TWY E.

At 10:38:46, when OK-TVW was taxiing on TWY F, and passing by the tailplanes of N277EA, it crashed with its winglet leading edge of the right half of its wing to the stabiliser of N277EA. For the illustration of the aircraft positions see Fig. 3 and 4. OK-TVW flight crew stopped the aircraft after the collision.

At 10:39:14, the OK-TVW crew responded to the previous report on the crash to N277EA and reported on the TWR-TEC frequency that it was them. When TWR-TEC inquired what happened, the OK-TVW crew specified that when passing by N277EA, they chipped off a piece of the N277EA stabiliser and both the aircraft must thus return.

At 10:40, TWR-TEC instructed both the aircraft to stay on the spot and subsequently advised them that the RFFS unit had been sent there.

The RFFS unit then secured the place of collision. In cooperation with the RFFS commander, the place of incident was investigated, the position of damaged N277EA components was documented, and the final position of both the aircraft located. As soon as these operations were completed, both the aircraft were pulled to the stands where the passengers got off the aircraft.



Fig. 3 – Situation at 10:38:46 in aircraft collision.



Fig. 4 – Situation after the collision and stopping of OK-TVW.

1.1.3 OK-TVW crew statement

1.1.3.1 Captain (pilot taxiing)

The captain came to the briefing office from the hotel some 40 minutes before his duty because this flight was supposed to be a check flight before obtaining the rating for flights to the Madeira aerodrome. During the preflight briefing of the flight crew lasting 20–25 minutes, the captain together with the FO, acting as the flight instructor, talked through the flight tactics, meteorological phenomena along the route, and possible risks at LPMA which could be encountered during this or future flights. They then briefed the cabin crew.

Upon boarding, they began a standard preflight preparation. As the passengers were boarding, ATC (Delivery) gave them a flight clearance based on which they started a departure briefing, including a taxi briefing. When being given flight clearance, they were also informed about the allocated departure slot (CTOT 10:35). When they started taxiing, there were still 10–15 minutes left.

When they were on TWY F, they saw aircraft in front of them, taxiing on TWY E. The instructor suggested they should continue on TWY F to THR RWY 06 and thus overtake

aircraft holding on TWY E. The captain did not remember the exact words said by the instructor, but recalled that they were running out of the departure slot and such a decision seemed reasonable at that moment so they continued taxiing after obtaining clearance to continue on TWY F to THR RWY 06 issued by ATC.

The captain commented on the situation before the collision:

“Of course we saw another airplane on TWY E but i believed in judgement of my much more experienced copilot (concerning distance between our aircrafts) and I thought as well that we will be really able to pass this aircraft (as far i remember i recieved confirmation from my instructor during pass that we are clear, and as you know pilot sitting on the left side is unable to see right wing). But just to be sure I steered little bit left of yellow line 15-20 m before actual pass to have whole airplane left of centerline and give us little bit more space. And i think i even informed my instructor about this maneuver saying out loud „just to be sure”.

He further said: *“Unfortunately as you know it was not enough. We have hit other airplane. I have stopped the airplane, instructor informed me that he misjudged the distance between our wing and other airplane stabiliser”.* Afterwards, they informed ATC and then the passengers of the situation.

1.1.3.2 Pilot-in-command – instructor (pilot monitoring)

He carried out the preflight procedures exactly in accordance with the Boeing SOP, including switching on the voice recorder in the pilot cabin. When passengers were boarding, the handling services dispatcher faced some problems related to the lack of staff for luggage loading, absence of the luggage trolley, and preparation of an air cargo bill. They were also waiting for the airport staff to remove the boarding bridge. Because of these operational complications, they were under time pressure with regards to the departure slot and possible delay with additional consequences. Having finished aircraft preparation for take-off, they conducted before take-off procedure and check-list. The aircraft was pushed back, engines were started, and the crew finished the before taxi procedure, the check-list, and obtained clearance for taxiing to holding position E for RWY 06.

He commented on the course of taxiing as follows: *„Captain began taxiing. We were moving slowly in a sequence of the airplanes taxing in front of us. The movement was relatively slow, as there was quite heavy ground traffic plus continues landing traffic flow. As we were in sequence approaching to intersection E, due to SLOT concern I offered to the captain to request taxi via F to holding point for take-off. I was motivated simply with the better possibility to comply our departure with the already running SLOT, as TWR could give us priority to depart before the traffic on E. Captain did not negate my offer. So, I requested ATC (Tower) to continue via TWY F to holding point RWY 06. My request was granted. The aircraft was cleared to continue to taxi to HLDG point RWY 06 via F and captain was slowly taxing. At that time from my perspective there was a safe clearance between our airplane and the airplane being on the position on TWY E. I have clearly heard the clearance for the airplane ahead on E to taxi to holding point E RWY 06. And I have clearly heard the clearance for the airplane staying in front of that airplane to line up. I as well have seen that airplane moving to line up the RWY. I saw that airplane ahead on TWY E has a clear way to continue closer to RWY”.*

He commented on passing the aircraft on TWY E as follows: *„As we were slowly approaching the intersection E, I was still confident with the clearance. I was as well estimating aircraft on the right on E started moving towards to the RWY as it had a clear*

way. The Captain slowed down even more and asked me for the right side clearance conformation. At that moment the clearance in my opinion was safe. So, I have confirmed. I continued watching the right side separation as we were passing TWY E via F. The Captain informed me that he will deviate slightly left of taxiway centerline to increase the clearance.”

