الهيئة العامة للطيران المدني
GENERAL CIVIL AVIATION AUTHORITY

United Arab Emirates

Air Accident Investigation Sector

Serious Incident

- Summary Report -

AAIS Case Nº AIFN/0006/2022

Aircraft Belly Structural Fairing Fracture due to Tire Burst During Flight

Operator:	Emirates
Make and Model:	Airbus A380-842
Nationality and Registration:	The United Arab Emirates, A6-EVK
Place of Occurrence:	During Cruise
State of Occurrence:	The United Arab Emirates
Date of Occurrence:	1 July 2022

This Investigation was conducted by the Air Accident Investigation Sector of the United Arab Emirates pursuant to Civil Aviation Law No. 20 of 1991, in compliance with Air Accident and Incident Investigation Regulation (AAIR), and in conformance with the provisions of Annex 13 to the Convention on International Civil Aviation.

This Investigation was conducted independently and without prejudice. The sole objective of the investigation is to prevent future aircraft accidents and incidents. It is not the purpose of this activity to apportion blame or liability.

The Air Accident Investigation Sector issued this Summary Report in accordance with national and international standards and best practice. Consultation with applicable stakeholders, and consideration of their comments, took place prior to the publication of this Report.

The Summary Report is publicly available at:

https://www.gcaa.gov.ae/en/departments/airaccidentinvestigation/Pages/InvestigationReports.aspx

The Air Accident Investigation Sector
The United Arab Emirates

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Investigation Process

The occurrence involved an Airbus A380 aircraft, registration marks A6-EVK, owned by Emirates. The occurrence was reported to the Air Accident Investigation Sector (AAIS) Duty Investigator by phone call to the Hotline Number +971 50 641 4667.

Based on the *Air Accident and Incident Investigation Regulation (AAIR)* of the United Arab Emirates, Appendix A, and the assessment of the occurrence consequences, the Investigation classified the occurrence as 'Serious Incident'.

The scope of this Investigation is limited to the events leading up to the occurrence and no in-depth analysis of non-contributing factors was undertaken.

Notes:

1. Whenever the following words are mentioned in this Report with the first capital letter, they shall mean the following:
   - (Aircraft) – the aircraft with registration A6-EVK involved in this serious incident
   - (Commander) – the commander of the serious incident flight
   - (Copilot) – the copilot of the serious incident flight
   - (Incident) – this investigated serious incident
   - (Investigation) – the investigation into this serious incident
   - (Operator) – Emirates
   - (Report) – this serious incident investigation Summary Report.
2. Unless otherwise mentioned, all times in this Report are given in 24-hour clock in Coordinated Universal Time (UTC), (UAE local time minus 4).
3. The structure of this Summary Report is an adaptation of the ICAO Annex 13 Final Report format.

Factual Information

History of the Flight

On 30 June 2022, at 1110 UTC (1 July 2023, 0310 local time), an Airbus A380 Aircraft, registration marks A6-EVK, operated by Emirates, was ready to depart for instrument flight rules (IFR) commercial flight under callsign UAE94G, from Dubai International Airport (OMDB[1]) to Brisbane International Airport (YBBN[2]), Australia. There were 529 persons on-board, comprising 501 passengers, 4 flight crewmembers, and 24 cabin crewmembers.

The Commander was the pilot flying (PF) and the Copilot was the pilot monitoring (PM).

After blocking out from parking stand Alpha 5, the flight crew requested for taxiing out from Zulu taxiway, and the flight crew was instructed by Ground South controller to taxi the Aircraft at hold short at the stopbar.

The Tower controller provided take-off clearance at 1110:06, and the flight crew replied affirmatively with a proper readback. The Aircraft lifted off at 1110:30.

After about 1hour 15 minutes in flight, and during cruise at flight level (FL) 310, both flight and cabin crews heard a bang sound associated with WHEEL TIRE PRESS LO triggered on the wheel page of the electronic centralized aircraft monitor (ECAM) indicating the body landing gear (BLG) wheel 17 zero pressure.

The flight crew carried out the ECAM procedure and reviewed the *flight crew operations manual (FCOM)* in the anticipation of suspected tire damage. The *L/G Wheel Tire Damage Suspected ECAM Not-Sensed Procedure* was activated (taxi with care + LDG distance affected).

The flight continued and the Aircraft landed uneventfully at YBBN.

[1] OMDB is the ICAO four letter airport code for Dubai International Airport, United Arab Emirates

[2] YBBN is the ICAO four letter airport code for Doha International Airport, United Arab Emirates

After landing, an inspection was performed and revealed wheel assembly 17 tire burst and belly fairing panel damage. There was no damage found on the other wheels.

Injuries to Persons

There were no injuries reported.

