



AIRCRAFT ACCIDENT REPORT

TURKISH/2019/12/31/F

Accident Investigation Bureau

**Report on the Serious Incident involving an Airbus
330-343 aircraft operated by Turkish Airlines Inc. with
nationality and registration marks TC-LOL which
occurred at Port Harcourt Intl. Airport, Omagwa,
Rivers State, Nigeria
On 31st December 2019**

This report is produced by the Accident Investigation Bureau (AIB), Nnamdi Azikiwe International Airport, Abuja.

The report is based upon the investigation carried out by Accident Investigation Bureau, in accordance with Annex 13 to the Convention on International Civil Aviation, Nigerian Civil Aviation Act 2006, and Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 2019.

In accordance with Annex 13 to the Convention on International Civil Aviation, it is not the purpose of aircraft accident/serious incident investigations to apportion blame or liability.

Readers are advised that Accident Investigation Bureau investigates for the sole purpose of enhancing aviation safety. Consequently, AIB reports are confined to matters of safety significance and should not be used for any other purpose.

Accident Investigation Bureau believes that safety information is of great value if it is passed on for the use of others. Hence, readers are encouraged to copy or reprint for further distribution, acknowledging the Accident Investigation Bureau as the source.

Safety Recommendations in this report are addressed to the Regulatory Authority of the State (NCAA) as well as other stakeholders, as appropriate. The Regulatory Authority is the authority that ensures implementation and enforcement.

©Accident Investigation Bureau Nigeria, 2021

TABLE OF CONTENTS

TABLE OF CONTENTS	i
TABLE OF FIGURES	iii
GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT	iv
SYNOPSIS	1
1.0 FACTUAL INFORMATION.....	4
1.1 History of the flight	4
1.2 Injuries to persons	5
1.3 Damage to aircraft	5
1.4 Other damage	6
1.5 Personnel information	6
1.5.1 Captain (Pilot Flying)	6
1.5.2 Co-pilot (Pilot Monitoring)	7
1.6 Aircraft information	8
1.6.1 General information	8
1.6.2 Powerplant.....	8
1.7 Meteorological information	9
1.8 Aids to navigation	9
1.9 Communications	9
1.10 Aerodrome information.....	9
1.11 Flight recorders.....	11
1.11.1 FDR data plot analysis	13

1.11.2 Quick Access Recorder (QAR) analysis by Airbus.....	14
1.12 Wreckage and impact information.....	14
1.13 Medical and pathological information.....	18
1.14 Fire.....	18
1.15 Survival aspect	19
1.16 Test and research	19
1.17 Organizational and management information.....	19
1.17.1 Turkish Airlines.....	19
1.18 Additional information	21
1.18.1 Flight delays.....	21
1.18.2 Wind reconstruction during the event	22
1.18.3 Wind conditions sum-up.....	23
1.19 Effective and useful investigation techniques	23
2.0 ANALYSIS.....	24
2.2 Conduct of the flight	24
2.2.1 Analysis of the flight using FDR data.....	25
3.0 CONCLUSIONS	29
3.1 Findings	29
3.2 Causal factor	29
3.3 Contributory factor.....	30
4.0 SAFETY RECOMMENDATIONS.....	31
APPENDIX.....	32

Appendix A: Airbus FDR parameters signs and conventions	32
---	----

TABLE OF FIGURES

Figure 1: Jeppesen DNPO approach chart.....	10
Figure 2: FDR data plot	12
Figure 3: Parameters of the aircraft in the final descent from 100 ft Radio Height	13
Figure 4: Overview of the approach from auto pilot disengagement	14
Figure 5: Photo of the aircraft parked at the apron after the occurrence.....	15
Figure 6: Photo of the No. 8 main wheel tyre.....	16
Figure 7: Photo of No. 2 engine	16
Figure 8: A close-up photo of the observed damaged area (circled)	17
Figure 9: Photo of one of the damaged runway edge lights	17
Figure 10: A photo of the tyre marks from the right main wheel tyres on the runway shoulder	18

GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT

AIB-N	Accident Investigation Bureau, Nigeria
AGL	Above Ground Level
A/THR	Auto Throttle
ATIS	Automatic Terminal Information Service
CAS	Calibrated air speed
DNPO	ICAO code for Port Harcourt International Airport
FCTM	Flight Crew Techniques Manual
FDR	Flight Data Recorder
ft	Feet
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
ILS	Instrument Landing System
NCAA	Nigerian Civil Aviation Authority
LOC	Localizer
LTFM	ICAO code for Istanbul Airport, Istanbul, Turkey
kt	Knots
PIC	Pilot in command
QAR	Quick access recorder
RA	Radio Altitude

TC-LOL

RWY Runway

WOW Weight-on-wheels, an FDR parameter

Aircraft accident report number: TURKISH/2019/12/31/F

Registered owner: Sky High IV Leasing Designated Activity Company

Registered operator: Türk Hava Yollari A.O.
(Turkish Airlines Inc.)

Aircraft type and model: Airbus A330-343

Manufacturer: Airbus Industrie

Year of manufacture: 2010

Nationality and registration marks: TC-LOL

Serial number: 1098

Location: Runway 21, Port Harcourt Intl. Airport, Omagwa, Rivers State, Nigeria.

Date and time: 31st December 2019 at about 03:30 h

All times in this report are local time (UTC +1) unless otherwise stated

SYNOPSIS

The Accident Investigation Bureau, Nigeria (AIB-N) was notified of the occurrence by the Nigerian Civil Aviation Authority (NCAA) on 31st December, 2019; the day of the occurrence. Investigators were dispatched to the scene the next day to commence post occurrence assessments, under the provisions of the Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 2019 and International Civil Aviation Organization (ICAO) Annex 13.

All relevant stakeholders were notified.

On 30th December 2019 at about 20:46 h, an Airbus A330-343 aircraft with nationality and registration marks TC-LOL operated by Turkish Airlines Inc. departed Istanbul Airport (LTFM), Istanbul; Turkey for Port Harcourt International Airport (DNPO), Omagwa, Rivers State; Nigeria, as a scheduled flight THY3WJ operating on Instrument Flight Rules (IFR) flight plan. There were 295 persons on board including 11 crew members. The Captain was the Pilot Flying (PF), while the Co-Pilot was the Pilot Monitoring (PM).

At 03:10 h, THY3WJ established two-way contact with Port Harcourt Approach reported descending to FL220 on-course NAPVA¹, and received weather information with relevant clearances.

The aircraft touched down with its main landing gear at about 612 m from the threshold, right of the runway centreline, crossed the right-side runway strip marking onto the right runway shoulder, impacted and damaged three runway edge lights, and returned to the runway at a distance of about 1,037 m from the threshold. The tyre marks further indicated that the aircraft returned to the runway centreline at about 1,478 m from the threshold.

The approach was performed at night and the crew reported haze and patches of fog at low level.

The Port Harcourt International Airport runway was equipped with only edge lights with no centreline and runway touchdown zone lights.

The investigation identified the following:

¹ A reporting point

Causal factor

The extra right aileron and rudder input by the PF in the last 100 ft caused the aircraft to drift right of the runway centreline.

Contributory factor

1. The inappropriate rudder application by the flight crew in the last 45 ft did not prevent the right drift before touchdown but rather increased the drift at touchdown.
2. The non-adherence to the provisions of the Standard Operating Procedures as contained in the Turkish Airlines Flight Crew Techniques Manual.

One Safety Recommendation was made.

