AIR ACCIDENTS
INVESTIGATION INSTITUTE
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CZ-18-0679

FINAL REPORT

**Investigation of causes of a serious incident
of Boeing B737-800 aircraft,
identification mark N624XA
at LKPD
on 1 August 2018**

Prague
May 2019

Abbreviations Used

AC	Altocumulus
ACMI	Aircraft – Crew – Maintenance – Insurance
AMC	Acceptable Means of Compliance
AGL	Above ground level
APP	Approach
ATIS	Automatic terminal information service
ATS	Air traffic services
BASE	Cloud base
BKN	Broken
BR	Mist
CI	Cirrus
CAT I	Instrument Landing Category I
CAVOK	Visibility, cloud and present weather better than prescribed values or conditions
CB	Cumulonimbus
CRM	Crew resource management
CU	Cumulus
CVR	Cockpit voice recorder
ČHMÚ	Czech Hydrometeorological Institute
DME	Distance Measuring Equipment
DFDR	Digital Flight Data Recorder
EASA	European Union Aviation Safety Agency
FAA ATP	Federal Aviation Administration, Airline Transport Pilot
FAP	Flight Analysis Program
FEW	Few
FCTM	Flight Crew Training Manual
FO	First Officer
FL	Flight Level
GS	Ground speed
GM	Guidance material
ILS	Instrument Landing System
LDA	Landing distance available
LGIR	Iraklion / Nikos Kazantzakis airport
FRS	Aerodrome fire-fighting service
LKAA	Flight Information Region Prague
LKCV	Čáslav military airport
LKPD	Pardubice airport
LKTB	Brno Tuřany airport
METAR	Aviation routine weather report
MSL	Mean sea level
MLW	Maximum landing weight
NIL	None
ORO	Organisation Requirements for Air Operations
PC/PT	Proficiency check / Proficiency training
PIC	Pilot-in-command
RA	Radio altimeter
RETS	Recent Thunderstorm
REG QNH	Regional pressure, the lowest atmospheric pressure in the area reduced to mean sea level according to standard atmospheric conditions

RMK	Remark
PF	Pilot flying
PM	Pilot monitoring
RVR	Runway visual range
RWY	Runway
QNH	Altimeter sub-scale setting to obtain elevation when on the ground
SC/AEC	Senior controller/Approach executive controller
SCT	Scattered
SCC	Senior cabin crew
SKC	Sky Clear
TCU	Towering Cumulus
TDZ	Touchdown zone
TEC	Tower Executive Controller
THR	Threshold
TS	Thunderstorm
TWR	Tower
TWY	Taxiway
TOP	Cloud top
UTC	Coordinated universal time
AAII	Air Accident Investigation Institute
VCTS	Thunderstorm in the vicinity
VML	Code of medical fitness certificate limitation – Correction for defective intermediate and near vision
VNL	Code of medical fitness certificate limitation – Correction for defective near vision
VRB	Variable
V_{REF}	Reference landing approach speed
VSLZab	Head of airport services

Used Units

ft	Foot (unit of length – 0.3048 m)
hPa	Hectopascal (unit of pressure)
kt	Knot (unit of speed – 1.852 km/h)
PSI	Pound per square inch (unit of pressure)

A) Introduction

Operator:	Travel Service, a.s.
Aircraft manufacturer and type:	Boeing B737-800
Identification mark :	N624XA
Location :	Pardubice LKPD
Date and time:	1 August 2018, 15:50 (all times are UTC)

B) Synopsis

On 1 August 2018, the AAII was notified of overrunning off the western end of RWY 27 during landing at LKPD by Boeing 737-800, identification mark N624XA, flying from Iraklion / Nikos Kazantzakis to the planned destination airport Pardubice – flight No. TVS1903. The crew performed ILS approach to RWY 27 after a shower of rain. The final approach segment under 1000 ft AGL was carried out by manual landing. The aircraft overflew the threshold at higher altitude and landed approx. 600 m beyond the touchdown zone. The crew failed to correctly apply the brakes during landing run in the remaining segment of landing distance available on RWY 27 and the aircraft main landing gear overran into the unpaved clearway by approx. 12 m.

The cause of the serious incident was investigated by the AAII commission. The investigation team comprised:

Investigator-in-charge	Ing. Stanislav Petrželka
Commission member	Pavel Mráček
	Ing. Martin Fořt – Smartwings, a.s.

AIR ACCIDENTS INVESTIGATION INSTITUTE
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on 27 May 2019

C) This Final Report Consists of the Following Main Parts:

1. Factual Information
2. Analyses
3. Conclusions
4. Safety Recommendations
5. Annexes

1. Factual Information

On 1 August 2018, flight No. TVS1903 (interrogation mark TVS6VY) for 159 passengers was planned to depart at 13:05 from LGIR under FAR Part 121 subpart S (Supplemental Operations). It was the second flight of the flight crew on the same day. The flight crew arrived at the airport approximately one hour before the scheduled departure of the first flight LKTB – LGIR. The first flight, LKTB – LGIR, was free of any issues. Departure of the second (event) flight, LGIR – LKPD, was planned at 13:05. When investigating the history of the event flight, the AAII Commission analysed the DFDR and CVR data, and examined statements of flight crew members, statements and records of ATS, Head of airport services, CHMI information, airport camera records, videorecording footage from the passenger cabin and photographs taken during the investigation.

1.1 Event Flight

1.1.1 History of the Flight

The aircraft started taxiing at 13:05. It took off from the Iraklion Airport at 13:15. Aircraft take-off weight was 71,274 kg. According to the crew, the course of the flight was issue free starting from taxiing through take-off, ascending to descending. The pilot flying was FO. Upon landing at LKPD, wind was 240°/4 kt and there were VMCs. To fly from LGIR to LKPD, the aircraft consumed 7,013 kg of fuel. The crew carried out routine preparation of the aircraft for approach and landing on RWY 27 at LKPD. Both LKPD APP and TWR provided clear topical information about the weather and the wet runway. The crew acknowledged this information each time. From the altitude of approximately 1000 ft AGL, FO/PF commenced manual landing. He carried out landing outside the TDZ. PIC took over control when the previously agreed non-standard speed of 80 kt was reached and attempted to brake home. Landing took place at 16:13. The flight crew failed to arrest the aircraft on the wet runway and overran the runway with the main landing gear into unpaved clearway by approximately 12 m. No passengers were injured, and the aircraft was not damaged. Passengers disembarked normally as instructed by the cabin crew in coordination with the fire-fighting service. Communication between flight crew members during approach and landing had a decisive impact on flight execution. Based on provided documentation, the flight crew were not on service shift overtime and had had adequate time of rest before the flight.

Figure 1 B 737 after overrunning the runway.

1.1.2 PIC Statement

"Approach to ILS RWY 27. FO leg. RWY length 8202 ft, WX 240/3, 10+ KM FEW 4600 SCT 120 T/S in vicinity, tower advised wet rwy, but provided no braking action report. Approach/Tower advised WX report as there is no ATIS on the field. Landing wt approx. 63,300 KG/Ref 147+5 kts. Touch down approximately at 16:13. ILS approach was set up and briefed prior to arrival. Flaps 30 landing with auto brakes set to 2.

During landing noticed the runway was wet with a noticeable glare. Flown on automation until 1000' AGL. Manual descent to landing was within parameters between 500–800 FPM, speed based upon Ref 147 and +5 kts with little or no variance. During last 50' the descent was arrested by FO and touch down was executed normally within the touchdown zone, estimating within the first 2000'–2500' although hard to determine based on glare on rwy and difficulty seeing the touch down zone markers.

Normal thrust reverse was applied and auto brakes activated normally. Aircraft began normal deceleration. Approaching the centre of the runway prior to taxiway "C" aircraft was slowing to 80 knots but did not seem to be decelerating anymore. I called for control of the aircraft and executed max manual braking. Passing taxiway "C" aircraft felt as if it was aquaplaning. I continued to apply maximum braking force and reverse as the aircraft continued forward with a static speed reduction. Approaching the last taxi way "D" aircraft began slowing but still felt like it was aquaplaning. Aircraft speed was not slow enough to make a turn off and over ran the end of the runway by 36 ft. Just prior to aircraft stop and when vacating runway end, reverse thrust was removed/stowed to prevent potential FOD ingestion and braking was the only thing used to bring aircraft stop.

Advised the tower that we vacated/overran the runway. They advised rescue equipment was coming towards the aircraft. Advised tower there were no injuries. I advised passengers to stay seated. After securing engines I opened the cockpit door to verbally advise flight attendants to advise passengers to remain seated and advised them the aircraft overran the runway. Advised cabin crew that stairs were coming shortly along with buses. Initially advised deplaning from L 2. Advised tower all passengers and crew were safe and no injuries. Performed normal after landing / shutdown procedures and awaited rescue equipment to inspect exterior which was found with no damage to the aircraft. Air stairs were brought to L1 and all passengers were deplaned normally without incident or injuries. Contacted DO to advise him of the situation.

Deplaned aircraft to inspect exterior myself and met by Police. Immediate pilot documentation check was performed, breathalyzer test conducted. Police Officer asked what caused the over run and I advised that it was an effect of hydroplaning. My assumption is that standing water at the midpoint of the runway caused the continued hydroplaning effect. I performed a thorough exterior inspection and photographed gear, wings and engine. No damage noted. Aircraft tires did not sink as ground was quite hard. Following inspection, airport manager and security personnel approached FO and myself to explain what the next steps would be. Police investigators arrived and a short written statement was provided by myself and the FO."

1.1.3 FO Statement

"LKPD Airport. ILS approach to rwy27. Runway length 8202 feet. Weather 240/30 10k + visibility. Few 4600. T/S in the vicinity. Weather provided by tower as there is no ATIS. Tower advised wet runway. No braking report was given. Landing weight was approximately 63,300 kg. V_{REF} was 147 plus 5 knots. Landed at approximately 16:13 GMT. ILS had previously been setup and briefed. Flaps 30 landing with auto brake set at 2. Aircraft was coupled until 1000 feet and then flown by hand. Aircraft was flared at 30 feet and power to idle at 10 feet. Aircraft touched down in landing zone at approximately 2000 ft. Runway was very wet with

a high sheen. Normal thrust reverse was applied, and auto brakes activated normally. Aircraft was decelerating normally. Prior to approaching taxiway "C" aircraft was at 80 knots. The aircraft stopped decelerating and the captain came on the controls. Approaching the far end the aircraft slowed and came to a stop approximately 34 feet of the runway. Runway appeared to have pooling water in the last 1000 feet. Tower was contacted and normal shutdown was performed. Aircraft was deplaned. Aircraft was inspected with no damaged noted. Breathalyzer and drug test performed by local police."

