INVESTIGATION REPORT ON INCIDENT TO M/s ALLIANCE AIR AVIATION LTD. (ALLIANCE AIR) ATR 72-212A AIRCRAFT, VT-RKJ ON 09.02.2022 AT MUMBAI

GOVERNMENT OF INDIA
DIRECTORATE GENERAL OF CIVIL AVIATION

FOREWORD

In accordance with Annex 13 to the International Civil Aviation Organisation Convention and the Aircraft (Investigation of Accidents & Incidents) Rules 2017, the sole objective of this investigation is to prevent aviation incidents and accidents in the future. It is not the purpose of the investigation to apportion blame or liability.

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

List of abbreviations used in the report

1.	AAC	Airworthiness Advisory Circular
2.	AIESL	Air India Engineering Services Ltd.
3.	AME	Aircraft Maintenance Engineer
4.	AMP	Aircraft Maintenance Personnel
5.	ARC	Airworthiness Review Certificate
6.	ATC	Air Traffic Control
7.	ATPL	Airline Transport Pilot License
8.	ATS	Air Traffic Service
9.	CAMO	Continuing Airworthiness Management Organisation
10.	CPL	Commercial Pilot License
11.	CSN	Cycles Since New
12.	CVR	Cockpit Voice Recorder
13.	DGCA	Directorate General of Civil Aviation
14.	DTL	Duty Time Limitation
15.	FDR	Flight Data Recorder
16.	FRTOL	Flight Radio Telephone Operator's Licence
17.	IFR	Instrument Flight Rules
18.	IR	Instrument Rating
19.	IST	Indian Standard Time
20.	LH	Left Hand
21.	LM	Line Maintenance
22.	LMM	Line Maintenance Manager
23.	MOE	Maintenance Organisation Exposition

24.	PIC	Pilot In-Command
25.	RH	Right Hand
26.	RWY	Runway
27.	SMGCS	Surface Movement Guidance and Control System
28.	TSN	Time Since New
29.	UTC	Coordinated Universal Time
30.	VFR	Visual Flight Rules

INDEX:

Investigation Report On Incident to M/s Alliance Air Aviation Ltd. (Alliance Air) Aircraft VT-RKJ on 09.02.2022

1.	Aircraft		
	Type	:	ATR 72-212A (600 Version)
	Nationality	:	INDIAN
	Registration	:	VT-RKJ
2.	Owner	:	MSN 1439 Leasing SPC Limited
	Lessor	:	DAE Leasing Ireland 21 Limited
	Operator	:	M/s Alliance Air Aviation Ltd. (Alliance Air)
3.	Pilot-in-Command	:	ATPL Holder
	Extent of injuries	:	NIL
	Co-Pilot/First Officer	:	CPL Holder
	Extent of injuries	:	NIL
4.	Date of incident	:	09.02.2022
	Time of incident	:	00:56 UTC
5.	Place of Incident	:	VABB (Chhatrapati Shivaji Maharaj International Airport, Mumbai)
6.	Co-ordinates of incident site	:	19° 05' 20" N; 72° 52' 47" E
7.	Last point of Departure	:	VABB (Chhatrapati Shivaji Maharaj International Airport, Mumbai)
8.	Intended place of Landing	:	VABJ(Bhuj Airport)
9.	No. of passengers on board	:	66 (excluding operating crew)
10.	Type of operation	:	Scheduled Commercial Air Transport Operation
11.	Phase of operation	:	Take-off roll
12.	Type of Incident	:	System/Component Failure - Non-Power plant (SCF-NP)

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

Synopsis:-

M/s Alliance Air ATR 72-212A aircraft VT-RKJ operated flight 9I-625 on 09.02.2022 from Mumbai to Bhuj. After departure of VT-RKJ another departing aircraft reported FOD on Runway-27 between taxiway N3 and N4. Runway inspection was carried out and an engine cowling was recovered on runway 27 along the centerline abeam taxiway N4.

After departure of VT-RKJ while the aircraft was in cruise phase, Mumbai ATC informed the flight crew of FOD found on the runway, operations were reported normal and flight was continued. Further, while the aircraft was in cruise (under Ahmedabad control) Ahmedabad ATC relayed Mumbai ATC message informing the crew of VT-RKJ that, ATR fuselage part was recovered at Mumbai post departure of VT-RKJ. The operating crew did not perceive the loss of the engine cowling and the flight was continued to Bhuj. After landing at Bhuj during walk around inspection AME observed that, engine #2 inboard lateral hinged cowling was missing. The incident was subsequently reported by the operator to DGCA.

DGCA-India, vide Order No DGCA-15018(02)/5/2022-DAS dated 21.02.2022 instituted investigation of the incident under Rule 13 (1) of Aircraft (Investigation of Accidents and Incidents), Rules 2017 by an Investigator-In-Charge.

The probable cause of the incident was improper locking of the inboard lateral hinged cowling of engine#2 prior to departure of the aircraft.

The following factors (of AIESL) contributed to the incident:-

a. The B1 AME failed to ensure proper supervision of the night halt tasks carried out by the technician.
b. The accumulated excessive hours of duty and shift work particularly with multiple shifts and additional overtime led to fatigue, resulting in impaired performance and increased risk-taking by the involved B1 AME due to inadequate man power planning by AIESL for the scheduled maintenance tasks.
c. Lack of supervision by the Shift In-Charge of AIESL w.r.t allotment of maintenance tasks and ensuring availability of appropriately authorised B1 AME for the scheduled Night Halt task of VT-RKJ.

1. Factual Information

1.1 History of flight:

M/s Alliance Air ATR 72-212A aircraft VT-RKJ operated a scheduled commercial passenger flight 9I-625 on 09.02.2022 from Mumbai to Bhuj. There were a total of 70 persons on-board (including 04 crew members) for the sector.

The First Officer was subjected to pre-flight B.A test at the Mumbai before departing for the flight and result was 'negative' for alcohol breath analyser test, as per DGCA guidelines during the period in view of COVID 19 pandemic, the PIC and on-board B1 (AME) had given 'undertaking' w.r.t non-consumption of alcohol. The operating flight crew were scheduled as per roster for flight duty on 09.02.2022 which consisted of 04 flight sectors; the incident flight sector (Mumbai to Bhuj) was the first flight sector of the day for the operating crew.

On the previous date (i.e., 08.02.2022) VT-RKJ had arrived at Mumbai at 16:59 UTC after operating a flight from Goa to Mumbai. The aircraft was scheduled for operations on the next day (09.02.2022) to operate 08 sectors, 9I-625(Mumbai-Bhuj) scheduled to depart at 00:45 UTC being the first flight sector.

The aircraft (VT-RKJ) was scheduled to undergo Night Halt (NH) inspection at Mumbai after its arrival from Goa (9I-658) on 08.02.2022 and before its departure to Bhuj (9I-625) on 09.02.2022.
The B1 AME allotted for the Night Halt inspection did not report for duty as per roster time for the Night halt inspection. He instead advised the technician for inspection of the aircraft and engines from the B1 perspective and reported to have monitored the tasks over telephone. The technician reported to have opened the inboard lateral hinged cowling for check of engine #2 during accomplishment of the Night Halt tasks, as the oil level and oil filter bypass indicator is visible from the inboard side for engine #2.
The technician reported to have closed the cowlings after inspection. B1 AME allocated for night halt inspection, reported for BA test at airline despatch at 00:00 UTC (05:30 IST) and reached the aircraft in morning of 09.02.2022 after 00:15 UTC (05:45 IST). He signed night halt inspection with time entered as 23:15 UTC (04:45 IST). The B1 AME signed necessary paper work for Night halt & pre-departure checks; he reported that a torch light was not used during aircraft inspection. The B1 AME continued on-board for Flight duty to Bhuj.