1.0 FACTUAL INFORMATION

1.1 History of the flight

On 30th December 2019 at about 20:46 h, an Airbus A330-343 aircraft with nationality and registration marks TC-LOL operated by Turkish Airlines Inc. departed Istanbul Airport (LTFM), Istanbul; Turkey for Port Harcourt International Airport (DNPO), Rivers State; Nigeria, as a scheduled flight THY3WJ operating on Instrument Flight Rules (IFR) flight plan. The flight had 295 persons on board including 11 crew members. The Captain was the Pilot Flying (PF), while the Co-Pilot was the Pilot Monitoring (PM).

According to the crew statements, the flight was delayed for two hours before departure. The crew added that at the time of initial contact with Port Harcourt Approach (APP), they noticed that the Automatic Terminal Information Service (ATIS), was off the air.

At 03:10 h, THY3WJ established two-way contact with Port Harcourt Approach reported descending to FL220 on-course NAPVA. APP acknowledged and cleared THY3WJ to Port Harcourt VOR (POT) FL220, to expect no delay for ILS Approach runway 21, and to stand by for a full meteorological report. The crew requested for further descent and was cleared to 2,400 ft. APP subsequently passed 0200 UTC meteorological report to the crew as follows: "WIND IS CALM, VISIBILITY 5KM IN HAZE, NO SIGNIFICANT CLOUD, TEMPERATURE 24°C, DEW POINT [23°C], QNH 1009." The clearance was acknowledged by the crew.

At 03:22 h, THY3WJ was handed over to Port Harcourt Tower by APP. At 03:26 h, THY3WJ established contact with Port Harcourt Tower, THY3WJ reported that it was established on the Localizer (LOC) runway (RWY) 21. Thereafter, Port Harcourt Tower acknowledged and cleared THY3WJ for landing RWY 21 in calm wind.

The PM stated that at 400 ft AGL, the PF disengaged the auto pilot and flew the aircraft manually. The crew further stated that the approach was stable before passing 1,000 ft AGL and to touchdown.

At 03:30 h, THY3WJ landed right of the runway centreline, where the right main wheel crossed the runway edge line and continued along the runway shoulder. The tyre tracks showed that the right main wheel returned to the runway centreline.

At 03:56 h, the crew reported to the Tower that they had a flat main wheel tyre and requested post-landing inspection of the runway.

At 04:26 h, the Tower informed the crew that there were three (03) edge lights to the right of the runway, after the rapid exit 03 had been damaged.

The incident occurred at night.

1.2 Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft
Fatal	Nil	Nil	Nil
Serious	Nil	Nil	Nil
Minor	Nil	Nil	Nil
None	11	284	295
Total	11	284	295

1.3 Damage to aircraft

The aircraft was slightly damaged.

1.4 Other damage

Three runway edge lights were damaged.

1.5 Personnel information

1.5.1 Captain (Pilot Flying)

Nationality:	Turkish
Age:	43 years
Licence type:	Airline Transport Pilot Licence (Aeroplane)
Licence:	Valid till 31st January, 2020
Aircraft ratings:	Boeing 737-300/900, Airbus A330, A350
Medical certificate:	Valid till 16th July, 2020
Instrument rating:	Valid till 31st January, 2020
Simulator:	Valid till 7th January, 2020
Proficiency check:	15th January, 2019
Route/line check:	14th June, 2019
Total flying time:	11,538:08 h
Total on type:	694:03 h
Total on type (PIC):	694:03 h
Last 90 days:	178:23 h
Last 28 days:	28:04 h
Last 7 days:	20:37 h
Last 24 hours:	10:12 h

1.5.2 Co-pilot (Pilot Monitoring)

Nationality:	Turkish
Age:	42 years
Licence type:	Airline Transport Pilot Licence (Aeroplane)
Licence:	Valid till 30th September, 2020
Aircraft ratings:	Airbus A330, A350
Medical certificate:	Valid till 23rd November, 2020
Instrument rating:	Valid till 31st September, 2020
Simulator:	Valid till 13th February, 2020
Proficiency check:	14th August, 2019
Route/line check:	25th February, 2019
Total flying time:	2,726:33 h
Total on type:	1,752:02 h
Total on type (PIC):	695:13 h
Last 90 days:	45:07 h
Last 28 days:	45:05 h
Last 7 days:	28:18 h
Last 24 hours:	06:33 h

The Captain's flight hours 28 days before the occurrence were logged in the last 7 days. Also, about half of the flight hours in those 7 days were logged within 24 hours. The PM has more than twice the PF's flight hours on type.

1.6 Aircraft information

1.6.1 General information

Type:	A330-343
Manufacturer:	Airbus Industrie
Year of Manufacture:	2010
Serial Number:	1098
Certificate of Airworthiness:	Valid till 26th December, 2020
Certificate of Insurance:	15th of November, 2020
Certificate of Registration:	Issued 26th of December, 2019
Noise Certificate:	Issued 26th of December, 2019
Airframe time:	33,413 h
Cycles Since New (CSN):	6647

1.6.2 Powerplant

	No. 1	No. 2
Engine type	Trent 772B-60	Trent 772B-60
Manufacturer	Rolls-Royce	Rolls-Royce
Serial number	41735	41027
Time since new	30,267 h	64,252 h
Cycles since new	6,033	22,449
Year of manufacture	2009	1995

Fuel type used: Jet A-1

1.7 Meteorological information

Time	0100 UTC	0200 UTC	0300 UTC
Wind	Calm	Calm	Calm
Visibility	5 km	5 km	5 km
Weather	Slight haze	Slight haze	Slight haze
Cloud	No significant cloud	No significant cloud	No significant cloud
Temperature/Dew point	24 °C/23°C	24 °C/23°C	21 °C/20°C
QNH	1009 hPa	1009 hPa	1009 hPa

1.8 Aids to navigation

Instrument Landing System (ILS) of runway 21 was available and serviceable at the time of the incident.

1.9 Communications

There was effective communication between the aircraft and the Air Traffic Control. Automatic Terminal Information Service (ATIS) was unserviceable and NOTAM issued on the 23rd November 2018.

1.10 Aerodrome information

Port Harcourt International Airport with location indicator DNPO has a bi-directional runway with designation 03/21. Runway 21 was the runway in use for the approach. The

runway has a dimension of length 3,000 m and width 60 m (75 m with shoulders). Aerodrome Reference Point is 05°00'55.6545"N 006°56'38.3168"E while the elevation is 91 ft.

The runway is equipped with ICAO Cat 1 approach lights and non-standard edge lights (no runway threshold identification lights, no runway centreline lights and no runway touchdown zone lights).

