



सत्यमेव जयते

**Final Investigation Report**  
**on**  
**Accident to M/s InterGlobe Aviation Limited**  
**Aircraft ATR-72-600, VT- IYX**  
**on 14 June 2021**

**Amit Kumar**  
**Investigator-in-charge**

**Ravi Ramakrishnan**  
**Investigator**

## **FOREWORD**

*In accordance with Annex 13 to the Convention on International Civil Aviation Organization (ICAO) and Rule 3 of Aircraft (Investigation of Accidents and Incidents), Rules 2017, the sole objective of the investigation of an Accident/Incident shall be the prevention of accidents and incidents and not 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 document has been prepared based upon the evidences collected during the investigation, opinion obtained from the experts and laboratory examination of various components. Consequently, the use of this report for any purpose other than for the prevention of future accidents or incidents could lead to erroneous interpretations.*

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## GLOSSARY

|        |   |
|--------|---|
| AAI    | Airport Authority of India                |
| AAIB   | Aircraft Accident Investigation Bureau    |
| AD     | Airworthiness Directive                   |
| AMSL   | Above Mean Sea Level                      |
| ARC    | Airworthiness Review Certificate          |
| ASAAR  | Airport Surveillance Radar                |
| ATC    | Air Traffic Control                       |
| AUW    | All Up Weight                             |
| BA     | Breath Analyser                           |
| CAR    | Civil Aviation Requirements               |
| C of A | Certificate of Airworthiness              |
| CFT    | Crash Fire Tender                         |
| CPL    | Commercial Pilot Licence                  |
| CVR    | Cockpit Voice Recorder                    |
| DAW    | Director of Airworthiness                 |
| DFDR   | Digital Flight Data Recorder              |
| F/O    | First Officer                             |
| FCOM   | Flight Crew Operation Manual              |
| FCTAM  | Flight Crew Training Manual               |
| FI     | Flight Idle                               |
| Hrs    | Hours                                     |
| IATA   | International Air Transport Association   |
| IAS    | Indicated Airspeed                        |
| ICAO   | International Civil Aviation Organisation |
| ILS    | Instrument Landing System                 |
| Kts    | Knots                                     |
| LH     | Left Hand                                 |
| LLZ    | Localiser                                 |
| TOGA   | Take off Go around                        |
| MEL    | Minimum Equipment List                    |
| MFC    | Multi Function Computer                   |
| MLG    | Main Landing Gear                         |
| MTOW   | Maximum Take Off Weight                   |
| NDB    | Non Directional Beacon                    |
| NLG    | Nose Landing Gear                         |
| NM     | Nautical Miles                            |
| PA     | Passenger Address                         |
| PF     | Pilot Flying                              |
| PIC    | Pilot in Command                          |
| PM     | Pilot Monitoring                          |
| QRH    | Quick Reference Handbook                  |
| RA     | Radio Altitude                            |
| RH     | Right Hand                                |
| SB     | Service Bulletin                          |
| VHF    | Very High Frequency                       |
| VMC    | Visual Meteorological Conditions          |

|     |                             |
|-----|-----------------------------|
| VOR | VHF Omni directional Range  |
| WOW | Weight on Wheels            |
| UTC | Universal Time Co-ordinated |

**Aircraft and Accident details of ATR 72 Aircraft VT- IYX  
on 14<sup>th</sup> June 2021**

|     |                               |   |            |
|-----|-------------------------------|---|------------|
| 1.  | Aircraft                      | Type  | ATR 72-600 |
|     |                               | Nationality   | Indian     |
|     |                               | Registration  | VT-IYX     |
| 2.  | Owner & Operator              | Limerick Aircraft Leasing Ltd<br>InterGlobe Aviation Limited (Indigo) |            |
| 3.  | Pilot                         | ATPL  |            |
| 4.  | Co-pilot                      | CPL   |            |
| 5.  | No. of Persons on board       | 07 Pax+04 Crew  |            |
| 6.  | Date & Time of Accident       | 14 Jun 2021 & 1430 UTC  |            |
| 7.  | Place of Accident             | Hubli Airport, Karnataka, India                                       |            |
| 8.  | Co-ordinates of Accident Site | Lat: 15° 21' 43" N  |            |
|     |                               | Long: 75° 05' 04" E   |            |
| 9.  | Last point of Departure       | Kannur Airport (VOKN), Kerala, India                                  |            |
| 10. | Intended landing place        | Hubli Airport (VOHB), Karnataka, India                                |            |
| 11. | Type of Operation             | Scheduled Operation   |            |
| 12. | Phase of operation            | Landing   |            |
| 13. | Type of Occurrence            | Abnormal Runway Contact (ARC)   |            |

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

## **SYNOPSIS**

On 14 June 2021, M/s InterGlobe Aviation Limited's ATR72-600 aircraft, VT IYX, while operating a scheduled flight from Kannur to Hubli, met with an accident during landing at Hubli airport.

On the day of accident, for Kannur-Hubli sector, the aircraft was under the command of an ATPL holder, who was pilot flying (PF). He was assisted by a CPL holder Co-Pilot, who was Pilot Monitoring (PM). There were 07 passengers along with 02 cabin crew.

During first approach, aircraft obtained the necessary landing clearance for runway 26 from ATC Hubli, till that time the flight was uneventful. While landing on the runway 26, aircraft touched down on the runway and bounced consecutively four times. All four touchdowns were hard, the first was a three pointer landing and on the subsequent three landings, the NLG touched the runway first. The VRTG (vertical G) value was high each time. After the fourth touchdown crew initiated a "Go-Around". During Go-Around landing gear unsafe procedure was displayed on the EWD for 20 seconds. However, this went unnoticed by the crew. Subsequently, when the landing gears were selected to move from down to up position the landing gear unsafe indication cleared automatically. Thereafter, the aircraft climbed as per instructions of ATC Hubli and entered a holding pattern.

During second approach on the same runway 26, when the landing gears were selected to move from up to down, landing gear unsafe procedure was displayed again, which was noticed by the crew. As there were three green indications on primary and one red indication for nose landing gear on secondary indication (overhead panel), crew disregarded the unsafe indication as per QRH procedure. Checklists were carried out and the landing phase was initiated. During second approach, aircraft again touched down on runway 26 and bounced consecutively three times, before coming to rest on the runway after the fourth touchdown. Crew switched off the engines on the runway and requested for assistance from the ATC.

Director General, Aircraft Accident Investigation Bureau vide order No. 12011/2/2021 – AAIB dated 16 Jun 2021 classified this occurrence as a Serious Incident. Later vide corrigendum dated 26.08.2021, based on the severity of damages to the aircraft, the occurrence classification was changed to Accident. Director General, Aircraft Accident Investigation Bureau vide above motioned order and subsequent corrigendum dated 11.01.2022, appointed Shri Amit Kumar, Safety Investigation Officer, AAIB as Investigator-In-Charge (IIC) and Shri Ravi Ramakrishnan Senior Consultant, AAIB as investigator to investigate this accident to determine the probable cause(s) under Rule 11 (1) of Aircraft (Investigation of Accidents and Incidents), Rules 2017.

Unless otherwise indicated, recommendations in this report are addressed to the regulatory authorities of the State having the responsibility for the matters with which the recommendation is concerned. It is for those authorities to decide what action is taken.

## 1. Factual Information

### 1.1 History of the flight

On 14 Jun 2021, M/s Indigo's ATR 72-600 aircraft, (flight no. 6E7979 and Reg. VT- IYX) was scheduled to operate four consecutive sectors, namely Bengaluru- Hubli, Hubli-Kannur, Kannur-Hubli and Hubli-Bengaluru with the same set of flight crew. Prior to this two more sectors were operated with a different set of crew and were uneventful.

Crew reported for Bengaluru- Hubli sector at around 0900 UTC at Bengaluru and signed the BA declaration prior to operating this sector. First two sectors were uneventful. For first sector PIC was pilot flying and Co-pilot was pilot monitoring. During second sector Co-pilot was pilot flying from 1000ft after take-off till joining on the ILS procedure for Kannur. However, take-off and landing for all sectors were carried out by the PIC.

Kannur to Hubli was the third planned sector for the flight crew. Aircraft was scheduled to depart from Kannur at 1330 UTC and was scheduled to arrive Hubli at 1440 UTC. For this sector PIC was pilot flying and Co-pilot was pilot monitoring. There were 07 passengers onboard and 02 cabin crew. Crew obtained weather *enroute* to Hubli prior to departure from Kannur. Aircraft took-off from Kannur at 1315 UTC. Aircraft was released from Kannur ATC and came in contact with Mangalore ATC. Subsequently, Mangalore ATC released the aircraft and at 14:16 UTC aircraft came in contact with ATC Hubli, while descending from FL124 to FL 80.ATC Hubli gave further descent and cleared the aircraft for VOR DME approach to runway 26. At 14:27:52 UTC, when the aircraft was established on final approach track for runway 26, crew reported aircraft's position to ATC Hubli. ATC Hubli acknowledged the same and cleared the aircraft to land on runway 26. Subsequently ATC Hubli, passed the METAR to the aircraft as wind 250 degree 07 knots and also apprised the crew of the runway conditions "raining over the field, runway surface wet".

On short finals, at 14:31:02 UTC, crew felt that runway lights were too bright, PF requested ATC Hubli to decrease the intensity of runway lights. ATC Hubli decreased the same. However, crew did not find the same satisfactory and requested ATC Hubli to increase the intensity of runway lights. ATC increased the intensity as requested.

On landing on runway 26, aircraft touched down and bounced consecutively four times. After second bounce, PM gave a call for "Go-Around". By then the aircraft had touched down and bounced thrice. PM again gave a call for "Go-Around". However, the PF responded "Hold Hold" to the "Go-Around" calls given by the PM. All four touchdowns were hard; the first one was a three pointer landing. The NLG touched the runway first during the subsequent three touchdowns. The VRTG (Vertical G) was high each time. The crew initiated a "Go-Around", only after the fourth touchdown. During "Go-Around", landing gear unsafe procedure displayed for 20 seconds. However, the indication went un-noticed by the crew. When the landing gears were selected up, the landing gear unsafe indication cleared automatically. Aircraft climbed as per ATC instruction and entered a holding pattern and carried out two right orbits. During hold crew discussed diversion to Bengaluru and also enquired the weather from ATC Hubli. ATC Hubli reported raining over the field and runway wet.



Later at 14:53:33 UTC, crew again enquired about raining condition, ATC Hubli, responded “light drizzling Sir”. Thereafter crew requested for approach and ATC cleared the aircraft for approach to runway 26. Meanwhile, another aircraft (B200) landed safely on runway 26. The METAR provided by ATC Hubli, to this aircraft was wind 230 degree 07 knots. However, post landing the aircraft reported strong winds 15 to 20 knots from left.

During second approach on the same runway 26, when the landing gears were selected down, landing gear unsafe procedure was displayed again, which the crew noticed this time. As there were three green indications on primary indication panel and one red indication for nose landing gear on secondary indication (overhead panel), crew referred to the QRH procedure and disregarded the unsafe indication. Checklists were carried out and the landing phase initiated. When the aircraft established on approach track to runway 26, ATC Hubli, passed the METAR “Wind 230 degree 07 knots”. Later while giving the landing clearance, ATC Hubli, reported Wind 230 degree 10 knots.

On landing, aircraft again touched down and bounced consecutively thrice, before coming to rest on the runway after the fourth touchdown. Landing was again hard and VRTG value was high twice during the first two touchdowns. After first bounce, PM gave a call for “Go-Around”. However, PF responded “No”. Subsequently, aircraft settled down.

When the nose wheel touched down the runway, crew observed a grinding noise and vibration. Therefore, the crew stopped the aircraft on the runway, informed ATC Hubli of a suspected nose wheel tyre burst and switched off engines on the runway itself. Further, crew requested ATC Hubli for CFT and ground support. ATC acknowledged the same. Later crew cancelled the CFT request.

The passengers disembarked normally on the runway 26, after the arrival of the passenger coach. There was no fire pre or post accident and nil injury reported. The services of the CFT were not used. During this accident the aircraft sustained substantial damages.

### 1.2 Injuries to persons

| Injuries    | Crew | Passengers | Others |
|-------------|------|------------|--------|
| Fatal       | NIL  | NIL        | NIL    |
| Serious     | NIL  | NIL        | NIL    |
| Minor/ None | 04   | 07         | NIL    |

### 1.3 Damage to Aircraft

The Aircraft sustained substantial damage during the accident. Maximum damage was confined to the aircraft’s forward section skin and frames. NLG and RH MLG had also suffered severe damages.

