INVESTIGATION REPORT ON TAIL STRIKE INCIDENT TO M/s INTERGLOBE AVIATION LTD. AIRBUS A 321neo AIRCRAFT, VT-IMW AT AHMEDABAD ON 15.06.2023

GOVERNMENT OF INDIA

DIRECTORATE GENERAL OF CIVIL AVIATION

FOREWORD

In accordance with the Aircraft (Investigation of Accidents & Incidents) Rules 2017, the sole objective of this investigation is to prevent aviation incidents and accidents in the future. It is not the purpose of the investigation to apportion blame or liability. The investigation conducted in accordance with the provisions of the above said rules shall be separate from any judicial or administrative proceedings to apportion blame or liability.

This report has been prepared based upon the evidences collected during the investigation and opinions obtained from the experts. Consequently, the use of this report for any purpose other than for the prevention of future incidents /accidents, could lead to erroneous interpretations.

List of abbreviations used in the report

1.	A/THR	Auto Thrust
2.	ADIRS	Air Data Inertial Reference System
3.	AME	Aircraft Maintenance Engineer
4.	AP	Auto Pilot
5.	ARC	Airworthiness Review Certificate
6.	ATIS	Automatic terminal information service
7.	ATPL	Airline Transport Pilot License
8.	ATC	Air Traffic Control
9.	BITE	Built-In Test Equipment
10.	CSN	Cycles Since New
11.	CVR	Cockpit Voice Recorder
12.	CRM	Crew Resource Management
13.	DGCA	Directorate General of Civil Aviation
14.	ECAM	Electronic Centralized Aircraft Monitoring
15.	EFB	Electronic Flight Bag
16.	FAC	Flight Augmentation Computer
17.	FCOM	Flight Crew Operations Manual
18.	FD	Flight Director
19.	FDR	Flight Data Recorder
20.	FC	Flight Cycle
21.	FCTM	Flight Crew Techniques Manual
22.	FH	Flight Hours

23.	FMA	Flight Mode Annunciator
24.	FMC	Flight Management Computer
25.	FMS	Flight Management System
26.	FMGC	Flight Management and Guidance Computer
27.	FMGS	Flight Management and Guidance System
28.	FPLN	Flight Plan
29.	FR	Frame
30.	FRB	Flight Report Book
31.	FRTOL	Flight Radio Telephone Operator's Licence
32.	FWD	Forward
33.	GPWS	Ground Proximity Warning System
34.	GS	Glide Slope
35.	IAS	Indicated Air Speed
36.	IFR	Instrument Flight Rules
37.	ILS	Instrument Landing System
38.	IR	Instrument Rating
39.	IST	Indian Standard Time
40.	LH	Left Hand
41.	LOC	Localizer
42.	LVTO	Low visibility take-off
43.	LVO	Low Visibility Operations
44.	LVP	Low Visibility Procedures
45.	MCC	Maintenance Control Centre

46.	MCDU	Multipurpose Control and Display Unit
47.	MLG	Main Landing Gear
48.	MSN	Manufacturer Serial Number
49.	OCC	Operations Control Centre
50.	PERF	Performance
51.	PIC	Pilot In-Command
52.	PF	Pilot Flying
53.	PFD	Primary Flight Display
54.	QRH	Quick Reference Handbook
55.	PM	Pilot Monitoring
56.	RA	Radio Altitude
57.	RH	Right Hand
58.	RVR	Runway Visual Range
59.	RWY	Runway
60.	SOP	Standard Operating Procedure
61.	STGR	Stringer
62.	TAF	Terminal Area Forecast
63.	TOGA	Takeoff - Go-Around
64.	TSN	Time Since New
65.	UTC	Coordinated Universal Time
66.	V_{app}	Approach Speed
67.	VFE	Maximum Speed for each Flap configuration
68.	VFR	Visual Flight Rules

69.	VLS	Lowest Selectable Speed
70.	VMO/MMO	Maximum Operating Speed/ Mach Maximum Operational
71.	ZFTT	Zero Flight Time Training

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Investigation Report on Tail Strike incident to M/s InterGlobe Aviation Ltd. Airbus A321neo aircraft VT-IMW at Ahmedabad on 15.06.2023

1.	Aircraft		
	Type	:	Airbus A321-252 NX
	Nationality	:	INDIAN
	Registration	:	VT-IMW
2.	Owner/Lessor	:	CALF(A4) AVIATION IRELAND DAC, IRELAND
	Operator/Lessee	:	M/s INTERGLOBE AVIATION LIMITED
3.	Pilot-in-Command	:	ATPL Holder
	Extent of injuries	:	Nil
	Co-Pilot/First Officer	:	ATPL Holder
	Extent of injuries	:	Nil
4.	Date of incident	:	15.06.2023
	Time of incident	:	08:37 UTC
5.	Place of Incident	:	Ahmedabad Airport (VAAH)
6.	Co-ordinates of incident site	:	23°05'13.5"N; 72°38'42.0"E
7.	Last point of Departure	:	Bengaluru Airport (VOBL)
8.	Intended place of Landing	:	Ahmedabad Airport (VAAH)
9.	No. of passengers on board	:	215
10.	Type of operation	:	Scheduled Commercial Air Transport Operation
11.	Phase of operation	:	Landing
12.	Type of Incident	:	Abnormal Runway Contact

(All timings in the report are in UTC unless or otherwise specified)

Synopsis:-

On 15.06.2023 M/s InterGlobe Aviation Ltd. (IndiGo) Airbus A321-252NX(neo) aircraft VT-IMW, operated a scheduled passenger flight 6E-6595 from Bengaluru to Ahmedabad. The PIC was the Pilot Flying and the First Officer was the Pilot Monitoring for the subject flight sector.

The Secondary flight plan was activated during the descent phase and FMS was prepared with landing configuration as CONF FULL. However CONF 3 was selected during approach. An ILS approach was carried out for RWY 23 at Ahmedabad. PIC made a decision to perform a 'Practice Autoland' during the final approach. The First officer was not qualified for CAT II/III operations. ATC informed the existing wind conditions to the crew, which were beyond the Autoland limitations for the aircraft. However, an Autoland was carried out. In accordance with the CONF FULL configured in FMS, the VAPP computed by FMS resulted in target speed lower than VLS which then contributed to a touch down below VLS-15kt. The aircraft touched down with pitch attitude of 10° which exceeded the geometric limitation w.r.t ground clearance and the tail fuselage section made ground contact.

DGCA-India, vide Order No DGCA-15019(01)/02/2023-DAS dated 21.06.2023 instituted investigation of the incident under Rule 13 (1) of Aircraft (Investigation of Accidents and Incidents), Rules 2017 by appointing an Investigation-In-Charge along with a member to associate in the investigation.

The probable cause of the incident was the aircraft speed reduction to the extent of VLS-15kt, the low energy state of the aircraft resulted in an increase of pitch beyond limits during the autoland and the ensuing contact of the aircraft tail section with ground during touchdown.

The following factors led to the incident:-

- Non-adherence to SOP (Standard Operating Procedures) during FMS configuration and during activation of the Secondary Flight Plan, i.e., FMS active and secondary FLPNs mishandling.
- Flaps CONF 3 selection made during approach against a planned approach with CONFIG FULL in the FMS performance page, leading to a lower target speed computation.
- PIC's non-compliance with the SOP for an Auto Land, including wind limitations and flight crew qualifications.
- Lack of effective CRM between the operating crew members.

1. Factual Information

1.1 History of flight:

M/s InterGlobe Aviation Ltd. (IndiGo) Airbus A321-252NX(neo) aircraft VT-IMW operated a scheduled passenger flight no. 6E-6595 from Bengaluru to Ahmedabad on 15.06.2023.
The subject flight sector was the first sector operated by the crew on 15.06.2023. The PIC was the Pilot Flying and the First Officer was the Pilot Monitoring for the sector from Bengaluru to Ahmedabad. The crew members who operated the flight underwent a Breath-analyser test for alcohol consumption at Bengaluru prior to departure to Ahmedabad and the test result was 'Negative'. Transit inspection of the aircraft was performed by AME before the flight from Bengaluru - Ahmedabad (6E-6595) on 15.06.2023.
There were a total of 215 passengers and 07 crew members on-board the aircraft at the time of the incident. The aircraft's chocks OFF time from Bengaluru was 06:35 UTC and it got airborne at 06:50 UTC.

The take-off from Bengaluru was performed by the PIC & the flight from take-off till top of descent was uneventful. During descent the PIC, who was the PF carried out briefing for the planned arrival to Ahmedabad via APANO 1A arrival ILS approach RWY 23 based on ATC clearance. A Flap 3/CONF 3 approach was decided after discussion among the cockpit crew which also included the Go-around plan. The briefing was carried out for an ILS Z approach RWY23 with CONF 3. The aircraft was configured for the planned configuration of CONF 3 and was stabilised for the approach. Runway in use at the time of approach was ILS RWY23.

During the approach the crew observed weather approaching from the North West and they informed the ATC of the approaching weather. During approach strong winds of the order of 30-35 kt were experienced during final turn and approach. On finals ATC reported wind gusts up to 20 to 25 kt. PIC reported that visibility was good but approach was 'bumpy' due winds; as the aircraft was Auto land current he decided to carry out auto land. During the ILS approach the PIC informed TWR that they were carrying out a 'Practice AUTOLAND'. Decision to perform an Autoland was made by the PF(PIC)during the final approach segment.

After flare-out, the landing was perceived as 'hard' by the crew. Auto pilot was disconnected post landing during landing roll. On reaching bay and switching off Engines, AME observed the tail strike and informed the crew.

1.2 Injuries to persons:

Injuries	Crew	Passengers	Others
Fatal	Nil	Nil	Nil
Serious	Nil	Nil	Nil
Minor/None	Nil / 07 (02 Cockpit crew and 05 Cabin Crew)	Nil/ 215	

1.3 Damage to aircraft:

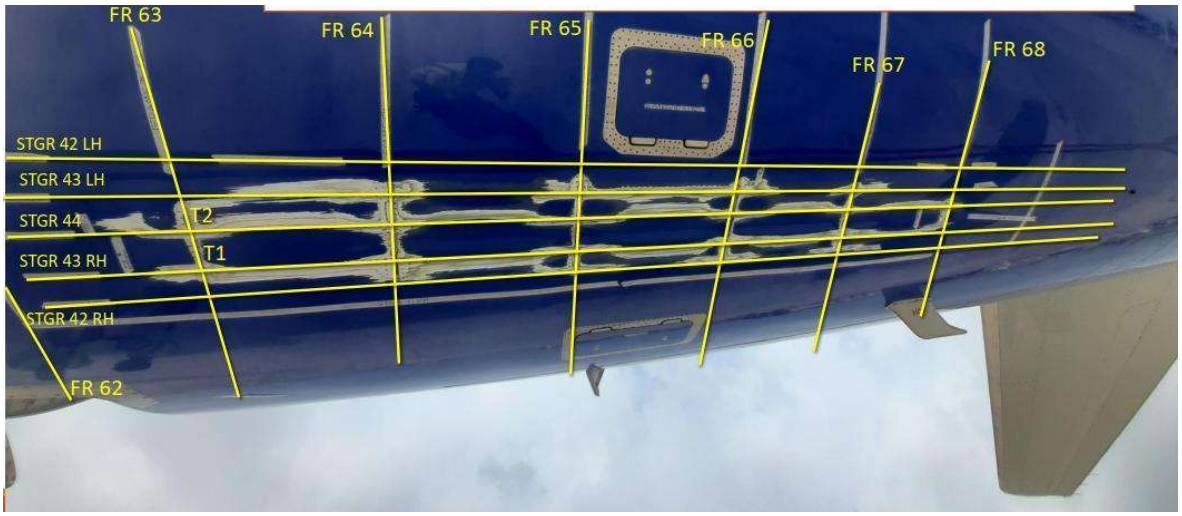
External damage:

1. Skin damage noted between FR(Frame) 62 and FR 69 & between STGR(Stringer) 42 LH TO 41 RH.
2. Total length of Damage: 3130 mm.
3. Damage starts 305 mm aft of FR 62 & extended to 160 mm aft of FR 68.
4. Maximum width of damage (at FR 67 & BTW STGR 42 LH TO 41 RH): 420 MM

Damages on RH Panel #
Drain mast installed on the skin was found bent by 10 MM and rubbed however no abnormalities were found on Drain mast support structure and its surrounding area.