1.1.4 SCC Statement

"On yesterday's flight from Heraklion to Prague, the plane crossed the RWY after landing. The landing was the same as usual until the moment we felt sharp braking on uneven surface. Then the plane stopped completely, so I decided to unfasten and check out the situation. I found out that we left the track, and therefore, I decided to inform the passengers of the landing in Pardubice and asked them to stay in their seats with their seatbelts fastened and wait for further instructions. Then we called colleagues to the back of the cabin if they were all right and informed them of the situation.

About less than a minute after landing, Mr. Captain contacted me to inform me of the situation, asking me to keep the passengers in their places. The passengers were perfectly calm and without any problems and very cooperative. Mr. Captain then apologized to the passengers for any complications and informed them that he was unable to land the plane properly because of the wet RWY, after a previous storm. I translated it to the passengers. Upon arrival of the ground personnel, the stairs were brought to the 1L door, we disarmed the doors, then the captain decided that I should follow the fire department's instructions and keep him updated. They decided to start disembarkation which they assisted us with. Passengers could take all their luggage and walk to the terminal at the airport.

None of the passengers were injured, they all worked with us and nobody complained, they were mostly happy to be okay. After leaving, most passengers took a picture of the aircraft and continued on to the terminal. After the passengers left, we checked the cabin with our colleagues and the captain told us to leave the aircraft and wait for him at the airport. There was a great CRM on board, we were being updated constantly by Mr. Captain or FO. Colleagues, though not so experienced, have done excellent work."

1.1.5 Statement of SC/AEC (Senior Controller/Approach Executive Controller)

Arrival of TVS6VY to LKPD was coordinated with LKCV APP for descent down to A 050. The arriving TVS6VY was coordinated together with the departing TVS2902. Subsequently, the departing TVS2902 was handed over to Ostrava RADAR. The arriving TVS6VY was vectored to ILS RWY 27 and was advised of landing conditions: *"RWY 27, wind 020° 2 kt, visibility 10 km, TS in the vicinity of aerodrome, FEW 4000 ft CB, SCT 8000 ft, temperature 28, dew point 20, QNH 1017, TL 060* ***RWY WET****."* The pilot correctly confirmed the information, including the RWY condition. Having been aligned to ILS 27, it was handed over to TWR FRQ 120.155. I was visually monitoring the aircraft from the APP site west of TWY B *"lined-up"* with blocks of flats in Chrudim and I advised my colleague, saying**:** *"Watch out, don't speak to him now, he is really busy. He is going to see the Follow Me car at delta. Call out the fire brigade, the aircraft is going to overrun the runway."*

1.1.6 Statement of TEC (Tower Executive Controller)

"TVS6VY switched to the frequency of Pardubice TWR approximately at FAF. After contact was established, the pilot was given clearance for landing on RWY 27 together with information on wind, runway condition (runway wet) and instructions for vacating RWY 27 via TWY D. The pilot repeated the clearance for landing together with further instructions. I was monitoring the aircraft during approach and landing. It was touching down on RWY 27 approximately 800–900 m from the RWY 27 threshold. Shortly before runway excursion at

16:12 UTC, I activated FRS and provided information about the excursion of B 737. After runway excursion, I received information from the pilot that they had overrun the RWY, the aircraft, the crew and passengers were OK and he was turning off the engines. I confirmed the information and advised him that the fire brigade would be there within a few seconds. The pilot requested a pullout. However, I instructed him to wait and then gave him permission to turn off the engines. After that, he was communicating with the FRS commander who had been already on spot with the Follow Me car."

1.1.7 Statement of the Head of Airport Services

"On 1 August, I performed a check approx. two hours before the incident after the first shower of rain had stopped and determined the runway was "wet". Because of high temperature, water was evaporating quickly from the RWY surface. The check was carried out in compliance with the internal document Procedures of Airport Preparation for Air Operations and CS-ADR-DSN (edition 4). At the time of the incident, I was in my office and heard an unusual sound of reversing engines. I got into the car and went to the airport. When passing building 37, I saw FRS vehicles going out. Having arrived at the western runway threshold, I found an aircraft which had overrun the RWY."

1.2 Injuries to Persons

Injury	Crew	Passengers	Other persons (inhabitants, etc.)
Fatal	0	0	0
Serious	0	0	0
Light/No injury	0/6	0/159	0/0

1.3 Damage to Aircraft

NIL

1.4 Other Damage

NIL

1.5 Personnel Information

1.5.1 Cabin crew

Pilot-in-command (PM)

Male – age: 50 years

License:	FAA ATP 3669821 valid
Qualification:	B 737 valid
Last PC/PT:	6 May 2018 / 5 May 2018
Medical certificate:	class 1, valid until 5 January 2019 (VML)
Flying experience:	7,300 h
Hours flown over the last 7 days:	15 h 20 min

First officer (PF)

Male – age:	52 years
License:	FAA ATP 3234496 valid
Qualification:	B 737 valid
Last PC/PT	10 December 2017 / 9 December 2017
Medical certificate:	class 1, valid until 5 July 2019 (VNL)
Flying experience:	10,986 h

Hours flown over the last 7 days: 8 h 00 min

1.5.2 Flight Personnel

The airlines appointed a four-member cabin crew for this flight.

1.5.3 ATS LKPD Shift

SC/AEC

Female – age:	43 years
Licence:	valid until 10 May 2019
Medical fitness certificate:	valid until 10 May 2019
ATCS qualifications:	ADI/TWR/RAD, APS/TCL, APS/PAR, OJTI
Work history:	since 1999

TEC

Male – age:	39 years
Licence:	valid until 30 April 2019
Medical fitness certificate:	valid until 9 November 2018
ATCS qualifications:	ADI/TWR/RAD, APS/TCL, APS/PAR
Work history:	since 2002

1.5.4 LKPD Airport Services

Head of airport services (VSLZab)

Male – age:	43 years
Work history in airport services:	15 years

1.6 Aircraft Information

1.6.1 Boeing 737-800, General Specifications

Identification mark:	N624XA
Manufacturer:	Boeing
Type:	Boeing B737-86J
Serial number:	32624
Certificate of airworthiness inspection:	FAA Standard Certificate of Airworthiness
Certificate of Release to Service:	Valid
Number of cycles:	23,092
Total hours flown:	48,433
Liability insurance:	Valid
Power units:	2xCFM56-7B26

1.6.2 Aircraft Load and Defects

LW was 63,300 kg. MLW of 65,376 kg was not exceeded. After landing, PIC recorded no aircraft system error messages in the aircraft logbook.

Tab. 1 Maintenance Status (aircraft maintenance schedule)

	Date	Hours	Cycles
Current	8/01/18	48433.0	23092
Next Calendar Item Due	8/3/18		
Next Hourly Due Item		48530.7	

Next Landing/Cycle Due Item			23119
Next AD Due	8/17/18	48565.3	24215
Weekly Check	8/8/18		
3 Yr Acft Reweigh	10/7/20		
FAR 47.40 Registration Expiration	3/15/21		
VOR Calibration Check	8/31/18		
Nav Data	8/15/18		
Phase 14 Check	9/29/18	48537.5	23141
Phase 48 Check	7/31/27	67896.2	33334
GMU/HMU Monitoring Flt (RVSM)	9/3/19		

1.7 Meteorological Information

1.7.1 CHMI Weather Report

According to the CHMI Aviation Weather Service report, the territory of the Czech Republic was under the influence of an insignificant pressure field.

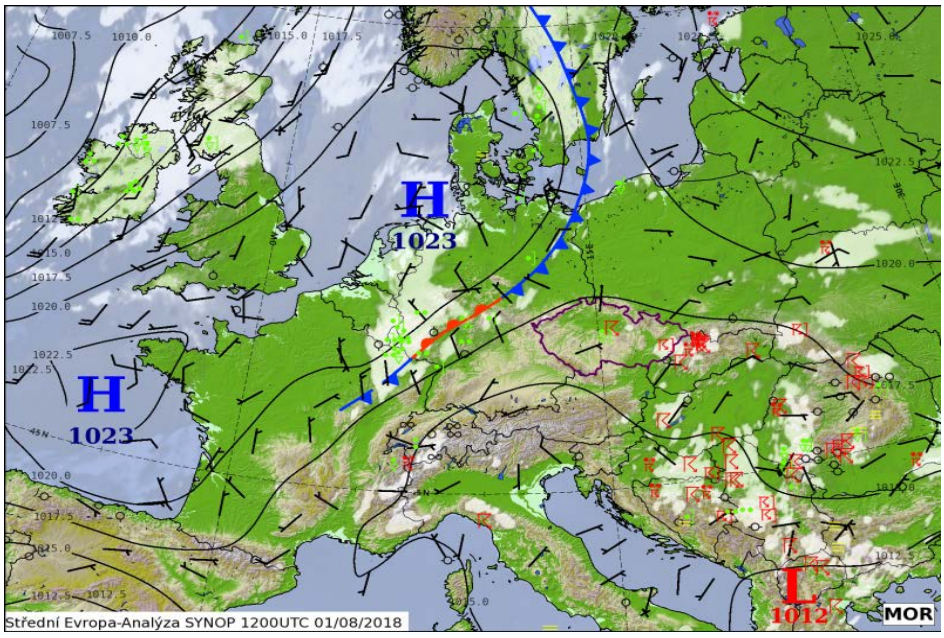


Figure 2 Synoptic situation

Ground wind:	040–120°/5–12 kt
Upper wind:	2000 ft MSL 040°/06 kt, 5000 ft MSL 080°/10 kt
Visibility:	over 10 km, sporadically 5–8 km
Weather:	Sky clear, scattered clouds
Cloudiness:	SKC/SCT CI, AC, CU, sporadically CB, the lowest layer SCT CU, TCU sporadically CB BASE CU FL060-070, CB FL040-050, TOP CU FL120-150, TCU FL190-220, CB FL330-380
Zero isotherm level:	FL135-140
Turbulence:	in places weak, from the ground / FL060
Ice:	NIL
QNH:	1,017–1,020 hPa
REG QNH:	15/18 1,015 hPa

1.7.2 Radar Image

The left part of Fig. 3 from 1 August 2018 15:30 shows the distribution of reflections corresponding to shower and storm cloud cover near Pardubice from 15:05 to 15:45, when a thunderstorm was recorded above LKPD (see the red cross for the LKPD location).
The radar image in the right part of Fig. 3 shows the cloud cover at 16:10.