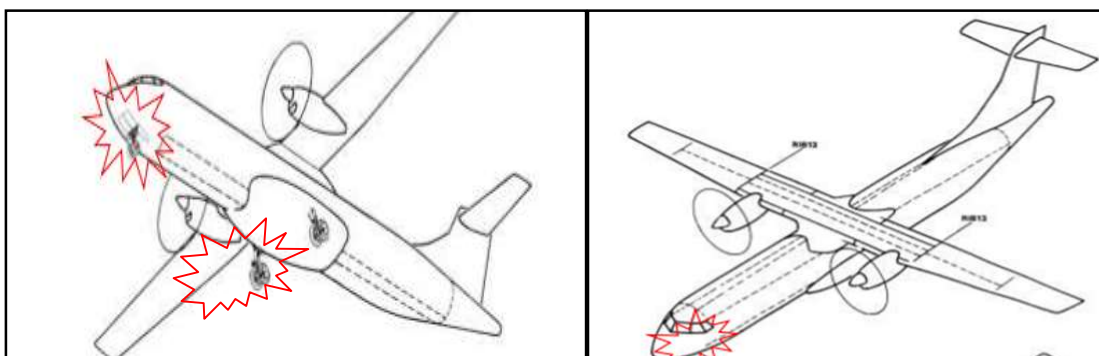


Figure 1: Damage to the aircraft

Further details of the damage are given in the section 1.12.

#### 1.4 Other damage

Nil

#### 1.5 Personnel Information

##### 1.5.1 Pilot – In – Command

|  |   |
|--|---|
| <b>Nationality</b>                                       | Indian  |
| <b>Age</b>   | 57 years  |
| <b>Date of Joining Organization</b>                      | 05/12/2019  |
| <b>Type of license</b>                                   | ATPL  |
| <b>Date of Initial Issue of license</b>                  | 19/11/2016  |
| <b>Valid upto</b>  | 18/11/2021  |
| <b>Date of last Medical Exam</b>                         | 01/07/2020  |
| <b>Class I Medical Exam validity</b>                     | 09/07/2021  |
| <b>Date of Issue FRTOL license</b>                       | 27/05/2024  |
| <b>FRTOL license valid upto</b>                          | 26/05/2019  |
| <b>Date of Endorsement as PIC</b>                        | 25/02/2021  |
| <b>Total flying experience</b>                           | 5999:50hrs  |
| <b>Experience on Type</b>                                | 252:08 hrs  |
| <b>Last flown on Type</b>                                | 14-06-2021  |
| <b>Total flying experience during last 1 year</b>        | 208:02 hrs  |
| <b>Total flying experience in during last six months</b> | 208:02 hrs  |
| <b>Total flying experience in last 30 days</b>           | 43:54 hrs   |
| <b>Total flying experience in last 7 days</b>            | 20:21hrs  |
| <b>Total flying experience in last 24 hrs</b>            | 02:56 hrs   |
| <b>Rest before duty</b>                                  | 16:54 hrs   |
| <b>Whether involved in any Accident/Incident</b>         | Nil   |
| <b>Date of last flight checks and Ground Classes</b>     | Ground refresher: 31/08/2020<br>Annual line check: 04/03/2021 |

The PIC is an ex-Indian Air force pilot. PIC joined the Indian Air Force on 13 Jun 1987. While serving in Indian Air Force PIC was trained and flown fighter aircrafts. PIC joined an Indian schedule airline on 07 Jul 2015, where he discharged duty both as a Co-Pilot and as a Captain on Q400 till 24 Nov 2019. PIC joined M/s InterGlobe Aviation Ltd on 05 Dec 2019. As per training requirement stipulated in DGCA prevailing CAR Section 8 Series F part II and Organization's approved Operation Manual Part D, issue IV, Rev 04, Chapter 01, PIC was trained on ATR-72-600 aircraft and was released as PIC on 04 Mar 2021.

The PIC had undergone the following courses as mentioned in Para 1.2.2, Flight Crew Training Program of Organization's Operation Manual Part D:

- (a) Standard Transition course from 27 July 2020 to 31 Aug 2020, conducted by M/s Indigo.

- (b) ATR-72 Type training course, conducted by M/s Indigo.
- (c) Low visibility take off and adverse weather operation training on simulator.
- (d) Induction Training on ATR 72-600 from 05 Oct 2020 to 10 Oct 2020.
- (e) ZFTT Simulator training (06 Landing/TOGA) on Simulator on 04 Oct 2020 & 30 Nov 2020, under a DGCA approved TRI
- (f) SLF Training with 102:15 cumulative hours was completed on 25 Jan 2021.
- (g) 10Route checks were completed on 04 Mar 2021.

However, on 21 Sep 2020, while carrying out type training on ATR 72-600, the Instructor had advised the PIC to *“Respect stabilization criteria on finals, initiate a Go-Around if required”*. PIC was also advised to *“Review let down procedures and makes maximum use of automation and facilities available onboard”*.

As per CAR Section 5, Series F, Part II, Flight Data Analysis Program is required to be implemented by the organizations for proactive identification of hazards in aircraft operation before they may result in an accident, serious incident and incident. As per M/s Indigo’s Flight Safety Manual, Para 6.2.2, *“After analysis and validation of exceedance, the exceedance will be graded as per severity levels”*. Accordingly, Appendix 20A (List of exceedance), categorizes high acceleration at touch down into three categories as follows:

| <b>Exceedance Description</b>   | <b>Yellow</b> | <b>Amber</b> | <b>Red</b>  |
|---------------------------------|---------------|--------------|-------------|
| High acceleration at touch down | <b>1.4G</b>   | <b>1.6G</b>  | <b>1.8G</b> |

- Yellow exceedences are exceedences of low severity. They are statistically important because those can indicate the airline trend for a given exceedance.
- Amber exceedences are exceedences of medium severity, which may require a written explanation from the flight crew. If there is no voluntary report raised, a confidential safety communication may be forwarded to the involved crew as an email along with a brief FDR description.
- Red exceedences are exceedences of high severity, which may require specific validation and analysis. If there is no voluntary report raised, a confidential safety communication may be forwarded to the involved crew as an email along with a brief FDR description. In order to help accurate analysis the crew may also be required to visit the flight safety cell.

As per exceedance records, between 04 March 2021 and 14 Jun 2021, the PIC had landed 17 times above 1.4G and twice above 1.6G. Actions were taken as required by the Organization’s approved manual.

**1.5.2 Co-Pilot**

|   |            |
|---|------------|
| <b>Nationality</b>                      | Indian     |
| <b>Age</b>                              | 31 years   |
| <b>Date of Joining Organization</b>     | 09/05/2019 |
| <b>Type of license</b>                  | CPL        |
| <b>Date of Initial Issue of License</b> | 11/04/2019 |

|  |   |
|--|---|
| <b>License Valid upto</b>                                | 10/04/2024  |
| <b>Date of Class I Medical Exam</b>                      | 08/07/2020  |
| <b>Class I Medical Exam validity</b>                     | 11/07/2021  |
| <b>Date of Issue FRTOL license</b>                       | 29/11/2018  |
| <b>FRTOL license valid upto</b>                          | 28/11/2023  |
| <b>Total flying experience</b>                           | 980:02 hrs  |
| <b>Experience on Type</b>                                | 740:51 hrs  |
| <b>Last flown on Type</b>                                | 14-06-2021  |
| <b>Total flying experience during last 1 year</b>        | 120:31 Hrs  |
| <b>Total flying experience in during last six months</b> | 120:31 hrs  |
| <b>Total flying experience in last 30 days</b>           | 03:53 hrs   |
| <b>Total flying experience in last 7 days</b>            | 02:32hrs  |
| <b>Total flying experience in last 24 hrs</b>            | 02:21 hrs   |
| <b>Rest before duty</b>                                  | 16: 45 hrs  |
| <b>Whether involved in any Accident/Incident</b>         | Nil   |
| <b>Date of last flight checks and Ground Classes</b>     | Ground refresher: 25/05/2021<br>Annual line check: 25/09/2020 |

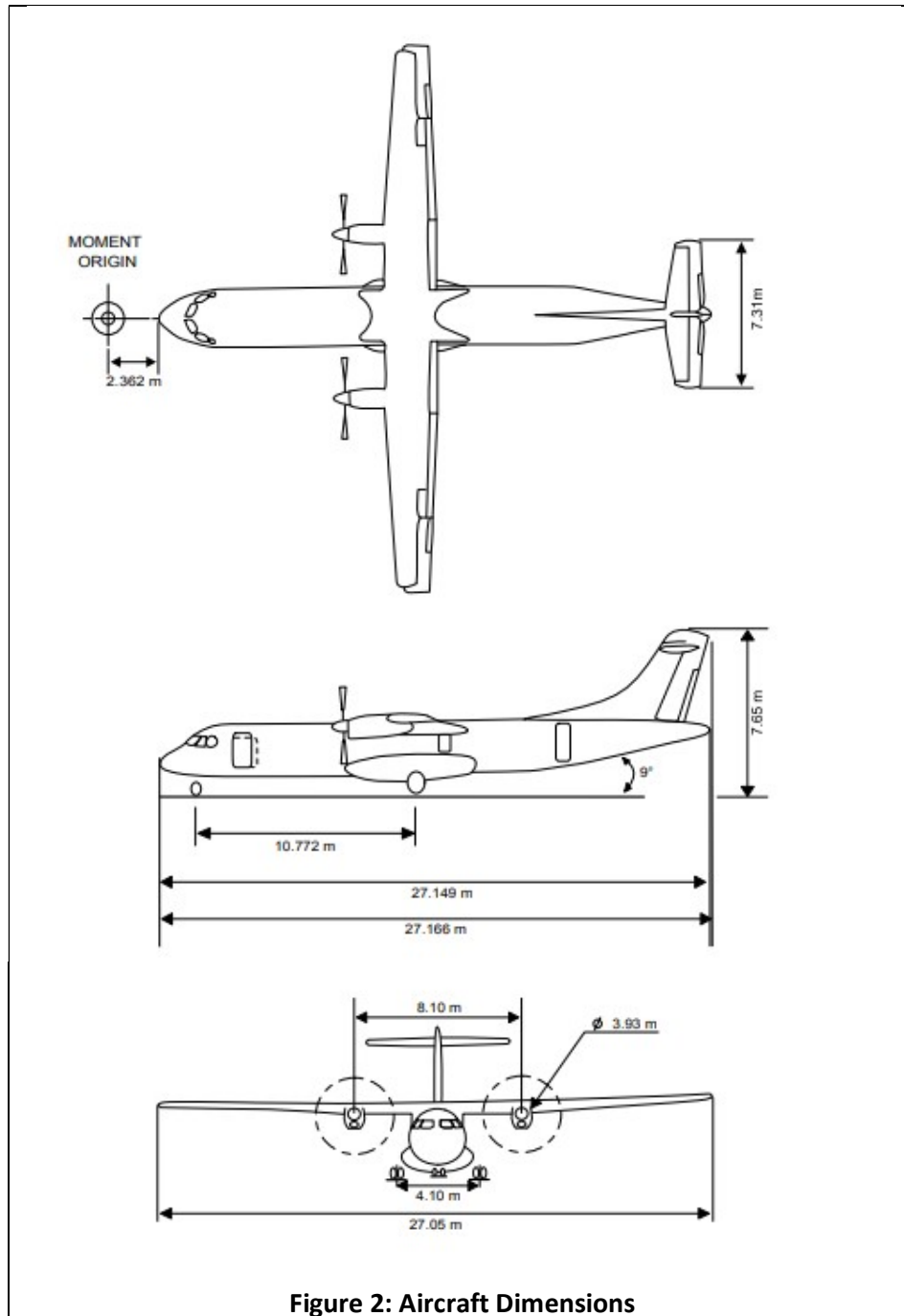
The Co-Pilot had undergone the following courses and completed them:

- (a) Type Training on ATR 72-600.
- (b) Induction Training on ATR 72-600 from 13 May 2019 to 21 Jun 2019.
- (c) Low visibility take off and adverse weather operation training on the simulator.
- (d) 06 Landing/TOGA on a Simulator on 20 Sep 2019, under a DGCA approved TRI.