He further said: „We have already passed the E with the cockpit position and it became more and more difficult for me to watch the clearance. At the moment the captain was initiating slight turn to deviate left of centerline and our right winglet turned, I noticed some strange and very small object falling down. I commanded immediately to stop the aircraft. Captain abruptly used brakes and stopped. I informed the captain that we might have collided with the other aircraft. At the beginning I could not exactly identify what happened, because, I haven't felt any hitting. Moreover the vision was blocked by our right winglet. So, I asked the captain to move a meter forward to be able better realize what happened. When we moved a meter forward, I was able to identify the object on the ground as a static discharger from the stabilizer of the aircraft on TWY E. It became obvious that we collided with the aircraft on E“.

The instructor then attempted to establish a radio communication with ATC to inform TWR. Due to the large quantity of ongoing communications on the TWR frequency, it took a little while before he was able to inform TWR about the fact that they had a collision with another aircraft. He also overheard the aircraft on TWY E reporting a possible collision to ATC. He thus also informed the aircraft crew on TWY E.

Having made sure the passengers were not in danger and no major damage occurred so there was no reason for emergency or priority calling and performance of any such procedures used for emergencies on board, he informed passengers and explained the situation, including all the relevant details, both in Czech and English, and apologised to them for any inconvenience. He called the senior cabin crew member to the pilot cabin and explained what had happened and what steps would follow. The atmosphere in the passenger cabin was very calm and the passengers were patient.

The crew then started the auxiliary power unit and switched off the engines. When the first RFFS unit arrived, they informed the crew that their aircraft was not damaged and the aircraft with which they had a collision was only slightly damaged at the edge of the left rear stabiliser. After the ground teams carried out all the checks, the aircraft was pulled back to the boarding bridge and the passengers disembarked.

1.1.4 N277EA crew statement

The N277EA pilot-in-command said that the crew decided to make use of a larger distance separation from the first aircraft which was in the holding position CAT I on TWY E due to the reduced effects of exhaust gases. They stopped approx. 8 m in front of the horizontal marking of the intermediate holding position on TWY E. He further said that the collision took place at the moment when he was about to release the breaks and move to the new position as soon as the holding position CAT I would be vacated by the previous departing aircraft.

1.2 Injuries to Persons

1.2.1 OK-TVW

Injury	Crew	Passengers	Other persons (inhabitants, etc.)
Fatal	0	0	0

Serious	0	0	0
Light/No injury	0/6	0/159	0/0

1.2.2 N277EA

Injury	Crew	Passengers	Other persons (inhabitants, etc.)
Fatal	0	0	0
Serious	0	0	0
Light/No injury	0/7	0/157	0/0

1.3 Damage to Aircraft

As a result of the collision, N277EA had a part of the end arch and the primary left stabiliser structure with dimensions of 120 x 120 mm chipped away – see Fig. 4. At the same time, the external electrostatic discharger at the trailing edge of the stabiliser was broken off – see Fig. 5.

As a result of the collision, OK-TVW had a damaged winglet leading edge of the right half of its wing approx. 0.4 m from the upper edge. The surface on the outside of the winglet was scratched in a downward direction against the direction of aircraft motion, which was possibly caused by the structure spring back at the moment of the collision – see Fig. 6.