Effective 06-DEC-2018

29-NOV-2018

PHG-DNPO

Nigeria Port Harcourt Port Harcourt Intl

7-10

ILS + VOR DME 21

IAC

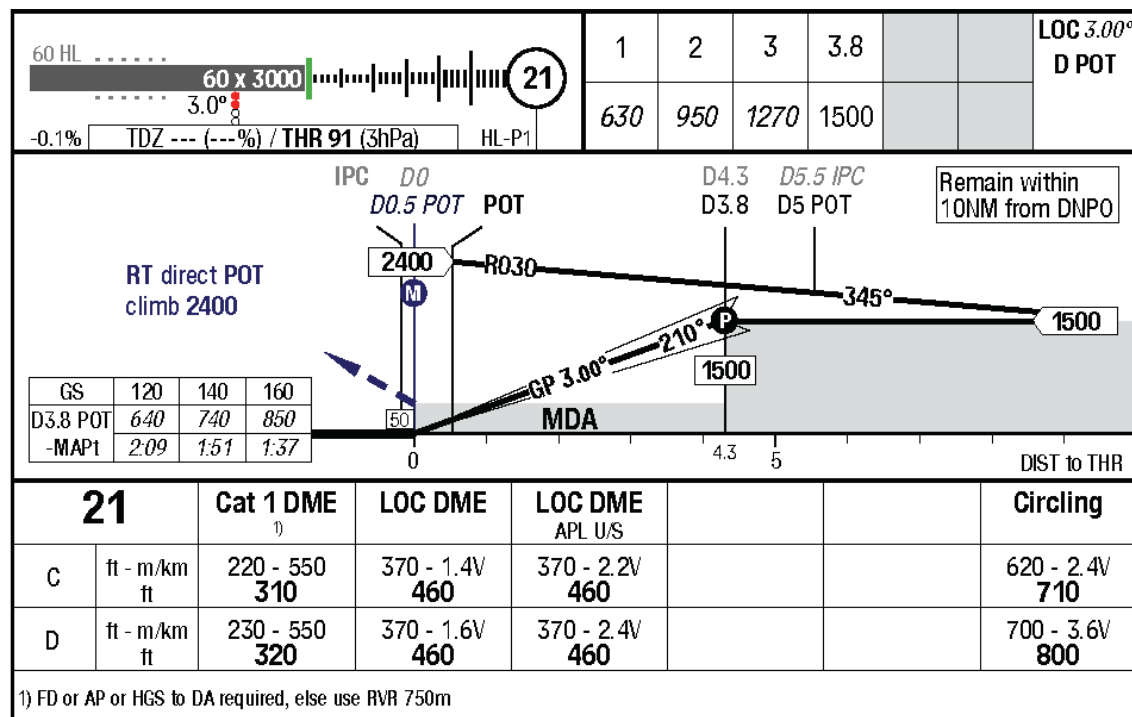


Figure 1: Jeppesen DNPO approach chart

1.11 Flight recorders

The aircraft was fitted with Solid-State Flight Data Recorder (FDR), Quick Access Recorder (QAR) and Cockpit Voice Recorder (CVR).

	Flight Data Recorder	Cockpit Voice Recorder
Manufacturer	L3 Communications, USA	L3 Communications, USA
Model	FA2100	FA2100
Part number	2100-4045-00	2100-1025-02
Serial number	000617546	000591433

The Flight Recorders were downloaded at the Turkish Airlines flight safety facility under supervision of the Turkish Transport Safety Investigation Centre, with the consent of the Accident Investigation Bureau, Nigeria (AIB-N). The files were sent to the AIB-N for analysis and transcription.

Turkish Airlines also provided the Quick Access Recorder (QAR) to Airbus for analysis.

The CVR records contained recordings of communication between the Tower and the crew of TC-LOL after the occurrence. The voice recordings of communication during approach and landing phase of the flight were found overwritten. The FDR data was analysed and plots are attached below:

TC-LOL

TURKISH AIR
TC-LOL
Descent from 100 ft RH

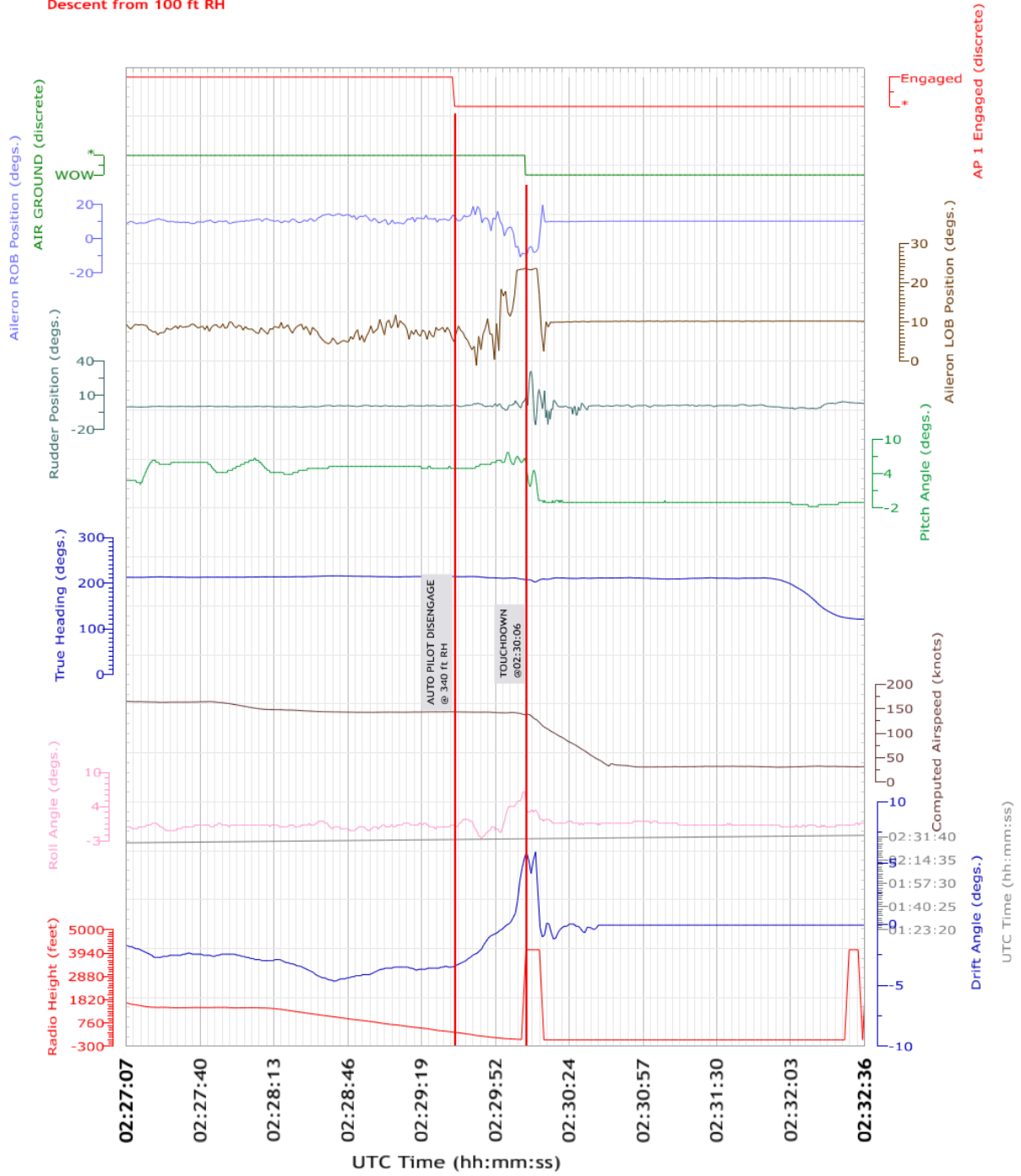


Figure 2: FDR data plot

1.11.1 FDR data plot analysis

According to FDR data, the aircraft cruised at FL360 and commenced descent towards DNPO at about 02:00:07 UTC.

The plot shows the following:

AUTO PILOT was disengaged at 324 ft Radio Height.

WOW: Aircraft touched down at 02:30: UTC with a VERTICAL SPEED of 540 fpm, COMPUTED AIRSPEED of 138 knots, 6° PITCH, ROLL ANGLE was 7°.