The PIC performed the walkaround inspection and First Officer was inside the cockpit. The PIC reported to have used torch light during walk-around inspection at Mumbai, however did not report any abnormal findings.
There was no defect reported prior to the departure. PIC was the Pilot Flying and the First Officer was the Pilot Monitoring for the incident flight sector. The aircraft was pushed back for departure from Mumbai (Stand C10) on schedule (00:46 UTC) and took off at 00:56 UTC. When Mumbai ATC informed cockpit crew about FOD on runway (while VT-RKJ was en-route to Bhuj) cockpit

crew checked parameters of flight and reported to ATC that operations were normal. Crew informed about the information received from Mumbai ATC to on-board B1 AME and that all parameter indications were normal.
Further, while the aircraft was in cruise (under Ahmedabad control), Ahmedabad ATC relayed Mumbai ATC message that, ATR fuselage part was found on runway at Mumbai after departure of VT-RKJ and crew confirmed all operations were normal. After this update, the cockpit crew called for the on-board B1 AME [travelling on duty] from the cabin and informed him about the message received from ATC. However, since all parameters appeared normal, a decision was made by the PIC to continue to destination (i.e., Bhuj). Crew informed the AME for inspection of the aircraft after landing.

First officer reported to have inspected the visible portion of wings from the cockpit right window and no abnormalities were observed. The on-board B1 AME and the crew reported that no attempts were made for assessing the aircraft from the cabin windows w.r.t aircraft part recovered at Mumbai, reported by ATC. The on-board B1 AME also reported that being a morning flight most of the passengers were asleep and the window shutters were closed.

After landing at Bhuj, during post flight inspection the B1 AME (who travelled on-board) observed that the engine#2 inboard cowling was missing, same was informed to the PIC. The defect was reported to concerned internal departments and in turn to DGCA. No secondary damage was found on the aircraft after inspection.

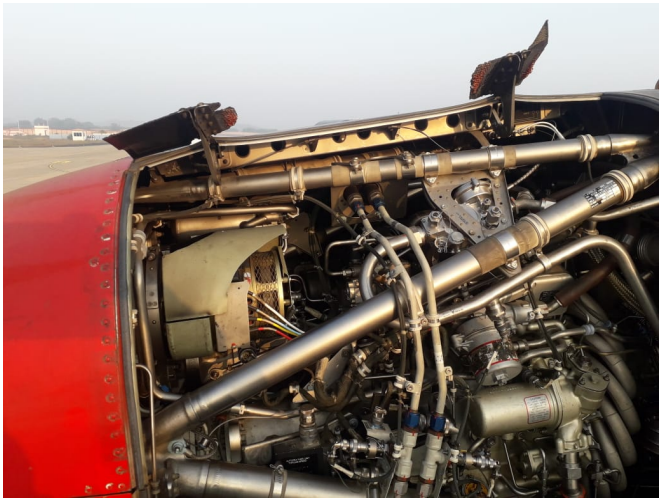
1.2 Injuries to persons:

Injuries	Crew	Passengers	Others
Fatal	Nil	Nil	Nil
Serious	Nil	Nil	Nil
Minor/None	Nil/04	Nil/66	

Total persons on-board : 70

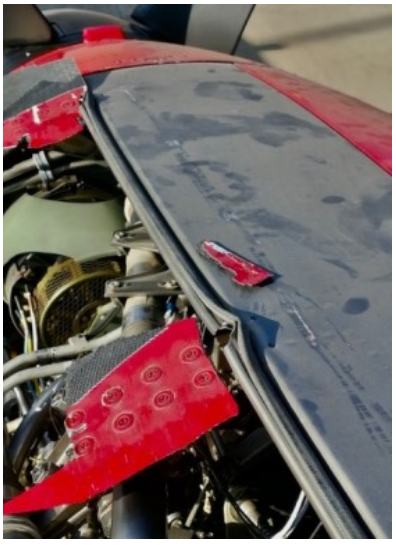
1.3 Damage to aircraft:

During inspection of engine#2 at Bhuj, telescopic cowl stay rod on intermediate frame was found buckled with crack. Approx 1.5cm tear and lifting of structure observed on Center Beam Assembly at the points of hinged lateral cowl attachments both forward and rear.



Photographs of the RH engine after landing at Bhuj [lateral hinged inboard cowl missing]

Photographs of the RH engine lateral hinged inboard cowl recovered from runway at Mumbai



Photograph of the hinges holding the lateral hinged inboard cowling and upper beam

1.4 Other damages:

No other damage has been reported.

1.5 Personnel information:

1.5.1 Details of Operating Crew:

The aircraft was operated by an appropriately licensed set of operating crew of Alliance Air at the time of incident. The details of the licences and ratings are as detailed below:-

Details	PIC	First Officer
a) Type of license	ATPL holder	CPL holder
b) Valid upto	13/06/2023	10/05/2026
c) Date of Initial issue	14/06/2018	31/01/2011
d) Class of license	Single/Multi-Engine, Land/Sea	Single/Multi-Engine, Land/Sea
e) Category of license	Aeroplane	Aeroplane
f) Age	40 years	34 years
g) Aircraft Ratings	Cessna 172-310, ATR-72-600	Cessna 152A, P-68, ATR-72-600
h) Date of Endorsement as PIC	02/08/2019	--
i) Date of last Medical Exam	05/03/2021	19/10/2021
j) Medical Exam validity	16/03/2022	26/10/2022
k) FRTOL Valid upto	12/11/2023	03/05/2026
l) Instrument Rating	Valid	Valid
m) Date of Last IR check	30/06/2021	08/08/2021
n) Date of last Proficiency Check	24/11/2021	24/01/2022
o) Total flying experience	3420hrs	1908hrs
p) Experience on Type	3030hrs	1641hrs
q) Experience as PIC on Type	1165:30hrs	N/A
r) Last technical refresher	17/06/2021	06/01/2022
s) Total flying experience in last 180 days	253:33Hrs	214:39hrs
t) Total flying experience in last 30 days	35:59hrs	50:29hrs
u) Total flying experience in last 7 days	01:45hrs	08:06hrs
v) Total flying experience in last 24 hrs.	01:45hrs	01:45hrs
w) Rest before duty	14:25hrs	12:30hrs

1.5.2 Details of involved B1 AME:

The aircraft was released for operations by an appropriately licensed and authorised B1 AME of AIESL. He also travelled on-board to Bhuj. The details of the licences and authorization are as mentioned below:-

a) Type of license	B1 – ATR 42-400/500/ 72-212A
b) Valid upto	24/10/2026
c) Date of last refresher	07.08.2020 to 08.08.2020
d) Type of company authorization held	Authorisation number : 111294, ATR 42-200/300 Series (PWC 120) –CAT B1; limitation 2,3,7 ATR 42-400/500 / 72-212A (PWC 120) –CAT B1; limitation 3,7 A319/A320/A321(CFM56)- CAT A
e) Date of company authorization	Initial issue: 25.10.2010, Last issued on 31.12.2021 valid till 31.12.2022

The details of duty performed by the involved B1 AME prior to the incident are as below:-

Sl. No	Date	Nature of duty and type of duty, Reporting time and end of duty (as per attendance register)	Duty period
1.	01.02.2022	Maintenance and Certification of aircraft at base and at outstation (on flight duty). Duty start time: 13:00 IST, Duty end time 21:00 IST	08 hours
2.	02.02.2022	Maintenance and Certification of aircraft at base and at outstation (on flight duty). A 320Neo Cat A assessment Duty start time: 14:00 IST, Duty end time 23:00 IST	09 hours
3.	03.02.2022	Maintenance and Certification of aircraft at base and at outstation (on flight duty). He was rostered for duty from 10:30 IST to 18:30 IST which includes Flight duty to Sindhudurg(9I-661/662) and flight duty to Diu (9I-623/624). Duty start time: 10:30 IST, Duty end time 18:30 IST	08 hours
4.	04.02.2022	Maintenance and Certification of aircraft at base and at outstation (on flight duty). He was rostered for duty from 10:00 IST to 18:00 IST which includes Flight duty Sindhudurg(9I-661/662) and flight duty to Diu (9I-623/624). Duty start time: 10:00IST, Duty end time 18:00IST	08 hours