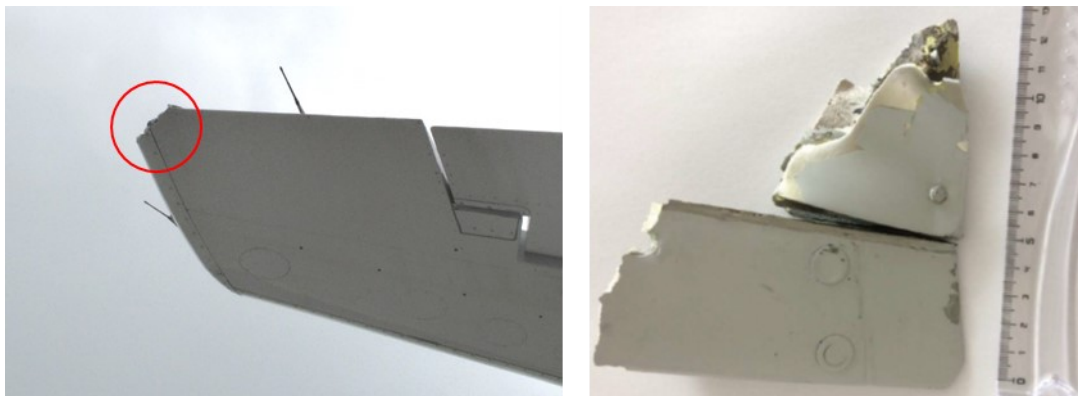


Fig. 5 – Damage to the N277EA stabiliser edge

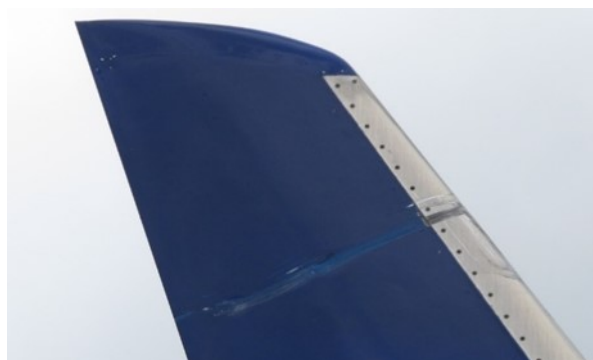


Fig. 6 – Damage to the OK-TVW winglet edge

1.4 Other Damage

NIL

1.5 Personnel Information

OK-TVW aircraft crew

1.5.1 Captain

Male, age:	38 years
Licence ATPL(A):	valid
B737 300-900/IR rating:	valid
Class 1 medical certificate:	valid

Flying experience:

Number of hours flown:	7,795 h
Pilot proficiency check:	28 January 2019
Annual line check:	28 December 2018

1.5.2 First officer

Male, age:	49 years
Licence ATPL(A):	valid
TRI (B737 300-900) rating:	valid
Class 1 medical certificate:	valid

Flying experience:

Number of hours flown:	12,477 h
Pilot proficiency check:	10 May 2019
Annual line check:	14 May 2019

Based on the Company Flight Command, he was appointed pilot-in-command and instructor for the captain who was in the process of acquiring rating for the Madeira aerodrome (category C aerodrome). He was the pilot monitoring during the event flight. Both the pilots had a sufficient rest: CPT 19:20 hrs and FO 16:15 hrs.

N277EA aircraft crew

1.5.3 Captain

Male, age:	37 years
Licence ATPL(A):	valid
B-737, CL-65, ERJ-170/190 rating:	valid
Class 1 medical certificate:	valid

1.5.4 First officer

Male, age:	30 years
Licence ATPL(A):	valid
B-737, CL-65, HS-125 rating:	valid
Class 1 medical certificate:	valid

1.6 Aircraft Information

1.6.1 Boeing 737-800 (TVS 5FI)

Registration:	OK-TVW
Manufacturer:	Boeing
Type:	Boeing B737-86Q
Manufactured in:	2004
Serial number:	30295

1.6.2 Boeing 737-800 (TVS 2858)

Registration:	N277EA
Manufacturer:	Boeing
Type:	Boeing B737-8CX
Manufactured in:	2002
Serial number:	32359

At the time of the incident, both the aircraft had the EASA Standard Certificate of Airworthiness.

1.7 Meteorological Information

1.7.1 METAR LKPR

The METAR at the time of the incident describes the weather at LKPR:

METAR LKPR 171030Z 13005KT 090V160 9999 SCT027 BKN044 13/07 Q1010 NOSIG

The level of clouds above the aerodrome had a colour similar to the critical part of aircraft standing on TWY E, which could have contributed to the deterioration of the possibility of distance estimation.

1.7.2 TAF LPMA Report

The TAF report presents the weather at the destination aerodrome:

TAF LPMA 171100Z 1712/1812 02018KT 9999 SCT016 SCT030 TEMPO 1712/1812 02022G35KT

TAF LPMA 171700Z 1718/1818 02015KT 9999 SCT016 SCT030 TEMPO 1718/1818 02020G30KT

1.8 Radio Navigational and Visual Aids

Taxiing in the area of the TWY F and TWY E intersection is guided by taxiway centreline marking, lighted information markers with taxiway marking, and taxiway side-strip marking. Holding positions CAT I and CAT II/III are marked on TWY E at appropriate distances from the edge of RWY 06/24.

Intermediate holding positions designed for safe passage of aircraft with priority taxiing when vacating RWY 24 after landing are marked on both the taxiways in the vicinity of the TWY F and TWY E intersection. The purpose of these intermediate holding positions during taxiing is to provide for safe passage in front of the holding aircraft; nevertheless, in case of holding at such a place, safe passage behind the holding aircraft is not ensured in any way. The crew taxiing in a queue of departing aircraft on TWY E may erroneously interpret the marking as a holding position behind the previous aircraft in the departure sequence.

1.9 Communications

At the time of the incident, both the aircraft were in contact with the Prague Ruzyně aerodrome control tower on the 134.560 MHz frequency.