Internal damage:

1. At FR 63 & STGR 44 to 43 RH found butt strap bent inwards.
2. Intercostal web attaching top of FR 64 to FR 65 & STGR 44 found deformed.
3. At FWD of FR 64 between STGR 44 to 43 RH, butt strap bend inward and found sealant crack on clip joining FR 64 & STGR 43 RH. At AFT of FR 64, butt strap bend inward between 44 & 43 RH.
4. At FWD of FR 65, clip between FR 65 & STGR 44 found bent. Vertical strut attaching bottom of FR 65 & top of FR 65, found bend from middle. At FWD of FR 65, butt strap bend between 44 & 43 LH and also between STGR 44 & 43 RH. Sealant crack between STGR 43 RH & 42 RH. Sealant crack at STGR 43 LH and attaching clip at FR 65 (FWD). At AFT of FR 65, between STGR 44 & 43 RH, puncture observed.
5. Butt strap bend inward & sealant crack at FR 66 between STGR 43 RH & 44. At AFT of FR 66, between STGR 44 & 43 RH, puncture observed & butt strap bend inward. At FR 66, between STGR 44 & STGR 43 LH found sealant crack.
6. At FR 67, STGR 43 RH & STGR 44, found butt strap bent inwards and also sealant crack between 44 & 43 LH. At FR 67, sealant crack at butt strap between STGR 43 RH & STGR 42 RH.
7. At FR 68, between 44 & 43 LH as well as between 42 LH & 43 LH, found sealant crack at butt strap.



1.4 Other damages:

Nil

1.5 Personnel information:

The details of the licences and ratings, of the Cockpit crew who operated the incident sector are as detailed below:-

Flight Crew details:		
	PIC	**First Officer**
a) Type of license	ATPL holder	ATPL holder
b) Valid up-to	07/02/2027	02/08/2027
c) Date of Initial issue	08/02/2007	03/08/2017
d) Class of license	AEROPLANE	AEROPLANE
e) Category of license	MULTI ENGINE	MULTI ENGINE
f) Age	63 years	50 years
g) Aircraft Ratings	PA34,A320	P68,A320
h) Date of Endorsement as PIC (on type)	18/01/2011	NA
i) Date of last Medical Exam	17/01/2023	18/04/2023
j) Medical Exam validity	21/07/2023	12/05/2024
k) FRTOL Valid up to	07/02/2027	01/01/2027
l) Instrument Rating	16/03/2023	08/03/2023
m) Date of Last IR check	16/03/2023	08/03/2023
n) Date of last Proficiency Check	16/03/2023	08/03/2023
o) Total flying experience	15436:08	3989:02
p) Experience on Type	11601:08	1263:17

Flight Crew details (cont.):	PIC	First Officer
q) Experience as PIC on Type	9754:47	NA
r) Last technical refresher	25/07/2022	22/11/2022
s) Details of any approval held LTC/instructor/ examiner held by the pilot.	NA	NA
t) Last flown on Type(date)	15/06/2023	15/06/2023
u) Total flying experience in last 180 days (prior to incident)	417.38	315.19
v) Total flying experience in last 30 days (prior to incident)	85.35	38.55
w) Total flying experience in last 7 days (prior to incident)	19.56	10.17
x) Total flying experience in last 24 hrs. (prior to incident)	08.51	08.51
y) Rest before duty	13.44	13.44

- During the last simulator training session of the PIC in March 2023, six(06) landings were performed w.r.t CAT II/III operations which complied with the recency requirements for CAT II/III operations.
- PIC Incapacitation and AUTOLAND topics were included in 'ZFTT Simulator Training' during Initial type rating course of First Officer in January 2020. However he was not trained and qualified for CAT II/ III operations.

1.6 Aircraft information:

Airbus A321-252NX is a twin engine aircraft installed with CFM LEAP-1A30 engines manufactured by CFM. The aircraft is certified in Normal category, for day and night operation under VFR & IFR.

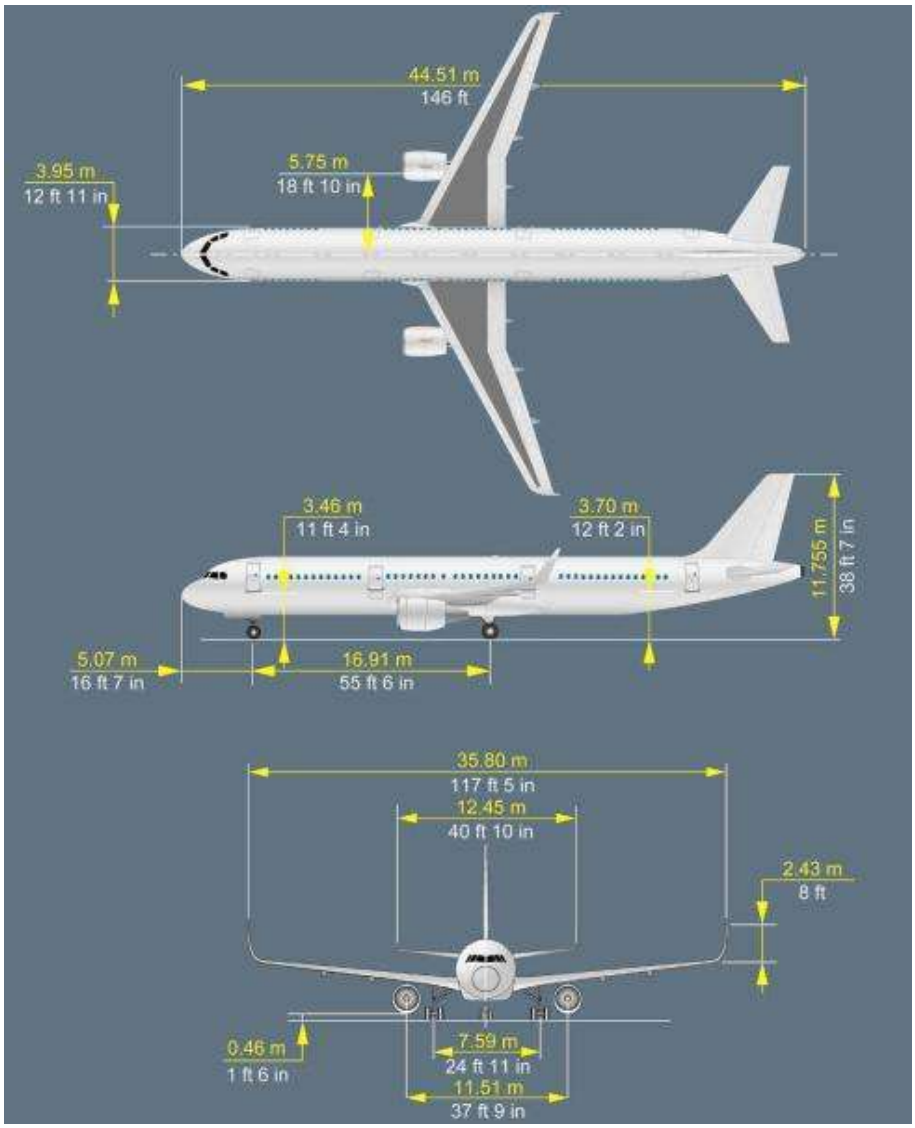
Prior to departure for the incident flight the aircraft weight and balance was within the operating limits. No relevant MEL was active on VT-IMW as on the date of incident.

The last practice Autoland for VT-IMW prior to the incident was carried out on 04.06.2023 and Autoland Satisfactory entry was made in the FRB/ Technical log, there was no message sent from OCC to the flight crew on 04.06.2023 for performing a 'Practice Auto land'.

Aircraft data:-	
Manufacturer	AIRBUS
Type	A321-252NX
Owner	CALF(A4) AVIATION IRELAND DAC
Operator	INTERGLOBE AVIATION LIMITED

Aircraft data:-	
Manufacturer Serial no.	10882
Year of Manufacture	2022
Certificate of Airworthiness	7609 Issue date: 04.11.2022
Airworthiness Review Certificate	7609 Issue date : 04.11.2022 Validity: 03.11.2023
Category	NORMAL
Certificate of Registration and validity	5519/2 Issue date: 01.11.2022 (entered in the register of India with effect from 28.10.2022) Validity: 26.10.2030
Minimum Crew Required	TWO
Maximum All Up weight	89000 kg
Last Major inspection	2000 FH / 1400 FC / 8 MONTH INSPECTION SCHEDULE
Last inspection	WEEKLY (7 DAYS/120 FH) INSPECTION
Airframe Hrs since new	2389:48hrs
Airframe hours since last ARC	2378:19hrs

Engine data:-	**Engine#1(LH)**	**Engine#2(RH)**
Manufacturer	CFM	CFM
Type	LEAP-1A30	LEAP-1A30
Engine Serial no.	59B109	59B112
Time Since new(TSN)	2389:48hrs	2389:48hrs
Cycles since new(CSN)	1590 cycles	1590 cycles
Time since last shop visit(TSV)	NA	NA
Cycle since last shop visit(CSV)	NA	NA
Last Major Inspection Carried out	NA	NA
Last inspection Carried out	PERFORMED WEEKLY (7 DAYS/120 FH) INSPECTION	



General Dimensions of A321-251

1.7 Meteorological information:

METAR information at Ahmedabad is as below:

VAAH 150900Z 20018G28KT 4000 DRDU SCT018 SCT025 33/23 Q1001 NOSIG=
VAAH 150830Z 19020G30KT 4000 DRDU SCT018 SCT025 34/23 Q1001 TEMPO 3000 RA=
[Winds 190° 20kt Gust 30kt, Visibility 4000m, Weather Low Drifting Dust, Cloud: Scattered at 1800ft and 2500ft, Temperature 34 °C Dew point 23 °C, QNH 1001hPa, QFE 0995 hPa. TEMPO Visibility 3000m in Rain]
VAAH 150800Z 20013G23KT 5000 FU SCT018 SCT025 35/23 Q1002 NOSIG=
VAAH 150730Z 18010G22KT 5000 FU FEW015 SCT025 34/23 Q1002 NOSIG=

TAF VAAH (In Pre-flight folder handed over to crew prior to the departure from Bengaluru)
ARRIVAL
TAF VAAH 142300Z 1500/1606 18012KT 3000 HZ SCT020 FEW025TCU BKN080 BECMG 1501/1503 21014KT -RA HZ TEMPO 1504/1512 19018G28KT 2000 .TSRA SCT018 FEW030CB BKN080 BECMG 1504/1506 18012KT 5000 DZ BECMG 1513/1515 4000 FU FEW020 FEW025TCU SCT080 BECMG 1516/1520 21008KT BECMG 1522/1524 3000 DZ HZ BECMG 1601/1603 21012KT .RA HZ SCT020 FEW025TCU BKN080 BECMG 1604/1606 4000 FU
TAF VAAH 150200Z 1503/1512 21014KT 3000 -RA HZ SCT020 FEW025TCU BKN080 BECMG 1504/1506 18012KT 5000 DZ TEMPO 1504/1512 19018G28KT 2000 TSRA SCT018 FEW030CB BKN080

Further based on India Meteorological Department data:
The Very Severe Cyclonic Storm "Biparjoy" (pronounced as "Biporjoy") over Northeast Arabian Sea moved nearly eastward with a speed of 12 kmph during 6-hours since 1730IST and lay centered at 1730 IST of 15.06.2023 over the same region near latitude 22.9°N and longitude 68.0°E, about 70 km west-southwest of Jakhau Port (Gujarat), 130 km west-northwest of Devbhumi Dwarka, 100 km west-southwest of Naliya and 240 km south-southeast of Karachi (Pakistan).
The landfall process commenced around 1830 hours IST of 15.06.2023 and continued till midnight of 15.06.2023.

1.8 Aids of navigation:

All aids to navigation were serviceable. No un-serviceability was reported.

VAAH - RADIO NAVIGATION AND LANDING AIDS

Type of aids, magnetic variation and type of supported operation for ILS/ MLS, basic GNSS, SBAS and GBAS, and for VOR/ILS/MLS station used for technical lineup of the aid	Identification	Hours of operation, as appropriate;
LOC 23 CAT I	IAHD	H24
GP 23	---	H24
DME ILS 23	IAHD	H24
DVOR/DME	AAE	H24
L	AH	H24

1.9 Communication:

Two way radio communications were available between aircraft and ATC. Neither the crew nor did the ATC unit report any un-serviceability.