Damage to Aircraft

The defragmented tire chunk impact structural panel (197ET) which was liberated and was not found. This panel was an access panel with standard fasteners. It spans Frames 67 to 72 on the fuselage and was located in the upper belly fairing area. It was supported by 110 screws and washers. The damage was observed between frames 69 and 72. The Aircraft maintenance records review did not reveal any previous damage or repair to this panel. (Figures 1, 2, and 3)

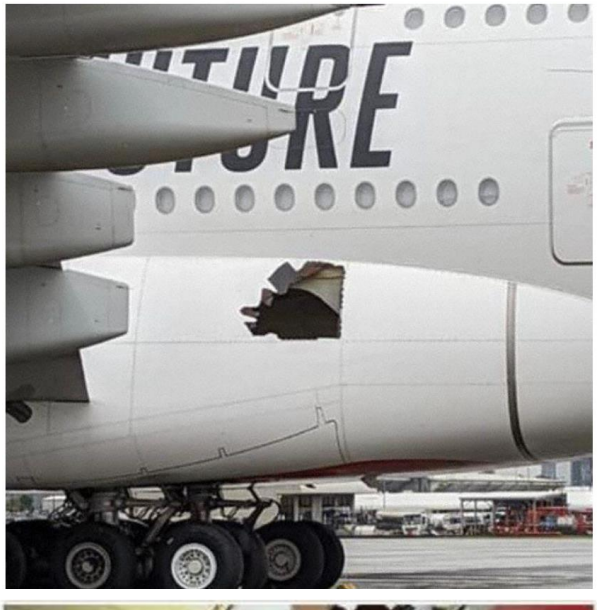

Figure 1. Fairing damage

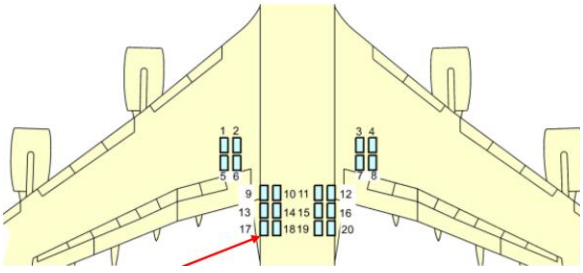

Figure 2. BLG Wheel 17

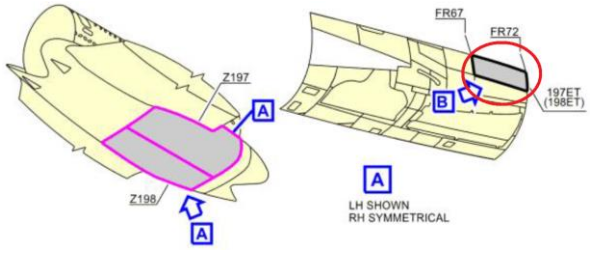

Figure 3. Damaged panel 197ET

Personnel Information

The Commander held an air transport pilot license (ATPL) issued by the General Civil Aviation Authority (GCAA) of the United Arab Emirates, which was valid until 28 February 2023. The Class 1 medical certificate was valid until 31 July 2023.

The Copilot held an ATPL issued by the GCAA with validity until 31 May 2023. His Class 1 medical certificate was valid until 25 July 2023.

Both flight crewmembers stated that they were well-rested and fit for the flight.

Aircraft Information

The A380-861 aircraft is a double-deck, wide-body, four-engine aircraft manufactured by Airbus. It is equipped with four GP7270 turbofan engines manufactured by Engine Alliance LLC.

The Aircraft was delivered the Operator on 20 December 2019 with manufacturer serial number 0260, and it has done 6412:38 flying hours with 917 cycles until the Incident date. The last maintenance check ‘3A’ was accomplished on 12 May 2022.

The Aircraft was airworthy and was released to service normally.

Wheel assembly (17)

Wheel 17 is a non-braked aft belly-landing gear (BLG) wheel assembly with radial tire size 1400 x 530 R23. The normal operating pressure 15.0 bar (218 psi) to 15.8 bar (229 psi) and the maximum rated pressure is 17.9 bar (260 psi).

The following are the general information of the wheel:

- Part Number: L3245021100000
- Serial Number: B1116
- Cycles Since New: 732
- Cycles Since Installed:171

The general information of the tire are as follows:

- Part Number: M16004
- Serial Number: 0056B149
- Cycles Since New: 171
- Cycles Since Installed:171

Figure 4 illustrates general description of the tire structure.