Sl. No	Date	Nature of duty and type of duty, Reporting time and end of duty (as per attendance register)	Duty period
5.	05.02.2022	Maintenance and Certification of aircraft at base and at outstation (on flight duty). Duty from 04:00 IST-12:00 IST ; Flight duty to Bhuj(9I-625/626) and Sindhudurg(9I-661/662). Duty start time: 04:00IST, Duty end time 15:30IST	11 hours 30minutes
6.	06.02.2022	Maintenance and Certification of aircraft at base and at outstation (on flight duty). Duty from 06:00 IST-14:00 IST and Flight duty to Sindhudurg (9I-661/662). Duty start time: 06:00IST, Duty end time 15:30IST	09 hours 30 minutes
7.	07.02.2022	Maintenance and Certification of aircraft at base and at outstation (on flight duty). Duty from 03:00 IST-11:00 IST; Flight duty to Bhuj(9I-625/626), Sindhudurg (9I-661/662) and Diu (9I-623/624). Duty start time: 03:00IST, Duty end time 21:30IST	18 hours 30minutes
8.	08.02.2022	Maintenance and Certification of aircraft at base and at outstation (on flight duty). Duty from 03:00 IST-11:00 IST; Flight duty to Bhuj (9I-625/626), Sindhudurg (9I-661/662) and Diu (9I-623/624). He signed out at 19:30IST and left for home after departure of 9I-657 (13:28 UTC/ 18:58 IST) Duty start time: 03:00IST, Duty end time 19:30IST	16 hours 30minutes
9.	09.02.2022	Maintenance and Certification of aircraft at base and at outstation (on flight duty). Duty from 03:00 IST-11:00 IST; Flight duty to Bhuj(9I-625/626) and Sindhudurg(9I-661/662). He reported at Alliance Air Flight dispatch at 00:00 UTC.	Duty start was in 1st shift for Flight duty to Bhuj, aircraft was grounded in Bhuj.

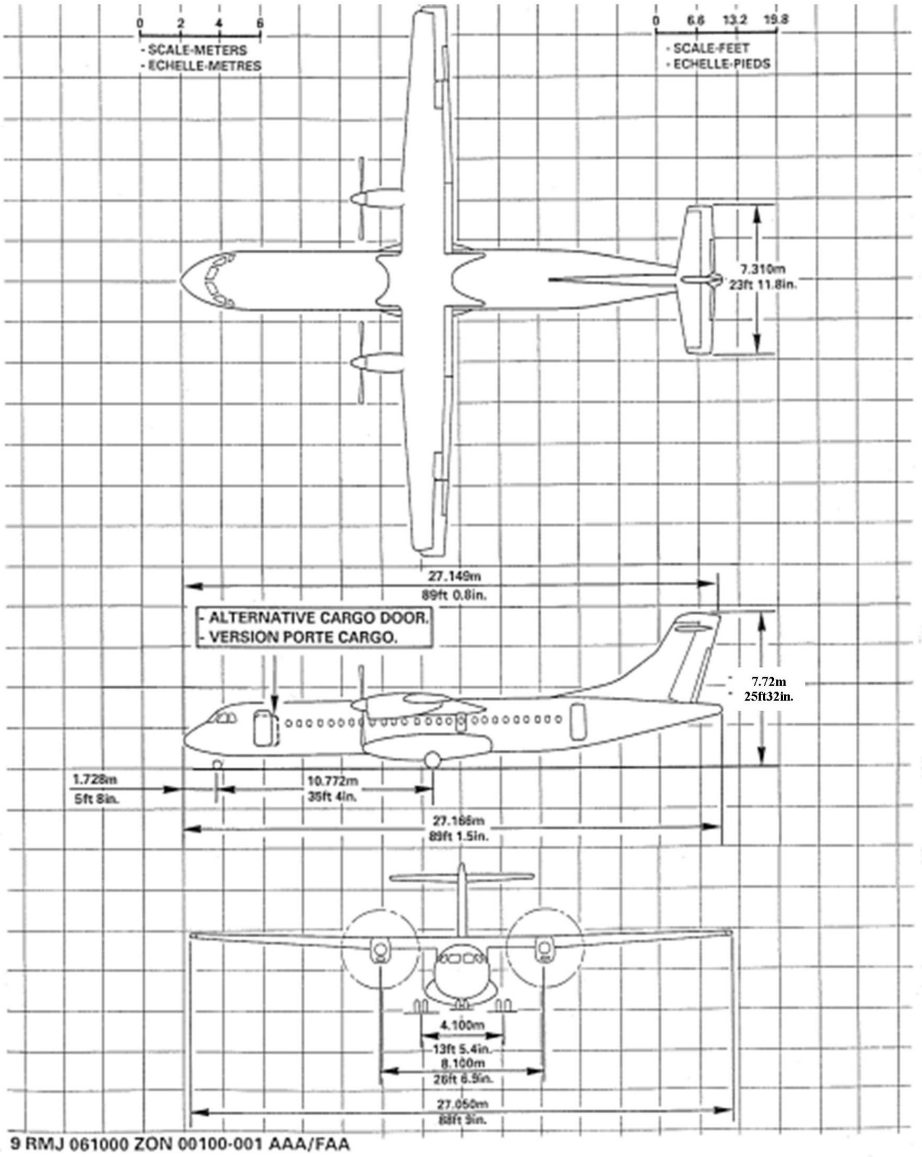
The last off day from duty for the involved B1 AME was 18 days prior to the incident (last off was on 21st Jan 2022).

1.6 Aircraft information:

ATR 72-212A (600 Version)is a twin engine aircraft installed with Pratt and Whitney PW-127 turbo prop engine. The propeller installed on the aircraft is a six bladed HAMILTON STANDARD 568F. The aircraft is certified in Normal category, for day and night operation under VFR & IFR.

Only the outer portion of wing (from wing tip till propeller) is visible from the cockpit.

1.6.1 Aircraft:-	
a) Manufacturer	ATR
b) Type	ATR 72-212A(600)
c) Owner	MSN 1439 Leasing SPC Limited
d) Lessor	DAE Leasing Ireland 21 Limited
e) Operator	Alliance Air Aviation Limited(Alliance Air)
f) Manufacturer Serial no.	1439
g) Year of Manufacture	2017
h) Certificate of Airworthiness issue date	25.07.2018
i) Airworthiness Review Certificate	Issue Date: 24.07.2021 Validity:- 25.07.2022
j) Category	Normal
k) Certificate of Registration	C of R No.4921/3 Validity:- 10.07.2032
l) Minimum Crew Required	02 Cockpit Crew
m) Maximum All Up weight	23000 Kg
n) Last major inspection	1 C Check on 05.10.2020 at TSN/CSN 4932:03/4497
o) Last inspection	2A Check on 16.08.2021 at TSN/CSN 6409:20/6029
p) Airframe Hrs since new	7096:57 Hrs



Dimensions and Areas
General Dimensions

1.6.2 Engine:-	LH	RH
a) Manufacturer	Pratt and Whitney	Pratt and Whitney
b) Type	PW 127M	PW 127M
c) Engine Serial no.	ED#1023	ED#1902
d) Time Since new(TSN)	11473:50 Hrs	2683:05 Hrs
e) Cycles since new(CSN)	10171	2678
f) Date of installation on VT-RKJ	19.02.2021	23.09.2021
g) Time since last shop visit(TSV)	1504:07 Hrs	656:41 Hrs
h) Cycle since last shop visit(CSV)	1587	687

1.6.3 Engine Nacelle/Pylons:

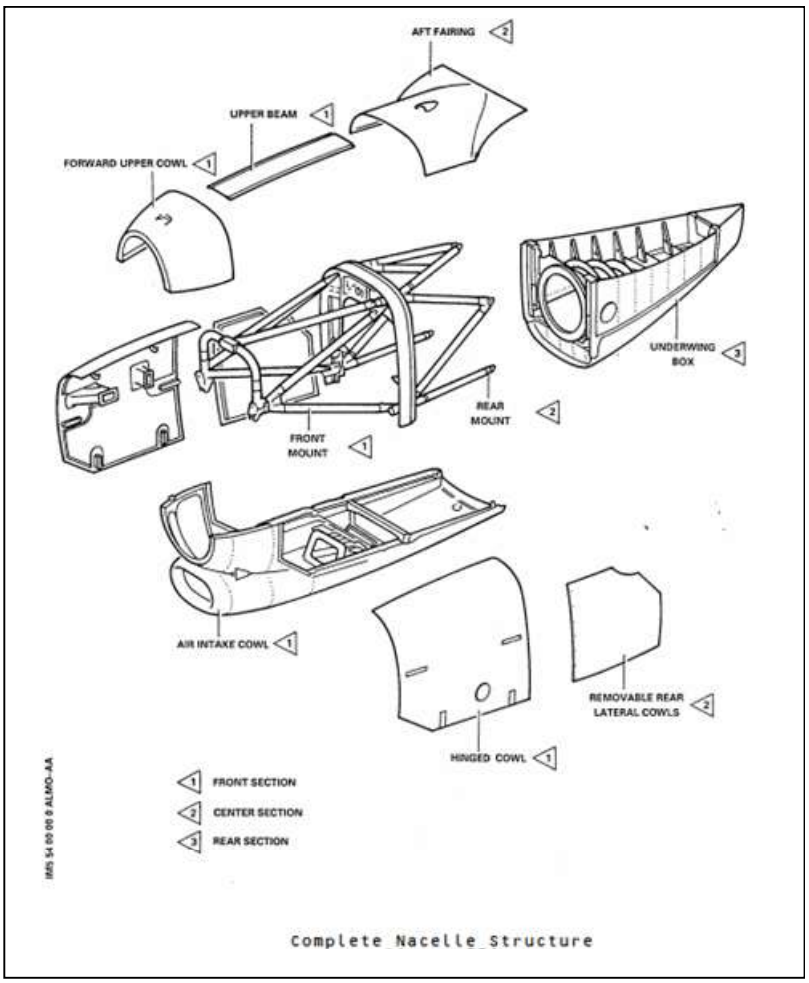
1.6.3.1 Description of Engine Nacelle/Pylon (Aircraft Maintenance Manual):