1.10 Aerodrome information:

Sardar Vallabh Bhai Patel International Airport is located in Ahmedabad city in the state of Gujarat. The runway details are as below:

DECLARED DISTANCES

RWY Designator	Take-off run available TORA (M)	Take-off distance available TODA (M)	Accelerate distance available ASDA (M)	Landing distance available LDA (M)
05	3505	3505	3505	3505
23	3505	3505	3505	3505

1.11 Flight recorders:

1.11.1 Cockpit Voice Recorder:-

The aircraft was installed with a Solid State Cockpit Voice Recorder capable of recording twenty five (25) hours of cockpit communications. Relative time mentioned is w.r.t the subject sector. The recorded data was downloaded and following salient observations are made:-

1. The PIC informed the First Officer before top of descent (relative time 01:22) that he is configuring the FMS for arrival on secondary flight plan and not in primary and First Officer replied 'right'.
2. Crew carried out arrival briefing for Ahmedabad based on available information including the actions in case of a go-around. During the discussion the PIC informed he is planning a CONF 3 landing and First officer replied that runway is long.
3. Crew discussed that V_{app} was 146kt and that IDLE reverse were to be used for landing.
4. After coming in contact with Ahmedabad the crew changed over to Ahmedabad, however crew were unable to contact Ahmedabad again when released by Mumbai (approx. 34 minutes to touchdown). The First Officer again requested Mumbai for Ahmedabad frequency and PIC took over the communications. Then PIC was able to contact Ahmedabad on frequency given by Mumbai.
5. Once in contact with Ahmedabad control the aircraft was cleared via APANO 1A arrival RWY23 and to expect radar vector ILS approach RWY 23.
6. Crew carried out approach checklist at this time QNH was discussed as 1002 hPa and Minimum was discussed as 430ft.
7. A few seconds later the QNH was reported by ATC as 1001 hPa and PIC discussed as to QNH is dropping.
8. The PIC is observed to be concerned about the weather and kept informing the First Officer about the weather at Ahmedabad.

9. At relative time 01:58:17 the aircraft was advised to contact Ahmedabad tower at 10 miles from touchdown.
10. The aircraft then contacted tower at about nine miles to touchdown and Ahmedabad tower informed IFLY6595 that the Winds were 190° 26 kt gusting upto 29kt.
11. PIC enquired with the First Officer what wind information was given by the ATC. First Officer reply is blocked and the available information is that winds were 15 gusting.
12. Landing gear was extended between 01:58:54 and 01:58:58 relative time.
13. At relative time 01:59:50, the ATC Tower cleared IFLY6595 for landing on RWY23. The tower reported winds at this time were 190° 20kt gusting up to 25kts.
14. Flaps 3 were selected at relative time 01:59:58 and landing checklist was announced by First Officer followed by 'ECAM memo', PIC announced 'Landing no blue'. Landing checklist was completed.

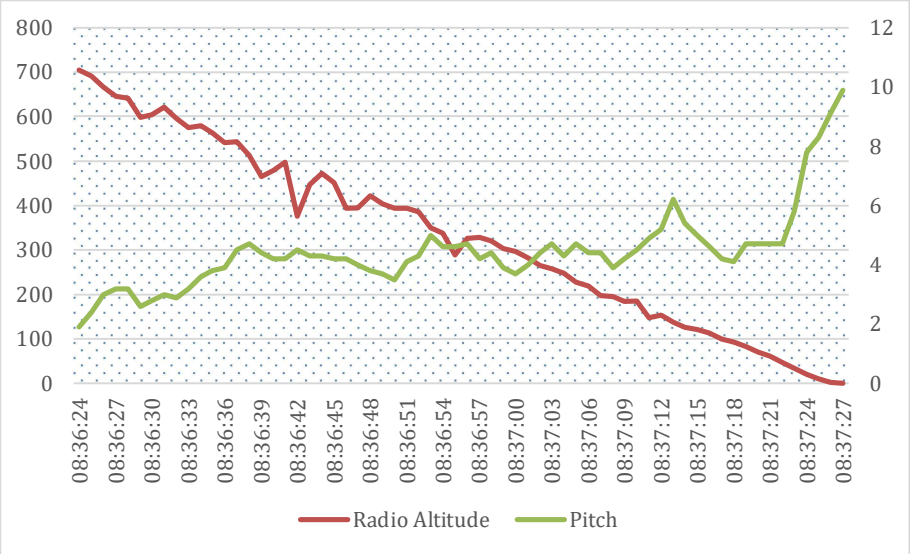
    The PIC is observed to be again discussing approaching weather with the First Officer and informed the Tower controller to expedite landing of other aircraft as weather was approaching and likely to hit the area soon.
15. At relative time 02:00:50 the PIC informed the First Officer that he is thinking of putting 'No DH', which would be the safest thing to do.
16. After the 1000ft autocall, the First Officer queried with the PIC regarding Configuration for landing at relative time 02:00:50. The PIC immediately replied that it is CONF 3 and it is the best for a go-around.
17. At 02:01:10 relative time PIC informed the First Officer to call 430 'minimum', so that PIC will disconnect the AutoPilot.
18. The PIC made a call to the ATC-Tower that 'Carrying out practice Auto land' at relative time 02:01:25. The controller acknowledged the call and advised the crew that sensitive areas are not protected.
19. '400' autocall is recorded at 02:01:33 relative time.
20. PIC announced 'Land green' at 02:01:48 relative time and advised First Officer for 'Low brake' as they are doing an autoland they have to select low brakes also.
21. The sound of ground contact is heard at 02:02:27 relative time following which the PIC announced Reversers and advised the First Officer to announce further checklist items.
22. During taxi at relative time 02:04:34 the PIC discussed with the First Officer that the winds were really gusty and that the aircraft was shaking even with automation. He added that imagine in such scenario hand flying is not easy and that the best thing to do is use automation.

1.11.2 Flight Data Recorder:-

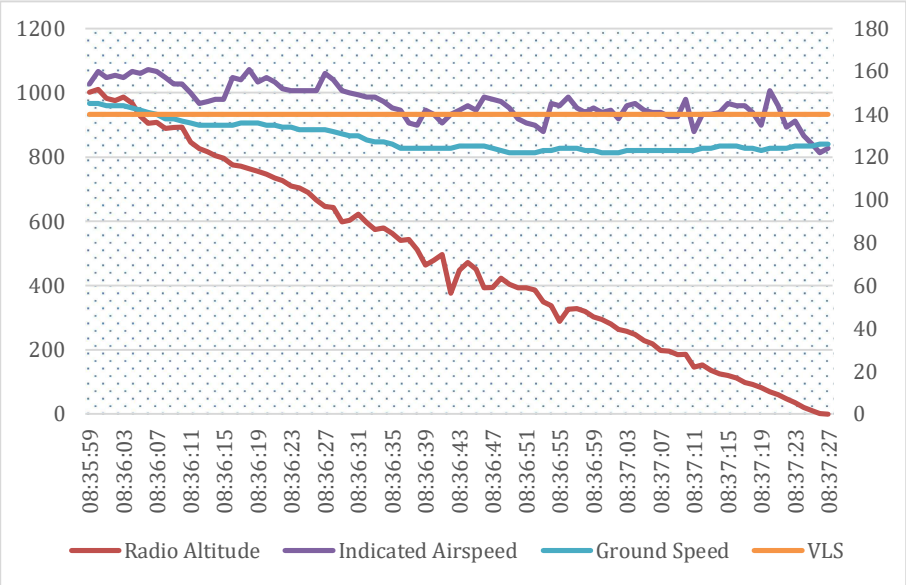
The aircraft was installed with a Solid State Flight Data Recorder. The recording of the unit was retrieved and major events are as interpreted below:-

1. The aircraft took-off from Bengaluru at 06:50 UTC.
2. The PIC was the PF at the time of take-off.
3. The aircraft reached the cruise altitude of 36000ft by 07:14 UTC.
4. After 08:01:39 UTC the aircraft started descent.
5. Auto Pilot #1 was engaged from take-off and remained engaged for the flight duration till landing.
6. Flap 1 was selected at 08:23:51UTC.
7. By approx. 08:30UTC at 4800ft baro altitude, the aircraft was aligned on runway heading.

8. Flaps 2 were selected and the configuration was Flaps 2 at 08:31:45 UTC. VLS was revised to 140kt, which remained so till landing.
9. At 08:33:56UTC, passing 2477ft radio altitude the aircraft speed was 176kt IAS/ 70kt Ground speed. Speed mode selection was changed to MANAGED mode and the Vapp became 136kt.
10. Flaps 3 configuration was achieved by 08:35:07UTC.
11. The Autopilot #2 was engaged (in addition to already engaged Auto Pilot #1) at 08:27:34 UTC and 6064ft baro altitude in approach and it remained selected till rollout.
12. Flaps selection recorded value is 28 during final approach at 08:35:07 UTC.
13. At 1000 ft. aircraft was configured for landing and was on profile, speed trend was fluctuating.
14. At approx. 08:36:25 UTC (CVR relative time 02:01:25) aircraft was passing 700ft radio altitude on approach.
15. Passing 700ft in approach the IAS was 151kt and ground speed was 133 kt.
16. Below 700ft radio altitude, the Vapp dropped below VLS (140). The ground speed was about 122-127kt.
17. The wind direction was approximately 180° ±10° during final approach below 1000 to 100ft radio altitude. Winds were variable below 1000 feet quartering left headwind varying between 20 to 35kt.
18. Passing 60ft radio altitude the aircraft speed was 144kt IAS and 124kt ground speed.
19. There was a significant change in winds below 60ft radio altitude from approx. 28kt to 11kt at touchdown and change in direction from about 175° to about 130°.
20. The aircraft pitch was about 4°-5° during final approach below 500ft radio altitude. Below 50ft radio altitude the aircraft pitch started increasing from 4.7° and reached a maximum of 10º at touchdown of main wheels which was at 08:37:26UTC.
    The aircraft vertical speed was 128ft/min at touchdown and vertical acceleration of 1.85g. The aircraft speed, IAS at touchdown was 125kt and ground speed was 124 kt.
21. Upon touchdown the TLA #1 and #2 were progressively retarded to reverse thrust.



Radio altitude and Pitch Vs Time (UTC)

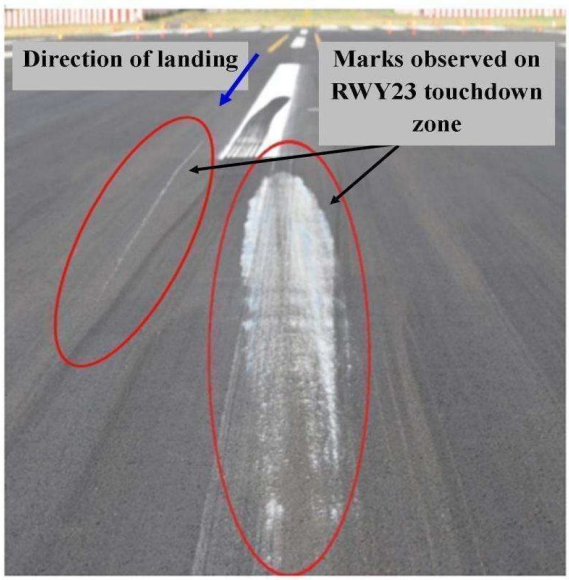


Radio altitude, Indicated Air Speed, Ground Speed and VLS Vs Time (UTC)

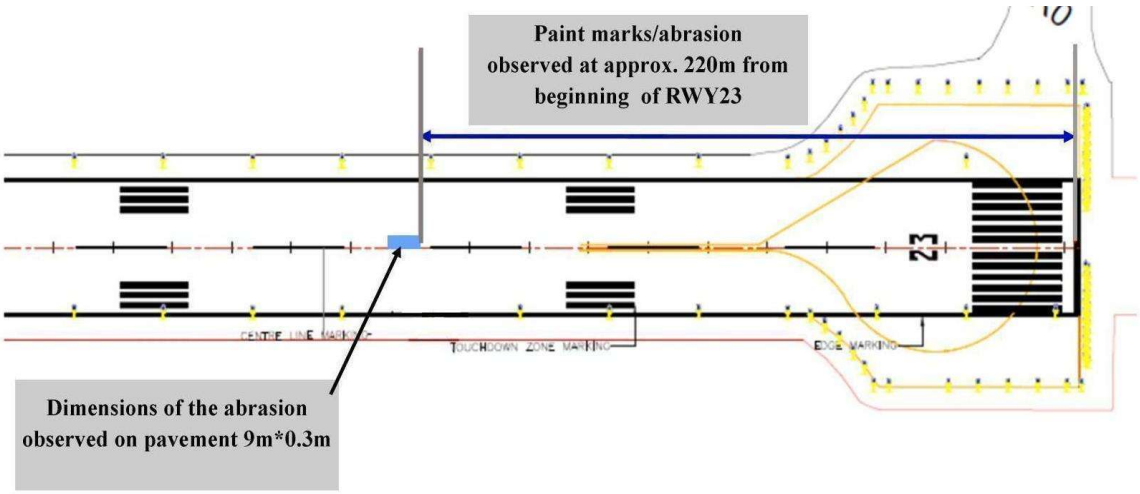
1.12 Wreckage and impact information:

VT-IMW landed at Ahmedabad on Runway 23 at 0837 UTC (1407 IST) and was parked at Stand 09 at 0842 UTC (1412 IST). During runway inspection at around 1000 UTC (1530 IST), operations vehicle observed abnormal abrasion on runway pavement measuring approx. 9m. Paint marks/ abrasion were located at approx. 220m from beginning of RWY23.

Later while inspecting all the parked aircraft on apron observed aft belly portion of fuselage and drain mast abraded in respect of VT-IMW aircraft parked at Stand 9.