1.10 Aerodrome Information

The Prague/Ruzyně aerodrome is an international aerodrome for commercial and non-commercial air transportation, and is equipped for IFR flights. It has two runways marked 06/24 and 12/30. Runway 24 is equipped for precision instrument approach up to the

minimum category of ICAO CAT IIIb. On the event day, at the time of the incident, RWY 06 was in use, operated according to Art. 2.20.9.5 of AIP CR in the mode of *High Intensity Runway Operations*, requiring that crews of medium type class aircrafts should primarily use the intersection with TWY E (TORA 3,060 m) for take-off.

At the place of the incident, taxiway TWY F is 25.5 m wide and is fitted with 9.5m-long taxiway shoulders for the total width of 44.5 m. Taxiway TWY E, including taxiway shoulders, is 50 m wide. Visual navigational aids on TWY F and TWY E consist of centreline and side-strip marking, taxiway side-strip markers, taxiway centreline markers and information markers. For the intersection diagram see the figure given in Annex 1. The ADC LKPR map did not contain any limitations, warnings or instructions regarding the limit for the minimum distance between the aircraft.

1.11 Flight Recorders and Other Means of Recording

1.11.1 Flight Recorders

For the purpose of investigation, the records from the OK-TVW flight data recorders and cockpit voice recorders were collected and analysed. The CVR record makes it clear that it started recording from the moment of the briefing before taxiing (after oil pressure build-up in engine No. 2).

Transcription of communication between OK-TVW crew members at the critical decision-making moment:

CPT let's move it here and let's go first

FO we should pass

FO yeah I'm watching that

CPT I'm gonna go little bit to the left

FDR and CVR records from N277EA were not available. According to the crew, the aircraft was on hold and the crew did not know there would be a need to provide CVR for further analysis.

1.11.2 ATS records

The relevant records of radio communication between the aircraft and TWR-TEC on the 134.560 MHz frequency, synchronised with A-SMGCS records, were used for the purpose of investigation.

1.12 Serious Incident Location Description

The collision took place at the TWY F and E intersection in the direction towards RWY 06. N277EA was on TWY E in the position approx. 8 m in front of the marking of the intermediate holding position. When OK-TVW was trying to bypass it on TWY F, it slightly deviated from the TWY F centreline marking. The broken-off parts of the stabiliser and electrostatic discharger were found at the TWY F and E intersection.

1.13 Medical and Pathological Information

The persons participating did not report any health complaints. Immediately after the incident, both the crews were subjected to an indicative alcohol breath test and to the test for other addictive substances with a negative outcome.



Fig. 8 – Position of OK-TVW after stopping on TWY F.

1.14 Fire

NIL

1.15 Search and rescue

NIL

1.16 Tests and Research

1.16.1 Movement trajectory

For the purpose of investigation, the trajectory of both aircraft movement prior to the collision was derived retroactively on the basis of measured final positions. The inserted detail in Fig. 9 marks in red the trajectory of the OK-TVW winglet edge at the level of the first contact with the N277EA stabiliser, which corresponds with the size of the identified damage to both the aircraft, i.e. approx. 0.1 x 0.1 m.

The A-SMGCS system records show that at 10:38:45–10:38:48, there was an obvious change in the N277EA symbol position (SSR transponder antenna) (from the position at stopping back by approx. 5–11 m) and also the shortened distance between the symbols of transponder antennas – see Fig. 10.



Fig. 9 – Derived movement trajectory of OK-TVW winglet edge in collision with N277EA stabiliser.

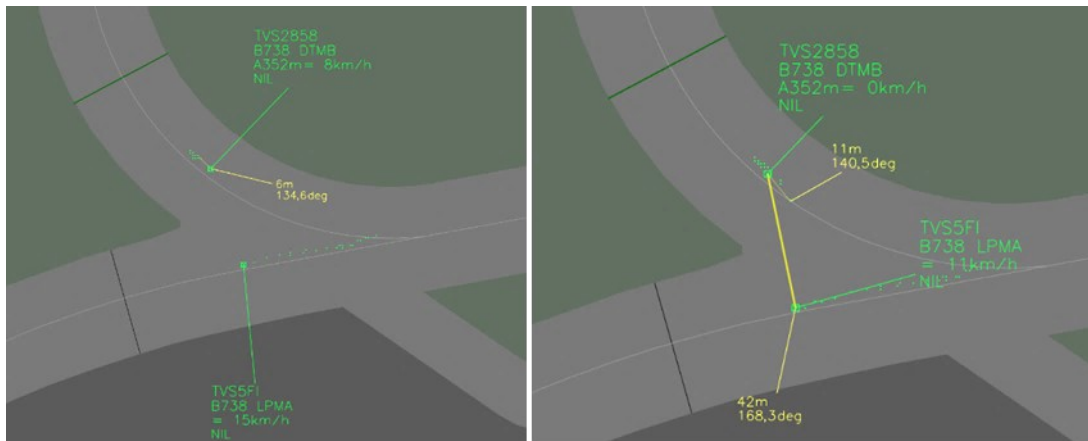


Fig. 10 – Position of the N277EA symbol (SSR transponder antenna) between 10:38:45 and 10:38:48.