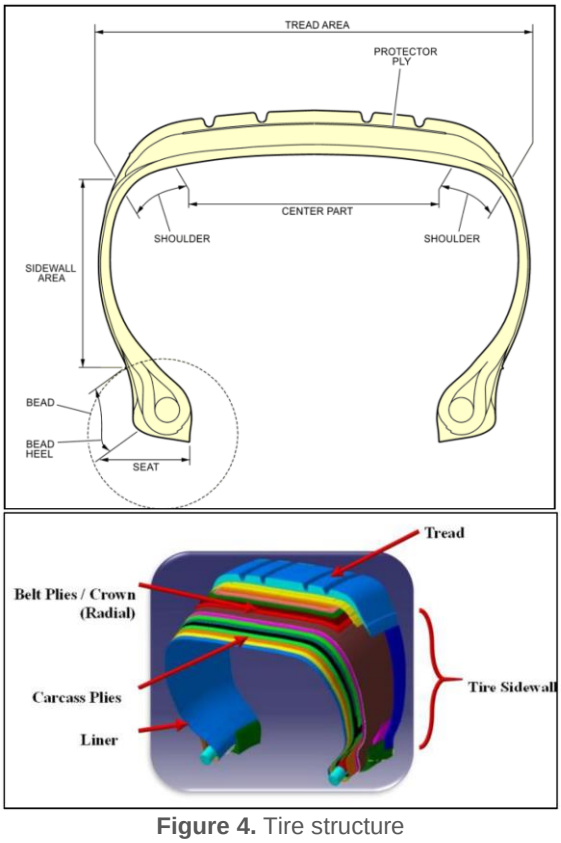

Figure 4. Tire structure

Wheel and tire assembly movement

Tire involved in the event was a brand-new tire (no re-treads) received from Michelin, France on 7 January 2022. EASA Form 1 (figure 5) shows a release date of 12 March 2020. Table 1 below illustrates the involved wheel replacement history.

Table 1. Wheel (SN B1116)

ON OFF	18/02/2020 10/07/2021	A6-EVN	BLG-20	Tire SN 9100C133	280 cycles Worn to limit
SHOP	15/07/2021	SHOP		Repair + MOD + NDT	-
ON OFF	20/07/2021 22/01/2022	A6-EOU	BLG-19	Tire SN 9330C131	277 cycles Worn to limit
SHOP	24/01/2022	SHOP		Repair + NDT	-
ON	27/01/2022	A6-EVK	BLG-17	Tire SN 0056B149	-


AUTHORISED RELEASE CERTIFICATE
Certificat Libératoire Autorisé
EASA FORM 1
Formulaire 1 de l'EASA
DIRECTION GENERALE DE L'AVIATION CIVILE
FRANCE
MANUFACTURE FRANÇAISE DES PNEUMATIQUES MICHELIN
Place des Carmes Déchaux
63000 CLERMONT-FERRAND
FRANCE
(MICHELIN AIRCRAFT TIRE)
20 / 5804 / URG / N / R
0056B149
N/A
1400X530R23
M16004
0056B149
NEW

Figure 5. EASA Form 1

Tire pressure check

Tire pressure readings are checked, using TPIS, every Daily Check. The last daily check on the Aircraft was accomplished on 30 June 2022, at 22:20 UTC. Wing landing gear wheel (WLG) 5 and BLG wheel 15 were replaced during this check.

Position (17) wheel and tire assembly history on A6-EVK

Table 2 illustrates the wheel and tire assembly history on the Aircraft

Table 2. History of wheel position (17)

ON OFF	05/06/2019 02/10/2020	SN B1038	197 cycles	Found worn to the bottom of the groove at one spot
ON OFF	02/10/2020 23/07/2021	SN B0961	274 cycles	Worn to limit
ON OFF	23/07/2021 27/01/2022	SN B0978	272 cycles	Found worn to the bottom of the groove at one spot
ON	27/01/2022	SN B1116	-	-

Aircraft design specifications

The aircraft is designed to withstand tire burst events under design certification specifications JAA JAR 25.729e, which is superseded by EASA CS-25.734, AMC-25.734. The specifications state that for overpressure burst prevention, means must be provided in each wheel to prevent wheel failure and tire burst that may result from excessive pressurization of the wheel and tire assembly.

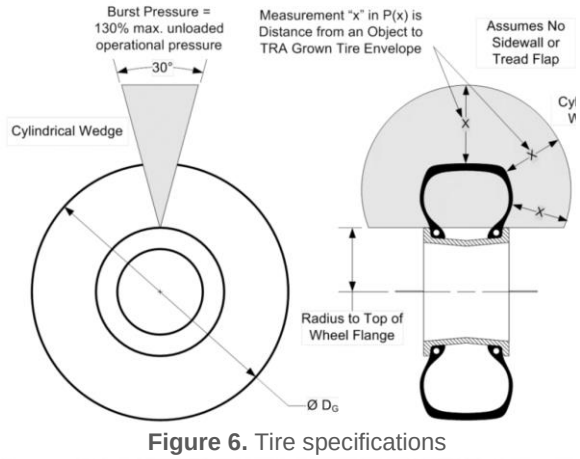

Figure 6. Tire specifications

Figure 7. Tire burst pressure effect -radial effect

Pressure calculation for an object away from the tire is a function of tire geometry, tire burst pressure and ambient pressure.

The tire burst pressure is assumed to be 130% of the maximum unloaded operational pressure, which is the unloaded tire rated pressure reduced by a factor of 1.07

249 psi/1.07 = 232.7 psi

232.7 + 14.7 = 247.4 psi

247.4 * 1.3 = 321.6 psi

Tire failure analysis

The damaged tire (figure 7) was shipped to manufacturer facility to provide supplementary information from detailed tire visual inspection and complementary analysis, a proposal of tire failure process scenario as well as a tentative root cause of tire failure burst.