## **1.6 Aircraft Information**

### **1.6.1 Aircraft General Description**

The ATR 72-212A (600) is a short haul regional airliner developed and produced in France and Italy. The aircraft is a turbo prop aircraft designed to carry 64-78 passengers. The aircraft is designed and manufactured by ATR (joint venture between AIRBUS-France and LEONARD-Italy). The aircraft is equipped with a glass cockpit with a maximum takeoff weight of 23000 kg and a maximum cruise speed of 280 knots TAS, with a range of 1528 km and a ceiling height of 25000 ft. Three dimensional views of ATR-72 aircraft are depicted below:



### 1.6.2 Landing Gear position and warnings

The landing gear position detection and indication system consist of two independent systems. Primary system is managed by MFC module 1A. The associated gear position is displayed on the main instrument panel. Secondary system is managed by MFC module 2A. The associated gear position is displayed on the overhead panel. Each system uses its own detectors and indications: down lock and air/ground signals from proximity sensors, up lock signal from mechanical micro switches. Each system commands gear extension and retraction, gear anti-retraction system and the warning associated to "LDG GEAR NOT DOWN" with the associated procedures on EWD.

**Note:** Gear must be considered down when one system indicates three green lights. Each system has its own WOW circuit: WOW1 into MFC module 1B and WOW2 into MFC module 2B. The WOW signals are used by the MFC to have the system using WOW information switched to the appropriate air/ground configuration.

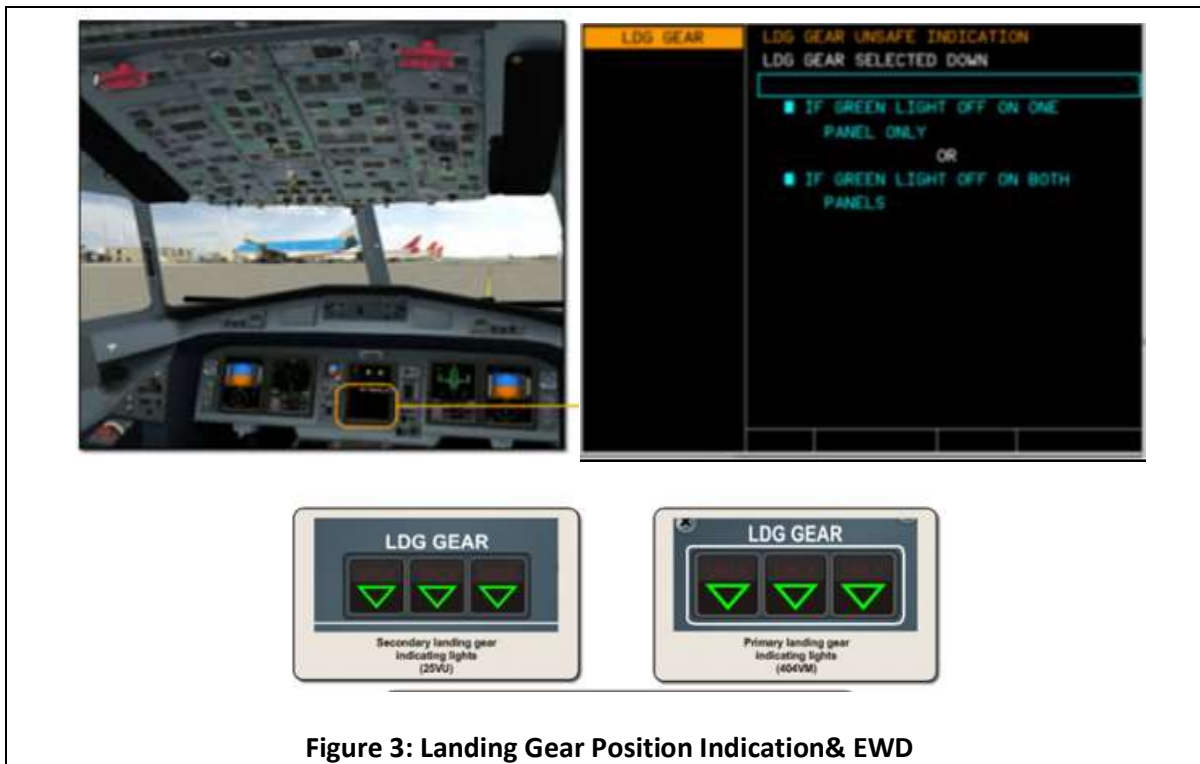


Figure 3: Landing Gear Position Indication & EWD

| <p>6E / 75<br/>FCOM</p>  | <p>PROCEDURES</p> <p>NON NORMAL OPERATIONS<br/>ABNORMAL PROCEDURES</p>  | <p>PRO.NNO</p> <p>Page n°156</p>                | <table border="1"> <thead> <tr> <th colspan="2">LDG GEAR UNSAFE INDICATION</th> <th>A32.05</th> </tr> </thead> <tbody> <tr> <td colspan="3"> <ul style="list-style-type: none"> <li>■ If LDG GEAR selected DOWN                             <ul style="list-style-type: none"> <li>■ If GREEN light OFF on one panel only                                     <ul style="list-style-type: none"> <li>▶ UNSAFE INDICATION..... DISREGARD<br/><i>If on one panel all green lights come on, the unsafe indication is false.</i></li> </ul> </li> <li>■ If GREEN light OFF on both panels                                     <ul style="list-style-type: none"> <li>▶ LDG GEAR GRAVITY EXTENSION procedure ( A32.03 ) ..... APPLY</li> </ul> </li> </ul> </li> <li>■ If LDG GEAR selected UP                             <ul style="list-style-type: none"> <li>■ If RED light ON on one panel only                                     <ul style="list-style-type: none"> <li>▶ UNSAFE INDICATION..... DISREGARD<br/><i>If on one panel, light comes on but indications are normal on the other panel, the unsafe indication is false.</i></li> </ul> </li> <li>■ If RED or GREEN light ON on both panels                                     <ul style="list-style-type: none"> <li>▶ ICING CONDITIONS : LEAVE AND AVOID</li> <li>▶ IAS MAX : 160 kt</li> <li>▶ LDG GEAR lever ..... DOWN<br/><i>Flight with landing gear extended has effect on fuel consumption and climb gradient. LDG GEAR lever selection in DOWN position may be delayed to optimize performance.</i></li> <li>▶ TCAS ..... TA ONLY</li> </ul> </li> </ul> </li> </ul> </td> </tr> <tr> <td colspan="3"> <p><b>Additional Information</b></p> <p>1) <b>Landing gear selected DOWN</b></p> <ul style="list-style-type: none"> <li>- For alert: "RA &lt; 500 ft" condition is inhibited in case of radio altimeter failure</li> <li>- For alert: the condition "One PL at Fl and RA &lt; 500 ft" is inhibited during 150 s after the retraction of at least one landing gear leg, to cover the case of the one engine go-around</li> <li>- If overhead panel (detection system 2) gives false indication, use of emergency audio cancel will be requested to cancel aural warning CRC as soon as FLAPS 30 will be selected</li> <li>- If one gear remains unlocked, perform turns to increase load factor and perform alternating sideslips in an attempt to lock the gear</li> </ul> </td> </tr> </tbody> </table> | LDG GEAR UNSAFE INDICATION |       | A32.05  | <ul style="list-style-type: none"> <li>■ If LDG GEAR selected DOWN                             <ul style="list-style-type: none"> <li>■ If GREEN light OFF on one panel only                                     <ul style="list-style-type: none"> <li>▶ UNSAFE INDICATION..... DISREGARD<br/><i>If on one panel all green lights come on, the unsafe indication is false.</i></li> </ul> </li> <li>■ If GREEN light OFF on both panels                                     <ul style="list-style-type: none"> <li>▶ LDG GEAR GRAVITY EXTENSION procedure ( A32.03 ) ..... APPLY</li> </ul> </li> </ul> </li> <li>■ If LDG GEAR selected UP                             <ul style="list-style-type: none"> <li>■ If RED light ON on one panel only                                     <ul style="list-style-type: none"> <li>▶ UNSAFE INDICATION..... DISREGARD<br/><i>If on one panel, light comes on but indications are normal on the other panel, the unsafe indication is false.</i></li> </ul> </li> <li>■ If RED or GREEN light ON on both panels                                     <ul style="list-style-type: none"> <li>▶ ICING CONDITIONS : LEAVE AND AVOID</li> <li>▶ IAS MAX : 160 kt</li> <li>▶ LDG GEAR lever ..... DOWN<br/><i>Flight with landing gear extended has effect on fuel consumption and climb gradient. LDG GEAR lever selection in DOWN position may be delayed to optimize performance.</i></li> <li>▶ TCAS ..... TA ONLY</li> </ul> </li> </ul> </li> </ul> |   |  | <p><b>Additional Information</b></p> <p>1) <b>Landing gear selected DOWN</b></p> <ul style="list-style-type: none"> <li>- For alert: "RA &lt; 500 ft" condition is inhibited in case of radio altimeter failure</li> <li>- For alert: the condition "One PL at Fl and RA &lt; 500 ft" is inhibited during 150 s after the retraction of at least one landing gear leg, to cover the case of the one engine go-around</li> <li>- If overhead panel (detection system 2) gives false indication, use of emergency audio cancel will be requested to cancel aural warning CRC as soon as FLAPS 30 will be selected</li> <li>- If one gear remains unlocked, perform turns to increase load factor and perform alternating sideslips in an attempt to lock the gear</li> </ul> |  |  |
|--|---|---|--|----------------------------|-------|---|--|---|--|--|--|--|
| LDG GEAR UNSAFE INDICATION   |   | A32.05  |  |                            |       |   |  |   |  |  |  |  |
| <ul style="list-style-type: none"> <li>■ If LDG GEAR selected DOWN                             <ul style="list-style-type: none"> <li>■ If GREEN light OFF on one panel only                                     <ul style="list-style-type: none"> <li>▶ UNSAFE INDICATION..... DISREGARD<br/><i>If on one panel all green lights come on, the unsafe indication is false.</i></li> </ul> </li> <li>■ If GREEN light OFF on both panels                                     <ul style="list-style-type: none"> <li>▶ LDG GEAR GRAVITY EXTENSION procedure ( A32.03 ) ..... APPLY</li> </ul> </li> </ul> </li> <li>■ If LDG GEAR selected UP                             <ul style="list-style-type: none"> <li>■ If RED light ON on one panel only                                     <ul style="list-style-type: none"> <li>▶ UNSAFE INDICATION..... DISREGARD<br/><i>If on one panel, light comes on but indications are normal on the other panel, the unsafe indication is false.</i></li> </ul> </li> <li>■ If RED or GREEN light ON on both panels                                     <ul style="list-style-type: none"> <li>▶ ICING CONDITIONS : LEAVE AND AVOID</li> <li>▶ IAS MAX : 160 kt</li> <li>▶ LDG GEAR lever ..... DOWN<br/><i>Flight with landing gear extended has effect on fuel consumption and climb gradient. LDG GEAR lever selection in DOWN position may be delayed to optimize performance.</i></li> <li>▶ TCAS ..... TA ONLY</li> </ul> </li> </ul> </li> </ul> |   |   |  |                            |       |   |  |   |  |  |  |  |
| <p><b>Additional Information</b></p> <p>1) <b>Landing gear selected DOWN</b></p> <ul style="list-style-type: none"> <li>- For alert: "RA &lt; 500 ft" condition is inhibited in case of radio altimeter failure</li> <li>- For alert: the condition "One PL at Fl and RA &lt; 500 ft" is inhibited during 150 s after the retraction of at least one landing gear leg, to cover the case of the one engine go-around</li> <li>- If overhead panel (detection system 2) gives false indication, use of emergency audio cancel will be requested to cancel aural warning CRC as soon as FLAPS 30 will be selected</li> <li>- If one gear remains unlocked, perform turns to increase load factor and perform alternating sideslips in an attempt to lock the gear</li> </ul>   |   |   |  |                            |       |   |  |   |  |  |  |  |
| <p><b>5 LDG GEAR UNSAFE INDICATION</b></p> <p><b>LDG GEAR UNSAFE INDICATION-Alert 1</b></p> <table border="1"> <thead> <tr> <th>CONDITION</th> <th>VISUAL</th> <th>AURAL</th> </tr> </thead> <tbody> <tr> <td>Any gear not seen down locked, and FLAPS 30, and ZRA &lt; 500 ft</td> <td>- MW light flashing red<br/>- <b>LDG GEAR NOT DN</b> red message on EWD<br/>- Red light on landing gear lever<br/>- Any green ▽ light turn OFF on either panel</td> <td>CRC which can not be silenced by pressing MW pb</td> </tr> </tbody> </table>   |   |   | CONDITION  | VISUAL                     | AURAL | Any gear not seen down locked, and FLAPS 30, and ZRA < 500 ft             | - MW light flashing red<br>- <b>LDG GEAR NOT DN</b> red message on EWD<br>- Red light on landing gear lever<br>- Any green ▽ light turn OFF on either panel  | CRC which can not be silenced by pressing MW pb |  |  |  |  |
| CONDITION  | VISUAL  | AURAL   |  |                            |       |   |  |   |  |  |  |  |
| Any gear not seen down locked, and FLAPS 30, and ZRA < 500 ft  | - MW light flashing red<br>- <b>LDG GEAR NOT DN</b> red message on EWD<br>- Red light on landing gear lever<br>- Any green ▽ light turn OFF on either panel | CRC which can not be silenced by pressing MW pb |  |                            |       |   |  |   |  |  |  |  |
| <p><b>LDG GEAR UNSAFE INDICATION-Alert 2</b></p> <table border="1"> <thead> <tr> <th>CONDITION</th> <th>VISUAL</th> <th>AURAL</th> </tr> </thead> <tbody> <tr> <td>Any gear not seen down locked, and at least one PL at Fl, and RA &lt; 500 ft</td> <td>- MW light flashing red<br/>- <b>LDG GEAR NOT DN</b> red message on EWD<br/>- Red light on landing gear lever<br/>- Any green ▽ light turn OFF on either panel</td> <td>CRC which can be silenced by pressing MW pb</td> </tr> </tbody> </table>  |   |   | CONDITION  | VISUAL                     | AURAL | Any gear not seen down locked, and at least one PL at Fl, and RA < 500 ft | - MW light flashing red<br>- <b>LDG GEAR NOT DN</b> red message on EWD<br>- Red light on landing gear lever<br>- Any green ▽ light turn OFF on either panel  | CRC which can be silenced by pressing MW pb     |  |  |  |  |
| CONDITION  | VISUAL  | AURAL   |  |                            |       |   |  |   |  |  |  |  |
| Any gear not seen down locked, and at least one PL at Fl, and RA < 500 ft  | - MW light flashing red<br>- <b>LDG GEAR NOT DN</b> red message on EWD<br>- Red light on landing gear lever<br>- Any green ▽ light turn OFF on either panel | CRC which can be silenced by pressing MW pb     |  |                            |       |   |  |   |  |  |  |  |
| <p><b>LDG GEAR UNSAFE INDICATION-Alert 3</b></p> <table border="1"> <thead> <tr> <th>CONDITION</th> <th>VISUAL</th> <th>AURAL</th> </tr> </thead> <tbody> <tr> <td>Any gear not seen down locked 30 s after landing gear was selected DOWN</td> <td>- MC light flashing amber<br/>- <b>LDG GEAR</b> amber message on EWD<br/>- Any green ▽ light turn OFF on either panel</td> <td>SC</td> </tr> </tbody> </table>   |   |   | CONDITION  | VISUAL                     | AURAL | Any gear not seen down locked 30 s after landing gear was selected DOWN   | - MC light flashing amber<br>- <b>LDG GEAR</b> amber message on EWD<br>- Any green ▽ light turn OFF on either panel  | SC  |  |  |  |  |
| CONDITION  | VISUAL  | AURAL   |  |                            |       |   |  |   |  |  |  |  |
| Any gear not seen down locked 30 s after landing gear was selected DOWN  | - MC light flashing amber<br>- <b>LDG GEAR</b> amber message on EWD<br>- Any green ▽ light turn OFF on either panel   | SC  |  |                            |       |   |  |   |  |  |  |  |