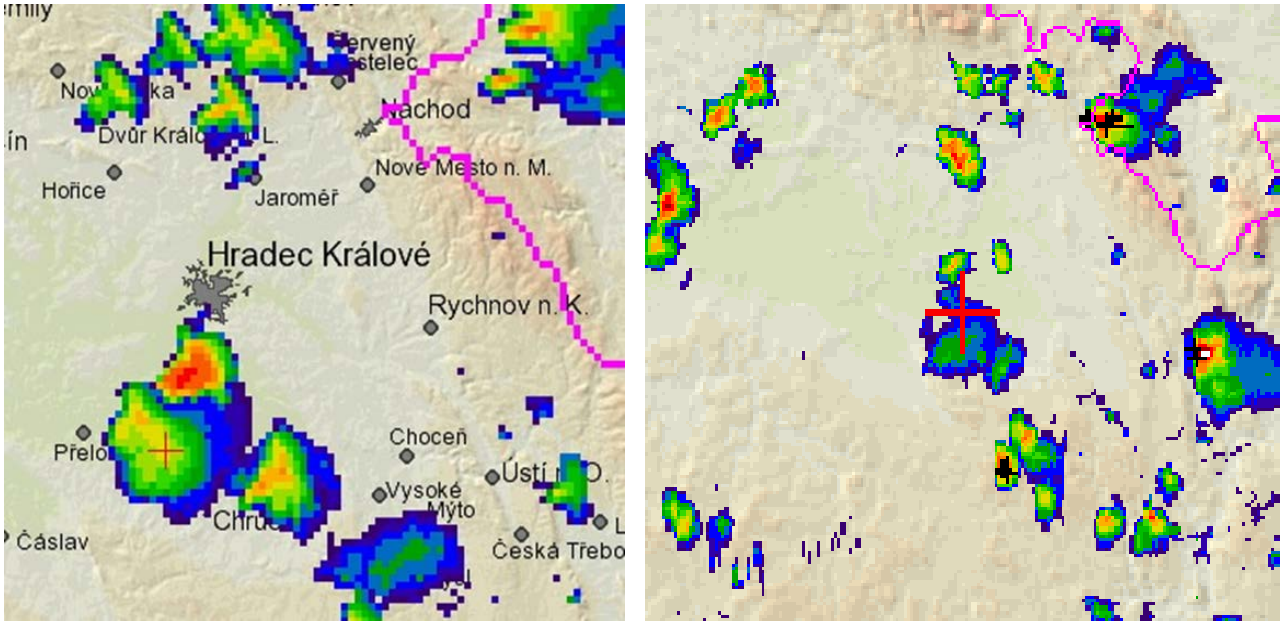


Figure 3 Radar image

1.7.3 METAR LKPD

METAR LKPD 011500Z 23004KT 9999 FEW046CB SCT120 28/19 Q1017 RETS NOSIG RMK BLU BLU=

METAR LKPD 011600Z VRB02KT 9999 VCTS FEW040CB SCT080 28/20 Q1017 NOSIG RMK BLU BLU=

SPECI 15:50Z: TS, WIND 240/3, 10KM OR MORE, FEW CB 4600ft, SCT120

TAF LKPD 0113/0212 06008KT CAVOK TEMPO 0113/0118 09014G24KT 6000 TSRA BKN040 CB

1.7.4 CHMI Conclusion

On 1 August 2018 prior to B 737 landing, the weather at the Pardubice airport was mostly cloudy after the passage of stormy clouds to south-west. Temperature stratification was unstable in places with receding convective clouds of CU, TCU and CB type. Visibility was well over 10 km. Air temperature in the said period was 28°C. The wind was blowing mostly from 040–100° at speed of 6 kt, temporarily up to 10 kt. The direction and speed of high-altitude wind up to the altitude of 5000 ft MSL were similar to the ground values. Dangerous meteorological phenomena in the vicinity of the airport included partial fading out of thunderstorm manifestations.

1.7.5 Precipitation Course and Intensity

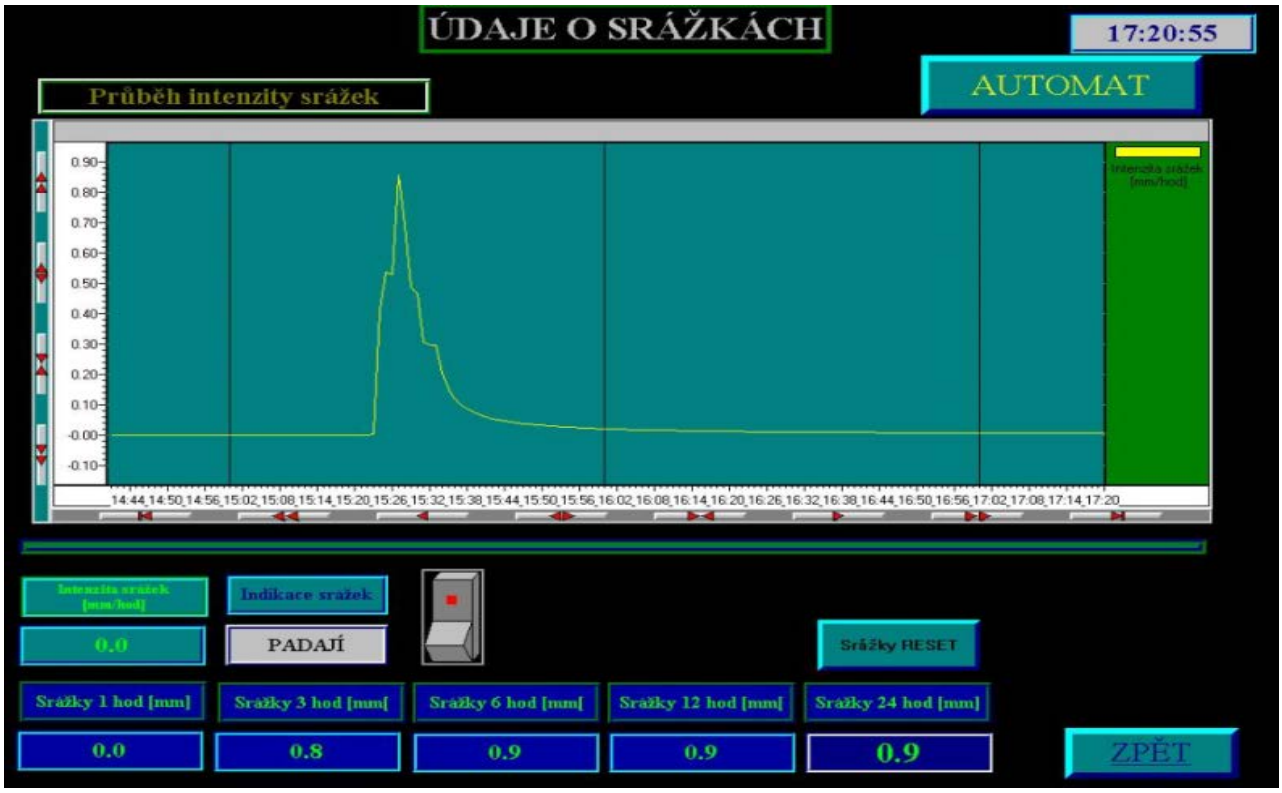


Figure 4 Precipitation over the given period in mm/m^2

1.8 Radio Navigational and Visual Aids

During approach and landing, all radio navigational and lighting aids at LKPD were operative. All the above aids were in operation throughout the entire time of approach and landing, and no defects or cut-offs were observed.

1.9 Communications

As the TVS1903 flight (interrogation mark TVS6VY) was switching to LKPD APP, the LKPD AEC APP advised of the topical weather and the runway condition. To conclude, the AEC clearly advised: *"RWY WET"*, then the pilot confirmed: *"RWY AND WEATHER IS COPIED TVS6VY ILS 27…".* When switching to LKPD APP, the pilot reported to LKPD TWR:

TVS6VY*:* *"PARDUBICE TWR TVS6VY ILS RWY 27."*
TWR: *"TVS6VY PARDUBICE TWR GOOD DAY RWY 27 CLEARED TO LAND,WIND 060°4 kt, AFTER LANDING VACATE VIA TAXIWAY D AND RWY IS WET."*
TVS6VY: *"CLEARED TO LAND RWY 27 VACATE VIA D AND RWY IS WET."*

1.10 Airport Information

The Pardubice airport is a military airport with permitted international operation of civil aircraft. It is located 4 km to the south-west of Pardubice. The elevation of the airport is 741 ft (226 m). The airport has a concrete RWY 09/27 with dimensions of 2,500 x 75 m. The landing distance available (LDA) of RWY 27 is 2,500 m. RWY 27 is fully equipped with ILS with distance measuring equipment (DME) with 25 NM reach for instrument approach CAT I with 600 m axial lighting row allowing for landing within runway visual range (RVR) of 550 m. RWY 27 is fitted with the Visual Approach Slope Indicator System (VASIS) with precision approach path indicator (PAPI) 3° in the form of a bar located left of RWY 27, 345 m beyond

the THR. The airport does not provide ATIS. All information is provided by APP and TWR control services.