For the purposes of confirming, or refuting the assumption that immediately prior to the collision, N277EA was able to reverse due to the TWY E longitudinal slope of 1% in the direction from RWY 06, a crew of another B737-800 performed a check in which the aircraft stopped in the very same position as N277EA. According to the crew, the aircraft of 63,000 kg take-off mass, after the brakes release, did not show any tendencies towards reverse motion.



Fig. 11 – TWY E and TWY F intersection view with the same type and variant of B737-800 aircraft on the site of N277EA stopping observed from the same type and variant of B737-800 aircraft OK-TSO. Both the aircraft were positioned at approximately the same locations as prior to the collision.

1.17 Organisational and Management Information

Smartwings, a.s. is an operation licence and AOC No. CZ-3 holder. It is authorised to operate commercial air services in accordance with the stipulations of the enclosed operational specifications, operating manual, Annex IV to Regulation (EC) No. 216/2008 and its implementing provisions.

Boeing B737-8CX, identification mark N277EA, with the crew was operated by Smartwings, a.s. on the lease/charter contract with the crew between the lessor and lessee based on the lessor AOC applying the commercial rights of the lessee. The lessee was noted in the operation specifications of the lessor.

Letiště Praha, a.s. is the operator of the Prague-Ruzyně Airport. Air Navigation Services of the Czech Republic provides air traffic services at the Prague-Ruzyně airport. The air traffic services are provided in accordance with legal regulations and international standards of civil aviation.

1.18 Supplementary Information

1.18.1 Requirements of the Rules

1.18.1.1 Commission Implementing Regulation (EU) No. 923/2012¹ Chapter 2 Avoidance of collisions:

SERA.3201 General

Nothing in this Regulation shall relieve the pilot-in-command of an aircraft from the responsibility of taking such action, including collision avoidance manoeuvres based on resolution advisories provided by ACAS equipment, as will best avert collision.

SERA.3210 Right-of-way

.....

d) Surface movement of aircraft, persons and vehicles.

1) In case of danger of collision between two aircraft taxiing on the movement area of an aerodrome or equivalent part of an operating site, the following shall apply:

.....

iii) an aircraft which is being overtaken by another aircraft shall have the right-of-way and the overtaking aircraft shall keep well clear of the other aircraft.

1.18.1.2 Regulation L4444 – Departing aircraft management

Regulation L4444 in Title 7, Procedures for air navigation services, determines the aircraft departure procedure control principles as follows:

7.9.1 Pořadí na odlet

Departures shall normally be cleared in the order in which they are ready for take-off, except that deviations may be made from this order of priority to facilitate the maximum number of departures with the least average delay. Factors which should be considered in relation to the departure sequence include, inter alia:

- a) types of aircraft and their relative performance;
- b) routes to be followed after take-off;
- c) any specified minimum departure interval between take-offs;
- d) need to apply wake turbulence separation minima;
- e) aircraft which should be afforded priority; and
- f) aircraft subject to ATFM requirements.

Note 1.— See also Chapter 6, 6.3.3.

Note 2.— For aircraft subject to ATFM requirements, it is the responsibility of the pilot and the operator to ensure that the aircraft is ready to taxi in time to meet any required departure time, bearing in mind that once a departure sequence is established on the taxiway system, it can be difficult, and sometimes impossible, to change the order.

¹) Commission Implementing Regulation (EU) No. 923/2012. 26 September 2012 laying down the common rules of the air and operational provisions regarding services and procedures in air navigation and amending Regulations No. 1035/2011 and Regulations (EC) No. 1265/2007, (EC) No. 1794/2006, (EC) No. 730/2006, (EC) No.1033/2006 and (EU) No. 255/2010

1.18.2 Operations Manual

Operations manual Part B BOEING B737 COMPANY PROCEDURES describes the procedures for setting the CVR to “ON” before the start-up of the power units so that it is possible to record the communication taking place prior to the start-up and during the briefing before taxiing:

AIRPLANE PRE-FLIGHT PREPARATION
.....
b) Crewmember sitting on the left-hand seat is considered as the Captain (CPT), crewmember sitting on the right-hand seat is considered as the First Officer (FO), regardless on his/her company position as this procedures are intended as a solely technical description of crewmember’s duties during flight. This is nothing to do with an actual post held in company hierarchy.
c) The FO shall perform:
<ul style="list-style-type: none"> • All prescribed procedures according to FCOM Vol. 1*
In addition to that procedures, FO will:
<ul style="list-style-type: none"> • Prepare appropriate OFP • Receive the ATIS information • Prepare the appropriate Jeppesen charts • Set Cockpit Voice Recorder ON

Operations manual, Part B BOEING B737 NORMAL PROCEDURES, Section 2(d) TAXI, TAKE-OFF AND CLIMB, describes activities and operation after receiving taxi clearance instruction:

2(d) TAXI, TAKE-OFF and CLIMB		
CPT		FO
	<i>When cleared for taxi:</i>	
“TAXI LIGHTS ON”		Switch ON the TAXI and RUNWAY TURNOFF LIGHTS
The CPT performs taxi at a speed max. 30 kt with an emphasis on the passenger’s comfort, particularly during turns and braking.		Monitors carefully taxi track and announces any conflict traffic.