Figure 3A: Landing gear Unsafe Indication NNO FCOM extract

### 1.6.3 Aircraft VT-IYX Specific Information

|  |                               |
|--|-------------------------------|
| <b>Aircraft Model</b>  | ATR 72-212A (600)             |
| <b>Aircraft S/N</b>  | 1552                          |
| <b>Year of Manufacturer</b>  | 2019                          |
| <b>Name of Owner</b>   | Limerick Aircraft Leasing Ltd |
| <b>C of R (Validity)</b>   | Valid                         |
| <b>C of A (Validity)</b>   | Valid                         |
| <b>C of A Category</b>   | Normal                        |
| <b>ARC issued on</b>   | 02/01/21                      |
| <b>ARC valid up to</b>   | 06/01/22                      |
| <b>Aircraft Empty Weight</b>   | 13055.227 kg                  |
| <b>Maximum Take-off weight</b>   | 23000 Kg                      |
| <b>Date of Aircraft weighment</b>  | 06/01/2021                    |
| <b>Max Usable Fuel</b>   | 5004.051Kg                    |
| <b>Max Payload with full fuel</b>  | 4527.578 Kg                   |
| <b>Empty Weight C.G</b>  | 15.805% MAC                   |
| <b>Next Weighing due</b>   | 26-Sep-2024                   |
| <b>Total Aircraft Hours</b>  | 2454:23 as on 14/06/2021      |
| <b>Last major inspection</b>   | 05.03.2021 (A3 check)         |
| <b>List of Repairs carried out after last major inspection till date of accident</b> | Nil                           |
| <b>Engine Type</b>   | PW 127M                       |
| <b>Date of Manufacture (LH)</b>  | 14/09/2018                    |
| <b>Engine(LH) Sl. No.</b>  | ED 1758                       |
| <b>Last major inspection (LH)</b>  | 05.03.2021 (A3 check)         |
| <b>List of Repairs carried out after last major inspection till date of accident</b> | Nil                           |
| <b>Total Engine Hours/Cycles (LH)</b>  | 2454:23 hrs /1976 Cycles      |
| <b>Date of Manufacture (RH)</b>  | 20/09/2018                    |
| <b>Engine (RH) Sl. No.</b>   | ED 1757                       |
| <b>Last major inspection (RH)</b>  | 05.03.2021 (A3 check)         |
| <b>List of Repairs carried out after last major inspection till date of accident</b> | Nil                           |
| <b>Total Engine Hours/Cycles RH</b>  | 2454:21 hrs /1976 Cycles      |
| <b>Aeromobile licence Valid till</b>   | 28/02/2025                    |
| <b>AD, SB, Modification complied</b>   | All complied                  |

### 1.7 Meteorological Information

METAR published by Hubli Airport between 1400 UTC to 1500 UTC was as follows:

| Time UTC | Wind Dir (°) | Wind Speed (kt) | Vis (m) | Temp (°C) | Dew Point (°C) | Weather | Clouds                      | QNH (hPa) |
|----------|--------------|-----------------|---------|-----------|----------------|---------|-----------------------------|-----------|
| 1400     | 250          | 07              | 4000    | 23        | 22             | FBL DZ  | SCT 800, SCT 1200, BKN 8000 | 1008      |
| 1430     | 230          | 07              | 3500    | 23        | 22             | FBL RA  | SCT 800, SCT 1200, BKN 8000 | 1008      |
| 1500     | 230          | 10              | 6000    | 23        | 22             | FBL RA  | SCT 800, SCT 1200, BKN 8000 | 1009      |

## 1.8 Aids to Navigation

All navigational aids available at Hubli airport were serviceable at the time of accident. The aircraft was equipped with standard navigational aids and there was no recorded defect with any of the navigational aids during the flight.

## 1.9 Communication

### 1.9.1 Communication between the aircraft and ATC Hubli

There was always two-way communication between the aircraft & ATC Hubli. The aircraft was in contact with ATC Hubli on 121.2 MHz frequency. Following are some relevant transcripts of ATC tape.

#### **1<sup>st</sup> Approach**

- At 14:27:52 UTC, Tower cleared the aircraft to land on runway 26 at winds 250/07
- At 14:28:01 UTC, ATC transmitted rains over the runway and runway surface wet.
- At 14:28:21 UTC, Aircraft reported a level of 4100 ft.
- At 14:30:45 UTC, ATC transmitted visibility of 3500 meters.
- At 14:31:19 UTC, aircraft requested for an increase in the intensity of runway lights after requesting a reduction of intensity at 14:31:02 UTC.
- At 14:33:28 UTC, aircraft transmitted to ATC that it is going around runway 26.

#### **2<sup>nd</sup> Approach**

- At 14:53:33 UTC, ATC transmitted light drizzle over the runway.
- At 14:53:47 UTC, aircraft transmitted a position of 2 miles inbound and requested if clear to proceed outbound.
- At 14:53:51 UTC, ATC approved the request and cleared aircraft for a VOR approach to runway 26 and to standby for further descend.
- At 14:54:47 UTC, ATC cleared IGO 7979 for a descent to 4500 ft and further descent as per procedure and at 14:54:57 UTC to report on establishing final approach track to runway 26.
- At 14:59:55 UTC, aircraft transmitted established runway approach track on runway 26.
- At 15:00:01 UTC, ATC cleared IGO 7979 to continue approach to runway 26 at winds 230/07
- At 15:00:15 UTC, aircraft transmitted a distance of 4.5 miles to touchdown.
- At 15:01:06 UTC, ATC cleared the aircraft to land on runway 26 at winds 230/10.



- At 15:03:24 UTC, the aircraft transmitted a suspected tyre burst and later at 15:04:00 UTC transmitted that it would be switching off on the runway suspecting a nose wheel collapse.
- At 15:04:11 UTC, aircraft transmitted a request for engineering and CFT.
- 15:05:32 UTC, ATC informed the aircraft of the arrival of CFT.
- At 15:06:52 UTC, aircraft transmitted for a requirement for towing and later at 15:10:17 UTC transmitted that CFT was not required and requested for some vehicles to illuminate the area and passenger coach to which at 15:10:36 UTC, ATC replied that the operational jeep was near the aircraft for any assistance.
- At 15:11:13 UTC, aircraft transmitted to the ATC to pass instructions for connecting the GPU and they were shutting OFF.

### 1.10 Aerodrome Information

Hubli Airport is situated in the State of Karnataka in India. It is operated and managed by Airport Authority of India (AAI). The IATA Location Identifier Code is HBX and ICAO Location Indicator Code is VOHB. Hubli Airport operates as domestic airport under IFR/VFR condition. The Airport Rescue and Fire Fighting Services is Category '4'. Precision Approach Path Indicator (PAPI) is available at both ends.

**Airport Co-ordinates:** Lat: 15°21'42.62" N, Long: 75°05'03.72" E and Elevation: 2172 feet

The orientation of the runway is 08/26. The detail of runway distances is as below;

| Runway | TORA<br>(M) | TODA<br>(M) | ASDA<br>(M) | LDA<br>(M) | WIDTH<br>(M) | RESA<br>(M) |
|--------|-------------|-------------|-------------|------------|--------------|-------------|
| 08     | 2600        | 2600        | 2600        | 2600       | 45           | 240X90      |
| 26     | 2600        | 2600        | 2600        | 2600       | 45           | 240X90      |

**Runway friction test report:** Runway Friction test at Hubli airport is being carried out annually. The last runway friction test prior to the accident was carried out on 07 Sep 2020, the overall friction level taken from the center line of runway was found satisfactory as per Airport Authority of India Aerodrome Manual Part 4 Aerodrome Operating Procedures.

### 1.11 Flight Recorders

Both Solid State Cockpit Voice Recorder (SSCVR) and Solid-State Flight Data Recorder (SSFDR) were downloaded and readout was carried out.

#### 1.11.1 CVR Transcripts

Following are the relevant CVR transcripts to the accident:

##### **1<sup>st</sup> Approach**

- At 14:28:01 UTC, ATC transmitted rains over the runway and runway surface wet.
- At 14:31:19 UTC (approx.), PF requested for a reduction of intensity of runway lights and subsequently requested for an increase in intensity.

- At 14:31:32 UTC (approx.), landing checklists were carried out as per procedure.
- At 14:32:13 UTC (approx.), PM called out that the landing was bumpy.
- At 14:32:14 UTC (approx.), PM called out for a “Go-Around”.
- At 14:32:15 UTC (approx.), PF called out HOLD, HOLD, HOLD.
- At 14:32:19 UTC (approx.), PM called out for a “Go around” and repeated his calls for a “Go around”.
- At 14:33:28 UTC (approx.), PF transmitted to ATC of executing a “Go-Around”.
- At 14:33:55 UTC (approx.), PM confirmed landing gear up.
- At 14:34:58 UTC (approx.), PM confirmed Engagement of Autopilot in IAS mode.