1.11 Flight Recorders and Other Means of Recording

The pilot-in-command advised the company dispatching centre of the situation and was then instructed to safeguard the CVR against disabling the preservation of crew communication. The DFDR and CVR data were later downloaded for the purpose of analysis. The DFDR data were analysed using AirFASE application with incorrect FAP due to which a direct access to some parameters, namely the braking pressure and approach slope values, was not available. FAP is a program – converter between the aircraft data recordings and the computer application designed for their evaluation. FAP forwards the entries of flight parameters recording addresses. The software compatibility is unique for each aircraft, or a group of aircraft. CVR in the pilot area recorded a lively discussion between the two pilots on topics not directly related to the flight performance, and that for the whole time of approach and landing.

1.11.1 Data from the Critical Phase of Landing

The aircraft had the full landing configuration with the approach reference speed V_{REF} +12 kt at 4.7 NM from the airport. At 2 NM the aircraft was already on the required V_{REF} + 5 kt. The crew overflew THR RWY 27 at approx. 64 ft and performed touchdown outside TDZ at the distance of 965 m. THR is not shown in the correct position in the chart. The correct THR position is shown at 50 ft RA (by recalculating the position of the aircraft arrest) and is highlighted in Fig. 5 by red circle. Pass over THR at 64 ft, braking pressure and the GS deviation are recorded by the plotter due to the FAP inaccuracy.

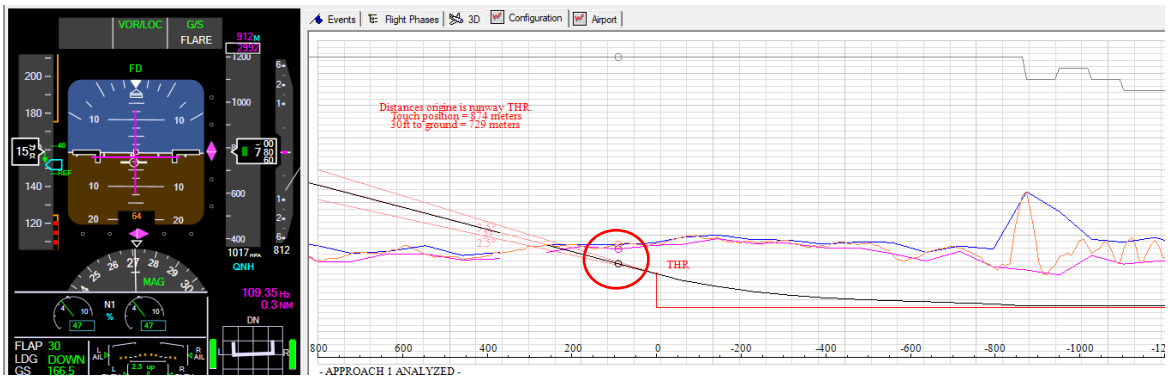


Figure 5 PFD and graphics parameters with calculated THR inside red circle

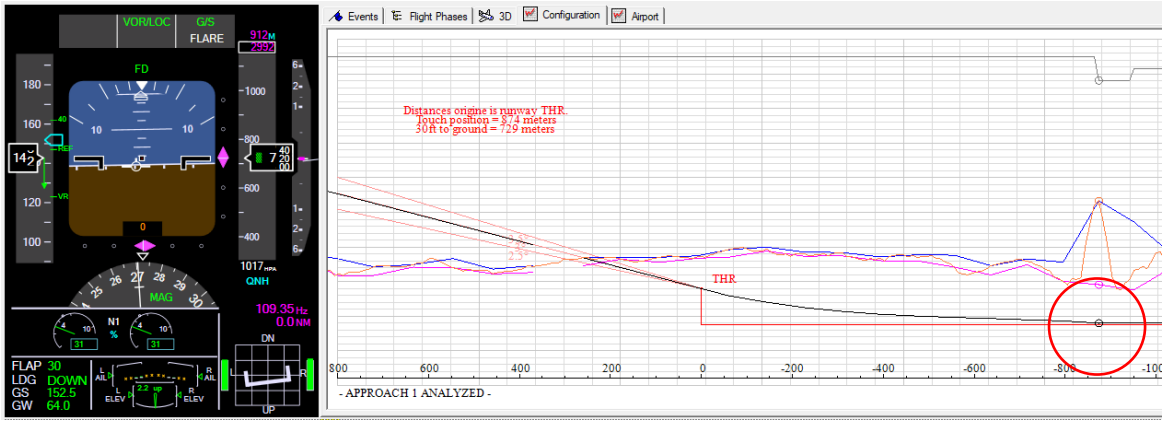


Figure 6 Touchdown at V_{REF} – 4 kt and Ground Speed 152.2 kt

Tab. 2 Deceleration Autobrake level 2, 3, Max

Aircraft Type	AB 2 Decel	AB 3 Decel	AB Decel Max
B737 NG,	5 ft/sec²	7.2 ft/sec²	14 ft/sec²

The deceleration speed of B 737 NG guaranteed by the manufacturer for AB 2 is 5 ft/sec^2. For AB max it is 14 ft/sec^2. After the touchdown on RWY, the crew was using AB 2 for approx. 31 sec and decreased the speed from the original GS 152.5 kt to approx. 70 kt GS. For another approx. 7 sec after resuming the control, PIC was using AB max/manual for braking home. The distance 1103 + 91 m (for the 91 m distance see the red circle in Fig. 5), is the distance measured from THR 27 where the aircraft touched RWY with all of the landing gear wheels. The landing was performed at 1.38 G of gravity load. Upon the touchdown on the main landing gear wheels, immediate extending of ground spoilers took place and the crew used the reversers on both power units with no delay. The aircraft was decelerating applying AB 2, later below the speed of 70 kt with AB max/manual simultaneously with using the reverse thrust in both engines down to GS 14 kt. During the aircraft deceleration phase, the revolutions N1 of power unit No. 1 were
at 71%, and the revolutions N1 of power unit No. 2 at 66%. Subsequently, the aircraft decelerated down to GS 2 kt. The revolutions N1 at reverse thrust on both engines were at 30% all the way down to GS 2 kt.

1.12 Wreckage and Impact Information

NIL

1.13 Medical and Pathological Information

No passengers or crew members were injured. Alien and Border Police officers serving at Pardubice airport carried out the preliminary procedures on site of the landing – indicative drug and alcohol tests with both the pilots of flight No. TVS1903 using analyser Drugwipe 5S and Drager alcohol tester. Both the tests had negative results.

1.14 Fire

NIL

1.15 Survival Aspects

No measures were taken in respect to survival aspects. The serious incident took place in the airport manoeuvring area. The instruction for deployment of the FRS unit was given already in time when the aircraft was still descending and landing, shortly before the touchdown, as SC/AEC LKPD having correctly assessed the landing trajectory concluded that there was a very high probability of the aircraft being unable to brake home on the runway and that overrunning would take place.

1.16 Tests and Research

NIL

1.17 Operating Body Information

The aircraft operator is a domestic airline company. The company had a valid leasing contract (ACMI) on the aircraft lease.

1.18 Additional Information

1.18.1 Binding Sterile Flight Deck Procedures (EU) *(highlighting added later)*

The sterile flight deck procedures have been laid down by Commission Regulation (EU) 2015/140 amending Regulation (EU) 965/2012 as regards undisturbed environment in the flight crew compartment and correcting that Regulation. In relation to that, EASA Executive Director Decision No. 2015/005/R amending AMC and GM to Part-ORO, Regulation No. 965/2012 was adopted. The Annex to the said Decision AMC and GM to Part-ORO – Issue 2, Amendment 1 stipulates:

"A new AMC1 ORO.GEN.110(f) is inserted as follows:

AMC 1ORO.GEN.110(f) Operator responsibilities

STERILE FLIGHT CREW COMPARTMENT

(a) Sterile flight crew compartment procedures should ensure that:

(1) flight crew activities are restricted to essential operational activities*; and*

(2) cabin crew and technical crew communications to flight crew or entry into the flight crew compartment are restricted to safety or security matters.

(b) The sterile flight crew compartment procedures should be applied:

(1) ***during critical phases of flight;***

(2) during taxiing (aeroplanes);

(3) below 10 000 feet above the aerodrome of departure after take-off and the aerodrome of destination before landing, except for cruise flight; and

(4) during any other phases of flight as determined by the pilot-in-command or commander.

(c) All crew members should be trained on sterile flight crew compartment procedures established by the operator, as appropriate to their duties.

A new GM1 ORO.GEN.110(f) is inserted as follows:

GM1ORO.GEN.110(f) Operator responsibilities

STERILE FLIGHT CREW COMPARTMENT

(a) Establishment of procedures

The operator should establish procedures for flight, cabin, and technical crew that emphasise the objectives and importance of the sterile flight crew compartment. These procedures should also emphasise that, during periods of time when the sterile flight deck compartment procedures are applied, cabin crew and technical crew members should call the flight crew or enter the flight crew compartment only in cases related to safety or security matters. In such cases, information should be timely and accurate.