1.18.3 Previous collisions at LKPR

On 18 June 2010, at the same site on LKPR, an air accident occurred – a collision of two aircraft during taxiing before take-off. During the collision, damage was caused to the winglet in the right half of the B737-8BK aircraft taxiing on TWY F behind the tail of the A321-131 aircraft standing on TWY E as No. 2 behind A320 aircraft standing on the TWY E holding position for RWY 06, and to the left half of the elevator plane and the left half of the stabiliser on A321-131. The AAI Commission reached the conclusion that the B737-8BK crew did not evaluate the distance between the edge of the right half of its own aircraft wing and the A321-131 correctly. FO was not able to determine the distance unequivocally. In this case, the cause of the collision was the non-observance of minimum safety separation from the standing aircraft on the part of the taxiing aircraft crew.

1.18.4 LKPR local traffic regulations

AD 2-LKPR-20 local traffic regulations valid at LKPR stipulate the safe separation distance only in Section 2.20.5 Operations of critical aircraft types²⁾:

2.20.5.7 Wingtip clearance

On the basis of operational safety study results safe wingtip clearance of 7.5 m from an obstacle is applied for taxiing on TWY.

1.18.5 Example of information concerning the wingtip clearance

As an example of information concerning the wingtip clearance during ground movement at the London Heathrow airport AIP UK, AD 2 AERODROMES, EGLL AD 2.20 LOCAL AERODROME REGULATIONS, Section 2 Ground Movement can be mentioned:

a. General

v. Flight crew are reminded of the extreme importance of maintaining a careful lookout at all times and are at all times responsible for wing tip clearance. The taxiway lighting system is an aid to pilots when they are operating on the manoeuvring area during darkness or in poor visibility. Notwithstanding the taxiway lighting system, pilots continue to remain responsible for wing tip clearance.

vi. In promulgated holding areas, ATC may require aircraft to pass each other. Avoidance of other aircraft is the responsibility of the flight crew involved. If doubt exists as to whether other aircraft can be safely overtaken, aircraft must stop, advise ATC, and request ATC for alternative instructions.

The text of explanatory notes to the critical points (Hot Spots HS1/HS2) correspond with the quoted regulation as well:

Pilots are to maintain a good lookout at all times and are responsible for wing tip clearance.

1.18.6 Similar event

The Air Accident Investigation Unit (AAIU), investigation authority in the Republic of Ireland, issued a report concerning a similar collision between two B738 aircraft that occurred in 2014. The report points out the human eye limitations when evaluating the relative distance between two objects observed from the cockpit at distances greater than 10 m. The same report mentions that the difficulties regarding this issue have been on an increase namely in aircraft in which – during observing from the cockpit – the passage part between the wing and the winglet is rounded and not angular. AAIU investigation conclusion:

“...for pilots operating winglet equipped aircraft and/or aircraft with large wingspan, it is not possible to accurately judge absolute distance between the wingtip and another object. Therefore, regardless of experience, there is a risk that in attempting to judge separation distance at close quarters to another object, a collision may occur. As such pilots should err on the side of caution and if doubt exists as to whether an aircraft can be passed safely, the flight crew should stop, advise ATC, and request alternative instructions if available.”

1.19 Useful or Effective Investigation Techniques

Serious incident investigation was carried out in compliance with Annex 13.

During the investigation, information contained in the internal final reports issued by Smartwings, a.s. and Letiště Praha, a.s. was used.

2) LKPR is [normally] available for aircraft up to size of Boeing 747-400 (wingspan 65 m, fuselage length 71 m). The critical types of aircraft are: Airbus 380, Airbus 340-600, Boeing 777-300 / 777-300ER, Boeing 747-8, Antonov 124, Lockheed C5 A/B.

2 Analyses

2.1 OK-TVW flight crew

- Both the pilots held valid licences and medical certificates.
- Both the pilots were qualified to perform the concerned event flight.
- FO designated as the flight commander and instructor held the relevant rating and aerodrome proficiency.
- Both the pilots had had sufficient time of rest before the flight.

2.2 N277EA flight crew

- Both the pilots held valid licences and medical certificates, and were qualified to perform the concerned event.
- Notified TWR of impact into aircraft during queuing on TWY E.