### **2<sup>nd</sup> Approach**

- At 14:54:47 UTC (approx.), ATC cleared IGO7979 to descend to 4500ft and further descend as per procedure.
- At 14:54:55 UTC (approx.), PF & PM commenced landing checklists.
- At 14:55:48 UTC (approx.), aural alert single chime. PM calls out Landing gear caution while continuing with check lists.
- At 14:55:57 UTC (approx.), PM commenced emergency check list procedure after confirming a landing gear caution.
- At 14:56:21 UTC (approx.), Emergency check list procedure completed and as per procedure continues with approach.
- At 14:56:22 UTC (approx.), Crew commenced the before landing checklist.
- At 14:59:55 UTC (approx.), IGO 7979 transmitted of having established on runway 26 and at 15:00 UTC (approx.), reported a distance of 4.5 NM from touchdown.
- At 15:01:06 UTC (approx.), IGO 7979 is cleared to land on runway 26 wind 10/230.
- At 15:02:21 UTC (approx.), PM called for a “Go-Around”.
- At 15:02:21 UTC (approx.), PF called “NO, HOLD” (Dragging noise).
- At 15:04:00 UTC (approx.), IGO 7979 transmitted to the ATC that they would be switching OFF on the runway as they suspect a nose wheel collapse.

### **1.11.2 Digital Flight Data Recorder**

DFDR was downloaded and analyzed, the sequence of events recorded in the DFDR relevant to the accident is given below:

#### **First Approach**

1. At 14:31:21 UTC, the aircraft was at approx.500ft RA, IAS 110 and target was 98kts. Rate of descent was 656ft/min and Pitch angle was-4°.

2. Between 14:31:48 UTC to 14:31:57 UTC, the aircraft was descending from approx. 150ft to 30ft RA. Elevators input kept on varying and deflection varied between  $-4^{\circ}$  and  $+7^{\circ}$ , IAS reached a maxima at 118kt around 52ft RA. Recalculated rate of descent was decreased from 900ft/min around 100ft RA and kept on reducing.
3. Between 14:32:00 UTC to 14:32:04 UTC, the aircraft was descending from approx. 30ft to 5ft RA. Elevators input keep on varying. Pitch angle was increased upto  $-0.3^{\circ}$  and then reduced to  $-2.3^{\circ}$ . IAS was approx 111k. Recalculated rate of descent was further decreased from 600ft/min to 100ft/min.
4. At 14:32:04 UTC, the aircraft was at approx 5ft RA. Rate of descent was increased from 100ft/min to 400ft/min. Pitch angle increased from  $-2.3^{\circ}$  to  $+0.3^{\circ}$ . Power levers were reduced to Flight Idle (FI).
5. First touchdown occurred approx. at 14:32:05 UTC: Aircraft made first touchdown with 111kt IAS and +1.9G VRTG. Pitch angle was  $-0.3^{\circ}$ . This was a three-pointer landing as all gears compressed during contact. A nose down order was applied during approx. 1.5 sec and then the aircraft bounced first time for approx 1.3sec.
6. Second touchdown occurred at 14:32:07UTC: Aircraft made a second touchdown after first bounce with +1.5G VRTG. Pitch angle was  $-2.0^{\circ}$ . This time aircraft NLG touched first. Elevators were again deflected in a nose down order. Then aircraft bounced again i.e., second time for approx 2.5sec.
7. Third touchdown occurred at 14:32:10 UTC: Aircraft made a third touchdown after second bounce with +1.8G VRTG. Pitch angle was  $-3.7^{\circ}$ . Aircraft's NLG touched the runway first again. Elevators were deflected in a nose down order. Then aircraft bounced again i.e., third time for approx 3.5 sec.
8. Fourth touchdown occurred at 14:32:14 UTC: Aircraft made fourth touchdown after third bounce with +3.3G VRTG and lateral acceleration +0.42G. Pitch angle was  $-5.9^{\circ}$ . Aircraft's NLG touched the runway first again like previous two instances. Elevators were again deflected in a nose down order. Aircraft touched down on NLG first. From first touchdown to the fourth touchdown PF applied nose down efforts and IAS continuously decreased from 111kt to 88kt.
9. "Go-Around" phase: After fourth touchdown, IAS continued to decrease till 80kt. Then aircraft started gaining altitude. Dual inputs were recorded for 4 second mainly in same direction. At 15ft RA, Flaps were at  $30^{\circ}$ . IAS was 89kt approx. Pitch angle started to decrease from  $+15.6^{\circ}$ . Angle of attack (AoA) max reached  $17.06^{\circ}$  right and  $14.9^{\circ}$  left with IAS 89kt. At 20ft RA, nose down input changes to nose up input. At 30ft RA, power levers were moved to the wall i.e., maximum and flaps were set at  $15^{\circ}$ . Landing gear unsafe indication came and remained for 20sec. At 400ft RA, when landing gear were retracted unsafe indication cleared automatically. Finally aircraft went around.
10. During second approach, when the landing gears were selected down, LDG Gear unsafe indication procedure was displayed a second time during final descent.

## ***Second Approach***

11. Aircraft made a second approach at approx 15:01 UTC. At this time aircraft IAS was between 102 and 113 kt (Vapp = 98kt).
12. Fifth touchdown occurred at 15:03:08 UTC. During second approach, aircraft made first touchdown with 98kt IAS and +1.9G VRTG. Pitch angle was +3.3°. Power lever were near the Fl. Both MLG were recorded compressed during contact and then the aircraft bounced.
13. Sixth touchdown occurred at 15:03:11 UTC. Aircraft made a second touchdown with +1.8G VRTG. Pitch angle was +0.3° and Power lever were at Fl. Both MLG were recorded compressed during contact then the aircraft again bounced.
14. Seventh touchdown occurred after 3 second, with -1.0° pitch angle and +1.2G VRTG. Then the aircraft again bounced.
15. Eighth touchdown occurred and landing gears were recorded compressed. At 15:04:08 UTC, finally the aircraft came to halt approx 1300m of the runway threshold.

### **1.12 Wreckage and Impact Information**

#### ***First approach and Go-Around***

During the first approach aircraft made a first touchdown approximately 500m from the threshold with 1.9G (VRTG) followed by a bounce. Subsequently, aircraft touched down and bounced thrice. Each time the VRTG was higher than 1.5G. Aircraft NLG and forward area suffered substantial damage. None of the part detached or disintegrated during first approach. After the fourth touched down, Crew initiated a “Go-Around”.

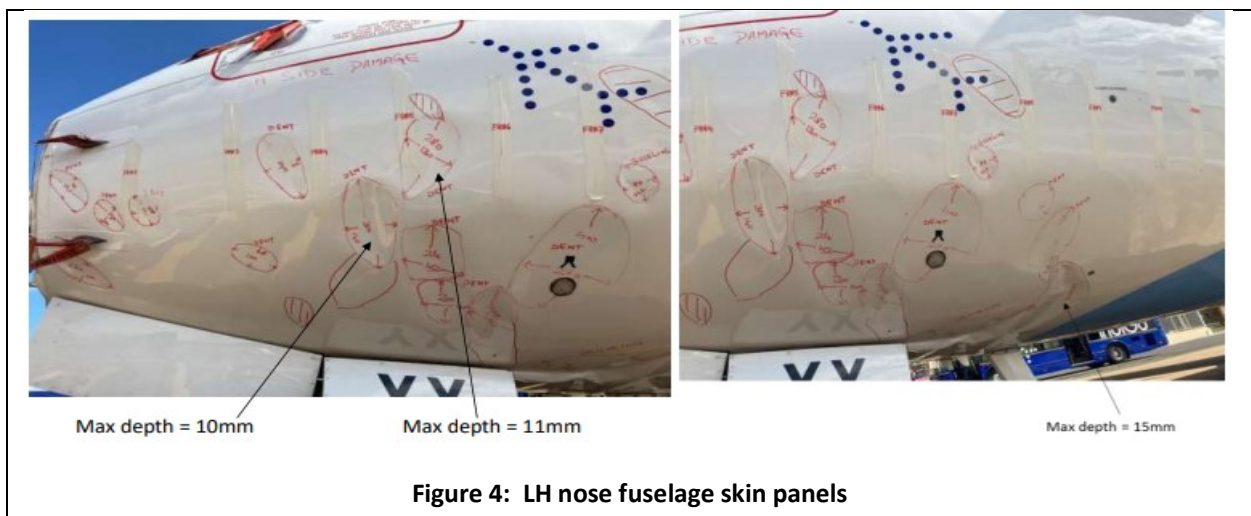
#### ***Second approach and landing***

During the second approach, the aircraft touched down and bounced consecutively four times before coming to a halt. Aircraft was stopped on the runway at 1300m from the runway 26 threshold. The NLG tyre burst and NLG wheel was severely damaged. Except the NLG tyre no other aircraft parts/components were found detached from the aircraft.

Post accident, the OEM assessed the following Major damages to the aircraft:

1. Skin Panel: The lower lobe panel junctions are located at stringer 11 and Frame 13. Lower lobe FWD and AFT panels were found damaged on both RH and LH sides. The damage found were dents and buckling of the skin panels. The damaged areas are located between FR1 and FR10. The maximum depths are 15mm on LH side and 20mm on the RH side. On lower area, aft of Fr7, the maximum measured deformation is 30mm (refer to below figures).
2. Cockpit: A gap was observed between the 11VU and pedestal showing evidence of movement that occurred in the cockpit.
3. Side panels of 8VU structures were found bent on both sides.
4. Side linings 211AZ and 212AZ were also found bent in their lower corners.
5. One LH cockpit floor panel 211EF was also found damaged at level of attachment holes.

6. Frames: Damages were found on frames between Frame 4 and Frame 9. The damage found were deformations, cracks, bent flange. The most damaged frames found were the frames 6 and 7. On below figures, location and type of damage are detailed for each frame.
7. On the RH side, Frame 5 lower flange was found deformed, following high skin deformation in this area.
8. Other internal structures: LH inner chord, LH stringer 20 and RH intercostal were also found bent.
9. LH stringer 20 was found severely damaged between Frame 7 and Frame 9.
10. NLG bay: NLG bay was found heavily deformed. The crucial damaged areas were located: - on RH side at level of NLG attachment (FR6) - on AFT bulkhead and corner between AFT (LH FR7) and LH bulkhead.
11. Antennas: VHF3 located on lower fuselage between FR9-10 was found slightly cracked in VHF3 tip radiuses. DME antennas located on lower fuselage between FR8-9 were found disbanded due to skin deformation in this area.
12. NLG Doors: LH AFT NLG door was found damaged at aft corner. After tap test inspection, the delaminated area was 58mm (x axis) by 54mm. The scratched area measures 20mm (x axis) by 5mm. RH FWD NLG door edge was found damaged. After tap test inspection, the delaminated area was confirmed 100mm long and 14 wide. RH AFT NLG door was found severely damaged (edge was found damaged, cracked rear fitting and inner skin got separated from honeycomb core).
13. NLG: NLG experienced ground loads above Certification Ultimate Loads.
14. LH and RH MLG were suspected to have experienced excessive loads. A specific analysis was performed by the OEM. The analysis demonstrated static margins of some parts of LH MLG were negative when static margins of RH MLG structural parts remained positive. Hence some parts of RH MLG were confirmed Unserviceable and scrapped and LH MLG was confirmed serviceable.