Photograph of VAAH (Ahmedabad) - RWY 23, location of VT-IMW tail ground contact



The location of marks/abrasion on Grid map of VAAH (Ahmedabad) [Not to scale]

1.13 Medical and pathological information:

Not applicable.

1.14 Fire:

There was no fire or smoke during or following the incident.

1.15 Survival aspects:

The incident was survivable.

1.16 Tests and research:

Not applicable.

1.17 Organizational& Management Information:-

1.17.1 InterGlobe Aviation Ltd:

M/s InterGlobe Aviation Ltd.(IndiGo) is a scheduled airline operating a fleet of Airbus A-320, A-320 neo, A-321neo and ATR 72 aircrafts. The airline operates flights on domestic and international sectors. The aircrafts are maintained by the airline which also holds a valid Aircraft Maintenance Organisation (AMO) approval from DGCA.

1.17.1.1 IndiGo CAT II/III READY RECKONER

Given the non-routine nature of the operation, flight crew may refer to this 'Ready Reckoner' during the 'SET-UP', as given below which has been developed in-house by the operator.

PRE-REQUISITES:

• Verify Crew qualification and currency

• Aircraft Status (Check on ECAM STATUS page/ QRH that the required landing capability is available)

• Weather (Destination & Alternate), check minima's and wind limitation for auto land

• NOTAMs – Check that the airport meets CAT II/ III requirements as applicable

• ATC clearance for a CAT II/ III approach obtained

Ready Reckoner (SOP Items)

• Approach Ban
• Minimum Visual References applicable to type of approach
• For Landing Distance (LD & FLD) calculation, determining optimum CONF/ AUTO BRAKE/ THR REV combination, as per SOP.
• Review Planned Designated RWY EXIT TWY & Taxi Route (refer AF specific LVP Routes for ARR RWY).
• Review of task sharing & crew call outs
• Review crew response to failures
• Cabin Crew Briefing

COCKPIT PREP

• Check Seat Position optimum
• FLAP & AUTO BRAKE as required.
• Flight deck lighting dimmed & Use of exterior lights

REVIEW OF FAILURE CASES

Above 1000 FT AGL:

• Downgrading conditions Downgrading from CAT III to CAT II is permitted only if:
- ECAM actions are completed.
- RVR is at least equal to CAT II Minima.
- Briefing is amended to include CAT II procedure and DH.
- Decision to downgrade is completed above 1000' AGL.
• Downgrading from CAT II to CAT I is permitted only if:
- ECAM actions are completed.
- RVR is at least equal to CAT I Minima.
- Briefing is amended to include CAT I procedure and DH.
- The decision to downgrade is completed above 1000' AGL.

Note: Switching from one autopilot to another above 1000' AGL is permitted.

Below 1000 FT AGL and above DH (CAT 2 or CAT 3 SINGLE) or above 100 feet RA / Alert Height (CAT 3 DUAL), a Go-Around should be performed in case of:

• Amber Caution (single chime), or
• Landing capability degradation

CALL OUTS

CALLOUTS & CREW ACTIONS –CAT II/III		
Flight Conditions	**CM1Actions/ Calls**	**CM2 Actions/ Calls**
OM/Equivalent Fix	CHECKED	OM/DME CROSSCHECK ALT…… FT
1000 FT RA	CHECKED Check FMA displays the aircraft capability (CAT2 or CAT3)	1000 (1)
AT 350 FT RA	LAND (Check ILS course)	
DH+100 FT(CATII/CATIII with DH)	CHECKED	100 ABOVE(1)
100 FT RA(CATIII)	CHECKED(1)/ CONTINUE	ONEHUNDRED(1)/ALERT HEIGHT
DH (CATII/CATIII with DH)	CONTINUE	MINIMUM(1)
AT 40FT RA	Monitor Flare by Flight Instruments	FLARE/NO FLARE(2)
AT 30 FT RA	Monitor Thrust Reduction	THRUST IDLE CHECK
AT 10 FT RA <<RETARD>> AUTO CALLOUT	MOVE the THRUST LEVERS to IDLE MONITOR LATERAL GUIDANCE(3)	Monitor engine parameters
AT TOUCHDOWN	BOTH THRUST LEVERS-REV IDLE/ MAX (As Required) BOTH THRUST LEVERS-REV IDLE	ROLLOUT SPOILERS REVERSE GREEN DECEL 70 KTs
BEFORE 20 KT	Disengage AUTO BRK (use brake pedals)	
AT TAXI SPEED	REVERSERs -STOW	
END OF ROLLOUT	DISCONNECT AP(4)	
DH/GO AROUND	GO AROUND – FLAPS GEAR UP	MINIMUM (1) FLAPS..... POSITIVE CLIMB GEAR UP

(1)MONITOR the radio automatic callout, if available.
(2)Between 50 and 40 feet: Check “FLARE” is Displayed on the FMA. If NO FLARE mode at 30 FT, discontinue the approach or perform a manual landing if visual references are acquired.
(3)Monitor the lateral guidance by using external reference.
(4)When leaving the runway at the latest, once planned exit taxiway is identified and to follow taxiway center line lights.

1.17.1.2 ILS CAT II/ III OPERATIONS – TRAINING & QUALIFICATIONS (RELEVANT EXTRACT)

1.17.1.2.1 Ground Training for PIC, First Officer for CAT II and CAT III Authorization

The ground training shall lay specific emphasis on the following:

All the technical aspects required for Cat-II and Cat-III operations, the aircraft equipment required for carrying out Cat-II and Cat-III approaches and associated weather phenomenon, with special emphasis on poor visibility in fog, rain, meteorological minima etc. This training shall be given by Ground Instructor / Flight Instructor / TRI / SFI / Examiner trained in Cat-II and Cat-III operations.

The techniques for Cat-II and Cat-III operations, effects on operations due failures in the airborne and ground equipment and their indications, and action required to be taken on various failures. This training shall be given by Flight Instructor / TRI / SFI / Examiner trained in Cat-II and Cat-III operations.

1.17.1.2.2 Simulator training and line flying of PIC & First Officer for CAT II/ CAT III authorization

The training exercises stipulated here under shall be the minimum to be carried out on an approved simulator. The Instructor shall ensure that the pilot acquires the required proficiency and if necessary additional training be given. In case of a gap between ground classes / simulator training and line flying of more than six months the pilot shall undergo a simulator training session of at least 8 Cat-II/III approaches. This may be combined with recurrent IR/PPC training.

In case an SFI has not held a CAT II/III authorization on type within the previous 36 months, then prior to imparting training for LVTO and CAT II/III operations, he must complete the ground training for LVTO and CAT II/III. Thereafter, the SFI shall observe and conduct under supervision LVTO and CAT II/III training under an SFI/TRI/Instructor/Examiner as appropriate prior to conducting LVTO and CAT II/III training.

Simulator training for CAT II/III is prescribed for a standard crew complement of one PIC and co-pilot.

a) Simulator training for PIC / First Officer

i) Pilots with no previous Cat-II/III Authorization.

ii) Pilots with previous Cat-II/III authorization on different design type.

iii)Pilots with previous Cat-II/III authorization on Same or Similar Design Type. (Similar design types are aeroplanes that have similar displays and procedures for Cat II/III operations such as fail operational A 320/ A330)

Note 1: CAT II/III training and checking may be conducted as part of PIC upgrade/co-pilot type training conversion course.

Note 2: Incapacitation procedures shall be practised.

iv) Pilots upgrading from Cat IIIA to Cat IIIB on the same aircraft type.

b) Line flying for PIC / First Officer

i) One ILS Cat II/ III approach for PIC with a CAT II/ III qualified First officer in weather conditions at or above the Cat I minima.

ii) One ILS Cat II/ III approach for Co-pilot with a Cat II/ III qualified PIC in weather conditions at or above the Cat I minima.

1.17.1.3 Recency requirements for CAT-II/III (Operations Manual- Part D)

To exercise the privileges of applicable CATII/III authorization, a PIC/ Co-pilot shall have carried out a minimum of 6 CAT II/III approaches to the authorized RVR including 3 landings in the approved simulator. For CAT II authorized pilots, at least one CAT II landing shall be conducted in the simulator exercise above. There is no separate requirement to maintain CAT II recency for such pilots.

Note: All the above required practice approaches on the aircraft for initial authorization and recency can be carried out at any Category I ILS runway where auto land can be carried out and which has been suitably assessed, after flight trials. Periodically a list is updated of airports/ runways where practice CAT II/ III approaches/ auto land may be carried out. All practice & actual Cat II/III approaches to be logged in Cat II/ III logbook issued by the organization.

1.17.1.4 Recurrent training and checking for CAT-II/III (Operations Manual- Part D)

a) Recurrent Ground Training

Recurrent ground training shall provide any remedial review of topics specified in initial Cat-II and Cat-III ground training, to ensure continued familiarity with those topics. Emphasis shall be placed on any programme modifications, changes to aircraft equipment or procedures, review of any occurrences or incidents that may be pertinent, and finally emphasis may be placed on re-familiarisation with topics such as flight mode annunciation for failure conditions or other information which the pilots may not routinely see during normal line operations. Topics to be addressed for each PIC and Co Pilot are those topics, necessary for the performance of the assigned duties for each respective crew member in the current assignment. In addition, operational aspects for assessment of equivalent TDZ RVR as given in e-manual are also covered. This training should be completed during annual refresher training.

b) Recurrent Simulator Training and Checks for PIC/ Co-Pilot

Pilot's knowledge and ability to perform the tasks associated with the particular category of operation for which he is authorized, is to be demonstrated during training and PPC/IR checks. This shall include a minimum of 3 CAT II/III approaches and a minimum of 1 go-around in the training and PPC/IR check profiles.

1.17.1.5 Operations Manual- Part A

1.17.1.5.1 Automatic landing

- Automatic landing is a portion of the LVO approach. An automatic landing system is only equipment providing automatic control of the aircraft during the approach & landing and is not related to a particular weather condition. This system is mandatory for all CAT III operations. However, it can also be performed for a CAT II approach provided the ILS performance is sufficient and ILS signals are protected. For training and qualification purposes it is permissible to use Autoland at or above CAT I conditions, subject to various limitations. In case of failures while performing an Autoland, at any time during the

approach, if visual references are sufficient, the Auto Pilot can be disengaged and the landing completed manually.

- In order to keep the aircraft's Autoland status valid approved pilots are expected to do an Autoland every 30 days to authorised runways. An entry "Autoland Satisfactory" is to be made in the FRB whenever a satisfactory Autoland is performed. If the Autoland was not satisfactory an "Autoland Unsatisfactory" FRB entry is to be made. In addition, PIC is to make detailed entry (reason) in defect report column of FRB for assisting trouble shooting by engineers. Auto Land for practise can only be performed at approved runways.
- If no practice/ actual LVO approach and auto land has been carried out in preceding 30 days the aircraft's Autoland status gets downgraded. This condition will be indicated to the crew by a Sticker stating AUTOLAND DOWNGRADED. This will indicate to the crew that although the aircraft is LVO and Autoland capable yet an actual approach with Autoland below CAT I minimums is not authorised. To restore its Autoland capability a satisfactory practice Autoland must be performed at the earliest and an entry made in the FRB stating "Autoland satisfactory".
- If the Autoland status has expired/downgraded, crew must perform a practice auto land only when the ADD/CDD/notices to crew section advises 'crew to carry out practice auto land' and a 'AUTOLAND DOWNGRADED' placard is placed in the aircraft.

  The airline has informed that they had a practice in which whenever a 'Practice Auto land' is required for the purpose of keeping aircraft's Auto land status, MCC was sharing the Autoland status mail with OCC and Dispatch on daily basis and OCC was further sending ACARS to crew using automated process. Also it has been informed that, no message was sent from OCC to the flight crew on 04.06.2023 and 15.06.2023 for performing a 'Practice Auto land'.

1.17.1.5.2 Automatic landing in CAT I or better weather conditions

The automatic landing system's performance has been demonstrated on runways equipped with CAT II or CAT III ILS approaches. However, practice automatic landing in CAT I or better weather condition is permissible on approved runways with CAT I ground installations or on CAT II/III ground installations when ILS sensitive areas are not protected, if the following precautions are taken:

- The Company has checked that the ILS beam quality and the effect of terrain profile before the runway have no adverse effect on AP/FD guidance. In particular, the effect of terrain discontinuities within 300 meters before the runway threshold have been evaluated.
- There is no certification requirement to prove that the automatic landing system will perform as expected at all conceivable airports. The aircraft use FLARE modes for automatic landing. The FLARE mode is initiated at a given radio altitude (RA), which can be either advanced or delayed as a function of V/S. A higher V/S in the last part of the approach due to terrain profile before the runway threshold or higher descent glide slope angle will cause the flare mode to engage earlier than usual. The aircraft may temporarily float above the runway surface before pitch is reduced to resume a gentle descent down the runway leading to a long flare.