(b) ***Flight crew activities***

When sterile flight crew compartment procedures are applied, flight crew members are focused on their essential operational activities without being disturbed by non-safety related matters. Examples of activities that should not be performed are:

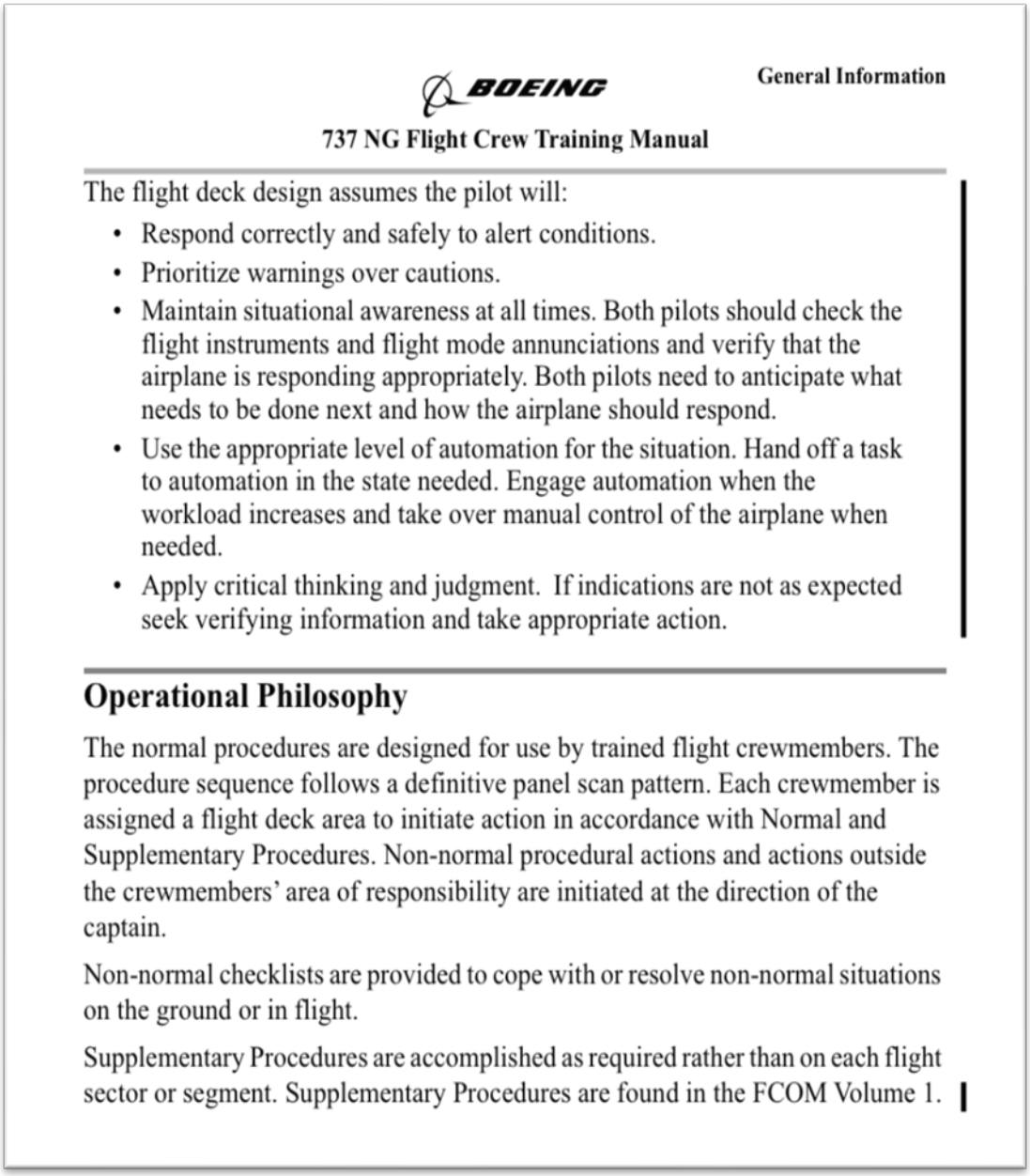
(1) radio calls concerning passenger connections, fuel loads, catering, etc.;

(2) non-critical paperwork; and

(3) ***mass and balance corrections and performance calculations, unless required for safety reasons****. …"*

1.18.2 Binding Procedures for Boeing Flight Crews (USA)

The binding procedures *Sterile Cockpit* from B737 NG Flight Crew Training Manual issued by Boeing are described in Fig. 7 below.



The flight deck design assumes the pilot will:

- Respond correctly and safely to alert conditions.
- Prioritize warnings over cautions.
- Maintain situational awareness at all times. Both pilots should check the flight instruments and flight mode annunciations and verify that the airplane is responding appropriately. Both pilots need to anticipate what needs to be done next and how the airplane should respond.
- Use the appropriate level of automation for the situation. Hand off a task to automation in the state needed. Engage automation when the workload increases and take over manual control of the airplane when needed.
- Apply critical thinking and judgment. If indications are not as expected seek verifying information and take appropriate action.

Operational Philosophy

The normal procedures are designed for use by trained flight crewmembers. The procedure sequence follows a definitive panel scan pattern. Each crewmember is assigned a flight deck area to initiate action in accordance with Normal and Supplementary Procedures. Non-normal procedural actions and actions outside the crewmembers' area of responsibility are initiated at the direction of the captain.

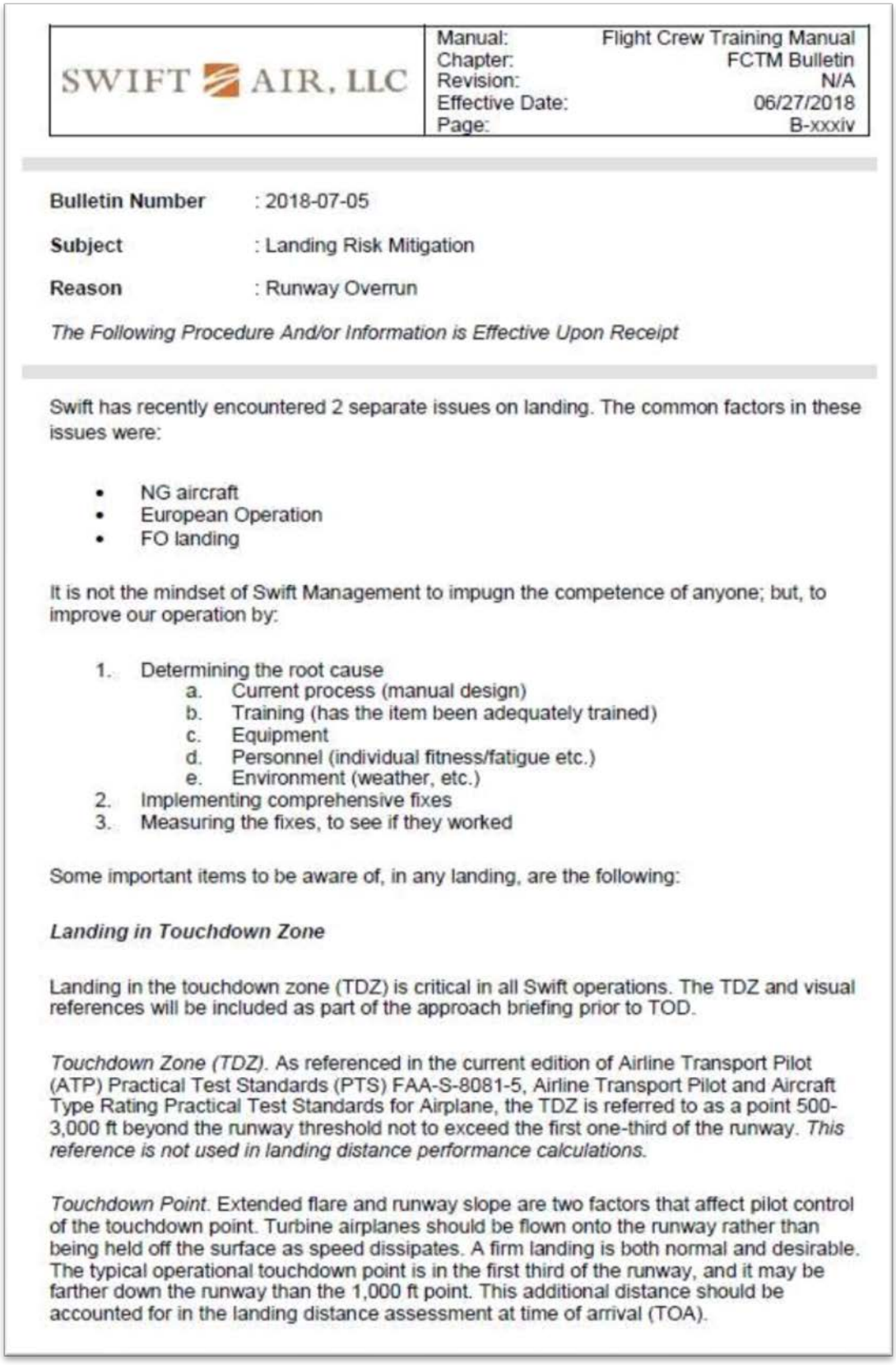
Non-normal checklists are provided to cope with or resolve non-normal situations on the ground or in flight.

Supplementary Procedures are accomplished as required rather than on each flight sector or segment. Supplementary Procedures are found in the FCOM Volume 1.

Figure 7 Boeing Sterile Cockpit Procedures

1.18.3 FCTM – Flight Crew Training Manual for SWIFT AIR, LLC crews.

In the following figures (8–13), the binding procedures for flight crew training at SWIFT AIR, LLC are described.



SWIFT AIR, LLC

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Bulletin Number : 2018-07-05

Subject : Landing Risk Mitigation

Reason : Runway Overrun

The Following Procedure And/or Information is Effective Upon Receipt

Swift has recently encountered 2 separate issues on landing. The common factors in these issues were:

- NG aircraft
- European Operation
- FO landing

It is not the mindset of Swift Management to impugn the competence of anyone; but, to improve our operation by:

1. Determining the root cause
    a. Current process (manual design)
    b. Training (has the item been adequately trained)
    c. Equipment
    d. Personnel (individual fitness/fatigue etc.)
    e. Environment (weather, etc.)
2. Implementing comprehensive fixes
3. Measuring the fixes, to see if they worked

Some important items to be aware of, in any landing, are the following:

Landing in Touchdown Zone

Landing in the touchdown zone (TDZ) is critical in all Swift operations. The TDZ and visual references will be included as part of the approach briefing prior to TOD.

Touchdown Zone (TDZ). As referenced in the current edition of Airline Transport Pilot (ATP) Practical Test Standards (PTS) FAA-S-8081-5, Airline Transport Pilot and Aircraft Type Rating Practical Test Standards for Airplane, the TDZ is referred to as a point 500-3,000 ft beyond the runway threshold not to exceed the first one-third of the runway. *This reference is not used in landing distance performance calculations.*

Touchdown Point. Extended flare and runway slope are two factors that affect pilot control of the touchdown point. Turbine airplanes should be flown onto the runway rather than being held off the surface as speed dissipates. A firm landing is both normal and desirable. The typical operational touchdown point is in the first third of the runway, and it may be farther down the runway than the 1,000 ft point. This additional distance should be accounted for in the landing distance assessment at time of arrival (TOA).

Figure 8 Definition of Landing in Touchdown Zone

Runway Conditions

Contaminated runway. A runway is contaminated when more than 25 per cent of the runway surface area (whether in isolated areas or not) within the required length and width being used is covered by:

water, or slush more than 3 mm (0.125 in) deep;
loose snow more than 20 mm (0.75 in) deep; or
compacted snow or ice, including wet ice.