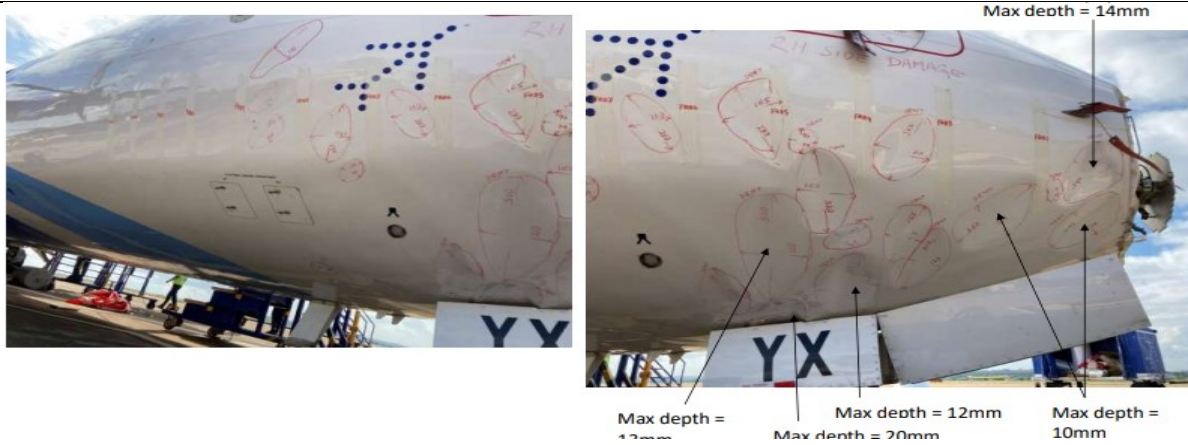


Figure 5: RH nose fuselage skin panels



Figure 6: Lower nose fuselage skin panel (AFT of Frame 7)



Figure 7: Lower nose fuselage skin panel (AFT of Fr 7)

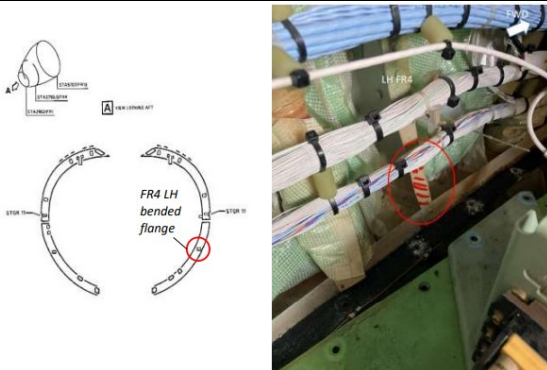


Figure 8: LH Frame 4

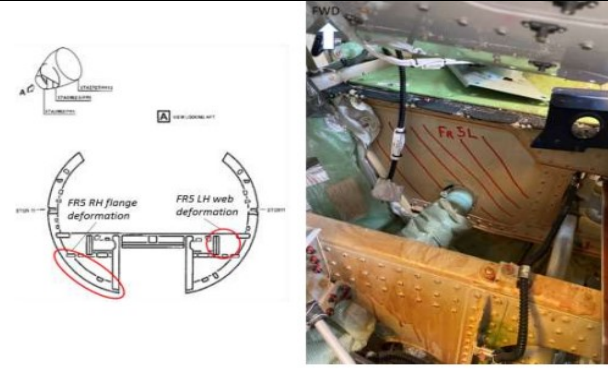


Figure 9: LH Frame 5

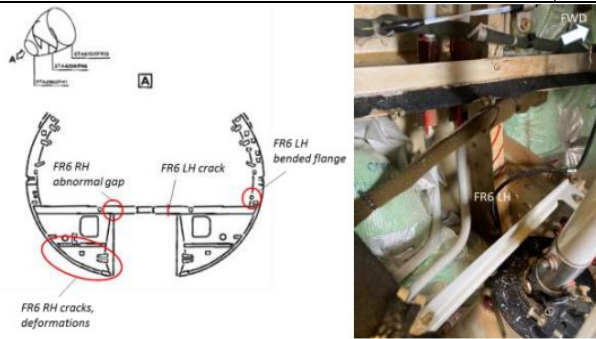


Figure 10: LH Frame 6



Figure 11: LH Floor beam at Frame 6



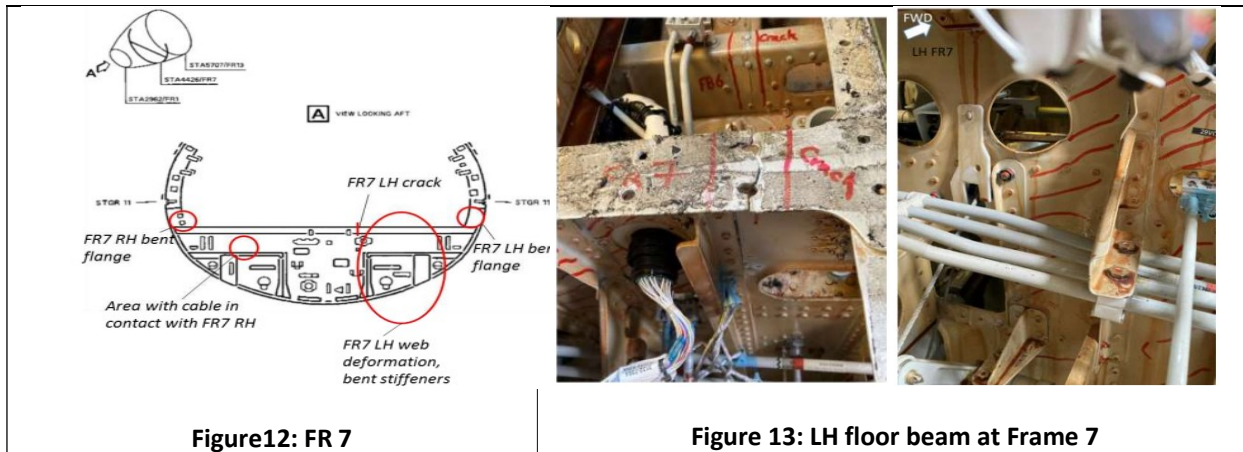


Figure 12: FR 7

Figure 13: LH floor beam at Frame 7

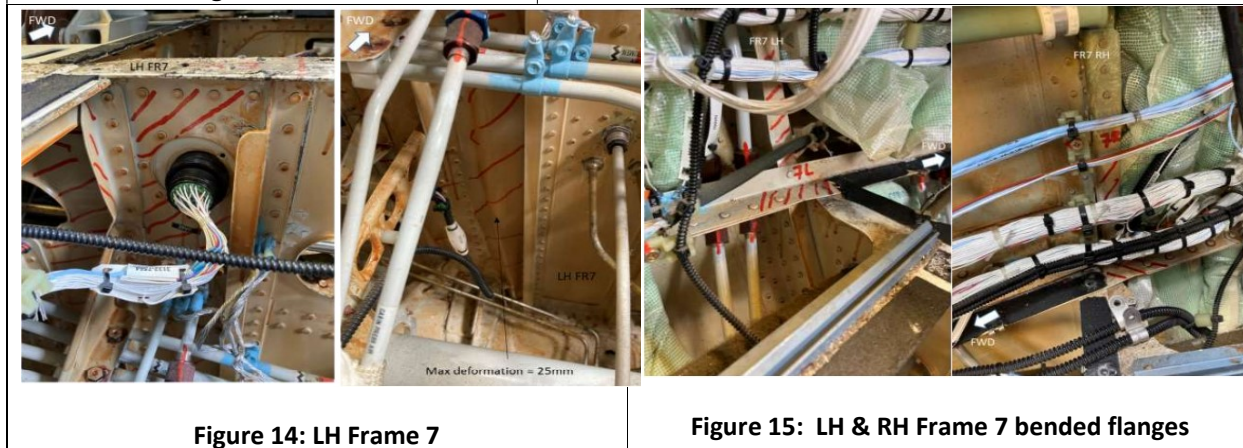


Figure 14: LH Frame 7

Figure 15: LH & RH Frame 7 bended flanges

### 1:13 Medical and Pathological Information

The crew had signed the preflight medical declaration as per prevailing DGCA regulation at Bengaluru. However, post-accident medical examination was not carried out for the consumption of alcohol/psychoactive substance as there is no prevailing DGCA regulation.

**Note:** This occurrence was initially classified as a Serious Incident and later based on the severity of damages sustained by the aircraft the occurrence classification was changed to an accident.

#### 1.13.1 Crew medical test requirement as per DGCA's CAR

DGCA CAR Section 5, Series F, Part III, dated 4 August 2015, mandates for post flight medical/BA test for flight crew under the following circumstances.

- If a crew member operates a flight without undergoing the pre-flight breath-analyzer examination,
- For all scheduled flights originating from destinations outside India.
- After an accident.

However, in the case of a serious incident no such requirement is mandated by the DGCA.

### 1.14 Fire

There was no fire pre or post accident.

## 1.15 Survival Aspects

The accident was survivable.

## 1.16 Tests and Research

Nil

## 1.17 Organizational and Management Information

The aircraft was operated by M/s InterGlobe Aviation Ltd (Indigo), a scheduled airline operator holding AOC number S-19 in passenger & cargo categories. As on date of accident, AOC was valid till 02.08.2022. M/s Indigo aircraft fleet consists of Airbus A320-Neo, A320-Neo, A321 Neo and ATR-72 aircraft. It has a total fleet of 275 aircraft (Airbus A-320 -184, A-321- 56 – 252 and ATR72 – 35) as on date. The operator carries out its own maintenance as CAR 145 approved organization. There is in house training facility for the pilots, engineers and cabin crew.

## 1.18 Additional Information

### 1.18.1 Extract from the Flight Crew Training Manual (FCTM)

Description of bounce landing and recommended procedure to be followed by the flight crew for recovery are given in the “Abnormal situation”, Chapter 64 dated Nov 2019 of operators FCTM. Extract of the relevant portion of the FCTM are shown below.

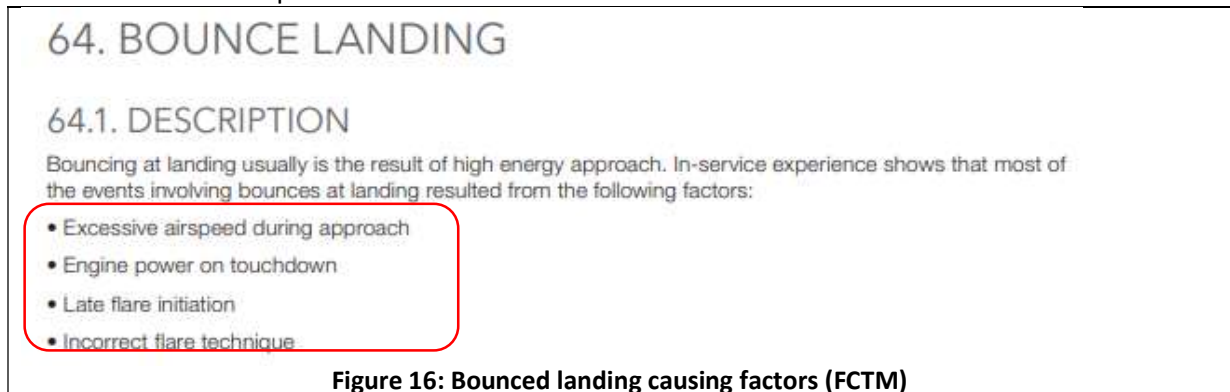


Figure 16: Bounced landing causing factors (FCTM)

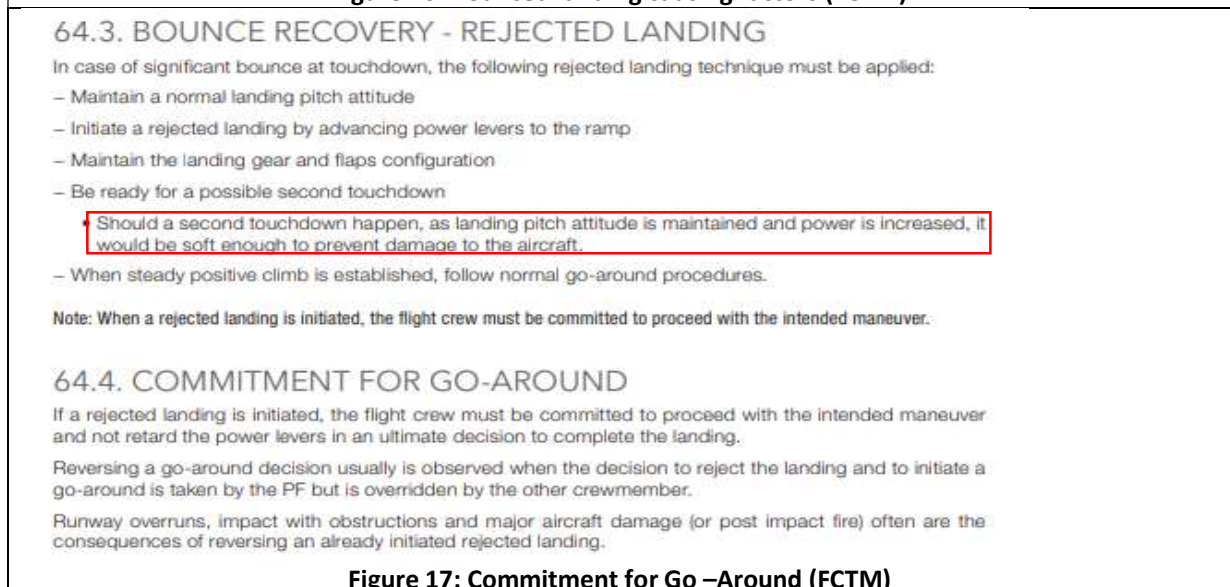


Figure 17: Commitment for Go –Around (FCTM)



### 1.18.2 Extracts from the Flight Crew Operation Manual (FCOM)

Flaring procedure to be followed by the flight crew is documented in the Additional Normal Procedure (ANOR) of operator's FCOM dated 04 June 2020. The relevant portion of the FCOM is shown below.