Tire structure in bead area

The involved S/N 0056B149 tire corresponds to PN M16004 tire specification. Figure 8 illustrates the tire structure in the bead zone for the PN M16004

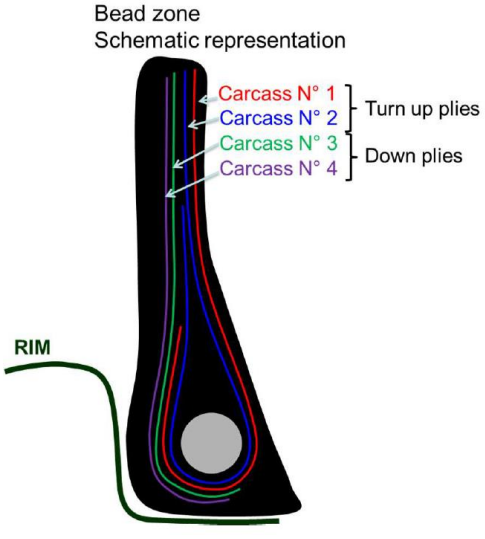

Figure 8. Tire structure

The internal pressure is supported by carcass and summit plies. In normal conditions, all carcass plies work together and the total stress on sidewalls is globally uniformly distributed. For the M16004 tire, the structure is made of four carcass plies. Carcass plies No. 1 and 2 (NC1 and NC2) are turn up plies whereas carcass plies NC3 and NC are down plies.

The structure at the bead zone is different: down plies pass between the bead core and the rim while turn up plies move away and pass on the other side of the bead core. As a consequence, the distance between turn up and down plies gradually increases, and turn up and down plies locally work as independent groups.

In a radial tire configuration, all carcasses have an identical angle bordering on 90 degrees. As ply stiffness is directly related to carcass angle, the four carcasses have the same stiffness and then globally hold the same force which is directly related to the tire internal pressure (figure 9). Burst

takes place when the internal force supported by cable carcass reaches rupture force.

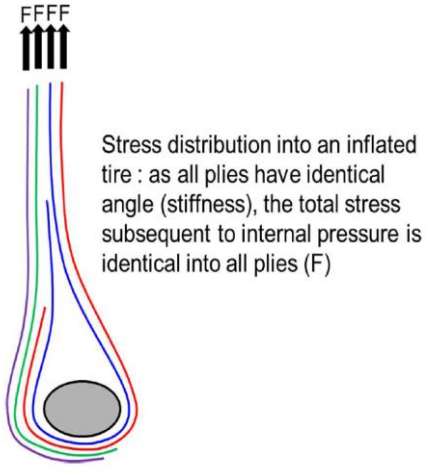

Figure 9. Stress/force distribution in an inflated tire

Visual inspection

The inspection of the burst zone demonstrated frayed cords coming from carcasses NC3 and 4, indicating damage by tire rolling after the burst event (figure 10). Pulling up the cables of NC3 and 4 carcass plies exposes the wraps of No. and 2 carcass plies. The absence of cables of the down plies (NC3 and NC4 carcasses) under the bead core evidence that down plies were snatched when the burst occurred.

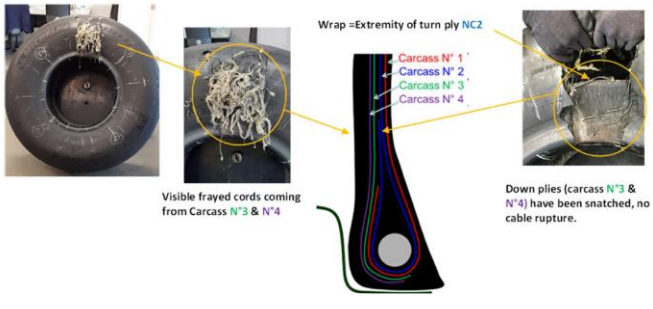

Figure 10. Visual inspection of burst zone

The separation between the bead flange rubber (BJ) and the outermost casing ply (NC4) in figure 11 is possibly due to a high level of heat or stress coming from the internal structure of the tire (NC2 turn-up).

This stress and heat generated gas have moved towards the outer surface of the tire and created this separation. This separation may have been visible from the outside of the tire before the blow-out.

During the inspection, there was an observation of an unexpected angle variation between carcass cables. When observed, NC2 carcass cables present a significantly lower angle than the theoretical one (figure 11). Outside this region, cable orientation was consistent with the expected value and no cable damage was noticed.

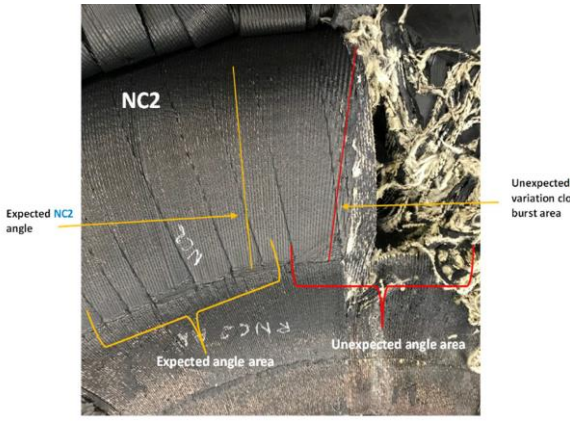

Figure 11. Local cable orientation gap between carcass plies

The unanticipated angle change was concentrated in the vicinity of the rupture and along the NC2 carcass cable (burst side and opposite side). The space between NC2 textile cords widens as a result of this angle variation. This widening of the space between the NC2 cloth cords was used to detect the angle variation. On the side opposite the burst location, where this gap between NC2 textile cords was more noticeable (figure 12).