1.17.1.5.3 Practice approaches

All practice approaches on aircraft are to be carried out under weather conditions at or above CAT I minimums. The practice approaches can be carried out by the Flight Crew who are qualified and may not be current.

Practice Auto Approaches, at or above CAT I minimum, can be carried out on any ILS equipped runway.

With weather conditions being better than CAT I minima, the LVPs may not have been implemented. Therefore, the Critical and Sensitive areas would not be protected and may result in interference to the ILS signal. The flight crew must continuously monitor the indications.

Further, practice Auto Approach Auto Land for A320/321 can only be carried out on the runways mentioned in an Annexure to Operations Manual Part A (which includes Ahmedabad-VAAH RWY23), in-addition to all runways with CAT II/ III facility/ approaches.

1.17.1.6 IndiGo- Operations Notice (Airbus)- FLT/OPS/N-NO:32 Fuel Efficiency & Reducing Carbon Footprint (RELEVANT EXTRACT)

Background: Adequate fuel is essential, and correct fuel vital. Pilots play a significant role in fuel management, and hence it is imperative that aircraft are operated in a manner, which is cost efficient without compromising safety. Conservation begins from the finalisation of fuel figures, all the way to shut down, a principle not always followed.

It is also stated that, 'considering the increasing size of operations, an attempt to control rising carbon emissions & also operating costs by saving every kilogram (KG) of fuel ……..'

Priority for Fuel Conservation	
SET OUT/ IN	6 Kg/ Min
Flap 3 Landing	8 Kg / Landing

Measures for Reducing Carbon Footprint & Cost Saving Techniques
SET OUT Vs 2 Engine Taxi Out
Lower Thrust Reduction altitude (Company default 400 ft)
Cost Index Climb vs 280/320/M0.80 (Managed vs Selected SPD CLB)
Optimum Altitude vs 2000 ft lower
Cost Index vs Fixed Mach
1 minute Direct Routing
Cost Index Descent vs 280/320/M0.80
CDO where available
Efficient energy management – timely selection of flaps and gear with idle thrust Vs 1 minute level flight with Gear down and Flaps Full
Landing Flap 3 vs Flap FULL
Idle Reverse vs Max Reverse (using more brakes for deceleration)
SET IN Vs 2 engine taxi
Optimum APU usage (before engine shutdown)
APU shutdown once GPU connected at the stand

Techniques to reduce Fuel burn & Carbon emissions:

- **FLAP 3 LANDINGS:**

Flap3 landing is a worldwide regular practice on the A-320. Apart from landing in gusty wind conditions, it is also executed as a fuel saving measure, when landing performance permits.

IndiGo recommends Flap 3 Landings whenever professional assessment and judgement determines that they are appropriate for execution. Also, landing performance permitting, Flap3 Configuration is the preferred landing configuration every time. Going forward it is informed that during PIC RCs the ability of the U/T PIC to execute Flap3 approach and Landing shall be observed in all RCs.

Full Flap Landings are recommended in the following cases:

- Landings at Performance Limited Airfields.
- Tailwind Component 10k or higher (due high ROD)
- Landing Performance limited

[Refer Annexure 3 for Common Misconceptions and Errors related to Config 3 Landings.]

After the incident the **Operations Notice (Airbus)- FLT/OPS/N-NO:32** has been replaced with **Operations Notice(Airbus) FLT/OPS/N-NO: 02-06C** on SAFETY, SUSTAINABILITY & OPERATIONAL EFFICIENCY. The relevant extract on landing with Flaps 3 is as below:
CONF-3 LANDINGS: Pilots shall use their assessment and judgement to determine the appropriate Landing Configuration. CONF-3 should be considered depending on the available runway length and go-around performance, or in case of windshear/severe turbulence during approach. While CONF-Full provides better handling capability in turbulent conditions, CONF-3 provides more energy and less drag. Pilots shall also refer to conditions outlined in FCOM, FCTM & OMB Chapter 2.

1.18. Additional information:

1.18.1 Airbus Report:-

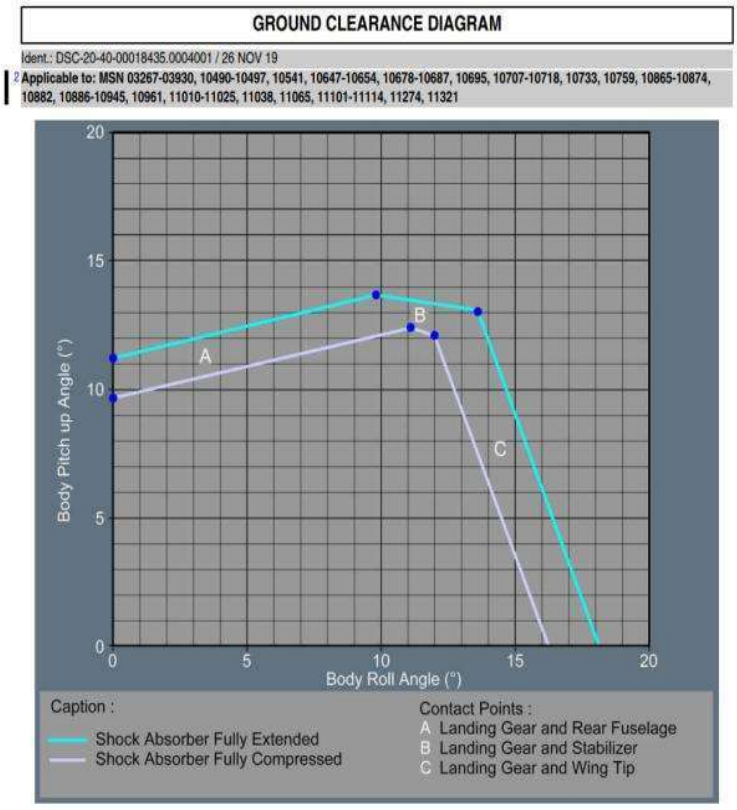
The FDR of the incident flight was evaluated by Airbus and the following were reported:-
The auto-land approach has been initiated with significant wind conditions:
- Longitudinal wind variations from -30kts (headwind) and 0kts
- Left lateral wind variations from +23kts and +10kts
Touch down occurred with landing CONF 3 selected.

Analysis of the FMS BITE indicated that a copy of the active FPLN to secondary FPLN has been done at 07:58:36 UTC with landing configuration as default, meaning CONF FULL.
Then, indeed CONF 3 has been selected in the active FPLN by the crew during cruise (MCDU 5R button recorded pushed) around 08:00:41 UTC, before the top of descent (T/D).
At 08:07:12 UTC, secondary FPLN was activated during the descent. This led the landing configuration to revert to CONF FULL as copied previously.
In accordance with the CONF FULL considered by the FMS, the Vapp computation resulted to be lower than VLS which then contributed to a touch down below VLS-15.

Airbus concluded that as per the above analysis, the reported issue was due to FMS active and secondary FLPNs mishandling and wind gusts during final approach and flare.
No aircraft misbehaviour has been observed on this event.

The PITCH WARNING is available with the below conditions:-
PITCH WARNING PIN-Prog active ; Radio-Altimeter < 20Ft; TOGA mode not active; Autopilots OFF; Pitch + pitch rate > 8.25°.
As per DFDR data the during flare phase Pitch angle reached +10.02° with both AP's engaged. As per the above mentioned PITCH WARNING conditions, AP's must be OFF to active the PITCH PITCH warning. This was the reason for non-activation of PITCH PITCH warning during the event.

1.18.2 FCOM Reference: Ground Clearance Diagram



Pitch attitude limit with MLG fully compressed for A321 is 9.7°. Pitch attitude limit with MLG fully extended is 11.2°.

1.18.3 FCOM Reference: STANDARD OPERATING PROCEDURES - DESCENT PREPARATION (Relevant Extract)

DESCENT PREPARATION

Descent preparation and arrival briefing should be completed before top of descent.

LANDING INFORMATION

WEATHER AND LANDING INFORMATION.....OBTAIN PM
NAV CHARTS CLIPBOARD.....PREPARE BOTH

ECAM

ECAM STATUS.....CHECK PM

LANDING PERFORMANCE

LANDING CONDITIONS.....CONFIRM PF-PM

Check if the landing conditions changed compared with the landing distance computation at dispatch, or with a previous computation (e.g. runway, weather conditions, in-flight failure affecting performance, diversion).

FMS

ARRIVAL page.....COMPLETE/CHECK PF

F-PLN A page.....CHECK PF

DES WIND page.....CHECK PF

Enter winds for descent before T/D.

PERF APPR page.....COMPLETE/CHECK PF

Enter the QNH, temperature, and wind at destination.

Note: Insert the average wind given by the ATC or ATIS. Do not insert the gust value. During approach, the Ground Speed Mini function (managed speed mode) takes into account the instantaneous gust.

- Insert the minimum.

Note: After the activation of the SEC F-PLN, check the VAPP, and modify if necessary.

- Check or modify the landing configuration. Always select the landing configuration on the PERF APPR page: CONF FULL in the normal landing configuration. CONF 3 should be considered, depending on the available runway length and go-around performance, or if windshear/severe turbulence is considered possible during approach.

{[*FCOM-AIRCRAFT SYSTEMS- MCDU- PERF APPR PAGE DESCRIPTION: AUTO FLIGHT-FLIGHT MANAGEMENT]: CONF FULL is the default landing configuration (LDG CONF)}- PERF APPR Page is depicted below (FCOM reference)*

SEC F-PLN page.....AS RQRD PF

Before the top of descent, the SEC F-PLN should either be set to an alternate runway for destination, or to the landing runway in case of circling. In all cases, routing to the alternate should be available.

If there is a last-minute runway change, then the flight crew only needs to activate the secondary F-PLN, without forgetting to check/set the new minimum and navaids.

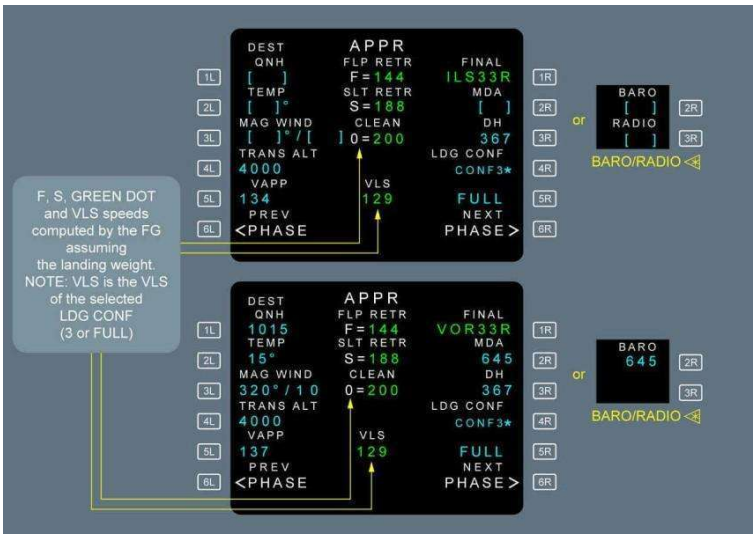
FMS PREPARATION.....CROSSCHECK PM

After the PF prepares the FMS, the PM checks all the data entered in the FMS. The PM should have the same mental image of the intended arrival and approach procedure, trajectory, and constraints than the PF. The PM should check with the PF if anything is not clear.

SEC F-PLN page.....AS RQRD PF

GPWS LDG FLAP 3 pb-sw.....AS RQRD PF

If the flight crew plans on landing in FLAPS 3 configuration, the GPWS LDG FLAP 3 PB-SW should be set to ON.



PERF APPR PAGE

1.18.4 FCTM Reference: CONTENT OF A LANDING PERFORMANCE DATA CROSSCHECK

When SOPs request a crosscheck of landing performance data, both the PF and the PM must verify all the following values:

- RWY Ident

This ensures that the runway used for the computation in the EFB and/or inserted in the FMS is the same

- RWY Length

This ensures that the flight crew took into account any NOTAM that affects the runway length

- Airport Weather Information (Wind, QNH, Temperature, Runway condition)
- Landing Weight
- FLAPS
- FLD
- VAPP.

1.18.5 FCOM AUTOLAND CHECKLIST (RELEVANT EXTRACT)

AT 350 FT RA

LAND ON FMA.....CHECK/ANNOUNCE PF

ILS/GLS /MLS COURSE ON PFD.....CHECK PF

If the ILS / GLS course pointer and the runway track differ by more than 5 °, perform a goaround, or a manual landing if visual references are sufficient.

AT 40 FT RA

FLARE ON FMA.....CHECK/ANNOUNCE PM

Note: If the FMA does not display FLARE, perform a go-around, or a manual landing if visual references are sufficient.

Note : FLARE.....MONITOR PF

AT 30 FT RA

THR IDLE ON FMA.....CHECK PM

THRUST IDLE.....CHECK PM

AT 10 FT RA

An automatic "RETARD" callout triggers.