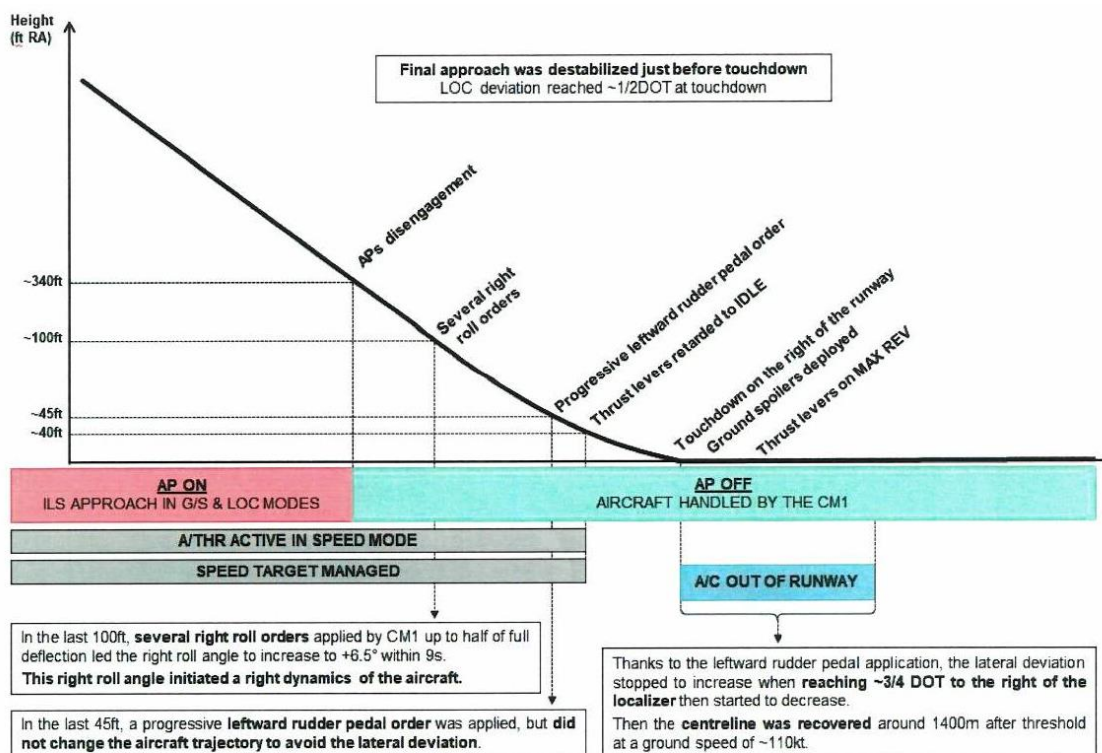
The following table captures parameters of the aircraft in the final descent from 100 ft Radio Height:

Radio Height (feet)	100	80	50	40	30	20	15	Touchdown
Time	02:29:52	02:29:54	02:29:57	02:29:59	02:30:01	02:30:02	02:30:03	02:30:05
Rudder (degrees)	2	2	-3	2	4	0	0	7
CAS (knots)	142	142	141	142	141	140	140	138
Aileron LOB (.deg)	5	14	14	13	21	23	23	24
Aileron ROB (.deg)	12	10	5	5	-5	-8	-10	-9
Pitch(.deg)	6	6	8	6	7	7	6	6
Localizer	-0.17	-0.17	-0.12	-0.25	-0.25	-0.33	-0.35	-0.56
Glideslope	0.41	1.25	3.81	3.81	2.50	1.87	1.68	0.89
Roll (.deg)	-1	-1	3	4	4	5	5	6
True Heading (.deg)	211	211	211	211	211	209	208	208
Drift(.deg)	-1	0	0	0	1	3	4	6

Figure 3: Parameters of the aircraft in the final descent from 100 ft Radio Height

An independent analysis of the flight data was requested from Aircraft manufacturer, Airbus, by the operator via the Turkish Transport Safety Investigation Centre. Findings from the Airbus report are also referenced.

1.11.2 Quick Access Recorder (QAR) analysis by Airbus



REFERENCE: TechRequest 80731186

EVENT DATE : December 31st 2019

Page 3/24

Figure 4: Overview of the approach from auto pilot disengagement

1.12 Wreckage and impact information

Aircraft tyre marks found on the runway showed that the aircraft touched down right of the runway centreline, at about 612 m from the threshold. The right main wheel crossed the runway edge line onto the runway shoulder at about 27 m from the touchdown point, impacted and damaged three runway edge lights, and returned to the runway at a distance of about 1,037 m, from the threshold.

TC-LOL

The tyre marks further indicated that the aircraft returned to the runway centreline at about 1,478 m from the threshold.

Nos. 3 and 7 main wheel tyres were scuffed. No. 8 Main wheel tyre was found deflated with shredded plies. The right inboard flap was dented on its lower surface. A dent was observed to the internal fan cowl of engine No. 2. Debris from the tyres was found on the runway.



Figure 5: Photo of the aircraft parked at the apron after the occurrence

TC-LOL



Figure 6: Photo of the No. 8 main wheel tyre



Figure 7: Photo of No. 2 engine



Figure 8: A close-up photo of the observed damaged area (circled)



Figure 9: Photo of one of the damaged runway edge lights



Figure 10: A photo of the tyre marks from the right main wheel tyres on the runway shoulder

1.13 Medical and pathological information

No medical or pathological test was conducted on the flight crew.

1.14 Fire

There was no pre- or post-impact fire.

1.15 Survival aspect

The occurrence was survivable in that the aircraft was structurally intact and taxied under its own power to the apron at the international wing of the airport, where the crew and passengers disembarked normally, using the passenger exit doors.

1.16 Test and research

Not applicable.

1.17 Organizational and management information

1.17.1 Turkish Airlines


Turkish Airlines is the national flag carrier of Turkey. Established in 1933 and headquartered at the Istanbul Atatürk Airport, the airline operates scheduled flight services to 280 destinations around the world, including key cities across Africa, Asia, Europe as well as North and South America. The airline has over 320 aircraft in its fleet and it is a member of the Star Alliance.

The airline's primary air hubs are situated at Istanbul Atatürk Airport, Esenboğa International Airport and Sabiha Gökçen International Airport.

Turkish Airlines Flight Crew Techniques Manual (FCTM)

Extract 1 - Flight Crew Techniques Manual (FCTM PR-NP-SOP-250 FLARE AND TOUCHDOWN)

AIRBUS


FCTM extract	
 TURKISH AIRLINES TÜRK HAVA YOLLARI A330/A340 FLIGHT CREW TECHNIQUES MANUAL	PROCEDURES NORMAL PROCEDURES STANDARD OPERATING PROCEDURES - LANDING
FLARE AND TOUCHDOWN	
<u>PITCH CONTROL</u>	
[...]	
<p>Prior to flare, avoid destabilization of the approach and steepening the slope at low heights in attempts to target a shorter touchdown. <u>If a normal touchdown point cannot be achieved or if destabilization occurs just prior to flare, a go-around (or rejected landing) should be performed.</u></p> <p>The PM monitors the rate of descent and should call "SINK RATE" if the vertical speed is excessive prior to the flare.</p> <p><u>From stabilized conditions, the flare height is about 40 ft.</u></p> <p>This height varies due to the range of typical operational conditions that can directly influence the rate of descent.</p>	
[...]	
<p>Avoid under flaring</p> <ul style="list-style-type: none">- The rate of descent must be controlled prior to the initiation of the flare (i.e. nominal 3 ° slope and rate not increasing)- <u>Start the flare with positive (or "prompt") backpressure on the sidestick and holding as necessary</u>- <u>Avoid significant forward stick movement once Flare initiated</u> (releasing backpressure is acceptable).	