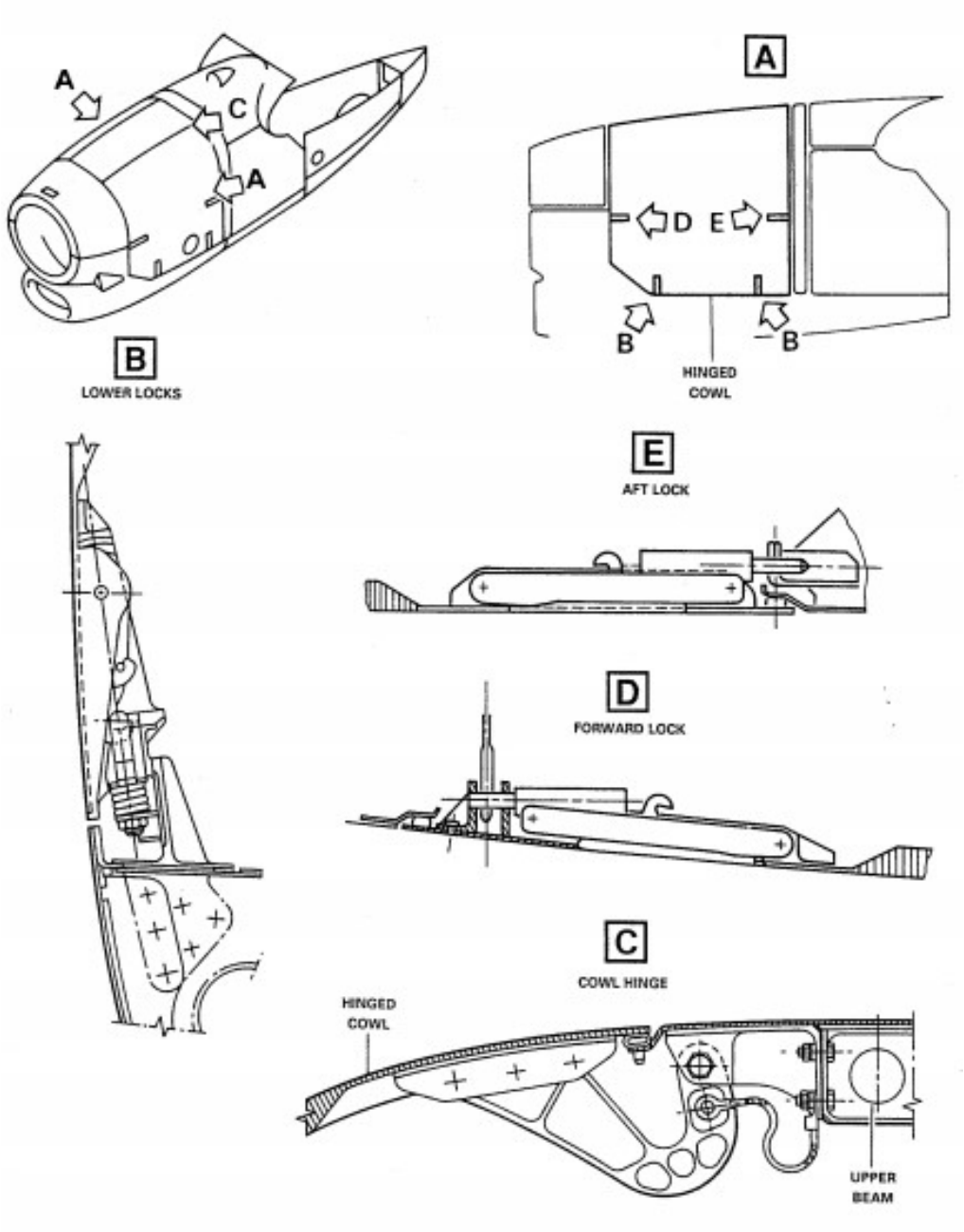
The engine nacelles are fixed to the center box lower surface and to the wing front spar, between ribs 10 and 12. Each nacelle includes the following:-

A. A front section including:
-Front engine mount
-Air intake cowl
-Upper beam
-Two lateral hinged cowls
-Forward upper cowl

B. A center section including:-
-Rear engine mount
-Firewall
-Intermediate frame
-Two rear lateral cowls
-Aft upper fairing

C. A rear section including:
-Underwing box
-Fairings.





Opening Lateral Cowls

Upper Beam:-

The upper beam as depicted in figure above is made of titanium sheet metal, connects the forward arch of the engine mount to the intermediate frame and accommodates the hinges for the hinged lateral cowls.

Hinged Cowls:-

Two cowls, opening upwards, are hinged on either side of the upper beam (refer figure below). They are made of carbon/Nomex fireproof sandwich and are covered on their outer face by bronze mesh. They include DC starter generator and AC generator ventilation air outlets and inlets, oil level inspection and fire extinguisher nozzle introduction access door. Each cowl is held closed by four locks. The travel of each cowl is limited by a telescopic rod.

Two opening cowls are hinged by curved fittings on a longitudinal support beam attached between the mount forward upper fitting and the intermediate frame. Cowl locking is by quick fasteners of the "COWL CLOSED" type and each cowl opens from bottom to top.

The travel of each cowl is limited by a telescopic rod. Cowl sealing is achieved by seal with integral retaining heads.

1.6.3.2: <u>Procedure for Opening and closing of Hinged Engine Cowls (Aircraft Maintenance Manual):</u>

<u>OPENING OF ENGINE HINGED COWLS</u>

REF. FIG. BELOW

1. Unlock locks (3) and (4).
2. Open hinged cowl (1) and extend telescopic strut fully to allow automatic locking in extended position.