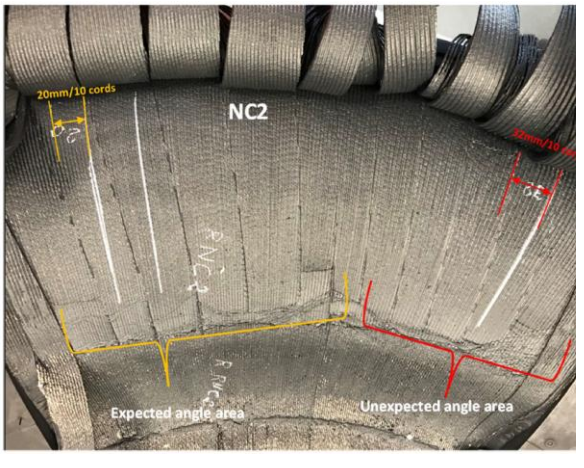

Figure 12. Cable gap on the opposite side of the burst area

In the unexpected angle variation area, the gap was measured, that is 32 mm for 10 textile

cords, as opposed to 20 mm for 10 textile cords in an area without unexpected angle variation (figure 12), which reflects the target density to reach the point of measurement.

Additional testing was conducted on the joint to identify its type (figure 13). It is most likely that the observed joint corresponds to a casing joint that happened during the step of depositing the NC2 carcass on the drum of the tire-building machine after the reel's end, based on Michelin's industrial experience and industrial records of reel changes.

Figure 13. Joint on NC2 carcass

X-ray tomography results

A radial section was taken at the level of the burst area from the tire shoulder above the burst area to the lower part of the opposite sidewall, in order to observe the casing cord gap along the casing profile (figure 14).

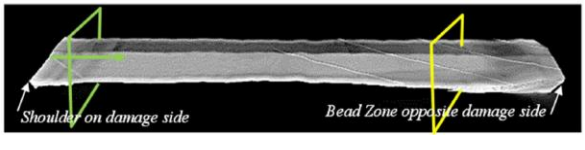

Figure 14. Sidewall sectioning

The cord gap observation along the section points out that:

- Close to damage [burst] area, NC2 carcass shows a cord gap (distance between the threads) twice as large as cord gap on NC1 carcass as (figure 15).
- This gap gradually slightly decreases down to NC turn-up on opposite damage side.

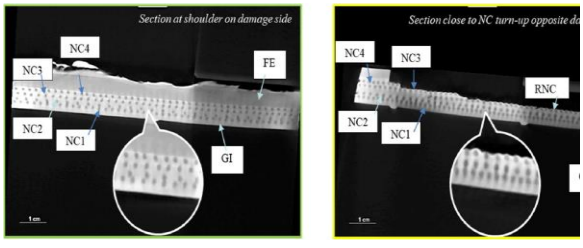

Figure 15. Casing cord gap difference between NC2 and NC1

Comparative measurements of casing cord gap/spacing between NC2 and NC1 carcasses were taken on two zones on the opposite side of the burst (figure 16).

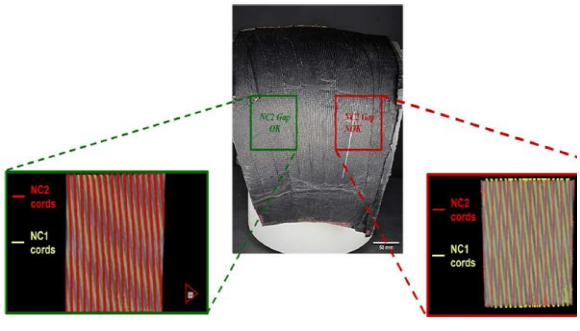

Figure 16. Location of cord gap spacing comparative measurement between NC1 & NC2

- Zone 1: area without cord spacing variation on NC2
- Zone 2: area with cord spacing variation on NC2, in the continuation of the damage [burst] area along the carcass profile on the opposite side of the burst.

In order to facilitate measurement, the color contrast on the figures above was enhanced to show NC2 cords in red on the foreground and NC2 cords in yellow/light green in the background.

Fractography

Electron microscope scanning of NC2 carcass cord edge was implemented on cord samples located in the burst area (figure 17).

Figure 17. NC2 cord edge scanning location

The rupture aspect of both fiber types (figure 18) was compared to those coming from laboratory testing and the tire manufacture's experience, in order to determine the rupture mode of the fibers.

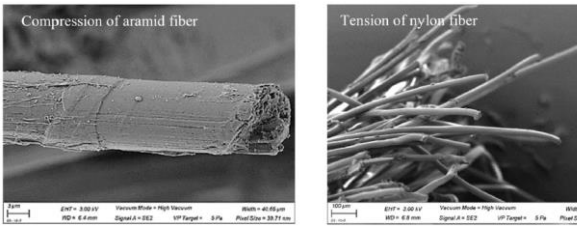

Figure 18. Aspect of aramid and nylon fibers

In conclusion to the test results based on this comparison, the rupture mode of the aramid fibers was due to fiber compression whereas the rupture mode of nylon fibers was due to tension. The hybrid combination of aramid/nylon was then exposed to alternating tension-compression solicitation, which was consistent with the fatigue failure mode observed on NC2 casing at the tire burst area.