THRUST LEVERS.....IDLE PF

The autothrust disconnects.

LATERAL GUIDANCE.....MONITOR PF

Monitor the lateral guidance by using external references

AT TOUCHDOWN

Note: In the case of NWS or Anti-Skid failure, set the AP OFF at touchdown.

ROLL OUT ON FMA.....CHECK/ANNOUNCE PM

BOTH THRUST LEVERS.....REV MAX or REV IDLE PF

GND SPLRS.....CHECK/ANNOUNCE PM

REVERSERS.....CHECK/ANNOUNCE PM

DIRECTIONAL CONTROL.....MONITOR/ENSURE PF

If autobrake is selected:

AUTO BRK.....CHECK/ANNOUNCE PM

Check and announce BRK LO or BRK MED on the FMA. If no ground spoilers are extended, the autobrake is not activated.

AUTOBRAKE.....MONITOR PM

During all the rollout, the PM monitors that the FMA displays BRK LO or BRK MED, and calls out if the autobrake mode disengages.

AT 70 KT

SEVENTY KNOTS.....ANNOUNCE PM

BOTH THRUST LEVERS.....REV IDLE PF

BEFORE 20 KT

AUTO BRK.....DISARM PF

END OF ROLL OUT

REVERSERS.....STOW PF

AP.....OFF PF

1.18.6 Pilot Defect Report (PDR):-

After landing at Ahmedabad the following entry was made in the technical log book:
'SECTOR SNAG NIL . NOTE: CARRIED OUT AUTOLAND IN CONF3 AS WINDS WERE GUSTING 190/20-25kt AFTER FLARE OUT AC DID HARD LANDING.'

1.18.7 FCOM Reference: Limitations: MAXIMUM WIND CONDITIONS FOR ILS/MLS CAT II OR CAT III AND FOR GLS CAT I : VT-IMW (Relevant Extract)

Headwind : 15 kt
Tailwind : 10 kt
Crosswind : 10 kt
Wind limitation is based on the surface wind reported by ATC. If the wind displayed on the ND exceeds the above-noted autoland limitations, but the tower reports surface wind within the limitations, then the autopilot can remain engaged. If the tower reports a surface wind that exceeds the limitations, only CAT I automatic approach without autoland can be performed.

LIM-AFS-20-10-00020149.0001001: ILS/MLS CAT II and CAT III autoland and GLS CAT I autoland are approved in CONF 3 and CONF FULL.

LIM-AFS-20-10-00020158.0001001: Automatic landing system performance is demonstrated with CAT II or CAT III ILS/MLS airport installation. However, automatic landing in CAT I or better weather conditions is possible on CAT I ground installations or on CAT II/III ground installations when ILS/MLS sensitive areas are not protected, if the following precautions are taken:

- The airline checked that the ILS/MLS beam quality, and the effect of the terrain profile before the runway have no adverse effect on AP/FD guidance. Particularly, the effect of terrain profile within 300 m before the runway threshold must be evaluated.
- The flight crew is aware that LOC or G/S beam fluctuations, independent of the aircraft system, may occur. The PF is prepared to immediately disconnect the autopilot, and to take the appropriate action, should not satisfactory guidance occur.
- At least CAT2 capability is displayed on the FMA and the flight crew uses CAT II/III procedures.
- Visual references are obtained at an altitude appropriate for the CAT I approach. If not, a go-around must be performed.

1.18.8 FCTM REFERENCE: APPROACH USING LOC G/S FOR CATII CATIII

FLIGHT PREPARATION
In addition to the normal flight preparation, the following preparation must be performed when CAT II or CAT III approach is planned:
- Ensure that destination airport meets CAT II or CAT III requirements
- Check aircraft required equipment for CAT 2 or CAT 3 in QRH
- Check that crew qualification is current
- Consider extra fuel for possible approach delay
- Consider weather at alternate

APPROACH PREPARATION

LIMITATIONS
- The crew will check that tower wind remains within the limit for CAT II or CAT III approaches
- The autoland maximum altitude must be observed.

AIRPORT FACILITIES

The airport authorities are responsible for establishing and maintaining the equipment required for CAT II/III approach and landing. The airport authorities will activate the LVP procedures as the need arises based on RVR. Prior to planning a CAT II/III approach, the crew must ensure that LVP are in force.

CREW QUALIFICATION

The captain must ensure that both crew members are qualified and that their qualification is current for the planned approach.

APPROACH BRIEFING

Before commencing a CAT II/III approach a number of factors must be considered by the crew. In addition to the standard approach briefing, the following points should be emphasised during an approach briefing for a low visibility approach:

- Aircraft capability
- Airport facilities
- Crew qualification
- Weather minima
- Task sharing
- Call-outs
- Go-around strategy

APPROACH PROCEDURE

TASK SHARING

The workload is distributed in such a way that the PF primary tasks are supervising and decision making and the PM primary task is monitoring the operation of the automatic system.

PF Tasks

The PF supervises the approach (trajectory, attitude, speed) and takes appropriate decision at DH or in case of failure.

Since the approach is flown with AP / FD / A/THR, the PF must be continuously ready to take-over:

- If any AP hard over is experienced
- If a major failure occurs
- If any doubt arises.

The PF announces "LAND", when displayed on FMA.

PM Tasks

For aircraft without HUD or with single HUD, the PM is head down throughout the automatic approach and automatic landing.

For aircraft with DUAL HUD, the PM may be head up or head down.

The PM monitors:

- The FMA and calls all mode changes below 350 ft as required (i.e. after PF calls "LAND")
- The Auto call out
- The aircraft trajectory or attitude exceedance

- Any failures.

The PM should be go-around minded.

FLARE/LANDING/ROLL OUT

During the flare, decrab and roll-out, the PF will look outside to assess that the autoland is properly carried out, considering the appropriate visual references.

For CAT II approaches, autoland is recommended. If manual landing is preferred, the PF will take-over at 80 ft at the latest. This ensures a smooth transition for the manual landing.

Pull to REV MAX (or REV IDLE if conditions permits) at main landing gear touchdown (not before).

The use of auto-brake is recommended as it ensures a symmetrical brake pressure application. However, the flight crew should be aware of possible dissymmetry in case of crosswind and wet runways.

The PM should make the standard callouts and advise ATC when the landing roll is completed.

1.18.9 FCTM REFERENCE: AUTOLAND IN CAT I OR BETTER WEATHER CONDITIONS

The flight crew may wish to practice automatic landings in CAT I or better weather conditions for training purposes. This type of approach should be carried out only with the airline authorization. The flight crew should be aware that fluctuations of the LOC and/or GS might occur due to the fact that protection of ILS sensitive areas, which applies during LVP, will not necessarily be in force. It is essential; therefore, that the PF is prepared to take over manually at any time during a practice approach and rollout, should the performance of the AP become unsatisfactory.

1.18.10 FCOM REFERENCE: MANAGED SPEED/MACH TARGET

For managed speed/Mach, the lowest target is VLS, and the highest target is:
- VMAX in the case VMAX is equal to VFE, or
- VMAX - 5 kt in the case VMAX is equal to VMO/MMO.

When speed/Mach is managed, the target is defined as follows:

AP/FD Engaged Mode or FMS Flight Phase	**Managed Speed/Mach Target**
- The FMS flight phase is the approach phase In this case, the APs and/or FDs may be on or off Or - F-G/S, G/S, LAND, FLARE or ROLL OUT is engaged	VAPP, corrected by the Ground Speed Mini function. Before reaching the landing configuration, the speed will not go below: - Green Dot, in clean configuration - S, in CONF 1 - F, in CONF 2 - F, in CONF 3, when CONF FULL is the landing configuration (as defined in the PERF APPR page).

	VAPP is memorized at 700 ft RA, so if the FMS loses the VAPP below 700 ft RA, the managed speed target will still be computed. The lower limit of the managed speed target is the VAPP that is computed by the FMS, and displayed on the MCDU. If the VAPP computed by the FMS is not available, the VAPP is VLS +5 kt. The higher limit of the managed speed target is the VFE NEXT (or VFE - 5 kt in full configuration) of the landing configuration.

1.18.11 FCOM REFERENCE: GROUND SPEED MINI FUNCTION

When the aircraft flies an approach in managed speed, the managed speed target, displayed by the magenta triangle on the PFDs, is variable. This managed speed target is the VAPP, displayed on the PERF APPR page, corrected by the Ground Speed Mini function.

ACTIVATION CONDITIONS

The Ground Speed Mini function is active when:

- The speed is managed
- The FMS flight phase is the approach phase.

The Ground Speed Mini function does not correct Green Dot, S and F speeds.

PRINCIPLE

The Ground Speed Mini function takes advantage of the aircraft inertia when the wind varies during the approach in order to provide an appropriate indicated target speed (i.e. the managed target speed represented by the magenta triangle on the PFD). When the flight crew flies this indicated target speed, the energy of the aircraft is maintained above a minimum level that ensures standard aerodynamic margins versus the stall.

The minimum energy level is the energy level the aircraft will have at touchdown with an indicated airspeed equal to VAPP, and with the wind equal to the tower reported wind as inserted in the PERF APPR page. The ground speed then equals the Ground Speed Mini. The Ground Speed Mini is not displayed to the flight crew.

During the approach, the FMGS continuously computes the managed target speed in order to keep the ground speed at or above the Ground Speed Mini.

MANAGED SPEED TARGET COMPUTATION

The computation of the managed speed target uses the tower headwind component, the current headwind component, and the VAPP.

TOWER HEADWIND COMPONENT

The tower wind is the average wind provided by the ATIS or the tower. The flight crew enters the tower wind in the MAG WIND field in the PERF APPR page.
The tower headwind component is the projection of the MAG WIND on the runway axis. This computation is based on the runway inserted in the FMS active F-PLN.

CURRENT HEADWIND COMPONENT

The projection of the current wind measured by the ADIRS on the aircraft longitudinal axis is the current headwind component (instantaneous headwind).

VAPP COMPUTATION

The FMS computes the VAPP, and displays it on the PERF APPR page. The VAPP computation takes into account the tower headwind component. VAPP is the highest of the following computations:

- VAPP = VLS + 1/3 x TWR HEADWIND COMPONENT, or
- VAPP = VLS + 5 kt.

Note: "1/3 of the TWR HEADWIND COMPONENT" has 2 limits:

- 0 kt as the minimum value (no wind or tailwind)
- +15 kt as the maximum value.

The flight crew can manually modify the VAPP and the MAG WIND values on the PERF APPR page.

MANAGED SPEED TARGET COMPUTATION

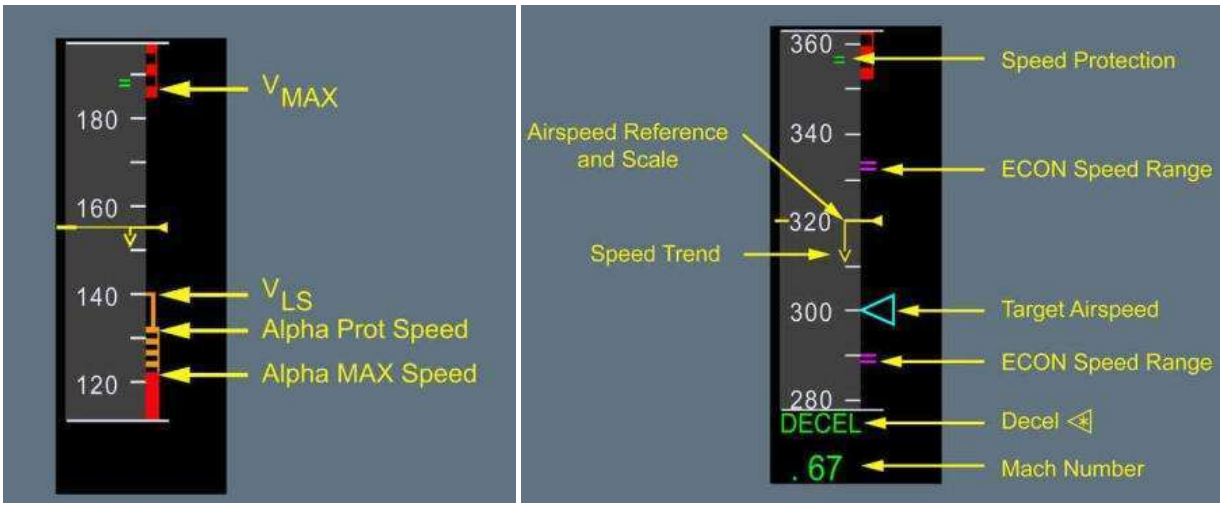
The FG continuously computes the managed speed target that is equal to VAPP plus an additional increment. This increment takes into account the headwind variation during the final approach.

Managed speed target = VAPP + 1/3 x (CURRENT HEADWIND COMPONENT – TWR HEADWIND COMPONENT).