NOTE : Blank engine air inlets and outlets to prevent ingress of foreign bodies

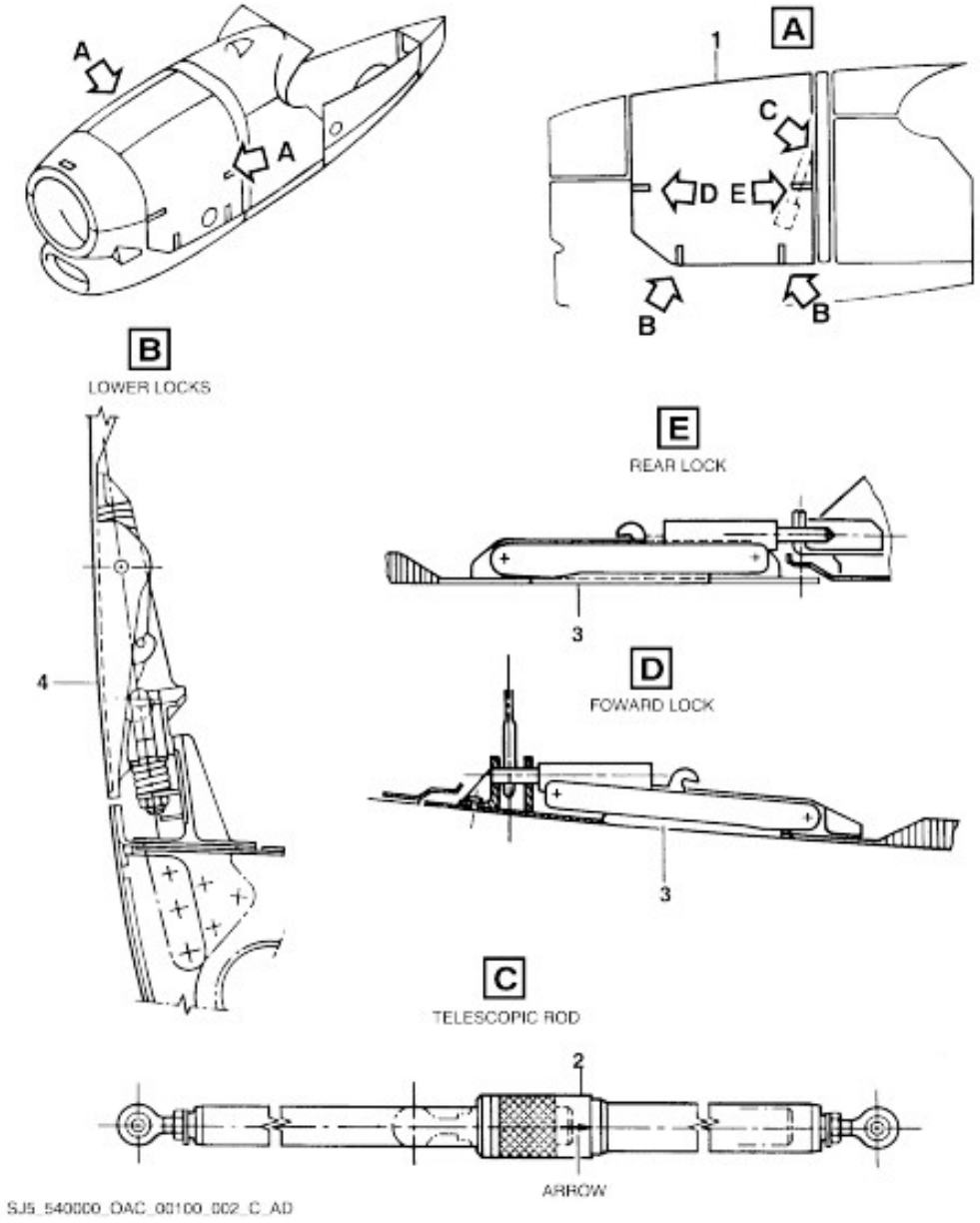
<u>CLOSING OF ENGINE HINGED COWL</u>

REF. FIG. BELOW

NOTE: Check seals all around the cowl for good condition.

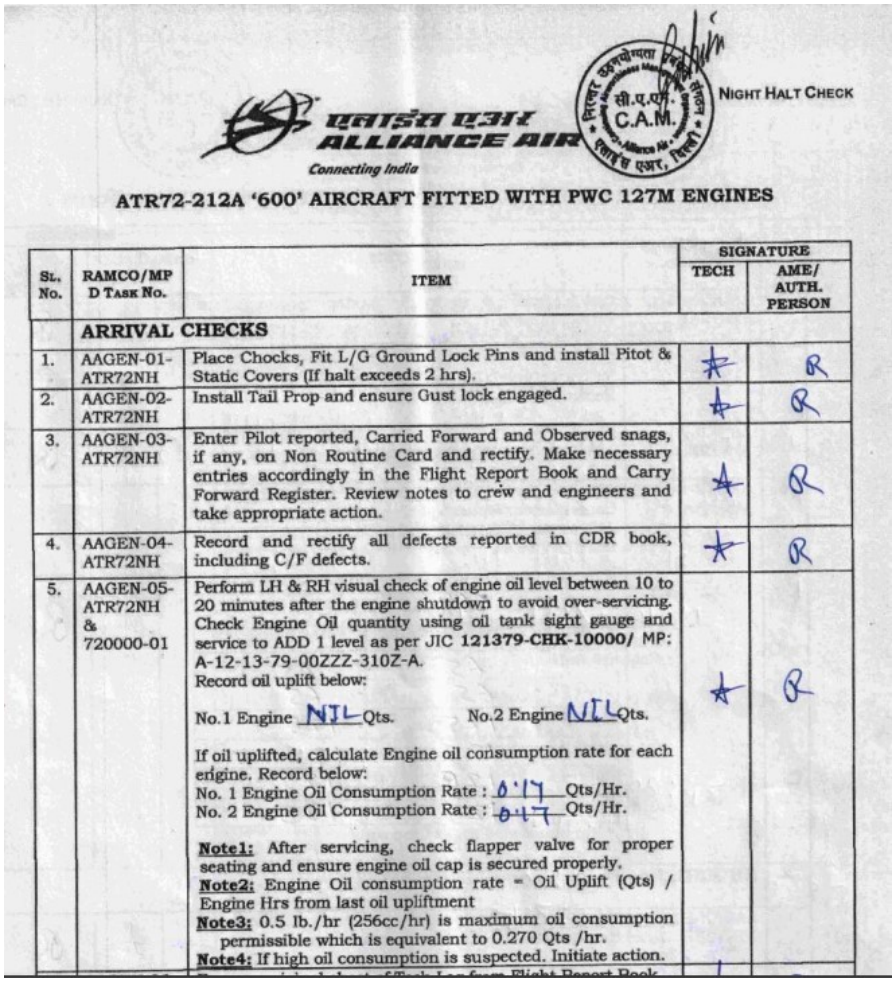
1. Remove protective blanks installed on air inlets and outlets.
2. Hold engine hinged cowl and unlock telescopic strut by operating sleeve axially (2) as per arrow.
3. Close hinged cowl (1).
4. Lock locks (3).

5. Lock locks (4).
6. Make certain that locks operate correctly (adjustment of tension) and that locking is performed correctly



1.6.3.3: <u>Conduct of Night halt check on 08.02.2022</u>:

Night halt check for VT-RKJ was scheduled after arrival on 08.02.2022 and prior to the departure on 09.02.2022.
Night halt check included Airframe, Engine and propeller inspections including oil level check, and oil filter impending by-pass indication.



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NIGHT HALT CHECK

ATR72-212A '600' AIRCRAFT FITTED WITH PWC 127M ENGINES

St. No.	RAMCO/MP D Task No.	ITEM	SIGNATURE TECH	SIGNATURE AME/ AUTH. PERSON
	ARRIVAL CHECKS			
1.	AAGEN-01-ATR72NH	Place Chocks, Fit L/G Ground Lock Pins and install Pitot & Static Covers (If halt exceeds 2 hrs).	✓	R
2.	AAGEN-02-ATR72NH	Install Tail Prop and ensure Gust lock engaged.	✓	R
3.	AAGEN-03-ATR72NH	Enter Pilot reported, Carried Forward and Observed snags, if any, on Non Routine Card and rectify. Make necessary entries accordingly in the Flight Report Book and Carry Forward Register. Review notes to crew and engineers and take appropriate action.	✓	R
4.	AAGEN-04-ATR72NH	Record and rectify all defects reported in CDR book, including C/F defects.	✓	R
5.	AAGEN-05-ATR72NH & 720000-01	Perform LH & RH visual check of engine oil level between 10 to 20 minutes after the engine shutdown to avoid over-servicing. Check Engine Oil quantity using oil tank sight gauge and service to ADD 1 level as per JIC **121379-CHK-10000/** MP: A-12-13-79-00ZZZ-310Z-A. Record oil uplift below: No.1 Engine NIL Qts. No.2 Engine NIL Qts. If oil uplifted, calculate Engine oil consumption rate for each engine. Record below: No. 1 Engine Oil Consumption Rate : 0.17 Qts/Hr. No. 2 Engine Oil Consumption Rate : 0.17 Qts/Hr. **Note1:** After servicing, check flapper valve for proper seating and ensure engine oil cap is secured properly. **Note2:** Engine Oil consumption rate = Oil Uplift (Qts) / Engine Hrs from last oil upliftment **Note3:** 0.5 lb./hr (256cc/hr) is maximum oil consumption permissible which is equivalent to 0.270 Qts /hr. **Note4:** If high oil consumption is suspected. Initiate action.	✓	R