Aircraft manufacturer analysis

The manufacturer was involved in assessing the damage and the airworthiness of the Aircraft. The manufacturer technical team was involved in assessing the damaged to the Aircraft, especially to the belly fairing.

Belly fairing damages

Belly fairing damaged: 197ET (P/N L53383818000800)

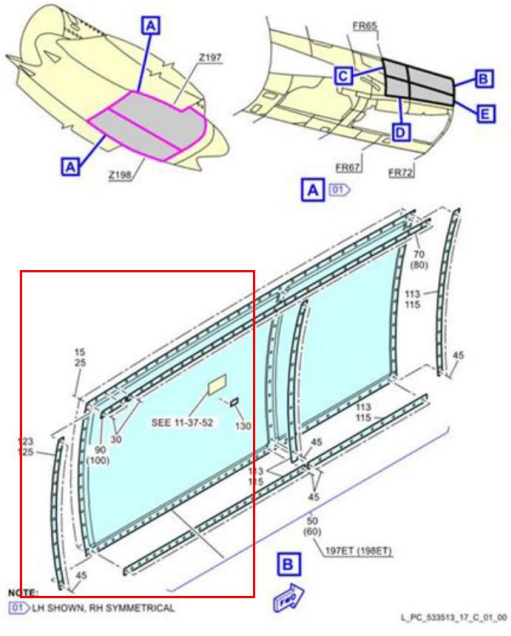

Figure 19. Belly fairing panel 197ET

Panel lower attached stringer 10 rear bracket found cracked (length 75mm)

Particular risk analysis (PRA)

Wheel and tire failures (WTF)

Wheels and tires failures (nose or main landing gears) have the potential for generating high-energy debris in close proximity to structure and/or system installation.

The analysis considers the following failure conditions:

- Gear extended - Tread Shed
- Gear extended - Flailing Tread
- Gear extended - Wheel rim release
- Gear retracted - Tire burst
- Gear retracted - Flailing Tread
- Gear retracted - Wheel rim release

The PRA dedicated to WTF analyzes the consequences of such failures at the Aircraft level. It makes sure that they are all acceptable from a safety point of view and will not result in hazardous or catastrophic failure.

The PRA WTF demonstrates compliance with the aircraft with applicable Airworthiness Requirements.

- The damages on 197ET are consistent with a blast due to the wheel 17 tire burst.

- The A380 Wheel and Tire Failure PRA covers this event.
- Impact on belly fairing components will not result in a safety hazard for the aircraft.

The belly fairing panel 197ET is not a structural part but an aerodynamic fairing (Category C structure). This panel is not designed to sustain tire blast load.

Tire manufacturer investigation results

The observations described during the testing of the burst tire involved in this Incident are similar to those identified by the tire manufacturer with the tire involved in the previous event that occurred in 2017.

The manufacturer formed a taskforce which performed a root cause analysis. It was confirmed that, during the manufacturing of the subject tire, a convergence of factors occurred:

- During the NC2 carcass laying step, the casing ply material feeding was interrupted (due to the reel being empty).
- The remaining length of the casing ply material fell off the reel and got stuck to a part of the machine frame (uncured rubber being very sticky).
- The production machine operator did not observe that and continued the operations by activating the motorized rotation of the assembly drum. This action distorted the part of NC2 carcass ply that was stuck to the machine frame and induced a local variation of the NC2 carcass ply angle associated with a local variation of the gap between NC2 textile cords.
- The machine operator did not notice either the distorted part of the ply when finishing the NC2 carcass laying and continued building the tire casing. It was not more possible to detect the local non-conformity with industrial non-destructive controls.

Accordingly, the tire manufacturer had identified two actions to be implemented as of March 2019:

1. installation of casing ply supports[3] on the machines; and
2. communication on work method update to the operators.

Based on the detailed observations, the tire manufacturer concluded that the failure of Incident tire (S/N 0056B149) is likely to be ascribable to a similar convergence of the same factors concluded in the examination mentioned above.

The manufacturer also concluded that the casing ply supports were fully effective when the tire involved in the 2022 event was produced in March 2020. The casing ply supports were either no longer in place on the machines or in a state which did not allow their full efficiency.

Aerodrome Information

Dubai International Airport was certificated by the GCAA in accordance with Part IX – *Aerodromes*, of the *Civil Aviation Regulations*.

The Airport ICAO code is OMDB, its coordinates are 25°15'10"N 55°21'52" E, and it is located 4.6 kilometers east of Dubai city. The airport elevation is 62 ft.

The Airport is equipped with two asphalt runways 30R/12L and 30L/12R. The runway 12L threshold is displaced by 450 m and the runway 12R threshold is displaced by 715 m. The runway 12R threshold is 1,880 m ahead of the 12L threshold. From the centrelines, runways 12L and 12R are 385 m apart.