The managed speed target has the following limits:

- VAPP, as the minimum value
- VFE next, in CONF 0, 1, 2, 3, VFE - 5 kt in CONF FULL, as the maximum value.

1.18.12 FCOM REFERENCE: Characteristic speeds discussed in the report



Air Speed Scale

The characteristic speeds displayed on the PFD are computed by the Flight Augmentation Computer (FAC), according to the FMS weight data (for PFD/MCDU display consistency and accuracy purposes).

VLS (of normal landing configuration: CONF 3 or FULL), F, S and Green Dot speeds are also displayed on the MCDU TAKEOFF and/or APPR pages. VLS is indicated by the top of the amber strip along the speed scale indicates this speed. It represents the lowest selectable speed providing an appropriate margin to the stall speed.

Vapp is the Final approach speed. It is Calculated by the FMGCs and displayed on MCDU APPR page. VAPP = VLS + wind correction. The wind correction is limited to a minimum of 5 kt and a maximum of 15 kt. The flight crew may modify VAPP through the MCDU. During autoland or when A/THR is on or in case of ice accretion or gusty crosswind greater than 20 kt, VAPP must not be lower than VLS +5 kt.

The target airspeed is either computed by the FMGC in managed speed mode (magenta triangle) or manually entered on the FCU in selected speed mode (blue triangle).The target speed is a magenta double bar (=) when associated with the ECON speed range.

1.18.13 Additional inputs from crew account of the incident

PIC reported that visibility was good but approach was 'bumpy' due winds; as the aircraft Auto land status was current, he decided to carry out auto land as he felt that there is higher safety in doing so.

The First Officer reported that he had practised Auto Land during his type rating training in-case of PIC In-capacitation, though he was not CAT II/III qualified. There was no "PITCH PITCH " alert generated during flare.

The PIC who was the PF prepared the FMS for arrival by making a copy of the active flight plan to secondary and announced that arrival is prepared in secondary, which was also acknowledged by the First Officer during descent preparation (CVR). However, the First Officer informed during discussion that he was not aware of the same.

1.19 Useful or effective investigation techniques:-

Nil.

2. Analysis:-

2.1 Serviceability of the aircraft:-

Airbus A321-252NX(neo) aircraft VT-IMW of IndiGo was issued a Certificate of Registration on 01.11.2022 by DGCA-INDIA (entered in the register of India with effect from 28.10.2022) and its last ARC is valid till 03.11.2023. The aircraft (MSN-10882) was manufactured in 2022. The aircraft had accumulated a total of 2389:48hrs since new.
Transit inspection of the aircraft was performed by AME before the flight from Bengaluru - Ahmedabad (6E-6595) on 15.06.2023. No relevant MEL was active on VT-IMW as on the date of incident.

Based on the approved Operations Manual -Part A of M/s InterGlobe Aviation Ltd. a Practice Autoland is conducted to keep the aircraft's Autoland status valid, wherein qualified pilots are required perform an Autoland every 30 days to authorised runways followed by an entry in the FRB i.e. whether the "Autoland" was satisfactory or not, for the purpose keeping aircraft "Autoland" status valid.
The airline has informed that they had a practice in which whenever a 'Practice Auto land' is required for the purpose of keeping aircraft's Auto land status, MCC was sharing the Autoland status mail with OCC and Dispatch on daily basis and OCC was further sending ACARS to crew using automated process. However no documented procedure could be produced by M/s InterGlobe Aviation Ltd. in this regard.
It has been informed by M/s IndiGo that, no message was sent from OCC to the flight crew for performing a 'Practice Auto land' for the subject flight on 15.06.2023. It has also been informed that the practice of sending ACARS messages to flight crew for carrying out practice auto land has been discontinued post subject incident, as the landing capability can be tested on ground itself.

The last practice Autoland for VT-IMW prior to the incident was carried out on 04.06.2023 and Autoland Satisfactory entry was made in the FRB/ Technical log, there was no message sent from OCC to the flight crew on 04.06.2023 for performing a 'Practice Auto land'.

"Pitch Pitch" autocall was not generated during flare as AutoPilot 1 & 2 were engaged during landing.

The major and all lower inspections were carried out as and when due. The left Engine S/N 59B109 had logged 2389:48Hrs / 1590 Cycles and the right Engine S/N 59B112 had logged 2389:48Hrs / 1590 ECYC. There was no defect reported prior to departure for the subject flight sector.

Prior to the incident flight, the weight and balance of the aircraft was well within the operating limits.

The serviceability of the aircraft was not a factor which contributed to the incident.

2.2 Weather aspect:

The weather forecasts provided to the crew were valid for the arrival time at Ahmedabad. TAF for Ahmedabad (VAAH) included in the flight folder indicated that forecasted winds were from 190 degree and 18kt with gusts up to 28kt were expected. Hence, the forecast clearly indicated the possibility of significant wind and gusty conditions at the time of arrival at Ahmedabad.

The Maximum Wind Conditions for an autoland as defined in FCOM by Airbus for VT-IMW is Headwind: 15kt; Tailwind: 10kt and Crosswind: 10kt
The FCOM further states that, Wind limitation is based on the surface wind reported by ATC. If the wind displayed on the ND exceeds the above-noted autoland limitations, but the tower reports surface wind within the limitations, then the autopilot can remain engaged. If the tower reports a surface wind that exceeds the limitations, only CAT I automatic approach without autoland can be performed.

The PIC continued the approach with intention of an autoland, though the approach was being performed with ATC reported winds in excess of the FCOM limitations for an autoland.

Airbus analysis also points that, the auto-land approach has been initiated with significant wind conditions:
- Longitudinal wind variations from -30kts (headwind) and 0kts
- Left lateral wind variations from +23kts and +10kts

Weather was a contributory factor in the incident.

2.3 Flight Crew Training and Qualifications:

Practice automatic landing in CAT I or better weather condition is permissible on approved runways with CAT I ground installations or on CAT II/III ground installations when ILS sensitive areas are not protected. The practice autoland can only be carried out by the Flight Crew who are qualified for Cat II/ III operations.

Crew after training and checks on simulator followed by one approach on aircraft are qualified for CAT II/III operations. The PIC was appropriately trained and qualified for CAT II/III operations in which an autoland is carried out. The same was also included in the last training on simulator in March 2023, which also complied with the recency requirement.

PIC Incapacitation and autoland topics were included in 'ZFTT Simulator Training' during Initial type rating course of First Officer in January 2020. However he was not trained and qualified for CAT II/ III operations.

Ahmedabad ILS RWY 23 has been approved by M/s InterGlobe Aviation Ltd. for Practice Auto Land and the information is detailed in the approved Operations Manual of M/s InterGlobe Aviation Ltd.

To exercise the privileges of applicable CAT II/III authorization, a PIC/ Co-pilot shall have carried out a minimum of 6 CAT II/III approaches to the authorised RVR including 3 landings in the approved simulator. Hence, there is no recency requirement for qualified crew to perform

a practice autoland on aircraft. From the above it can be seen that practice autoland has to be conducted for the purpose of maintaining aircraft "Autoland" status as valid or for initial crew qualification and not for crew recency requirements, however there is also no restriction on the operating crew from M/s InterGlobe Aviation Ltd. on performing "Autoland", if used within aircraft limitations.

The PIC was appropriately trained and qualified for CAT II/III operations whereas the First Officer was not trained and qualified for CAT II/ III operations.

SOP For CAT II/ III Auto Land

M/s IndiGo has a "Ready Reckoner" which combines all the company requirements for ready reference to its crew when a CAT II/III Auto Land is planned to be performed, the same procedure is followed for a Practice Auto Land in CAT I conditions.

This document outlines the entire process from Pre-requisites to review of failure cases prior to performing an Autoland, including crew qualifications and wind limitations. Whereas in the subject incident no review/ discussion/ briefing were conducted by the PIC and he directly informed the ATC regarding his intention to perform a 'Practice Autoland'. The First Officer did not alert the PIC regarding his qualification status for Cat II/III operations.

FCOM reference: Descent preparation - FMS configuration states that: Landing configuration to be selected on the MCDU-PERF APPR page: CONF FULL in the normal landing configuration. CONF 3 should be considered, depending on the available runway length and go-around performance, or if windshear/ severe turbulence is considered possible during approach. CONF FULL is the default landing configuration (in PERF page) during FMS configuration, which may be selected as CONF 3 by the crew, when required.

2.3 (a) Company Operations notice on use of Flaps - CONF 3:

Vide **Operations Notice (Airbus)- FLT/OPS/N-NO:32** IndiGo recommended use of Flap 3(CONF 3) Landings whenever professional assessment and judgement determines that they are appropriate for execution. The operations notice also stated that, landing performance permitting, Flap3 Configuration is the preferred landing configuration every time. In-addition the document stated that, during PIC Rout Checks the ability of the U/T PIC to execute Flap3 approach and Landing shall be observed in all Route Checks.
Full Flap Landings were recommended in the following cases: Landings at Performance Limited Airfields, Tailwind Component 10kt or higher (due high ROD) and Landing Performance limited.

The **Operations Notice (Airbus)- FLT/OPS/N-NO:32** has been replaced with **Operations Notice(Airbus) FLT/OPS/N-NO: 02-06C** on SAFETY, SUSTAINABILITY & OPERATIONAL EFFICIENCY. The operator has amended its Operations notice and has informed to the pilots that they shall use their assessment and judgement to determine the appropriate Landing Configuration. CONF-3 should be considered depending on the available runway length and go-around performance, or in case of windshear/severe turbulence during approach. While CONF-Full provides better handling capability in turbulent conditions,

CONF-3 provides more energy and less drag. Pilots are further advised to also refer to conditions outlined in FCOM, FCTM & OM-B on the subject.

2.4 Operational handling:

2.4.1 Descent Preparation:

The aircraft reached the cruise level of 36000ft by 07:14 UTC. FMS BITE indicated that a copy of the active FPLN to secondary FPLN has been done at 07:58:36 UTC with landing configuration as default (CONF FULL). Then, CONF 3 was selected in the active FPLN by the crew during cruise around 08:00:41 UTC, before the top of descent (T/D).

The PIC informed the First Officer before top of descent (about 40 minutes before touchdown) that he was configuring the FMS for arrival on secondary flight plan and not in primary which was acknowledged by the First Officer. The PIC who was the PF for the sector prepared the FMS for arrival; he was responsible to appropriately plan the FMS- ARRIVAL, F-PLN A and PERF page. The PF is also required to enter the QNH, temperature and wind at destination and minimum.

Based on Airbus procedures:

After the PF prepares the FMS the PM is required to check the data entered made by the PF in the FMS. So, that PM would have the same mental image of the intended arrival and approach procedure, trajectory, and constraints than the PF. The PM should check with the PF if anything is not clear.

As per the available evidences neither did the First Officer crosscheck or raise any concern about the FMS arrival data nor did he query the PIC about the flight plan or landing performance data.

2.4.2 Secondary Flight Plan:

FCOM guidelines state that, the secondary flight plan is an option available to the crew. Before the top of descent, the SEC F-PLN should either be set to an alternate runway for destination. So that, if there is a last-minute runway change, then the flight crew only needs to activate the secondary F-PLN.

The FCOM procedure also advises to check the VAPP after the activation of the SEC F-PLN, and modify it, if necessary. Also crew is required to check /modify the landing configuration.

The PF is required to select the landing configuration on the PERF APPR page: CONF FULL in the normal landing configuration. CONF 3 should be considered, depending on the available runway length and go-around performance, or if windshear/severe turbulence is considered possible during approach, the forecasted winds were from 190 degree and 18kt with gusts up to 28kt were expected. When the flight crew plans on landing in FLAPS 3 configuration, the GPWS LDG FLAP 3 PB-SW is set to ON. Upon completion of this task, ‘Flaps’ in ECAM checklist will also be indicated as complied (No Blue) as soon as Flaps are in ‘CONF 3’.

2.4.3 FLT PLAN handling:

The PIC who was the PF prepared the FMS for arrival by making a copy of the active flight plan to secondary and announced it which was also acknowledged by the First Officer during descent preparation. However, the First Officer informed that he was not aware of the same, the First Officer did not cross check the FMS data and the acknowledgement was likely not made

consciously and was made in the flow while the crew were performing descent preparation without having the mental picture of the approach planned by the PIC.
However the PIC configured the arrival Performance in active flight plan. After 08:01:39 UTC the aircraft started descent. At 08:07:12 UTC (30 minutes to touchdown) secondary FPLN was activated during the descent. This led to the reversion of landing configuration to CONF FULL as copied previously. This activation of the secondary flight plan was not announced by the PIC. This disconnect between the either crew members is further evident during the unannounced activation of the secondary flight plan at 08:07:12 UTC (i.e., 30 minutes to touchdown) which led to the reversion of landing configuration to CONF FULL as copied previously. Initial entries and changed entries to automated systems were not verbalised and acknowledged.