B.	**ENGINE, NACELLE, PROPELLER AND FUEL**			
1.	AAGEN-B1-ATR72NH	Visually check for condition of No. 1 & No. 2 Engine Nacelles, Access Panels and Drains.	✓	R
2.	AAGEN-B2-ATR72NH	Carry out the inspection of Engine Air Intake area including first stage impeller for FOD. Check the condition of visible Power Turbine blades and exhaust sections.	✓	R
3	720000-10	Visual check of Main oil filter impending by-pass indicator, as per **JIC 792261-CHK-10000/** MP: A-79-22-60-00ZZZ-281Z-A. [LH & RH ENGINE]	✓	R
4	AAGEN-B4-ATR72NH	Check that propeller blades in feather position align with the marks on the spinner.	✓	R
5	AAGEN-B5-ATR72NH *	Drain water from Fuel Tank and Surge Tank as per **JIC 122428-DRN-10000/** MP: A-12-24-28-00ZZZ-220Z-A.	✓	R

Relevant portion of Night Halt inspection schedule w.r.t Engine oil inspection conducted prior to departure on 09.02.2022

The technician opened the inboard lateral hinged cowling for check of the engine oil of engine#2, as the oil level and oil filter bypass indicator are visible after opening lateral hinged cowl(inboard) for engine#2.

For scheduled Night Halt check as per the 'Master Service Agreement' made between Alliance Air Aviation Ltd. and AIESL, the turnaround time (TAT days/Hours) is 04 hours.

The Night halt inspection schedule was signed with time entered as at 23:15 UTC by involved B1 AME on 08.02.2022 and pre-departure checks were signed by B1 AME on 09.02.2022 at 00:12 UTC.

1.7 Meteorological information:

METAR VABB 090030Z 07003KT 2500 HZ SCT020 21/18 Q1012 NOSIG
METAR VABB 090100Z 09003KT 2500 HZ SCT020 21/19 Q1013 NOSIG

The sunrise time on 09.02.2022 was 01:40 UTC (07:10 IST)

1.8 Aids of navigation:

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

1.9 Communication:

Two way radio communications was available between aircraft and ATC.

Mumbai ATS:-
The aircraft was given taxi clearance via W7–RWY14- LEFT on N1 Holding Point RWY 27.
VT-RKJ was given takeoff clearance from runway 27 at 00:56:12 UTC.
At 01:10:12 UTC IGO6014 was given clearance for line-up on runway 27 along with takeoff clearance.
IGO6014 which departed after 9I-625 reported FOD on runway between N3 and N4 at 01:13:26 UTC and ATC advised Follow Me vehicles for runway inspection.
IGO6014 later at 01:15:34 UTC informed that the FOD was on centerline of runway, when queried about location of FOD by Mumbai ASR.
Follow Me vehicle reported aircraft part was found on Runway at 01:18:10 UTC to Mumbai Tower.
At 01:20:30 UTC Mumbai Tower informed Mumbai Area Control North that aircraft parts were found near N3-N4 reported by IGO6014 and the last two departures were LLR625 and IGO5209 to Bhuj and Shamshabad respectively. It was also requested to confirm with LLR625 and IGO5209 whether all operations were normal.
After 01:21:23 UTC Follow Me vehicle which performed runway inspection reported that an aircraft part has been found on runway 27 along the centerline between N3 and N4.
At 01:24:08 UTC Mumbai Area Control North informed 9I-625 about FOD found on runway; LLR625 reported that all operations were normal. Soon after, Mumbai radar services were terminated and advised LLR625 to contact Ahmedabad 123.75 when in range. (Position of aircraft was BBB/R330/084Nm)

At 01:27:34 UTC Mumbai Area Control North-Planning requested Tower controller for the nature of FOD, to which Tower responded that exact information is not available but the item recovered seems to be a fuselage part and is RED in colour. Tower informed that the component is most likely from the LLR625 which departed to Bhuj and it is of 3x3 feet dimension and that "ATR" is mentioned on the recovered component.
Mumbai Area Control North-Planning read back the message w.r.t 'Fuselage ATR 3x3 feet'; Tower confirmed it and again mentioned that the component is RED in colour.
Tower also informed Mumbai Area Control North-Planning that as per information from Airside, they have requested for an AME for identification of the item recovered. However since 'ATR' is mentioned on the recovered item, it is most likely from the departed Allied aircraft.
Following the above, at 01:31:25 UTC Mumbai Area Control North-Planning informed Ahmedabad control that after departure of LLR625, which would be under Ahmedabad control at this time, a Fuselage section of 3x3 feet with 'ATR' mentioned on it was recovered from the runway and requested to convey the message to LLR625, as the component is likely from LLR625.

Tower informed Mumbai Area Control North-Planning by 01:42:16 UTC that the component has been identified by AIESL AME as 'Engine cowling'.
Mumbai Area Control North-Planning contacted Ahmedabad Control at 01:43:19 UTC and conveyed that the AME at Mumbai has confirmed the component recovered as 'Engine cowling'. However, Ahmedabad Control informed Mumbai Area Control North-Planning that they were unable to contact LLR625.
Further at 01:54:27 UTC Mumbai Area Control North-Planning contacted Ahmedabad Control and confirmed whether information was conveyed to LLR625. Ahmedabad Control informed Mumbai Area Control North-Planning that LLR625 has reported all operations normal.

Further it has been informed that, Ahmedabad informed LLR625 about the aircraft part found at Mumbai on RWY27 at 01:44 UTC and at this time LLR625 was at R330 159 nm w.r.t BBB.

Ahmedabad ATS:-

At 01:31 UTC Mumbai Area Control informed Ahmedabad control that after departure of LLR625, which would be under Ahmedabad control at this time, a Fuselage section of 3x3 feet with 'ATR' mentioned on it was recovered from the runway and requested to convey the message to LLR625, as the component is likely from LLR625
LLR625 came in contact with Ahmedabad ATS unit at 01:36 UTC.
At 01:39:21 UTC Ahmedabad ATS unit informed LLR625 that after its departure from Mumbai part of ATR fuselage was found on runway, however readability was poor and the aircraft was unable to receive the message till 01:43:25 UTC. At 01:43 UTC crew of LLR625 requested for confirmation regarding type of component which was found at Mumbai on runway, Ahmedabad ATC informed that it was part of fuselage of 'ATR'.
At 01:43:27 UTC Mumbai controller via landline informed Ahmedabad (ACC) area controller that AME has confirmed that the part recovered is 'engine cowling' cover and requested to inform

LLR625. Further at 01:54 UTC Mumbai controller via landline queried with Ahmedabad area controller whether information about 'engine cowling' has been relayed to LLR625 and Ahmedabad control replied that LLR625 reported all operations were normal and that he had informed the LLR625 about the 'Fuselage part' recovered and he would further inform LLR625 that the component was 'Engine cowling'.
The aircraft was changed over to Bhuj at 02:03 UTC.

1.10 Aerodrome information:

Chhatrapati Shivaji Maharaj International Airport is an international airport located in Mumbai. The runway available is an instrument runway of orientation Runway 09/Runway 27 and Runway 14/ Runway 32.
The luminosity levels of stand C10 (stand on which VT-RKJ was parked) was satisfactory.

1.10.1 VABB (Mumbai) Runway details:-

Runway Designator	TRUE Bearings	Take-off run available (TORA) m	Take-off distance available (TODA) m	Accelerated stop distance available (ASDA) m	Landing distance available (LDA) m
14	134.52deg	2871	2871	2871	2471
32	314.52 deg	2871	2871	2871	2673
09	89.52 deg	3188	3188	3188	3048
27	269.52 deg	3188	3448	3448	2965

On 09.02.2022, after departure of VT-RKJ, departing aircraft (6E-6014) reported FOD on runway, ATC informed Apron at 01:14 UTC (06:44 IST) and Follow Me inspected the runway from 01:14 UTC (06:44 IST) to 01:24 UTC (06:51 IST). During the inspection Engine cowl and 02 stay rods were found on runway. The runway was cleared by 01:59 UTC (07:29 IST) after clearing the FOD.