Flight Recorders

Both cockpit voice recorder (CVR) and flight data recorder (FDR) were downloaded and analysed at Abu Dhabi Flight Recorder Laboratory.

It was observed that the recording of the Incident flight was overwritten as the flight continued to Brisbane and the time of the remaining part of the flight exceeded the CVR recording capacity (last two hours).

[3] The casing ply support is made of an elastic fabric band stretched in two fasteners installed on the NC2 carcass laying post. This support prevents the NC2 carcass at the end of the reel from falling on the tire building drum

Additional Information

ECAM message

ECAM WHEEL TIRE PRESS LO message is triggered in cruise when the value is less than 26% of the normal tire pressure as defined by the *FCOM* which is 217.5 PSI. This corresponds to 160.95 PSI. It is inhibited from the time the second engine is moved to PWR to an altitude of 1,500 ft or two minutes after liftoff.

The FCOM − ECAM Abnormal and Emergency Procedures, states that the WHEEL TIRE PRESS LO annunciation triggering conditions are fulfilled whenever any of the following events occurs:

- Any tire pressure is lower than the minimum value. The minimum value is a percentage of the normal tire pressure:
  - 11 % during flight phases 1 to 5]
  - 26 % during flight phases 6 to 11.
- The normal tire pressure is 217.5 PSI.
  - The pressures of two tires on the same axle are different.
- The minimum difference that triggers the alert is:
  - 15 % during flight phases 1 to 5
  - 21 % during flight phases 6 to 11.

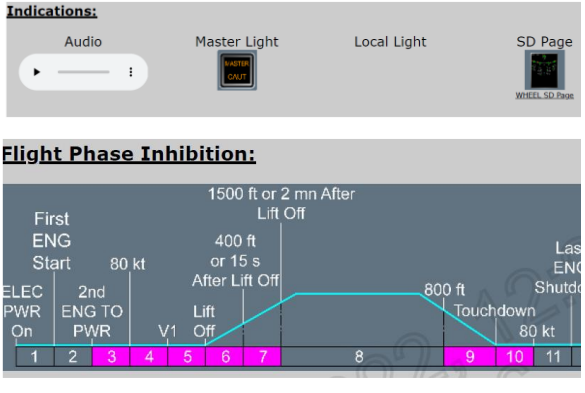

Figure 20. Flight phase inhibition

Wheel tire damage suspected procedure

The crew are required to apply the *Wheel Tire Damage Suspected* procedure when damage is suspected on one or several tires. This procedure can be displayed by pressing the ECP ABN PROC, and then selecting the L/G - WHEEL menu.

After the flight crew activates the procedure, the WHEEL SD page automatically appears.

Previous tire burst incident

On 17 April 2017, another Operator's Airbus A380-800, operating was climbing through FL260 out of Dubai when the crew heard a dull thump and received a WHEEL TIRE PRESSURE LOW ECAM message.

The crew determined that tire No. 10 had zero pressure, consulted with company dispatch and in common decided to continue the flight to Toronto, Canada. On approach to Toronto, the crew advised ATC of the situation, requested emergency services on stand-by for the arrival, and landed safely on Toronto's runway 06L.

A burst tire was confirmed by the airport emergency services associated by damage to the wheel well structure. The crew taxied the aircraft to the apron.

The Canadian Transport Safety Board (TSB) reported maintenance replaced the tire and observed some stiffener damage on the wheel well bulkhead vertical panel. The aircraft manufacturer was consulted and the aircraft was released for service under Design Deviation Authorization for one flight cycle. The tire manufacturer is investigating the cause of the tire burst.

Analysis

Tire Burst

As per the analysis stated in the tire teardown report provided by the tire manufacturer, the tire was manufactured in March 2020. The applicable corrective actions for the previous tire burst incident that took place in April 2017 were implemented but the effectiveness of the actions was not evaluated.

This Incident reveals that the actions performed to mitigate the production defects, that were defined by the manufacturer based on the analysis of tire production issues, could not actually mitigate the latent hazards during the tire production process. Therefore, the Investigation determines that the quality process requires modification to the ply production machine in order to stop the rotation of the roll before it ends.

Aircraft Manufacturer Structural Analysis

Airbus technical expert team examined damage on the belly panel due the tire burst and submitted the report.

The Investigation concurs with the conclusion that the defragmentation of part of the belly panel 197ET (P/N L53383818000800) did not impair the Aircraft performance as it is not a primary structural part and it was fitted as an aerodynamic fairing as per design.

Flight Crew Decision-making

As per the flight crew statement, the crew briefing, pre-flight preparations, pushback, taxi-out and takeoff were carried out normally.

After entering Mumbai flight information region (FIR), at FL 310, and about 1 hour 15 minutes from takeoff, the flight crew heard a bang sound associated with WHEEL TIRE PRESS LO ECAM message and the wheel 17 zero tire pressure, whereas the pressure of all other tires was normal.

The flight crew checked for all the systems on the ECAM system display pages to verify any other systems abnormality and nothing abnormal was observed.