Extract 1 – FCTM PR-NP-SOP-250 FLARE AND TOUCHDOWN

Extract 2 - Flight Crew Techniques Manual (FCTM AS-RUD OPERATIONAL RECOMMENDATIONS)

AIRBUS

FCTM extract


TURKISH AIRLINES
TÜRK HAVA YOLLARI
A330/A340
FLIGHT CREW
TECHNIQUES MANUAL

AIRCRAFT SYSTEMS
RUDDER

OPERATIONAL RECOMMENDATIONS

In order to avoid excessive structural loads on the rudder and on the vertical stabilizer, the flight crew must apply the following operational recommendations.

THE RUDDER IS DESIGNED TO CONTROL THE AIRCRAFT, IN THE FOLLOWING SITUATIONS

A. IN NORMAL OPERATIONS, FOR LATERAL CONTROL

- During the take off roll, when on ground, especially in crosswind conditions,
- During landing flare with crosswind, for decrab purposes,
- During the landing roll, when on ground.

[...]

THE RUDDER SHOULD NOT BE USED

- To induce roll
- To counter roll, induced by any type of turbulence.

Extract 2 – FCTM AS-RUD OPERATIONAL RECOMMENDATIONS

1.18 Additional information

1.18.1 Flight delays

Records available to the Bureau reveals that the crew were informed by Turkish air crew planning department of a scheduled departure at 17:25 h. They were later informed by the Crew Planning Department of a postponement to 18:40 h, and subsequently to 20:40 h. Push back commenced at about 20:46 h. Flight time was 6 h 53 minutes.

1.18.2 Wind reconstruction during the event

AIRBUS

5.3.2. WIND RECONSTRUCTION DURING THE EVENT

A specific wind reconstruction was computed by Airbus to determine the influence of the wind on the aircraft behavior during short final approach.

The wind reconstruction is computed on runway 3 axes, based on:

- Anemometric and Inertial data from FDR
- Anemometric correction: estimation of sideslip and ground effects
- Inertial bias reconstruction

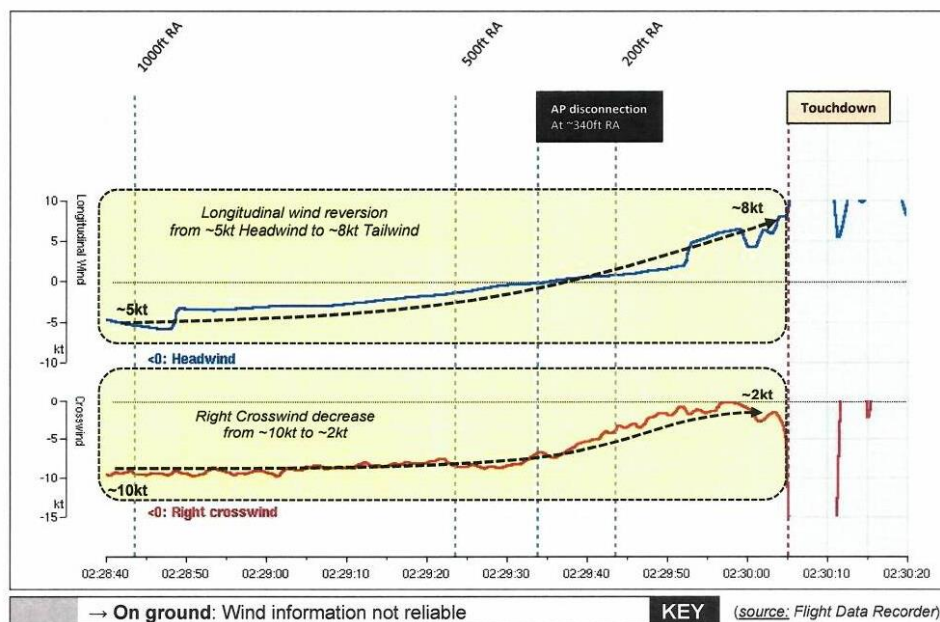
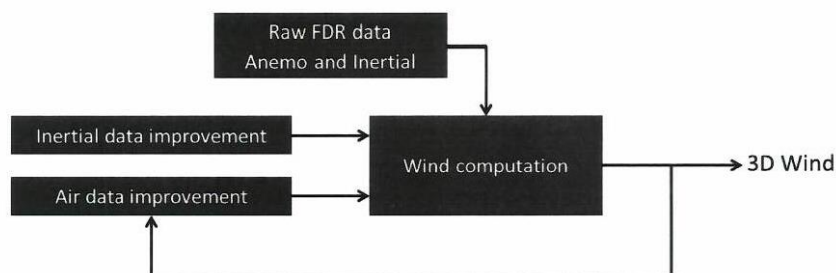
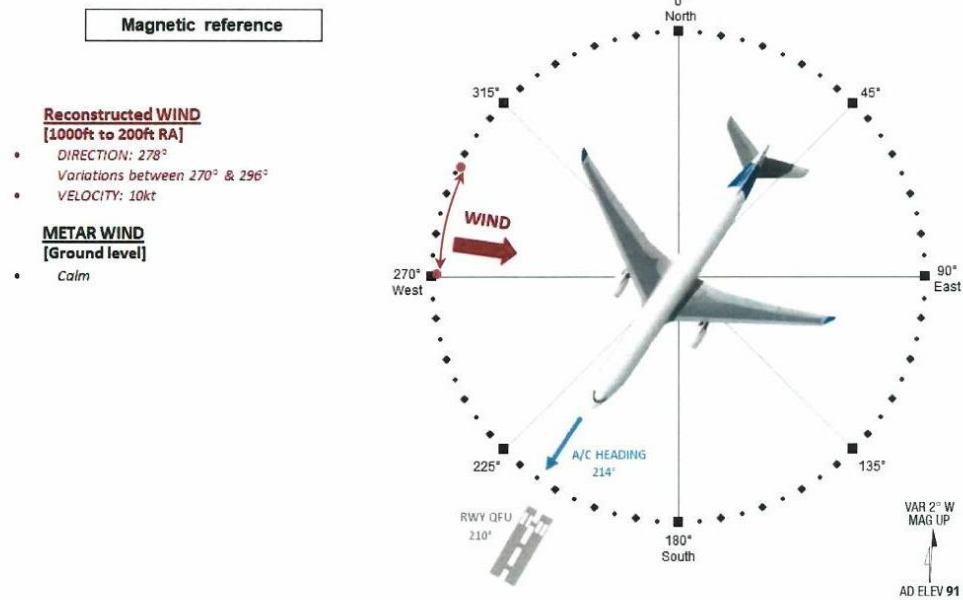


Figure 4 – Reconstructed wind along the runway axes

1.18.3 Wind conditions sum-up

5.3.3. WIND CONDITIONS SUM-UP



1.19 Effective and useful investigation techniques

Nil.

2.0 ANALYSIS

2.1 Analysis of the prevailing wind

METAR published about 30 minutes before the event reported calm wind conditions in haze. Reconstructed wind between 1,000 ft RadAlt and 200 ft RadAlt highlights a wind from 278° at 10 kt. Consequently, the aircraft did not encounter any adverse wind conditions during final approach and landing which could have affected the safe operation of the aircraft. The approach was at night time.