1.11 Flight recorders:

1.11.1 CVR:-

The aircraft was installed with a Solid State Cockpit Voice Recorder. The CVR unit was replaced after landing at Bhuj, the data was retrieved and it was utilised in the investigation. Following are the observations made:-

1. Push back was completed at 00:18:20 relative time followed by engine#1 start.
2. The aircraft then taxied to runway 27 and was given take-off clearance by 00:25:45 relative time.
3. The discussion between the cockpit crew members did not indicate that, either of them was aware of any abnormal situation w.r.t the aircraft.

4. At 00:53:43 relative time Mumbai radar enquired with 9I-625 to confirm whether all operations were normal as a FOD was found on runway at Mumbai. Crew replied that all operations were normal and that they would check at destination.
   Ensuing which the aircraft was changed over to Ahmedabad ATS unit by relative time 00:54:20.
5. At relative time 01:06:28 crew informed the AME about information received from Mumbai control, regarding Foreign object received on runway and that aircraft parameters were normal. The on-board B1 AME enquired about the kind of FOD to which crew replied that they got information about FOD. Crew also informed the AME that, before them two aircraft had landed and the FOD could belong to them also.
6. By relative time 01:12:59, Ahmedabad control informed 9I-625 that the damaged part recovered at Mumbai runway was an ATR part and requested to confirm whether all parameters were normal. Crew also enquired that the part was any specific part of ATR. Ahmedabad control replied that, it was ATR fuselage part. Crew replied that all parameters were normal and that they would check at destination.
7. After receipt of information from Ahmedabad control, at 01:14:05 relative time the on-board AME was called to the cockpit by the operating crew and same was informed to him. He also confirmed with crew that the parameters were normal. Crew informed the AME to check after landing.
8. Aircraft landed by relative time 01:58:09.

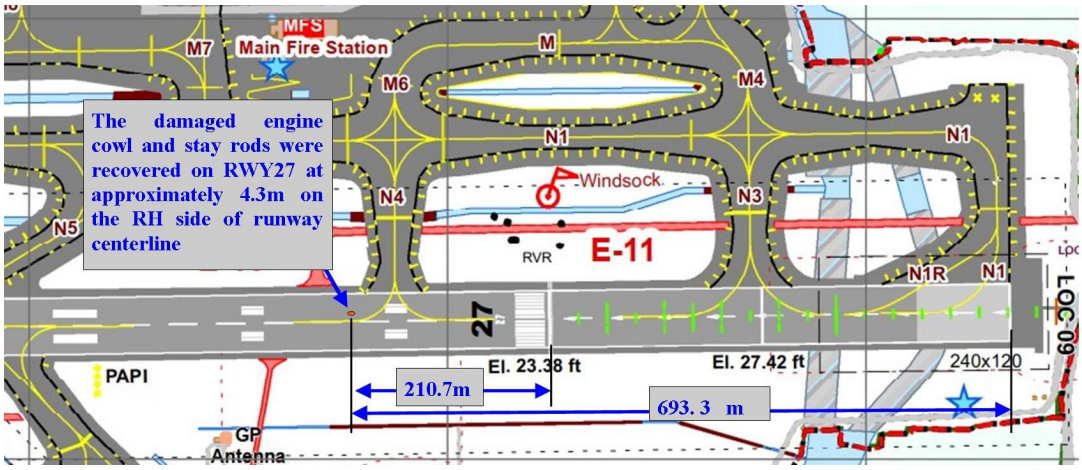
1.11.2 <u>DFDR:-</u>

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

1. Data recording started at 00:50:00 UTC and aircraft had started taxi with both engines ON.
2. By 00:56:24 UTC the PLA's of both engines were advanced to take-off power and take-off run was started. The recorded aircraft speed (IAS) reached 126 kt and the aircraft took-off at 00:56:54 UTC.
3. The aircraft reached maximum altitude of 16000 ft by 01:18:14 UTC
4. Descend was initiated by 02:05:40 UTC and aircraft landed by 02:28:16 UTC.

1.12 Wreckage and impact information:

The RH engine lateral hinged cowl(inboard) and stay rods were recovered on runway 27 abeam taxiway N4 at 210.7m from the displaced threshold of runway 27, 693.3m from start of runway and about 4.3m from the runway centerline.



The location of damaged cowl depicted on Grid map of VABB (Mumbai) [Not to scale]

1.13 Medical and pathological information:

The First Officer was subjected to pre-flight B.A test at 23:41 UTC (05:11 IST) at Mumbai before departing for the flight and result was 'negative' for alcohol breath analyser test. As per extant DGCA guidelines in view of COVID 19 guidelines the PIC and B1 AME(travelling on-board) had given 'undertaking' w.r.t non-consumption of alcohol at 23:51 UTC (05:21 IST) and 00:00 UTC (05:30 IST) respectively, the crew were cleared for flight operations.

1.14 Fire:

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

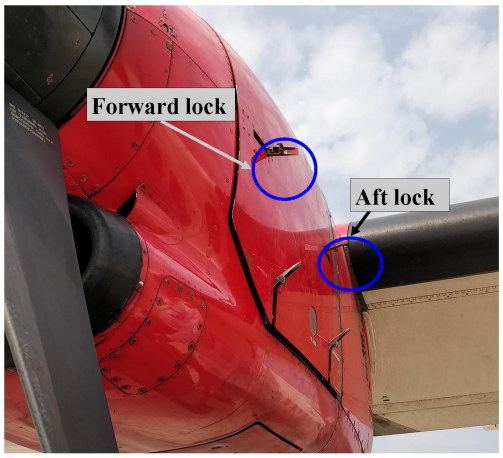
1.15 Survival aspects:

The incident was survivable. There was no injury reported to the passengers, crew or any other ground personnel.

1.16 Tests and research:

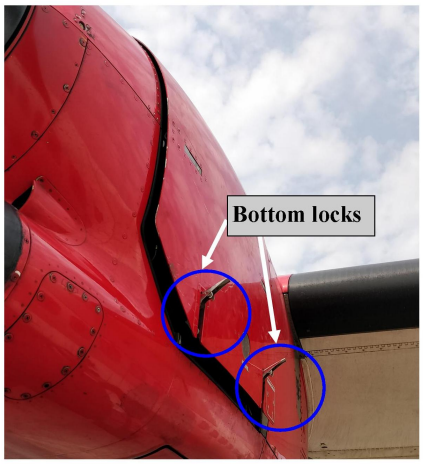
1.16.1 The matter was taken up by M/s Alliance Air with M/s ATR. M/s ATR reported that, latches and fittings were not damaged and they concluded that locking of the cowl was not done properly and as soon as the aircraft took off, the airflow ripped the cowl from the nacelle.

1.16.2 Tests were performed on the same aircraft after replacement of the affected cowling with various combinations of locking state of the cowl and following were observed in simulations:-



Aft lock, forward lock and bottom locks in Open condition

Fig 1(a)



Aft lock and forward lock placed to locked position prior to closing the cowl and bottom locks remaining open

Fig 1 (b)

Cowl closed and Aft lock and forward locked properly. Bottom locks remaining unlocked.

Fig 1(c)

Aft lock and forward lock remaining open. Both bottom locks locked after closing the cowl.

Fig 1(d)

Inboard Hinged Cowl indicating position with various conditions of the locking latches during simulations

Figure 1(a) - When both the horizontal 'forward lock' and 'aft lock' latches are open and inboard lateral hinged cowl is placed down, the cowl is not flush with the other engine cowls. The 'bottom lock' latches cannot be placed to lock position before completely closing the inboard lateral hinged cowl.

Figure 1(b) - When both the horizontal 'forward lock' and 'aft lock' latches are engaged in locked position prior to bringing the inboard lateral hinged cowl down inboard lateral hinged cowl is not flush with the other engine cowls. The 'bottom lock' latches cannot be placed to lock position before completely closing the inboard lateral hinged cowl.

Figure 1(c) - When both the horizontal 'forward lock' and 'aft lock' latches are locked after fully closing the inboard lateral hinged cowl the cowl is flush with the other engine cowls fixed engine cowls/fairings, even if the bottom locks remain open. The unlocked position of the bottom lock latches are clearly visible in this condition.

Figure 1(d) - When both the 'bottom lock' latches are locked after fully closing the inboard lateral hinged cowl the cowl is flush with the other engine cowls, even if the 'forward' and 'aft' locks latches remain open. The unlocked position of the 'forward lock' and 'aft lock' latches are clearly visible in this condition.