Dry runway. A dry runway is one which is clear of contaminants and visible moisture within the required length and the width being used.

Qualified Dry Runway- braking effect is as good as that of DRY runway.

Rain, but the grooved runway surface is not drenched

Wet runway. Water depth less than 1/ 8 inch (3mm). Braking effect is reduced from that of DRY/DAMP, but dynamic hydroplaning may not be experienced.

The TLR will only include dry or wet runways. If the runway is contaminated, it may require additional. Contaminated runway data is a function of Aerodata and is selected based on braking data.

Grooved vs. Un-grooved Runways

Grooved runways enable pavement surface to provide sufficient braking and directional control to aircraft and;

- reduces dynamic hydroplaning (standing water)
- reduces viscous hydroplaning (wet pavement with little to no standing water)

Un-grooved (hard-top) runways do not allow the same disbursement of water and may be subject to pooling of water.

Grooved runway information can be found on the Jeppesen 10-9 chart.

Many runways outside the U.S. are un-grooved. This must be taken into account when performing a landing assessment.

Factored Landing Distance (TLR)

The demonstrated (TLR) certified dry landing distance adjusted for airport and aircraft conditions, and then multiplied by the appropriate factor to satisfy a regulatory predeparture requirement. For example: (AFM demonstrated landing distance + MEL/CDL penalties) ×1.6667 = factored dry runway landing distance].[1] The Swift-Aerodata TLR does this for crews.

Figure 9 Runway Conditions, Factored Landing Distance

Boeing aircraft are certified with a demonstrated landing distance. The test flight is accomplished at Vref, touchdown at 1000', max manual braking and no reverse thrust. This is the distance in the AFM.

For example, *figure 1* shows the AFM distance for a 660 kg is 3558', then the required FAR 25 Dry Landing Field Length for dispatch is 3558' x 1.6667 = 5930'.

FAR 25 Wet *Landing Field Length* is the Dry distance increased by 15%, or Dry x 1.15
3558 x 4092
In the above example, the required Wet Landing Field Length would be 4175' x 1.15 = 4801'.

Boeing also provide Advisory Landing distances that include auto brake settings, non-normal configurations and contaminated runway conditions.

---------- FACTORED LANDING DISTANCE ----------

	FLAP 15		FLAP 30		FLAP 40	
LDW	DRY	WET/LVIS	DRY	WET/LVIS	DRY	WET/LVIS
660	6337	7287	5930	6820	5552	6384
640	6153	7075	5758	6622	5388	6196
620	5962	6856	5580	6417	5218	6000
/ 600	5772	6638	5403	6213	5048	5806
580	5582	6420	5226	6010	4880	5611
560	5393	6202	5050	5807	4712	5418
HW/KT	-27	-31	-26	-30	-26	-30
TW/KT	87	100	84	97	82	94

---------- DEMONSTRATED LANDING DISTANCE ----------

	FLAP 15		FLAP 30		FLAP 40	
LDW	DRY	WET	DRY	WET	DRY	WET
660	3802	4372	3558	4092	3331	3831
640	3692	4246	3455	3973	3239	3718
620	3577	4114	3348	3850	3131	3600
/ 600	3463	3983	3242	3728	3029	3483
580	3349	3852	3136	3606	2928	3367
560	3236	3721	3030	3484	2827	3251
HW/KT	-16	-19	-16	-18	-15	-18
TW/KT	52	60	51	58	49	57

Figure 1-Swift- Aerodata TLR

Landing Performance Assessment

Swift crews must perform a Landing performance assessment. Landing performance assessments are influenced by a multitude of variables. Airplane weight and configuration, use of deceleration devices, airport elevation, atmospheric temperature, wind, runway length, runway slope, and runway surface condition (i.e., dry, wet, contaminated, improved, unimproved, grass, etc.) are all factors in determining landing performance. The condition of airplane tires, brakes, and systems installed/operative/inoperative (e.g., antiskid braking, thrust reversers, etc.), and pilot abilities/technique all have a direct impact on the airplane's ability to come to a full stop after touchdown. Crews must be aware of the airplane's landing data/performance. Swift crews must also obtain the most current runway condition information within a reasonable time before initiating the approach phase of flight in order to assess the airplane operational landing distance to ensure that it does not exceed the

Figure 10 Landing Performance Assessment

landing distance available. **If the runway condition is in doubt or not known, use the wet runway data.**

Landing Performance Assessment Steps

Determine available landing distance for applicable runway from airport chart, applicable NOTAMS and PIREPS should also be considered

Assess Runway Condition: Reference TALPA ARC Chart (to be added) located in the cockpit. Also available in the FCTM 6.5B. Determine appropriate braking action condition, Good, Good-Medium, Medium, Medium-Poor, Poor.

Refer to the QRH PI NORMAL CONFIGURATION LANDING DISTANCE Chart for the applicable landing flap selection with the runway condition determined from Step 2. Make appropriate corrections from notes at the bottom of the chart.

Refer to TLR LANDING DISTANCE SECTION in the flight release. Compare the computed landing distance from the above steps to both the FACTORED (Conservative) , and DEMONSTRATED (Best case) values.

*NOTE: OPERATIONS ON RUNWAYS OR TAXIWAYS WITH A REPORTED BRAKE ACTION OF NIL IS PROHIBITED

FCTM

Autobrake MAX: Used when minimum stopping distance required. At wheel spin up transition to MAX Manual braking

Autobrake 3: Wet, slippery, short runways

Autobrake 1-2: Provides a moderate deceleration rate suitable for routine operations

Landing Guidance

•Fly a stable approach, on target, full landing configuration. engines spooled and on speed.

•Land in the Touch Down Zone- don't float. Boeing recommends a firm landing to dissipate energy, reduce the possibility of hydroplaning and to initiate autobraking and speed brake deployment.

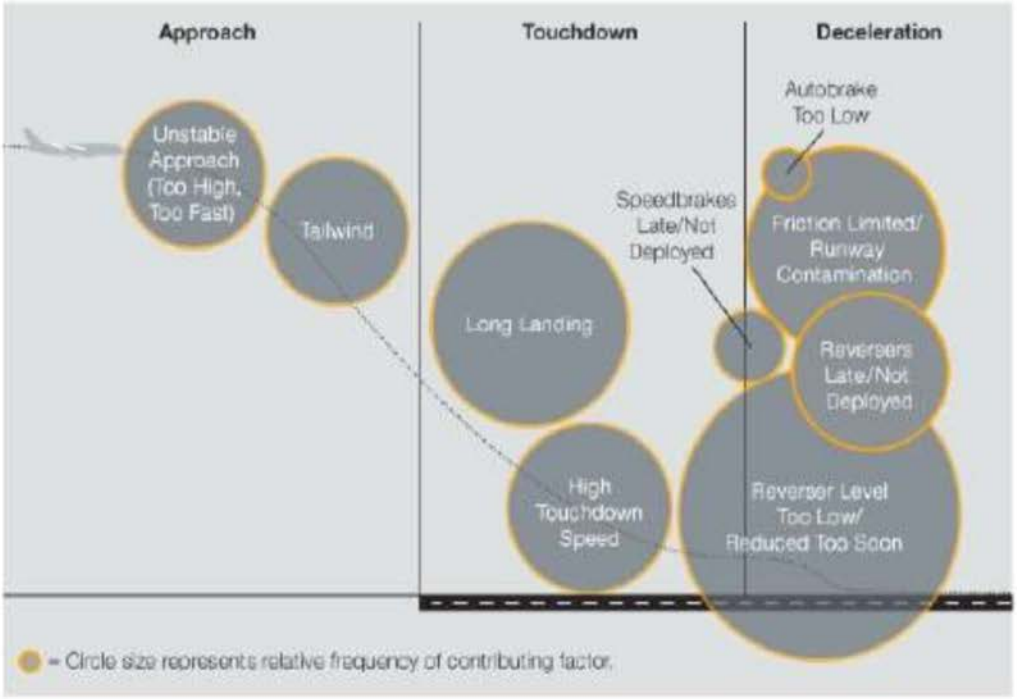
Figure 11 Landing Performance Assessment Steps, FCTM, Landing Guidance

Go-Around

Determine go-around point. Calculating and briefing a go-around point or the latest point on the runway by which the flight crew must touch down during the approach briefing also has potential to reduce overrun excursions. This go-around distance calculation can mitigate the approximately 44 percent of runway overrun excursions that are attributed to long landings.

In any event the decision should be made to go around in the event the aircraft will not touchdown within the TDZ.

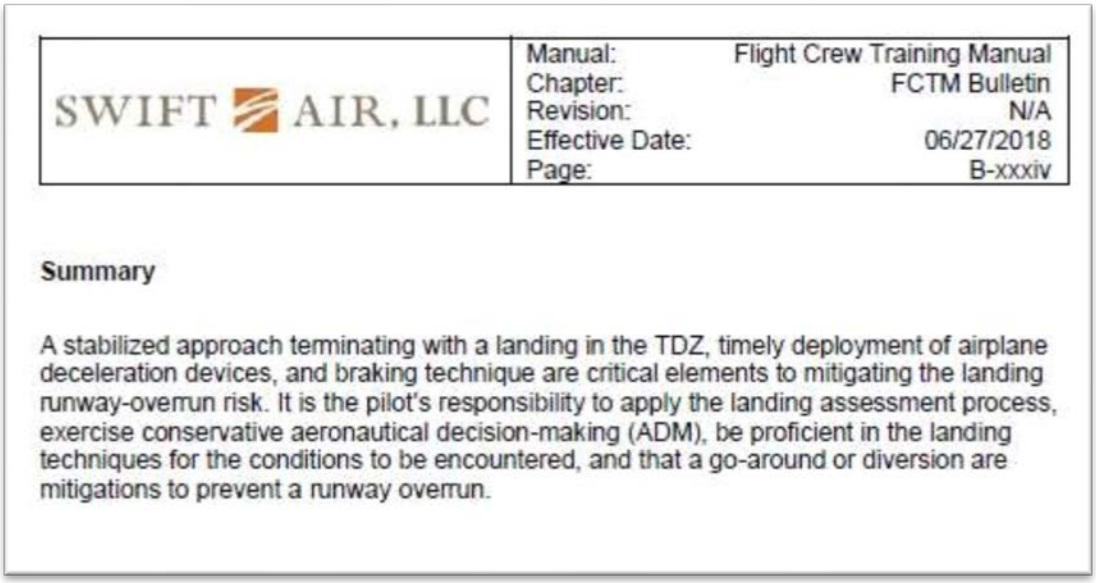
Causes of Runway Overruns



Float

If the flare is too abrupt and thrust is excessive near touchdown, the airplane tends to float in ground effect. Do not allow the airplane to float or attempt to hold it off. Fly the airplane onto the runway at the desired touchdown point and at the desired airspeed. If you are floating, slightly release the back pressure on the stick and it should touch down.