2.5 Events leading to the incident:

Crew carried out arrival briefing for Ahmedabad, for a CONF 3 landing including the actions in case of a go-around. After coming in contact with Ahmedabad the crew changed over to Ahmedabad, however crew was unable to contact Ahmedabad again when released by Mumbai (approx. 34 minutes to touchdown). The First Officer again requested Mumbai for Ahmedabad frequency and PIC took over the communications. Then PIC was able to contact Ahmedabad on frequency given by Mumbai. Once in contact with Ahmedabad control (approx. 30 minutes to touchdown) the aircraft was cleared via APANO 1A arrival RWY23 and was advised to expect radar vector ILS approach RWY 23; during this period (08:07:12 UTC, i.e., approx. 30 minutes to touchdown) secondary FPLN was activated during the descent. This led to the reversion in landing configuration to CONF FULL as copied previously. At no point was the activation of the secondary flight plan brought to the attention of the First Officer who was the Pilot Monitoring.

Crew carried out approach checklist and Minimum discussed was 430ft, QNH received from ATC was 1002 hPa. A few minutes later the QNH reported by ATC as 1001 hPa and PIC brought the attention of the First Officer towards the drop in QNH. The PIC was concerned about the weather and kept discussing with the First Officer about the approaching weather being observed by them at Ahmedabad during the descent and approach, even at 10Nm to touchdown.
The crew contacted Ahmedabad tower at about nine miles to touchdown and Ahmedabad tower informed that the Winds were 190° 26kt gusting up to 29kt. PIC rechecked with the First Officer regarding the wind information transmitted by the ATC. First Officer's reply is not clearly heard in CVR but the recorded information is that winds were 15 gusting.
About a minute and half later (approximately 02 minutes to touchdown), the ATC Tower cleared VT-IMW for landing on RWY23, the tower reported winds at this time were 190° 20kt gusting up to 25 kt. Flaps 3 was selected and Landing checklist was completed. The PIC is observed to be again discussing the approaching weather with the First Officer and informed the Tower controller to expedite landing of other aircraft as weather was approaching and was likely to hit the area soon.

During the approach just prior to the 1000 ft auto-call (about 01 minutes and 20 seconds to touchdown), PIC informed the First Officer that he was thinking of putting 'No DH', which he thought was the safest thing to do in the prevailing condition. Soon the First Officer queried with the PIC regarding configuration used; The PIC interrupted the First Officer, the reply was

immediate and not receptive towards the opinion/ input, which the First Officer was trying to communicate, the PIC stated that the configuration used was CONF 3 and it is the best for a go-around. The First Officer further did not speak up and state his intentions with appropriate persistence. The PIC promoted the course of action that he felt was the best, even though the prerequisites for an Practice Auto Land were not followed/ complied.

The PIC then advised the First Officer to remind of 'minimum' at '430', so that he would disconnect the Auto Pilot, following which (at approx. 01 minute and 10 seconds to touchdown) the PIC then made a call to the ATC that 'Carrying out practice Auto land'. The controller acknowledged the call and advised the crew that sensitive areas were not protected. The decision to perform a 'Practice Autoland' was not communicated in the cockpit; it was taken independently by the PIC and not after discussion with the First Officer indicating a lack of effective CRM and exclusion of the First Officer from the decision making, neither did the First Officer inform the PIC about his qualification status for Cat II/III operations. The "overall picture" and the approach plan were not shared with the First Officer.

The system design for managed speed/Mach is such that the lowest target is VLS. However, in the approach phase, VAPP is memorised at 700 ft RA, so that if the FMS loses the VAPP below 700ft RA, the managed speed target will still be computed. The lower limit of the managed speed target is the VAPP that is computed by the FMS, and displayed on the MCDU. In the subject scenario, the VLS was 140kt and the Ground Speed Mini function adjusted target speeds for the wind conditions during approach. However below 700ft radio altitude, the target speed was the memorised Vapp which in this case, due to selection of Landing Configuration as CONFIG FULL was less than VLS (which was calculated for selected configuration of CONF 3). This resulted in the target speed being lower than VLS. The PF and the PM did not monitor the drop in the target speed and the drop in aircraft speed below the VLS was not announced.

PIC announced 'Land green' and advised the First Officer for 'Low brake' about 30 seconds before touchdown. The First Officer did not respond to the actions of the PIC nor did he take any role in the monitoring and announcing the parameters during the 'Practice Autoland'.
There was a significant change in winds below 60ft radio altitude from approx. 28kt to 11kt at touchdown and change in direction from about 175° to about 130°. The aircraft pitch was about 4°-5° during final approach below 500ft radio altitude. Below 50ft radio altitude the aircraft pitch started increasing from 4.7°. The aircraft pitch increased beyond 5° below 40ft radio altitude and reached a max of 10° upon touchdown. The speed at touchdown was about 15kt below VLS. There were no callouts from the PF or the PM regarding the target air speed fluctuation below the VLS (140kt) during the approach.

Upon touchdown the PIC announced Reversers and advised the First Officer to announce further checklist items, as the First Officer did not announce any callouts during the final approach to flare. During TAXI IN at Ahmedabad, the PIC discussed with the First Officer that the winds were really gusty and that the aircraft was shaking even with automation. He added that in such scenarios manual flying is not easy and that the best thing to do is use automation, which is contrary to the limitations and system definition for performing an AUTO Land.

CRM issues identified were associated with poor decision-making, ineffective communication, and poor task or resource management. FCOM/SOP's defines the shared mental model upon which a good crew performance depends upon, the established SOP's had been ignored by the crew.

To summarise the above; due to CONFIG FULL selection made in the performance(PERF) page during the FMS setup and CONF 3 being selected during approach, the FMS memorised target speed (Vapp) which was below VLS for CONF 3 was maintained below 700ft during the approach. The decrease in speed is of the extent of VLS-15 which caused a decrease in aircraft energy. The low energy state of the aircraft and variations in the prevailing winds resulted in an increase of pitch and the ensuing tail ground contact during touchdown.

3. Conclusion

3.1 Findings:

1. The aircraft was having a valid Certificate of Airworthiness, Airworthiness Review Certificate and Certificate of Registration as on the date of incident.
2. The Operating cockpit crew members were having valid licences and ratings for operating the aircraft.
3. The crew members who operated the flight underwent a Breath-analyser test for alcohol consumption at Bengaluru prior to departure to Ahmedabad and the test result was 'Negative'.
4. The aircraft was released in a serviceable condition for the scheduled passenger flight from Bengaluru on 15.06.2023 for operating 6E-6595(Bengaluru to Ahmedabad). There were no defects reported prior to the incident sector.
5. The incident sector (Bengaluru-Ahmedabad) was the first flight sector for the subject crew members on 15.06.2023.
6. PIC was the Pilot Flying and the First Officer was the Pilot Monitoring for the subject flight sector.
7. Flight Duty Time of both the crew members was within the specified limits.
8. The Pilot Flying (PIC) was adequately trained and qualified for CAT II/ III operations, while the First Officer was not trained and qualified for Cat II/ Cat III operations.
9. There is no requirement for crew to perform 'Practice Autoland' to maintain the recency of their CAT II/III operations.
10. There were no instructions from M/s IndiGo to the flight crew for the subject flight to perform a 'Practice Auto land'.
11. PIC made a copy of the active FPLN to secondary FPLN at 07:58:36 UTC with landing configuration as default (CONF FULL). Then, CONF 3 was selected in the active FPLN by the crew during cruise around 08:00:41 UTC, before the top of descent.
12. Before top of descent that PIC configured the FMS for arrival on secondary flight plan, which was acknowledged by the First Officer.
13. Arrival briefing for Ahmedabad was conducted for a CONF 3 landing including the actions in case of a go-around.
14. The crew contacted Ahmedabad tower at about nine miles to touchdown and Ahmedabad tower informed that the Winds were 190° 26kt gusting upto 29kt. PIC rechecked with the First Officer regarding the wind information transmitted by the ATC. The First Officer did not alert the PIC about the correct winds.
15. Wind information transmitted by Ahmedabad ATC (Tower) prior to landing was 190° 20kt gusting up to 25kt. The FCOM limitations w.r.t Maximum Wind Conditions for an autoland are Headwind: 15kt; Tailwind: 10kt and Crosswind: 10kt. Since the tower reported surface wind exceeded the limitations, only CAT I automatic approach without Auto land could be performed.
16. During the issue of landing clearance, ATC informed the crew that the winds were 190° 20kt gusting to 25kt. The operating crew were aware of the prevailing wind conditions and still chose to continue with the 'Auto land'.

17. The winds as per FDR indicated that at the time of approach the prevailing wind conditions, i.e., wind speed was steadily beyond the aircraft limitations for an Auto land.
18. TAF available to the operating crew was 190° 18kt Gust up to 28kt for the period of arrival.
19. Before 1000 ft. the aircraft was configured for landing and was on profile, speed trend was fluctuating. AP1 remained active from take-off till landing. AP2 was selected at 1896 ft radio altitude during approach (08:27:32 UTC).
20. Passing 700ft in approach the IAS was 151kt and ground speed was 133 kt. Below 700ft radio altitude, the Vapp dropped below VLS (140) (the ground speed was about 122-127kt). This was a result of CONFIG FULL selection made in the performance (PERF APPR) page during the FMS setup and CONF 3 being selected during approach, the FMS memorised target speed (Vapp) was below VLS for CONF 3.
21. Decision to do an Auto land was made only during the final approach segment by the PIC below 700ft radio altitude and First Officer was not consulted during the decision making. Neither did the First Officer inform the PIC about his qualification status for Cat II/III operations.
22. Autoland was carried out, but neither was a briefing for Autoland nor was its checklist followed as per SOP.
23. Passing 60ft radio altitude the aircraft speed was 144kt IAS and 124kt ground speed. There was a significant change in winds below 60ft radio altitude from approx. 28kt to 11kt at touchdown and change in direction from about 175° to about 130°.
24. Winds were variable below 1000 feet quartering left headwind varying between 20kt to 35kt.
25. The aircraft geometry is such that aircraft tail would make ground contact when the aircraft pitch UP angle is near/ more than 9.7 degree UP with Shock Absorber Fully compressed and near/ more than 11.2 degree UP with Shock Absorber Fully extended.
26. Below 50ft radio altitude the aircraft pitch started increasing from 4.7° and reached a maximum of 10º at touchdown of main wheels which was at 08:37:26UTC. The aircraft vertical speed was 128ft/min at touchdown and vertical acceleration of 1.85g. The aircraft speed, IAS at touchdown was 125kt and ground speed was 124 kt.
27. Aircraft pitch attitude at touchdown was 10° and Tail portion of the fuselage made ground contact. The speed at touchdown was about 15kt below VLS.
28. 'Practice Auto land' is required to be performed every 30 days to authorised runways to keep the aircraft's Auto land status valid. The last 'Practice Autoland' for VT-IMW prior to the incident was carried out on 04.06.2023. The aircraft's autoland status was valid as on date of the incident.
29. Requirement to perform 'practice auto land' for maintaining the aircraft's Auto land status 'valid' has been discontinued post subject incident, as the landing capability is tested on ground itself.
30. "Pitch Pitch" autocall was not generated during flare as Autopilot was ON during landing.

3.2 Probable cause:

The probable cause of the incident was the aircraft speed reduction to the extent of VLS-15kt, the low energy state of the aircraft resulted in an increase of pitch beyond limits during the autoland and the ensuing contact of the aircraft tail section with ground during touchdown.

The following factors led to the incident: -

- Non-adherence to SOP (Standard Operating Procedures) during FMS configuration and during activation of the Secondary Flight Plan, i.e., FMS active and secondary FLPNs mishandling.
- Flaps CONF 3 selection made during approach against a planned approach with CONFIG FULL in the FMS performance page, leading to a lower target speed computation.
- PIC's non-compliance with the SOP for an Auto Land, including wind limitations and flight crew qualifications.
- Lack of effective CRM between the operating crew members.

4. Safety Recommendations:

1. Necessary corrective training may be imparted to the flight crew in-view of the findings detailed above.

LINJU VALAYIL PHILIP
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Date: 2025.03.19 15:02:38+05'30'

(LINJU VALAYIL PHILIP)
Deputy Director of Air Safety
Investigator-In-Charge

RAMESH CHAND
Digitally signed by RAMESH CHAND
DN: c=IN, o=Directorate General of Civil Aviation, ou=DGCA, 2.5.4.20=2d955f75404da027ce9c4957f619ff9c339cf24458f6ac55e70bd657c051c74a, postalCode=110037, st=DELHI, serialNumber=3b348d8c7a62754affee3afca3f28cf983a27ec0e187e44e583d3beae52e3f8d, cn=RAMESH CHAND
Date: 2025.03.19 10:00:30 +05'30'

(RAMESH CHAND)
Air Safety Officer
Member

Date : 19.03.2025
Place : New Delhi