**ANOR.1.3 Landing**

61231209-607b-4fb2-9c9f-075a50a2e613 04 JUN 2020 ALL

In order to minimize landing distance variations the following procedure is recommended:

- Maintain standard final approach slope (3 °) and final V<sub>APP</sub> until 20 ft is called on radial altimeter

At «20 ft» call by PM, reduce to FI and flare visually as required

**Note**  
20 ft leaves ample time for flare control from a standard 3 ° final slope.

During flare the airspeed decreases, resulting in a touchdown speed 5 to 10 kt lower than the stabilized approach speed.

**Figure 18: Flare height requirement (FCOM)**

**NOR.23 Go-Around**

79a8d109-b128-4f5f-8a43-2172088b3b56 04 JUN 2020 ALL

| PF  | PM  |
|---|---|
| <p><b>Go-Around</b></p> <p>▶ GO-AROUND ..... ORDER &amp; INITIATE<br/>Announce "Go-around, set power, flaps one notch".</p> <p>• <b>Simultaneously</b></p> <p>▶ GA pb ..... PRESS</p> <p>▶ PL 1+2 ..... ADVANCE TO RAMP</p> <p>▶ PITCH ..... ROTATE TO GA PITCH</p> <p>Follow FD bars and accelerate to GA speed.</p> <p>▶ FMA ..... CHECK<br/>Check Go-around mode engaged.</p> <p>▶ CAVALRY CHARGE ..... CANCEL</p> <p><b>Positive Climb</b></p> <p>▶ GEAR UP ..... ORDER</p> | <p>▶ FLAPS ..... RETRACT ONE NOTCH</p> <p><b>CAUTION</b></p> <p>▶ Adjust go-around torque and avoid overtorque.</p> <p>▶ PL 1+2 ..... CHECK<br/>Check GA TQ and NP at 100 %.</p> <p>▶ FLAPS ..... ANNOUNCE POSITION</p> <p>▶ FMA ..... CHECK<br/>Continue with same NAV SOURCE as for approach and check Go-around mode engaged.</p> <p>▶ POSITIVE CLIMB ..... ANNOUNCE</p> |

**Figure 19: Normal Go-Around procedure**

Similarly, "Go-Around" procedure and action required to be initiated by the flight crew in case of a significant bounce is also documented in the Normal Procedure of the FCOM dated 04 June 2020. An extract of the same is appended below:

- 1) MAX reverse is usable down to full stop if required, but to minimize flight control shaking due to reverse operation at high powers, it is helpful to release slowly PL back to GI when reaching low ground speeds (below 40 kt estimated)
  - 2) MAX braking is usable without restriction down to full stop, whatever the runway conditions may be, provided ANTISKID is operative.
  - 3) The tail bumper (with damping capabilities) effectively protect the tail in case of excessive attitude (resulting from prolonged/floating flares) provided the rate of sink at touchdown does not exceed 5 ft/s
  - 4) In case of a significant bounce, a go-around should be considered.
- Figure 20: An action required during a significant bounce (FCOM)**

### 1.18.3 Extract from FCTM Chapter 64 (Bounced landing)

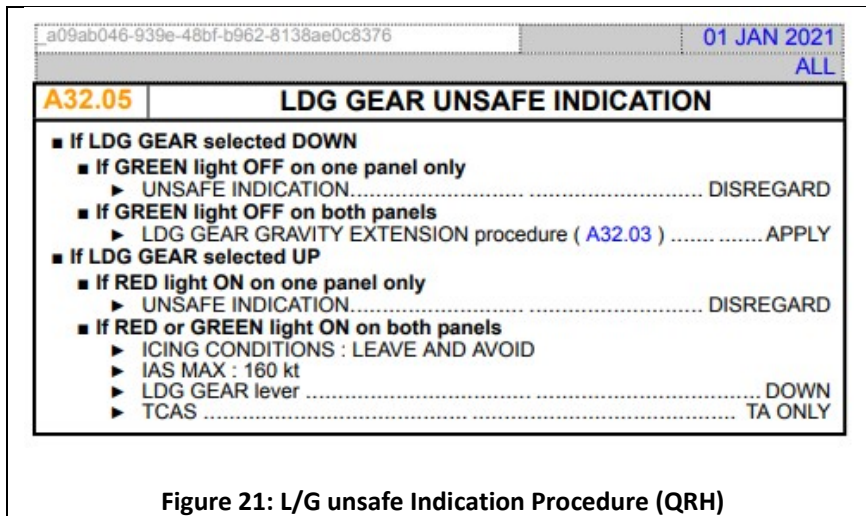
Landing techniques required to be followed in order to prevent bounced landings is documented in the operator's FCTM. Relevant extract is quoted below:

**"Correct landing technique:**

*Power reduction shall be initiated passing 20 ft. The touchdown shall occur with power levers at Flight Idle. In coordination with power reduction, the pilot flying progressively adjusts aircraft pitch to flare the aircraft. Airspeed reduction during flare is normal. Touchdown should occur at airspeed below VAPP. For indication, a pitch attitude below -1.5° at touchdown would result in contact with the runway on the nose landing gear first and would lead to a bounce."*

#### 1.18.4 Extract from the Quick Reference Handbook (QRH)

Procedure required to be followed by the flight crew in the case of LDG unsafe indication is given in the operator's (QRH) and extract of the relevant portion of QRH is appended below:



#### 1.19 Useful or effective Investigation Techniques

Nil

### 2. Analysis

#### 2.1 General

##### 2.1.1 Serviceability of aircraft

Aircraft's C of R, C of A, ARC and aero mobile license were valid and current as per applicable DGCA CAR's requirement. Aircraft had logged 2454:23 hrs till the date of accident. Last scheduled inspection carried out on the aircraft and engines was A3 Checks (Scheduled inspection) on 05<sup>th</sup> March, 2021 as per approved Aircraft Maintenance Program (AMP). The last CRS was issued on 13 June 2021, after carrying out layover inspection at Bengaluru.

All concerned Airworthiness Directives, mandatory Service Bulletins, and DGCA Mandatory Modifications on this aircraft and its engines were complied with as on date of event. No snag was pending on the aircraft. Aircraft was airworthy as per the current aircraft records.

On the day of accident, pre-flight and transit inspections were carried out as and when required in accordance with applicable requirements and no abnormalities were found recorded. Weight schedule of the aircraft was approved by the DAW(NR). Load and trim sheet was prepared before the flight and the C.G of the aircraft was within the OEM's prescribed limits. Further crew did not find any abnormalities or report any aircraft serviceability problem to ATC Hubli before first touchdown.

During "Go-Around", landing gear unsafe procedure was displayed due to the damages sustained during the preceding hard landings experienced by the aircraft. When the landing gears were retracted the indication cleared automatically. The indication reappeared when landing gears were

extended during second approach. The crew disregarded the indication in accordance with the QRH.

It is therefore, concluded, that the aircraft serviceability was not a contributory factor to this accident.

### **2.1.2 Weather**

ATC Hubli provided the METARs as and when required or requested by the crew. During first approach, METAR provided to the aircraft VT-IYX by ATC Hubli was visibility 4km and wind 250/07 knots. Further ATC had also clearly apprised the crew about the light rain and wet runway condition. Crew acknowledged the METARs and continued its approach to runway 26. Crew was well aware of the prevailing weather and runway condition.

Aircraft went around, while holding, crew requested for surface condition, ATC Hubli responded raining over the field and runway wet. When another aircraft (B200) holding over Hubli, enquired about the weather encountered by the aircraft VT-IYX, crew replied turbulent and gusty weather and winds from the left. Subsequently, another aircraft (B200) landed safely and broadcast winds were strong from the left 15 to 20 knots. VT-IYX crew had acknowledged the broadcast. However, aircraft VT-IYX continued its descent for 2<sup>nd</sup> approach on runway 26.

Before initiating second approach and landing, crew enquired about the weather from ATC Hubli. METAR provided to the aircraft VT-IYX by ATC Hubli was wind was 230/10 knots and drizzle. Again, crew opted to continue the approach on runway 26. Further crew had never reported any adverse weather condition to ATC Hubli or any intention to divert to Bengaluru due to adverse weather.

It is therefore, concluded, that the weather was not a contributory factor to the accident.

## **2.2 Crew Qualification and handling of the Aircraft**

### **2.2.1 Crew Qualification**

Both flight crew were appropriately licensed, qualified and authorized to operate the flight. Both crew had undergone the required training as and when required. However, during type training course once the PIC was advised to initiate "Go-Around" if required. Crew preflight medicals were valid as per prevailing DGCA's Civil Aviation Requirement (CAR). However, in the absence of mandatory DGCA's Civil Aviation Requirement (CAR) for conducting medical test in case of serious incident, post medical test of crew was not carried out. Therefore, during the investigation post accident medical condition for consumption of alcohol or psychoactive substance of both crew couldn't be ascertained.

### **2.2.2 Crew Handling of the Aircraft**

The aircraft carried out a non-precision approach on runway 26. Between 30ft RA to 5ft RA, elevators were deflected in both nose up and down orders. The resultant deflection was a nose down order. Pitch angle was -0.3 ° at 10ft RA and then reduced to -2.3° at 5ft RA. IAS was 111kt. At 5ft RA, power levers were retarded to FI.

Due to delayed flare, higher IAS than targeted speed (+13 than Vapp) and pitch angle -0.3° aircraft touched down with a VRTG of +1.9 G. Due to nose down attitude of the aircraft, the touchdown

was three pointers i.e., all three gears got compressed simultaneously. This was an undesired landing attitude of the aircraft. However, instead of initiating a “Go-Around”, nose down order was applied, as the PF was trying to settle down the aircraft anyway. Consequently, aircraft bounced in air. However, PF kept on applying nose down order.

Then the second touchdown occurred on nose landing gear first with  $-2.0^\circ$  of pitch angle, VRTG +1.5 G. This time the PM gave a call for “Go-Around”, but PF did not agree and replied “Hold Hold”. The PF intentions were clear of settling down the aircraft instead of initiating a “Go -Around”. Aircraft encounter another bounce and PF kept on applying the nose down order.

The third touchdown also occurred on nose landing gear first with  $-3.7^\circ$  of pitch angle, a VRTG +1.8 G and again elevators nose down order. A “Go-Around” call given by the PM was disagreed by PF. This further clarifies that PF was not committed to initiate a “Go-Around”. Aircraft encountered another bounce.

The fourth touchdown occurred. The aircraft touched down on nose landing gear first a third time. This time pitch angle was  $-5.9^\circ$ , a 3.3 G vertical and 0.4 G lateral. Then a dual input registered in the DFDR indicates PM took the control to initiate a much awaited “Go-Around”. However, the dual inputs were mainly in the same direction. This time aircraft bounced and “Go-Around” was initiated simultaneously.