2.2 Conduct of the flight

Records available to the Bureau revealed that the crew were informed by Turkish Airlines Crew Planning Department of a scheduled departure at 17:25 h. The flight was delayed, and departure rescheduled. The flight eventually departed at 20:46 h. There is no evidence that these delays and rescheduled departure introduced any fatigue on the crew's performance.

The take-off, climb, cruise, and initial descent phases of flight were uneventful. The crew stated that ATIS was off air. However, evidence available to the Bureau showed that ATIS was unserviceable and NOTAM was in force at the time of the occurrence. Also, the status of the ATIS was incorporated in the Aeronautical Information Publication (AIP).

The flight crew should have been aware of the status of the ATIS before conducting the flight.

2.2.1 Analysis of the flight using FDR data

In the last 100 ft before touchdown, there were several right aileron inputs applied by the PF up to half of full deflection which led to an increase in the right roll angle to +6.5° in 9 seconds.

In the last 100 ft, several nose-up and nose-down inputs were applied by PF.

In accordance with the following Flight Crew Technique Manual (FCTM), from stabilized conditions, the flare height is about 40 ft and should be started with a positive (or “prompt”) backpressure on the sidestick. The aircraft lateral deviation to the right increased close to the ground and aircraft touched down with a significant right offset from centreline (~1/2 DOT).

In the last 45 ft, there were also progressive left rudder applications; this was intended to arrest the lateral deviation and to change the trajectory of the aircraft that was already deviating progressively to the right. This left rudder application did not change the aircraft trajectory but was able to stop the lateral deviation increasing further when it reached a value approximately $\frac{3}{4}$ DOT to the right of the localizer then started decreasing.

The flight crew brought the aircraft back to the runway centreline at around 1,400 m from the threshold at a ground speed of approximately 110 kt.

The aircraft touched down with its main landing gear, right of the runway centreline, crossed the right-side runway strip marking onto the right runway shoulder, impacted and damaged three runway edge lights, and returned to the runway at a distance of about 1,037 m from the threshold. The tyre marks further indicated that the aircraft returned to the runway centreline at about 1,478 m from the threshold.

The FDR confirmed that, at 340 ft RadAlt, the flight crew disengaged both auto pilots via the sidestick instinctive pushbutton. At this point, the final approach can be considered

as stabilized. The final approach was manually handled by PF with the A/THR active in "SPEED" mode and the speed target was effectively managed.

After auto pilot disconnection, the PF applied several slight nose-up inputs leading the pitch angle to progressively increase from $+5^{\circ}$ to $+6.5^{\circ}$ and thus leading the rate of descent to decrease from 800 ft/min to 500 ft/min.

Below 200 ft RadAlt, according to the wind analysis, the tailwind component increased contributing to the CAS to decrease to 141 kt. The A/THR countered this Calibrated Airspeed decrease by thrust adjustments to maintain the speed target.

The longitudinal axis

In the last 100 ft, several nose-up and nose-down inputs were applied by the PF, leading the pitch angle to vary between $+7.5^{\circ}$ and $+5.5^{\circ}$ and the vertical load factor to vary between $+1.1G$ and $+0.9G$. These pitch stick inputs first led to a decrease of the rate of descent from 500 ft/min to 350 ft/min.

Then at about 40 ft RadAlt, thrust levers were pulled to "IDLE" and thrust started to decrease. Simultaneously, due to the trend of the tailwind to continue to increase, the CAS decreased below the speed target reaching 138 kt (VLS) prior to touchdown. As

A/THR was deactivated, this CAS decrease was not countered by thrust adjustments. This loss of speed (from 142 kt to 138 kt) led to a loss of lift at low height. The non-conventional flare (several nose-up and nose-down inputs applied in the last 100 ft), associated with the loss of lift at low height, led the rate of descent to increase from 350 ft/min to 600 ft/min prior to touchdown.

The lateral axis

From 100 ft RadAlt, the PF applied several right aileron inputs leading to a continuous right roll angle up to $+6.5^\circ$ for about 9 seconds. The maintained right roll angle led to increase in the aircraft track and the localizer deviation to the right: the aircraft drifted right of the runway.

At around 45 ft RadAlt, a left rudder pedal input was progressively applied up to half of full deflection. This input led the drift angle to increase up to $+5.5^\circ$ and the heading to decrease to 207° . This did not significantly change the aircraft trajectory to cancel the increasing lateral deviation.

As recommended in the FCTM, in normal operations, the rudder should only be used during landing flare in case of crosswind for decrab purposes.

In order to maintain or recover the aircraft on the runway centerline during flight, the roll control inside the recommended limitation is the most efficient way when the recovery of the runway centerline is needed. Just before touchdown, the right main landing gear was on the right edge of the runway with a high drift angle ($+5.5^\circ$). As contained in the FCTM, prior to flare, avoid destabilisation of the approach and steepening the slope at low height in attempts to target a shorter touchdown. If a normal touchdown point cannot be achieved, or if destabilisation occurs just prior to flare, a go-around (or rejected landing) should be performed. From stabilised condition, the flare height is about 40 ft. At this point, the flight crew should have adhered to this provision of the FCTM rather, they continued the flight.

According to the roll angle recorded at touchdown ($+6.5^\circ$), the right main landing gear touched down first followed by the left main landing gear. The aircraft touched down at about 450 m after the runway threshold with a localizer deviation around 1/2DOT to the right of the runway. The aircraft was therefore on the right of the runway. The LOC was

at approximately 6 m from the runway shoulder, but with the left drift angle (+5.5°) at touchdown, the right main landing gear outer wheel was on the right-side strip marking of the runway.

At about 15 seconds after touchdown, the aircraft was brought back to the centreline of the runway.

After touchdown, the left rudder applied in the last 45 ft was continued and increased to full deflection leading the heading to decrease to 202° and the drift angle to increase up to +6°. As a result of the left rudder application, the lateral deviation reached its maximum of about 3/4 DOT then started decreasing.

At this time, the aircraft was then out of the runway with the right main landing gear on the right shoulder of the runway. During the lateral runway excursion, three runway edge lights were impacted and damaged. These runway edge lights have metal components which must have cut through the No. 8 main wheel which deflated the tyre.

3.0 CONCLUSIONS

3.1 Findings

1. The flight crew were certified and qualified to conduct the flight in accordance with relevant regulations.
2. The Captain was the Pilot Flying while the Co-pilot was the Pilot Monitoring.
3. At the time of initial contact with Port Harcourt Approach (APP), the crew noticed that the Automatic Terminal Information Service (ATIS), was unserviceable.
4. The PM reported that the auto pilot was disengaged at about 400 ft AGL and the aircraft was flown to touchdown manually.
5. Post-occurrence inspection showed that the aircraft touched down right of the runway centreline about 612 m from the threshold, veered onto the runway shoulder and returned to the runway centreline.
6. The No. 3, 7 and 8 main wheel tyres were damaged.
7. Three runway edge lights were damaged.
8. Debris from the tyres and runway edge lights were found on the runway during post-incident inspection.

3.2 Causal factor

The extra right aileron and rudder input by the PF in the last 100 ft caused the aircraft to drift right of the runway centreline.

3.3 Contributory factor

1. The inappropriate rudder application by the flight crew in the last 45 ft did not prevent the right drift before touchdown but rather increased the drift at touchdown.
2. The non-adherence to the provisions of the Standard Operating Procedures as contained in the Turkish Airlines Flight Crew Techniques Manual.