Figure 12 Go-Around, Float, Causes of Runway Overruns



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Summary

A stabilized approach terminating with a landing in the TDZ, timely deployment of airplane deceleration devices, and braking technique are critical elements to mitigating the landing runway-overrun risk. It is the pilot's responsibility to apply the landing assessment process, exercise conservative aeronautical decision-making (ADM), be proficient in the landing techniques for the conditions to be encountered, and that a go-around or diversion are mitigations to prevent a runway overrun.

Figure 13 Summary

1.19 Useful or Effective Investigation Techniques

Annex 13 was adhered to at all times during the investigation of the serious incident.

2. Analyses

2.1. General

For determining the causes of the serious incident, the DFDR and CVR data analyses, the crew statements, and the LKPD personnel statements were used. Information from the FCTM, weather data at LKPD at the time of the incident, photodocumentation, videofootage from the airport cameras, and the videofootage obtained from the passenger cabin were also employed.

2.2 Crew Qualifications

The flight crew was qualified, and the pilots were holders of valid FAA ATP licences. Both the pilots were holders of valid PCs/PTs. The total flight hours of either of them represented flight experience that should – even under such circumstances as in this case – lead to correct evaluation of all the relevant flight data. Neither flight crew member was on service shift overtime and all of them had had adequate time of rest before the flight. It was ascertained and documented that PIC (6 times) and FO (3 times) had flight experience with landing at LKPD.

2.3 Aircraft Crew Preparation for Landing

The crew did not perform the aircraft landing performance calculation. The crew selected the flaps at 30° and the automated braking level, AB 2, most likely only by guess and prior experience with landing at LKPD. AB 2 was set and confirmed no sooner than during the landing checklist procedure. Both LKPD APP and TWR provided the crew with clear topical information about the weather and the wet runway – *RWY WET*. The crew acknowledged this information each time. **Approximately 8 min before landing during descent, the FO/PF raised the question whether to use AB 3** namely due to the expected rain. **The FO/PF received a negative response: "*won't really matter, you have the reversers".*** PIC/PM did not follow the CRM and evaluated the FO/PF's recommendation of necessity to use AB 3 with the above statement.

2.4 Aircraft Decelerating

The reading of the braking pressure from the flight data log used for the purposes of decelerating analysis had to be confirmed as inaccurate due to FAP. The decelerating process analysis is therefore only of an informative nature and it took the deceleration values scatter into account. The deceleration of the aircraft took place in the extent of approx. 1,306 m from the touchdown point of the main landing gear on RWY 27. During the first deceleration phase (approx. 31 sec), the deceleration value AB 2 (Tab. 2) was higher than the value guaranteed by the manufacturer for AB 2 due to the use of the reverse thrust. In case of the second deceleration phase (approx. 7 sec), the PIC used the maximum manual braking. That can, in effect, have higher deceleration values caused by the higher PSI pressure than AB max (3,000 PSI). The time period of application cannot be determined precisely due to the FAP. Flight data analysis (FDA) shows higher altitude of flyover over the THR, approximately 64 feet, which fact in itself contributes to longer flare to the total of 965 m beyond the THR, after which a regular use of the reverse thrust of both the engines follows. The aircraft speed at the moment of touch with RWY was in accordance with the manufacturer documentation. During landing and immediately after touchdown of the aircraft on RWY 27, tailwind of 4 kt was blowing. At 50 ft of altitude, the value of the tailwind began to rise up to 6 kt at the point of touchdown. The last two values of tailwind reported by the ATC were not taken into consideration by the flight crew, not even mentioned as a threat. The real tailwind value at the moment of touchdown was stronger than the reported values but still within the limits of the aircraft for landing (*Max tail wind 10 kt*). The value *factored distance (+15%)* should have warned the pilots that the true *stopping distance* could be longer than LDA. When calculating the true stopping distance it is obvious that there is only 46–97 m allowance from the overall length of 2,500 m RWY and that is in case that the landing would be performed on TDZ (455 m beyond THR) and that there would be only headwind or zero wind.

Tab. 2 Factored and Unfactored Stopping Distance

Reported conditions (at time)	Factored distance [m]	Unfactored distance [m]
Speci 240°/3kt (-13min)	2764	2403
ATC (-10min)	2823	2454
ATC (during landing approval)	**2929**	2546

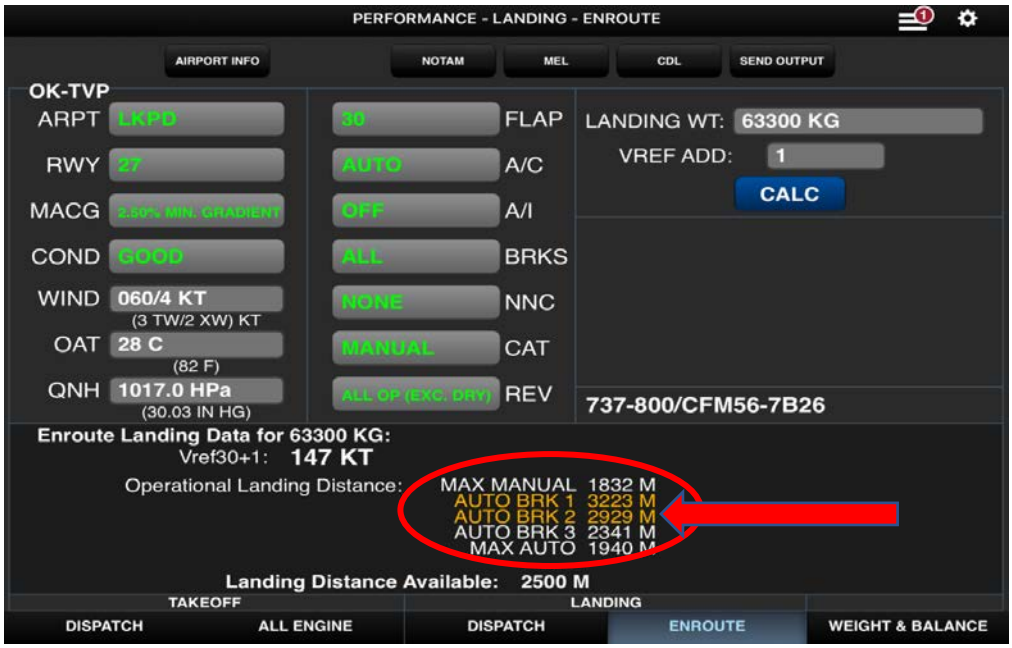


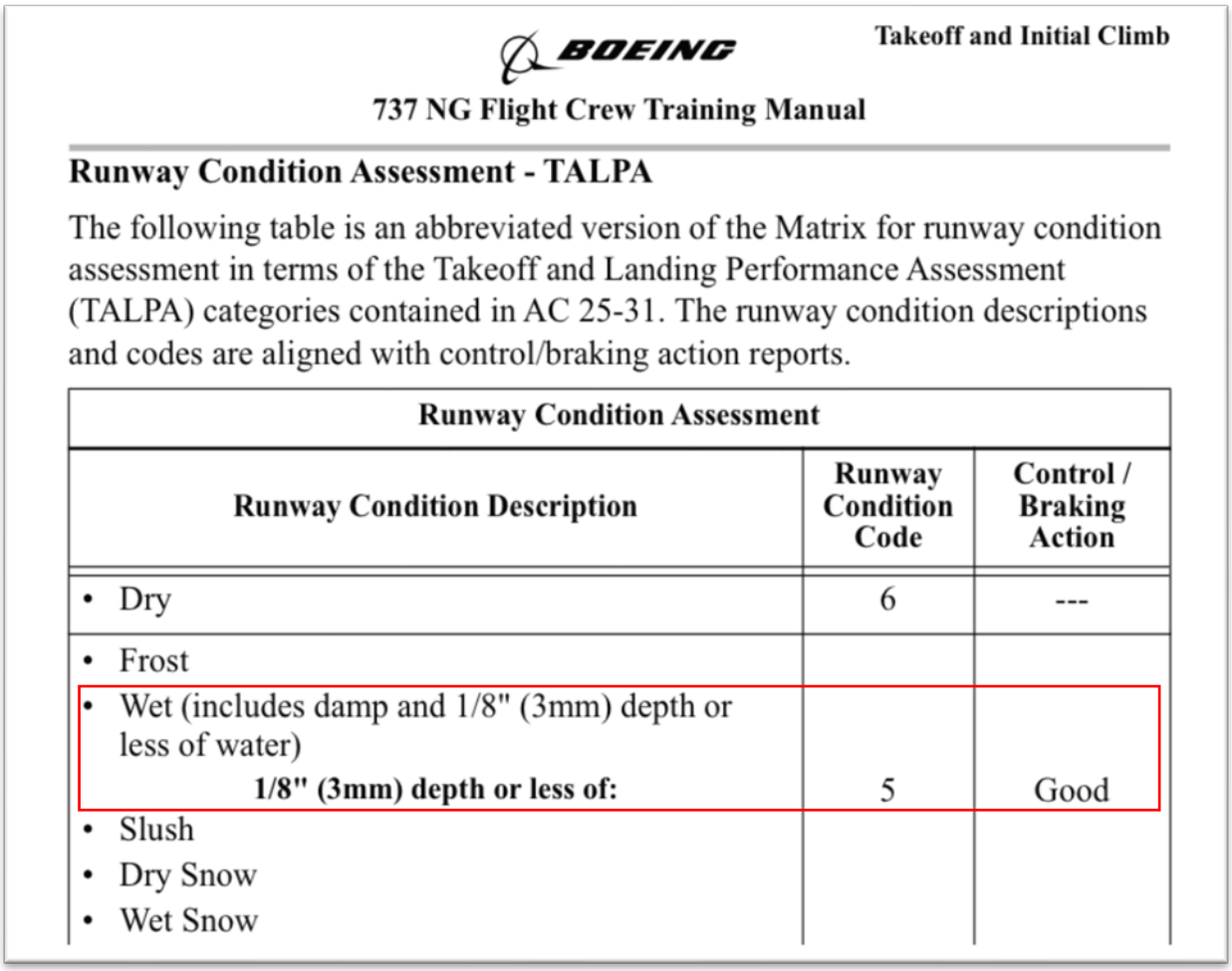
Fig. 14 Simulation of calculation with correction 1 kt, Boeing OPT software

2.5 FCTM

2.5.1 *Runway Conditions* – excerpt

A runway is contaminated when more than 25 per cent of the runway surface area (whether in isolated areas or not) within the required length and width being used, is covered by: water, or slush more than 3 mm (0.125 inch) deep. Wet or damp runway, water depth less than 1/8 inch (3 mm). Braking effect is reduced from that of DRY/DAMP, but dynamic aquaplaning may not be experienced.