The Operator's Maintenance Control Center (MCC) contacted the flight crew to confirm the ECAM message and upon confirmation, they suggested conducting the inspection of wheels upon landing in Brisbane and request for a maintenance technician to be available upon landing.

As per the flight crew statement during the interview, after the initial confirmation of no abnormalities in the Aircraft, the decision to continue the flight, return to base, or land at the nearest airport was not complicated. However, based on their situation assessment, returning to Dubai airport would have required dumping about 100 tons of fuel in order to comply with the maximum landing weight. Additionally, returning to Dubai Airport may have caused diversion of other flights since the Aircraft may have required to be stopped on the runway for visual inspection which could have led to blocking the runway.

The flight crew carried out a risk assessment considering calculation of remaining fuel quantity on landing at Brisbane (was calculated to be about 386 tons, 9 tons less than maximum landing weight). They also considered the absence of any ECAM indication of a system malfunctions. They counted that returning to Dubai would require a significant amount of fuel dump to comply with the maximum landing weight which could lead to blocking the active runway for some time disrupting air traffic and operations, and similarly diversion to the nearest airport (Mumbai International Airport, India) would create a similar situation as Dubai Airport. They also counted for diversions to any airport nearest to the flight route in case of any Aircraft performance downgrade. Accordingly, the flight crew decided to continue the flight to the original destination.

The belly fairing fracture was not visible to the flight crew, and there was no visual indication of that event, the flight crew did not consider that in their risk assessment. The sound of bang that took place at the time of the fairing fracture was not also counted for. The Investigation is not in a position to determine whether the decision made by the flight crew to continue the flight was the most appropriate alternative or not.

For checking their functionality, the flight crew extended the landing gear at 3,000 feet above the ground before which was earlier than the normal procedure. According to their statement, they did that because they would have adequate altitude for canceling the approach or performing a go-around in case the landing gears do not extend. That assumption was formulated based on the wheel 17 zero tire pressure indication that immediately followed the bang.

The Aircraft landed smoothly at runway 19L in Brisbane International Airport. The flight crew stopped on the runway for visual inspection before resuming taxi to the gate.

Conclusions

From the evidence available, the following findings, causes, and contributing factors were made with respect to this Incident. These shall not be read as apportioning blame or liability to any particular organization or individual.

Findings

Findings relevant to the flight operations

(a) The Aircraft was certificated, equipped, and maintained in accordance with the requirements of the *Civil Aviation Regulations* of the United Arab Emirates.

(b) The Aircraft was airworthy when dispatched for the flight, and there was no defect or malfunction detected that could have contributed to the Incident.

(c) Both flight crewmembers were licensed and qualified for the flight in accordance with the requirements of the requirements of the *Civil Aviation Regulations* of the United Arab Emirates.

(d) Both flight crewmembers were well-rested and fit for the flight.

(e) The Commander was the pilot monitoring (PM) and the Copilot was the pilot flying (PF) at the time of Incident. After the Incident, the Command took control.

(f) The weather was not a contributing factor to the Incident. The Aircraft took off at night time and continued a day flight.

(g) The flight crew performed actions as per the *FCOM* relevant to suspected tire damage.

(h) The Investigation is not in a position to determine whether the decision of the flight crew to continue the flight was the most appropriate alternative or not.

(i) The Aircraft landed safely at the destination airport.

Findings relevant to the tire burst

(a) During the tire manufacturing process, the production machine operator continued the motorized rotation of the assembly drum despite that reel was empty.

(b) The machine operator did not notice the distorted part of the ply when finishing the NC2 carcass laying and continued building the tire casing.

(c) The flight crew were not aware of the liberated tire chuck and the consequent belly fairing damage. Considering the location of the fairing, it was not possible for the flight or cabin crews to witness the damage.

Causes

The Air Accident Investigation Sector determines that cause of the tire burst was a defect occurring during the tire manufacturing process. This flaw induced a local variation of the NC2 carcass ply angle coupled with a localized variation in the gap between NC2 textile cords. As a consequence, the tire proved incapable of withstanding the difference between the internal pressure of the inflation gas and the surrounding atmospheric pressure, ultimately resulting in the tire burst. A chunk of the tire liberated and impacted a fairing panel fitted at the wheel well and fractured it.

Safety Recommendations

Michelin Actions Taken

Based on the investigation findings, Michelin, the tire manufacturer, confirmed that the precautionary measures already deployed are fully appropriate and should be pursued.

Michelin implemented the following actions:

- As of July 5th, 2022, the casing ply supports have been put back in order on the tire-building machines,
- Since July 5th, 2022, a daily control plan has been implemented reinforcing the existing manufacturing process control plan. Since July 11th, 2022, each tire of PN M16004 has been released after verification that the casing ply support is still on the machines and in good condition.
- A process evolution study (Central Quality Planning) has been launched to implement an industrial robust solution on tire building machines. This evolution encompasses a prototype assessment phase to be carried out by the end of 2022, followed by a deployment phase on all involved machines at the plant over the first quarter of 2023.

The Air Accident Investigation Sector determines Michelin actions are adequate and no further safety recommendation is warranted.

This Summary Report is issued by the:

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