4.0 SAFETY RECOMMENDATIONS

4.1 Safety Recommendation 2021-024

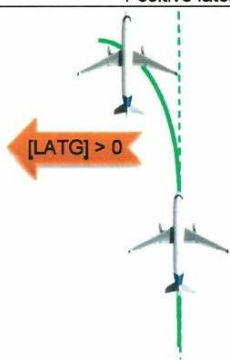
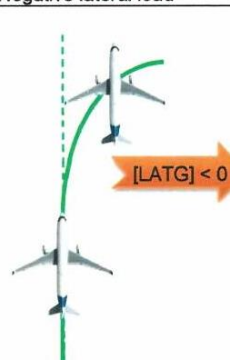




Turkish Airlines Inc. should ensure flight crew adherence to provisions of the Standard Operating Procedures as contained in the Turkish Airlines Flight Crew Techniques Manual vis-à-vis landing techniques

APPENDIX

Appendix A: Airbus FDR parameters signs and conventions

AIRBUS

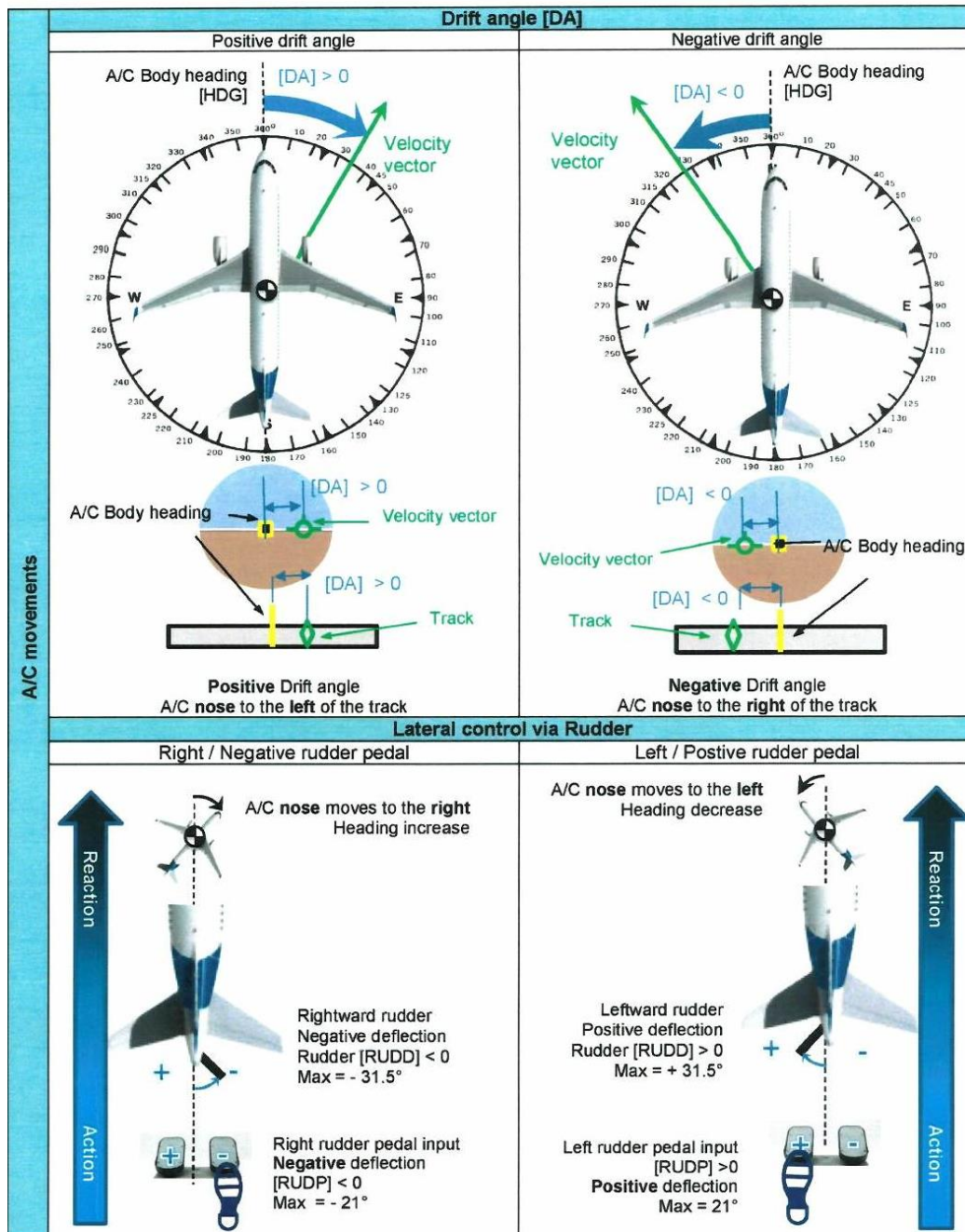
Annex 1. SIGNS AND CONVENTIONS

Load factor	Lateral load factor [LATG]	
	Positive lateral load	Negative lateral load
	 <p>Positive [LATG] A/C goes to the left of the track (pilots bodies are attracted to the right of the airframe)</p>	 <p>Negative [LATG] A/C goes to the right of the track (pilots bodies are attracted to the left of the airframe)</p>
	Longitudinal load factor [LONG]	
	Positive longitudinal load	Negative longitudinal load
	 <p>Positive [LONG] A/C decelerates Ground speed decrease</p>	 <p>Negative [LONG] A/C accelerates Ground speed increase</p>
	Vertical Load factor [VRTG]	
	Positive vertical load	Negative vertical load
	 <p>[VRTG] > 1 A/C goes towards the sky [VRTG] increase = more lift</p>	 <p>[VRTG] < 1 A/C goes towards the ground [VRTG] decrease = loss of lift</p>

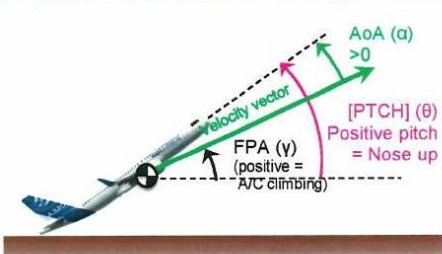
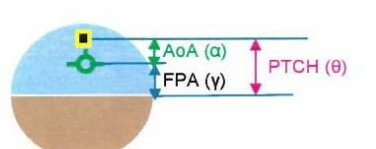
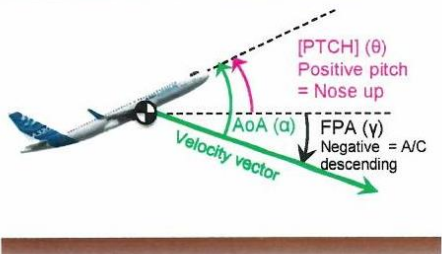
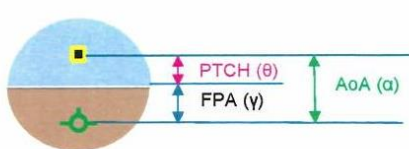