2.5.2 *Runway Condition Assessment*



BOEING

Takeoff and Initial Climb

737 NG Flight Crew Training Manual

Runway Condition Assessment - TALPA

The following table is an abbreviated version of the Matrix for runway condition assessment in terms of the Takeoff and Landing Performance Assessment (TALPA) categories contained in AC 25-31. The runway condition descriptions and codes are aligned with control/braking action reports.

Runway Condition Assessment		
Runway Condition Description	**Runway Condition Code**	**Control / Braking Action**
• Dry	6	---
• Frost		
• Wet (includes damp and 1/8" (3mm) depth or less of water) **1/8" (3mm) depth or less of:**	5	Good
• Slush • Dry Snow • Wet Snow		

Fig. 15 Runway Condition Assessment – Braking Action Good

2.6 Analysis of the Crew's Decision-making Process

PIC/PM pinpointed the contamination of RWY with water as the possible cause of dynamic aquaplaning. Over a period of 24 h, and at the time of B 737 landing on RWY 27 at LKPD, the maximum of 0.9 mm/m^2 of precipitation was measured. Videofootage and photodocumentation show that the concrete panels on RWY 27 were wet at some places, but mostly only damp, and at many places even completely dry. Given the position of the sun and the temperature of 28°C, the wet and damp concrete panels could cause visible glare during approach and landing. Such glare made the PIC think that the RWY was contaminated with water. Nevertheless, given the measured amount of precipitation, it is possible that dynamic aquaplaning may not be experienced (2.4.1).

PIC further stated that the visible glare had made it impossible to well recognise the runway markings which assist pilots in finding directions and identifying TDZ. At approx. 1000 ft, FO/PF turned off the automatic control and was carrying out landing by hand. Although PIC/PM could not see runway markings on TDZ well, he failed to employ *back up by instruments* so that FO/PF had relevant and correct flight trajectory information. FO/PF thus had to land the aircraft only based on his own estimate. The footage from the camera placed at the Pardubice airport shows prolonged "soaring" of the aircraft with touchdown beyond TDZ at approx. 965 m away from RWY 27 THR. The crew also failed to determine the Go-around point. After touchdown on RWY 27, DFDR captured unloading of the right main gear wheels for some 1 sec. Such unloading occurred at the time of retracting of ground spoilers. The crew was advised by TEC/TWR to vacate RWY 27 via TWY D. Data downloaded from DFDR confirmed that the reverse thrust of both engines had been used immediately after retracting of ground spoilers after touchdown on RWY 27. Except for a single moment when FO/PF was suggesting the use of AB 3 (due to possible rain), the flight crew was not realising that in case of use of full reverse of both the engines and AB 2, they were in any case far beyond LDA of 2,500 m. They should have also taken the sudden tailwind with a threat of possible long flare into consideration. The videofootage shows the use of reverse engine thrust also in immediate vicinity of the aircraft crossing the runway marking. Nonetheless, the data from flight recorders and videofootage from the passenger cabin revealed no heavy braking of aircraft in the last third of RWY 27. No damage and no traces of heavy braking were observed on main gear wheels and tyres. The crew observed the visual markings indicating the approaching end of RWY only after the aircraft had decelerated to 80 kt. Until this decision-making point of PIC/PM, the crew were busy discussing topics not related to flight performance. Afterwards PIC/PM took over control too indifferently and commenced manual braking of aircraft. It was this "pace" of his decision-making which, together with all the previous mistakes, was the last error which resulted in PIC's failure to brake aircraft home on RWY after taking control and the aircraft stopped with its main gear approx. 12 m beyond the end of RWY.

The flight crew failed to comply with ***sterile flight deck procedures***. Non-compliance with the said procedures resulted in the crew's loss of situational awareness (**SITAW**). The consequences of the said non-compliance included the failure to adhere to the prescribed procedures, ***landing performance calculations,*** and superficial assessment of risks and vulnerabilities. Compliance with the said procedures imposes on a crew member not to carry out other activities during the critical flight phases than those necessary for the safe aircraft operation. Both the flight crew members were lively chatting about topics not related to flight performance thus diverting their attention from their functions and obligations. Because of mutual distraction by unsubstantial topics, both the pilots stopped being "inside the flight" and were relying only on a routine approach and superficial assessment of risks. The contradiction between the visual assessment of the runway condition by PIC before and after landing only confirms the loss of situational awareness of the entire flight crew.

2.6 Weather Assessment

The rain shower was a TS manifestation. The measured contamination of RWY with water was 0.9 mm/m^2. Air temperature was 28°C. Air temperature significantly and immediately caused evaporation of water on RWY. Braking effect on RWY was reduced from that of dry/damp, but dynamic aquaplaning may not be experienced. At the time of landing, there were VMCs. Tailwind of 060°/4 kt, reported by LKPD ATS, was within acceptable limits for landing of B 737. The measured values of precipitation and related degree of contamination of RWY 27 with water were interpreted well by TEC/TWR and SC/AEC and communicated to the crew as *"RWY WET".* The crew had meteorological information from METAR reports,

TAFs and LKPD SPECI reports. The reports corresponded to the actual weather conditions at the airport and in the surrounding area.

3. Conclusions

3.1 Investigation Conclusions

The AAII Commission concludes as follows:

Pilot-in-command/PM:

- was medically fit,
- had a valid FAA ATP licence,
- had sufficient flight experience on the given B 737 type,
- failed to calculate the *aircraft landing performance*,
- failed to comply with *CRM* when recommended by FO/PF to use AB 3,
- failed to employ *back up by instruments* during FO/PF's landing,
- did not assess lading beyond TDZ as *destabilised*,
- failed to command *Go-around*,
- failed to take over control in time in order to use AB max/manual and brake home on RWY.

First Officer/PF:

- was medically fit;
- had a valid FAA ATP licence,
- had sufficient flight experience on the given B 737 type;
- failed to calculate the *aircraft landing performance*,
- conducted only routine preparation of the aircraft for approach and landing,
- recommended a switch from AB 2 to AB 3 in line with FCTM,
- was not sufficiently assertive after the reaction of the PIC to his recommendation,
- performed landing beyond TDZ in conflict with the procedures of the manufacturer.

The flight crew:

- failed to adhere to ***sterile flight deck procedures*** and thus lost situational awareness,
- after aircraft's RWY overrunning, well assessed the risk to passengers and started deplaning only after the stairs were provided in cooperation with the FRS,
- the flight personnel well assessed the situation after aircraft excursion, informed the PIC and proceeded as instructed by the flight crew. They correctly managed and organised the deplaning procedures in cooperation with FRS and thus prevented panic among passengers.

The LKPD ATS shift:

- was medically fit,
- held valid operating licenses and qualifications,
- was actively involved in speeding up the FRS intervention,
- performed their duties in compliance with applicable regulations.

The aircraft:

- had a valid FAA Standard Certificate of Airworthiness,
- had a valid liability insurance,

- was properly serviced and released to service,
- did not exceed the MLW limit or the tailwind limit during landing in spite of a long-term increase from 4 to 6 kt,
- braking effect on RWY was reduced from that of dry/damp, but dynamic aquaplaning may not be experienced,
- PIC did not record any aircraft system error messages; all aircraft systems were operating in standard mode during landing,
- neither main gear tyres nor wheels were damaged due to braking,
- the aircraft was not damaged after overrunning the runway.

RWY 27 at LKPD:

- RWY 27 was operable. VSLZab carried out a RWY check in compliance with the internal document Procedures of Airport Preparation for Air Operations and CS-ADR-DSN (edition 4). TEC/TWR and SC/AEC correctly advised the aircraft crew of the actual condition of the RWY,
- given the low level of contamination of RWY 27 with water at the time of landing, which was 0.9 mm/m^2 , it is possible that in fact no aquaplaning was experienced.

3.2 Causes

The flight crew failed to comply with ***sterile flight deck procedures***, which resulted in the loss of situational awareness ***SITAW***, which lead to non-compliance with the procedures stipulated by FCTM, failure to calculate *aircraft landing performance*, and failure to assess risks and vulnerabilities during landing.

4. Safety Recommendations

Given the cause of the serious incident, the AAII issues no safety recommendation.

5. Annexes

Figure 16 Over-the-stand view of the B 737 1 sec prior to touchdown on RWY

Figure 17 B 737 touchdown on RWY 27

Figure 18 B 737 during decelerating – braking

Figure 19 Videofootage sequences (1–6)

1. Altitude of RWY 27 THR flyover
2. The altitude above the runway markings, ILS in the background
3. RWY 27 contaminated with water – detail
4. Detail of RWY contaminated with water, PAR in the far background (Precision Approach Radar)
5. Reverse thrust in operation
6. Reverse thrust in operation shortly before the overrunning of RWY 27 end markings