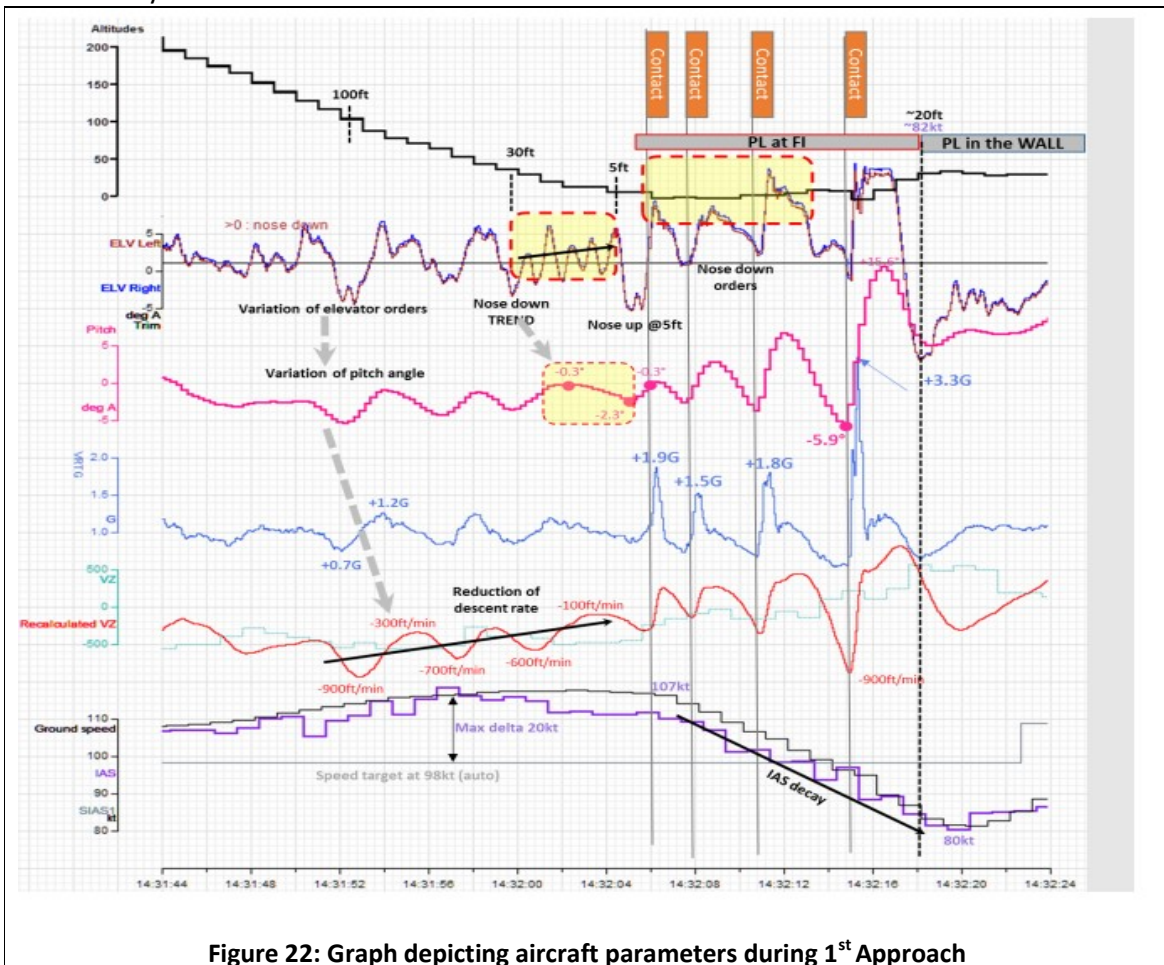


Figure 22: Graph depicting aircraft parameters during 1<sup>st</sup> Approach



The crew initiated a “Go-Around”, only after the fourth touchdown. During “Go-Around” landing gear unsafe procedure was displayed for 20 sec. However, the indication was not noticed by the crew. When the landing gears were selected up, the landing gear unsafe indication cleared automatically. Aircraft climbed as per ATC instruction and entered a holding pattern and carried out two right orbits. During hold crew discussed diversion to Bengaluru and also enquired the weather from ATC Hubli. ATC Hubli reported raining over the field and runway wet.

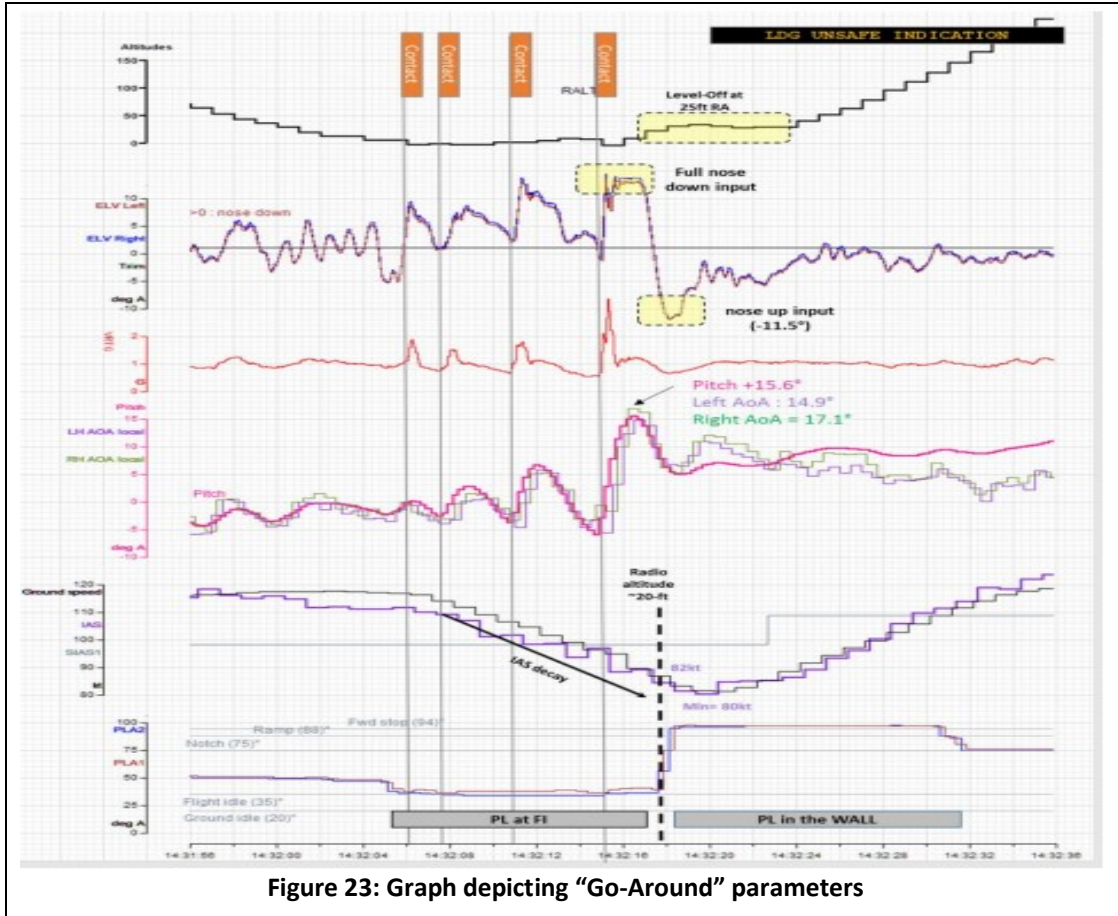


Figure 23: Graph depicting “Go-Around” parameters

Later at 14:53:33 UTC, crew again enquired about raining condition, ATC Hubli, responded “light drizzling Sir”. Thereafter, crew requested for approach and ATC cleared the aircraft for approach to runway 26.

During second approach on the same runway 26, when the landing gears were selected down, landing gear unsafe procedure was displayed again. Crew noticed the indication this time. Crew followed QRH procedure and disregarded the unsafe indication. Checklists were carried out and the landing phase initiated. When the aircraft was established on approach track runway 26, ATC Hubli, passed the METAR to the aircraft.

On landing, aircraft touched down on MLG with +3.3° of pitch angle, power lever were at FI just before touchdown and the IAS was less than Vapp target. However, VRTG was high(+1.9 G) and aircraft bounced. PM gave a call for “Go-Around” PF replied “No, Hold”. Aircraft bounced. A second touched down occurred on with +0.3° of pitch angle and both power lever were at FI. However, VRTG was again high. Aircraft bounced again. Subsequently third touched down occurred followed by another bounce. Aircraft touched down fourth time. However, VRTG was less than 1.5G.

When the nose landing gear wheel touched down, crew observed a grinding noise and vibration. Therefore, the crew stopped aircraft on the runway and informed ATC Hubli of a suspected nose wheel tyre burst and switching off engines on the runway itself. At 15:04:08 UTC, finally the aircraft came to rest approx 1300m of the runway threshold.

**Summary:** During first approach, aircraft was flared at 5ft however, as per FCOM aircraft should be flared at 20ft. IAS value was +13 Vapp (target) however, as per FCTM aircraft should touchdown with Vapp or less in order to prevent bounce landing. Over all aircraft attitude was not in a desired safe landing configuration range. Delayed decision of “Go-Around” by crew was also not in accordance with the procedure mentioned under bounce recovery in the FCOM. PF continuing to apply nose down orders after touchdowns, signify that the PF was not-committed to initiate a “Go-Around”. The issue has been addressed under the heading *Commitment to “Go-Around”* in the FCTM. Further dual input during “Go-Around” indicates PM disagreement with PF actions in the prevailing situation. During second approach also, PF intention was clear to land the aircraft anyhow. Further, as per the trend of exceedance records for high acceleration at touchdown, the PIC had landed with high vertical G between 04.03.2021 and 14.06.2021 on 19 occasions.

In view of above, it is concluded that landing technique followed was not as per documented procedures laid down in Operator’s FCTM/FCOM/FSM.

### **2.3 Circumstances leading to this accident**

- Aircraft met the stabilized criteria at 500ft AAL.
- Aircraft profile till 5ft RA was globally nose down.
- Crew initiated delayed flare at 5ft RA, rather than initiating flare at 20ft height as recommended in the FCOM/FCTM.
- Aircraft touchdown with higher IAS than Vapp (target) and overall aircraft’s attitude was nose down.
- Aircraft touched down the runway surface with high vertical acceleration.
- After experiencing significant bounce during very first touchdown PF did not initiate a “Go-Around” as required under the prevailing circumstances.
- After second touchdown and bounce, PM gave a call for Go-Around”. However, PF was not committed for initiating a “Go-Around”.
- From first touchdown till fourth touchdown, nose down order was given by the PF.
- After experiencing consequently four touchdown and bounces, finally crew initiated the much awaited “Go-Around”.
- Dual input took place after fourth touchdown mainly in same direction.
- Landing gear unsafe indication came and went unnoticed by both crew.
- Aircraft went around and entered required holding pattern as instructed by ATC Hubli.

- Aircraft initiated approach for the same runway. Landing gear unsafe procedure was again displayed. Crew noticed this time and responded as per QRH procedure.
- During 2<sup>nd</sup> approach, again the aircraft touched down the runway surface with high VRTG.
- This time PM gave a “Go-Around” call on first bounce. However, PF responded No Hold.
- After encountering four touchdowns and subsequent bounces, aircraft finally came to rest.

### **3. Conclusion**

#### **3.1 Findings**

1. The Certificate of Airworthiness, Certificate of Registration and Airworthiness Review Certificate of the aircraft were valid on the day of accident.
2. All concerned airworthiness directives, mandatory service bulletins, mandatory modifications on the aircraft and its engines as on date of accident had been complied with.
3. No snag was pending for maintenance prior to the accident flight.
4. Both operating crew were licensed, qualified and authorized on ATR72-600 aircraft to operate the flight.
5. Both crew had adequate rest prior to undertake the flight on 14 Jun 2021.
6. The taxi out, takeoff and cruise was uneventful.
7. Crew initiated a delayed flare at 5ft RA and touched down with higher IAS.
8. The aircraft had a bounced landing during the first approach and bounced as many as four times and thrice on the NLG before going around. The undercarriage damage and the tyre burst are suspected to have occurred during touchdowns.
9. There was a delay in initiating a “Go-Around” as required in the prevailing circumstances.
10. Landing gear unsafe indication came and went unnoticed by both crew.
11. During 2<sup>nd</sup> approach, again the aircraft bounced as many as three times before coming to rest.
12. Crew had never reported any adverse weather condition to ATC Hubli.
13. Post flight crew medical was not carried out at Hubli.

#### **3.2 Probable Cause of the Accident**

*The probable cause of this accident is attributed to inappropriate aircraft landing technique and not following the bounced landing recovery procedure i.e., delayed flare, high speed at touchdown and delay in initiating a “Go-Around”.*

*Contributory factors for this accident were lack of situational awareness and lack of commitment to initiate a “Go-Around” after experiencing a significant bounce.*

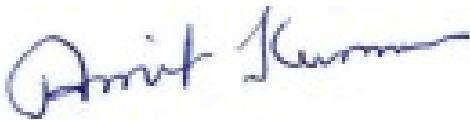
#### **4. Safety Recommendations**

It is recommended that

4.1 DGCA may formulate a procedure to ensure post flight medical examination/ BA test in case of serious incidents also.

4.2 Corrective training under DGCA guidelines may be imparted to the involved crew. The corrective training should stress upon "Go-Around" procedure, bounced landing and recovery procedure in detail.

4.3 The organization (M/s Indigo) may sensitize all pilots regarding bounced landing and recovery procedure in detail.



**Amit Kumar**  
**Investigator-in-charge**



**Ravi Ramakrishnan**  
**Investigator**

**Date: 23 October 2022**

**Place: New Delhi**