2.3 OK-TVW aircraft

- Had a valid airworthiness inspection certificate.
- Had valid public liability insurance.

2.4 N277EA aircraft

- Had a valid airworthiness inspection certificate.
- Had valid public liability insurance.

2.5 The Event History

The following facts emerged from the explanation provided by the OK-TVW flight crew and from the analysis of the recorded material. Prior to the flight, replacement of the aircraft, alterations in the flight crew line-up, and delay in ground handling procedure took place. The crew began taxiing for take-off from RWY 06 at 10:33 (that was 10:35 CTOT).

At 10:38:10, N277EA stopped on TWY E approx. 8 m away from the intermediate holding point markings as the second one in the queue behind the B737. The distance between the intermediate holding point from the TWY F axis is 54 m. The rear fuselage part and the tailplanes of N277EA were overreaching all the way into the intersection (into the right side strip) with TWY F.

A-SMGCS system does not provide sufficiently precise information that could lead to unequivocal determination whether N277EA was in motion or not. Movement of the symbol (of the SSR transponder antenna) of N277EA was, however, evident even after the event time and notification of collision by the crew.

At 10:38:10, OK-TVW was taxiing on TWY F towards the intersection with TWY E and the crew could see both aircraft on TWY E, the one immediately taking off and N277EA stopping approx. 74 m behind the former one. In this situation, in order to reduce the risk of running out of the allocated CTOT validity, the FO (flight commander and instructor) suggested to the captain the option of overtaking the traffic on hold via TWY F all the way to the RWY 06 threshold. He assumed that the crew could lower the risk of the take-off delay and requested TWR-TEC for the option of take-off from the RWY 06 threshold. When TWR-TEC agreed and using standard phraseology issued an instruction to continue on TWY up to HP

RWY 06, the crew acknowledged the instruction and continued taxiing at 10:38:23. The distance measured between the symbols of both the aircraft was 88 m.

In the given situation, the advantage of using TWY F viewed from the time saving perspective was questionable as the take-off sequence from RWY 06 was determined by TWR-TEC depending on the given traffic situation.

Presently TWR-TEC issued clearance to enter RWY 06 for the first aircraft (TVS3BD) in the queue, and the crew acknowledged the same at 10:38:30. The run up was evident at 10:38:39 from the aircraft symbol in the record.

The OK-TVW crew continued in taxiing. During the collision at 10:38:46, the measured distance between the symbols of both the aircraft was approx. 39 m. After approx. 9 s more of movement onward, the aircraft stopped.

2.6 The distance of the wingtip from obstacles

The aerodrome manoeuvring area traffic represents a dynamic process where the conditions constantly change. During taxiing, PIC is responsible for prevention of a collision with other aircraft. It is therefore important to comply with the CRM requirements so that the potential danger of a collision could be avoided.

The LKPR map did not contain any limitations, warnings or instructions regarding the limit for the minimum distance between the aircraft of B 737 category.

2.6.1 Human factor

Mutual awareness of the risen situation on the part of the OK-TVW flight crew depended on the evaluation of the newly resulting conditions for safe movement. The crew could see in what position N277EA was standing on TWY E and were aware of the fact it was limiting the space available for taxiing of their aircraft. FO had visual contact with both, the N277EA tailplanes as well as winglet on his own aircraft wing. Captain reduced the speed of movement and taxied slowly towards the intersection. He stated that due to being cautious he decided to drive the aircraft slightly to the left from the taxiway centreline marking in order to increase the distance from N277EA whose tailplanes were reaching over TWY F in the intersection with TWY E. In the moment of collision, the aircraft was moving forward at the approximate speed of up to approx. $15 \text{ km} \cdot \text{h}^{-1}$ already.

FO's awareness of TEC TWR having issued clearance to enter RWY 06 for the first aircraft (TVS3BD) in the queue led to his expectation for N277EA also to move forward towards RWY 06.

During approaching and following N277EA, however, FO did not discern that the space between the tailplanes of N277EA and the edge of the wing was not sufficiently large enough to allow safe passage. Instead of a standard phrase "*RIGHT SIDE CLEAR*" he notified the captain repeatedly using the phrase "*Good*".

This demonstrably erroneous decision on the part of FO was influenced by both, an incorrect estimate of the distance from N277EA when looking through the side window, see Fig. 12 (view angle of the winglet edge $> 45^\circ$ at the distance of approx. 28 m), as well as the decision to overtake the waiting traffic and thus eliminate the risk of expiry of the allocated CTOT slot.

It clearly follows from the A-SMGCS record that the first aircraft in the line commenced taxiing forward at 10:38:37 and thus provided space for N277EA. The captain of N277EA stated that after the CAT I holding position was vacated by the previous departing aircraft,

he was getting ready to release the brakes and move into this new position. The collision took place, however, in the moment of aircraft still standing motionless.



Fig. 12 – An example of view of the winglet from the FO's position through the right-side cockpit window.