REFERENCE: TechRequest 80731186

EVENT DATE : December 31st 2019

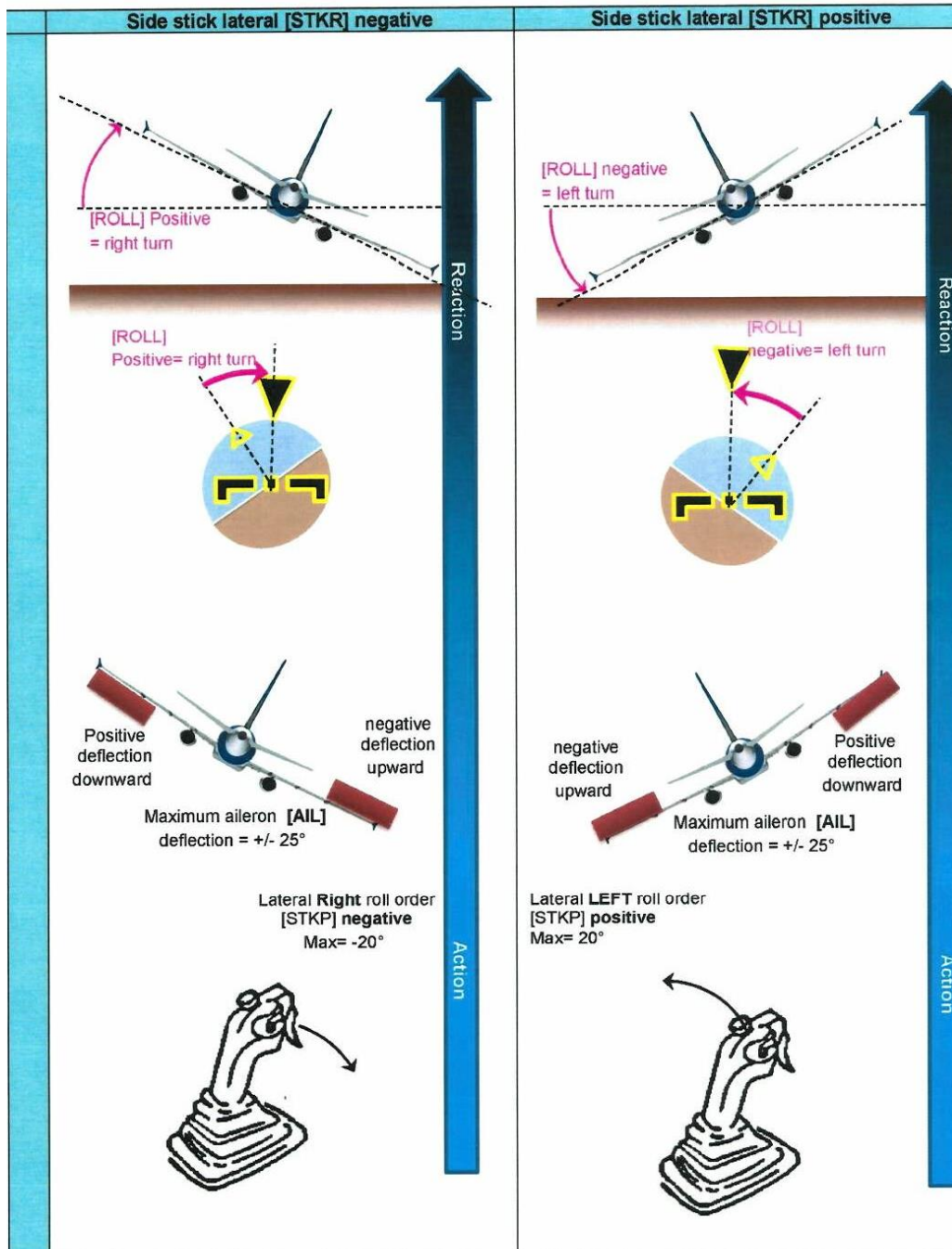
AIRBUS



AIRBUS

A/C movements	Pitch angle A/C climbing	Pitch angle A/C in approach
	 	 
Side stick longitudinal [STKP] negative	Side stick longitudinal [STKP] positive	
	 <p>Negative Side stick [STKP] < 0 Max = -16° or -18° (cf. box below)</p> <p>Elevators upwards Negative elevators [ELV] Elevator < 0 Max -30°</p> <p>Nose up Pitch increase</p> <p>Action → Reaction</p> <p><i>Trimmable Horizontal Stabilizer (STAB)</i> Normal Take Off range is between -7° (nose down) and 0°. Maximum STAB deflection is -14° (nose up) and +2° (nose down).</p>	 <p>Positive side stick [STKP] > 0 Max = +16° or +18° (cf. box below)</p> <p>Elevators downwards [ELV] Elevator > 0 Max +15°</p> <p>Nose down Pitch decrease</p> <p>Action → Reaction</p>
<p>MOD 203156 New generation sidestick (SSU)</p> <p>For Aircraft fitted with MOD 203156, maximum sidestick deflections are +/-18° instead of +/-16°.</p> <p>FDR recorded values can reach the mechanical stop value (+/-18°), but the stick order value used in flight control law computers is limited to +/-16° regardless of the actual sidestick deflection: there is a dead band between 16° and 18°.</p>		

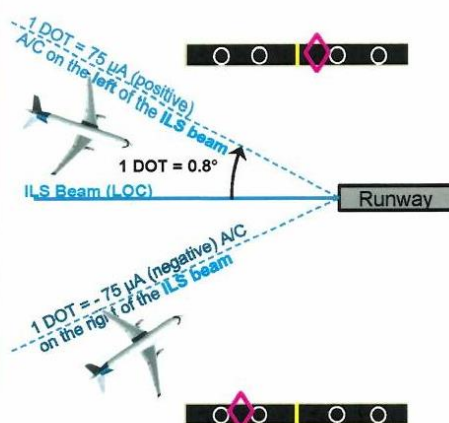
AIRBUS



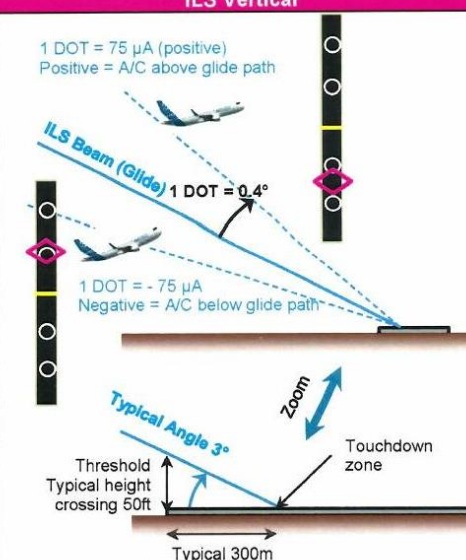
AIRBUS

Approaches

ILS Lateral

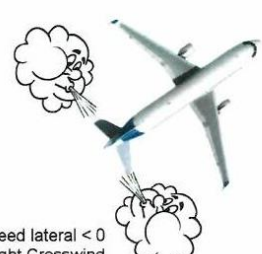


ILS Vertical



Wind lateral


Wind speed lateral > 0 = Left Crosswind




Wind speed lateral < 0 = Right Crosswind

Wind longitudinal

TAS < GS tailwind



TAS > GS headwind




CTAS = Corrected True AirSpeed
GS = Ground speed

Slats Flaps [A330-300]

Levers	Conf	Flaps [°]	Slats [°]
1	1	0	17
	1+F	8	17
2	2	14	21
3	3	22	23
4	Full	32	23

Spoilers



Max deflection speed brake: SP1: 25° SP 2 to 6: 30°
 Spoiler Partial extension: SP1: 14° SP 2 to 6: 20°
 Spoiler Full extension: SP1: 35° SP 2 to 6: 50°