The taxiing OK-TVW collided with its winglet on the right half of the wing to the edge of the left half of N277EA stabiliser at 10:38:46. As consequence of the collision, the edge of the stabiliser corner and the external electrostatic discharger broke off. At the FO's command "STOP", the captain immediately stopped the aircraft.

3 Conclusions

3.1 Conclusions of the Commission's Investigation

3.1.1 Crews

- Both the crews were fit to fly, pilots were holders of valid licences and rating, they had sufficient flight experience on the B737-800 type.
- As far as skill is concerned, FO of OK-TVW had the necessary expertise and experience gained from the operation at LKPR.

3.1.2 Aircraft

- Both the aircraft were airworthy prior to the collision.
- Damage sustained by both the aircraft was caused by the impact of the leading edge of the OK-TVW winglet on the right half wing to the edge of the left half of the N277EA stabiliser.
- Immediately after the collision, the damaged N277EA aircraft stopped on the spot, and the damaged OK-TVW aircraft stopped on TWY F, which remained blocked for further transport until the aircraft was pulled away to the apron.

3.1.3 Flight Performance

Several factors combined led to the collision:

- Immediately before the event, there were two aircraft already present on TWY E, whereas N277EA came to a hold on TWY E as the second one in line approx. 8 m away from the marking of the intermediate holding position, which is designated only for securing the safe spacing due to aircraft turn-off from RWY 24.

- While observing the non-standard situation occurred at the TWY E and TWY F, the OK-TVW crew evaluated incorrectly the risk in the N277EA tailplanes overreaching the verge of TWY F and thus forbidding safe passage.
- The OK-TVW crew was considering the traffic on hold on TWY E while attempting to reduce the risk of running out of the allocated CTOT slot validity by moving behind N277EA towards the vacant RWY 06 holding position on TWY F. TWR-TEC acknowledged and agreed with the manoeuvre and issued an instruction to continue on TWY F up to the RWY 06 holding point.
- In the moment when OK-TVW was entering the intersection, TWR-TEC issued clearance to enter RWY 06 to the first aircraft on hold (TVS3BD). This aircraft subsequently started moving towards RWY 06.
- Based on the TWR-TEC communication with TVS3BD and on the aircraft movement, FO of OK-TVW assumed incorrectly that N277EA would start moving towards the vacated position and thus they both would have room sufficient for passage behind him at the point of intersection.
- While his own aircraft right half of the wing was approaching the tailplanes – stabiliser of N277EA – the FO of OK-TVW having looked out from his seat in the cockpit evaluated incorrectly the distance of the tailplanes of the holding aircraft from the edge of his aircraft right wing during the passage.
- FO incorrectly informed the captain who then continued in taxiing until the instruction to stop issued by FO.

Situation following immediately after the collision:

- The N277EA crew notified TWR of the collision and the OK-TVW FO confirmed the stated situation to TWR immediately afterwards.
- Immediately after the collision, the damaged N277EA aircraft stopped on the spot, and the damaged OK-TVW aircraft stopped on TWY F, which remained blocked for further transport until the aircraft was pulled away to the apron.

3.2 Causes

The cause of the serious incident was non-observance of a sufficient spacing between two aircraft – the passing one and the one on hold – on the part of the crew of the passing aircraft.

Contributing factor was incorrect performance of CRM.

4 Safety Recommendations

4.1 Safety actions immediately adopted and applied by the Prague/Ruzyně aerodrome operator

Based on the internal investigation of the serious incident, the Prague/Ruzyně aerodrome operator adopted the following measures:

- To familiarise the operators operating from/to Prague/Ruzyně aerodrome with the herein described event in the form of presentation at the LRST meeting.

- Based on the discussion regarding the proposal on the LRST Prague/Ruzyně level, to publish a general note in the ADC map regarding “Wingtip Clearance” at holding positions in the next AIRAC.

4.2 Safety actions adopted and applied by the air carrier

Based on the internal investigation of the serious incident, the air carrier adopted the following safety actions:

- To inform all the flight crews of the incident.
- To submit the flight crew concerned to line check focused on CRM evaluated by the CRM instructor.
- To include avoiding ground collisions into the future repeated simulator training sessions and thus ensure that all the flight crew members take steps to avoid any ground collisions in the future.
- To emphasise the importance of an assertive approach during the next CRM revision training session and to include assertive methods of negotiating into the model situation in the future simulator revision training sessions.
- To check during the Line Operations Safety Audits or simulator sessions whether all the crew members use the correct relevant report language during standard as well as non-standard situations.

4.3 Safety Recommendations

With regards to the safety actions adopted by both, the air carrier as well as the Prague/Ruzyně aerodrome operator, the AAII shall not issue any further safety recommendations.

5 Annexes

Annex 1 Site diagram – TWY E and TWY F intersection at LKPR

Appendix No. 1

Site diagram – TWY E and TWY F intersection at LKPR