1.17 Organizational& Management Information:-

1.17.1 M/s Alliance Air

Alliance Air Aviation Ltd.(Alliance Air) is an airline holding a valid Air Operator Certificate no.S-8 issued by DGCA valid upto 30.04.2023. The airline is a government-owned enterprise. It operates a fleet of ATR 72-212A aircraft. The airline has its main operating and maintenance hubs at Indira Gandhi International Airport, New Delhi and Hyderabad International Airport.
The line and base engineering maintenance activities of Alliance Air aircraft's are outsourced to Air India Engineering Services Ltd.(AIESL) which is a DGCA approved CAR 145 organisation.
Alliance Air has a CAMO setup who monitors the continuous airworthiness requirements of the fleet of aircraft, the CAMO monitors the scheduled tasks which are in turn conveyed to the engineering service provider (i.e., AIESL).

1.17.2 Air India Engineering Services Ltd.(AIESL)

Air India Engineering Services Ltd.(AIESL) is a DGCA approved CAR 145 organisation.

1.17.2.1 Engineering Procedures Manual, Duties and Responsibilities (relevant portion is appended):

DY. GENERAL MANAGER (LM - B1 & B2)
He is responsible for ensuring that all aircraft maintenance carried out are to the standard specified in CAR-145. He reports to LMM & assist LMM in carrying out the following functions:

1. Administration of Line Maintenance Division including sections attached to it.
2. Ensure continuing airworthiness standards.
3. Implement Quality and safety standards as set forth in MOE.
4. Ensuring that all production (aircraft maintenance activities) is performed under the Supervision of duly licensed / authorised AMEs.

5. Ensure continuous availability and support of qualified workforce at all levels.
6. Support in planning of facilities, man-power, materials, and tools required based on the forecasted work.
7. Prepare rosters of Executives / AMEs / Aircraft Technician etc and related activities with a view to maximize availability of manpower at base.

SENIOR ASSISTANT GENERAL MANAGER (SHIFT IN-CHARGE – L/M)

SIC is directly responsible to the LMM for the efficient servicing of the Company's capability of aircraft under his jurisdiction and such other aircraft belonging to outside parties as are serviced by the AIESL, in accordance with the DGCA's rules and regulations and also those of AIESL.

In addition to the above responsibility of maintaining aircraft at a high standard of efficiency, SIC has responsibilities of a multiple character, the full extent of which is beyond precise definition, but interalia shall include the following:

1. Administration of shift in Line Maintenance Division including sections attached to it.
2. Monitoring of aircraft under his jurisdiction / and planning the accomplishment of required maintenance tasks including component replacement in consultation with production planning & control section in such a way that delay in flight operation is avoided/minimised.
3. Ensure that concise and clear instructions are given to his staff for carrying out their day-to-day work and solving their difficulties in carrying out work of unusual nature.
4. Maintain discipline amongst all employees under his control.
5. Report to respective LMM any acts of misconduct, indiscipline, insubordination etc,
6. Ensure that all employees attend to their work regularly and no time is wasted.
7. Ensure that undue overtime is not expended.
8. Ensure that optimum allocation of manpower is made according to the requirements of workload and norms/ rules laid down by the Company.

AIRCRAFT MAINTENANCE ENGINEER - LINE STATIONS

1. Observe Human factor, regulatory requirements of DGCA in the maintenance activity.
2. Allocation of work on aircraft, engines or systems as the case may be to Technician and supervising work progress to ensure compliance of airworthiness, quality control, safety standards and laid down procedures and for timely job completion.
3. Maintenance and certification of the airworthiness of aircraft covering inspection checks, modifications, parts replacements, defect rectification and special checks.
4. Inspection and certification of approved schedules of aircraft / engines, equipment / components and system within the scope of his licenses/ authorizations.
5. Completion of approved work packages and entries regarding reported defects in the Technical Log/ Pilot Defect Report/ Deferred Maintenance Records and subsequent issue of CRS before releasing the aircraft for flight.
6. Ensure adherence to required safety standards / precautions in the assigned area of work.

1.17.2.2 Duty time limitations of Aircraft Maintenance Personnel:-

The DGCA approved MOE of AIESL cross references EPM for the duty time limitation of aircraft maintenance personnel. DGCA AAC 05 of 2019 has been reflected in the Engineering Procedures Manual.

1.17.2.3 Duty allocation of Aircraft Maintenance Engineers:-

The AIESL line maintenance at Mumbai base had a total of five (05) authorised B1 certified AME's (ATR fleet) with the organisation, as on date of incident. Allocation of AME is done in 3 shifts.

On date of occurrence two out of these five AME's were attending refresher training. Two B1 AME's are also holding A320 family authorizations; one of them was allotted in the night shift on 07.02.2022 and 08.02.2022 and was allotted on A320 family aircraft due to requirement on Airbus side; the other AME was on leave.

On 08.02.2022 only 01 B1 authorised AME was available for scheduled flight handling with the organisation due to internal issues as above. The duty roster for February 2022 for AME's on ATR fleet was not be generated by AIESL due to shortage of adequate number of AME's. As per available information from AIESL, the roster was being prepared only a day or at the most a couple of days in advance due to the limited number of certifying staff.

On 08.02.2022 the available B1 AME was allocated for 1st shift (05:00-13:00 plus 2 flight duty in the prepared roster (which was hand corrected as 03:00-11:00 plus 2 flight duty). Also he was allocated for second shift for 01 flight duty. The same B1 AME was allocated for night shift on 08.02.2022. Further he was allotted the early morning departure on 09.02.2022 in first shift (from 04:00-12:00 plus 02 flight duty), the first flight being 9I-625 to Bhuj (incident flight sector).

1.17.3 <u>DGCA</u>

1.17.3.1 <u>Airworthiness Advisory Circular (AAC) 05 of 2019</u> (relevant portion is appended below):

CAR 145.A47 (b) requires that the planning of maintenance tasks and the organising of shifts, shall take into account human performance limitations. Further AMC145.A.47 (b) states that the Production planning Limitations of human performance in the context of planning safety related tasks refers to the upper and lower limits and variations of certain aspects of human performance (Circadian rhythm / 24 hours body cycle) which personnel be aware of when planning work and shifts

Human Performance and Degradation:

1. The physical and mental human performance of an individual is dependent upon vision, hearing, information processing capability, attention, perception, memory,

judgment and decision making ability. The physical ability could be impaired/limited by unhealthy work environment, improper lighting arrangement and adverse environmental conditions (e.g. extremely hot hangar, rain, cold, etc.).
The mental ability is also likely to degrade and eventually fall below optimal level if affected by lack of medical fitness, accumulation of stress (domestic/ work related), strict time line to accomplish the work.

2. Tiredness and fatigue can adversely affect human performance. Excessive hours of duty and shift work, particularly with multiple shifts or additional overtime, can lead to fatigue resulting in an impaired performance.

3. Some of the most critical performance errors associated with individual fatigue include but are not limited to:
    - Impaired judgement and decision making;
    - Impaired communication skills;
    - Decreased attention span and ability to recall information;
    - Irritability;
    - Slower reaction times; and
    - Increased risk-taking.

Factors affecting DTL for AMP and its management

Following factors should be taken into account by all organization to avoid any fatigue related error by an AMP:

Daily Limits:
As performance of maintenance personal exponentially varies with extended period of shift work, therefore, the time schedule of shift should be scrupulously adhered to avoid fatigue related issues. Generally, shift durations are 8 to 10Hrs, which may extend due to work exigencies with the prior permission of responsible post holder-Maintenance providing adequate rest period between the extended duty hours. Working more than 12 Hrs is considered un-desirable.
Note: Beginning of duty time for certifying personnel on flight duty should be calculated one hour before the flight departure and termination of the duty should be half an hour after the last certification.

Longer Limits:
Some of the residual fatigue may accumulate over weeks and months despite the provision of rest days and therefore limiting the work, which can be undertaken over longer period of time and provision of leave in reasonable time, is important.

Limits on Night Shifts:
a) There is significant evidence to suggest that risk increases at night by about 30% in relation to the morning/day shift. The efficiency reduces progressively during the night shift due to development of fatigue in adverse working condition. The risk becomes more

prominent, when night shifts are performed successively. Therefore, number of continuous night shift should not exceed more than two and same should be followed by at least two successive days rest period.

b) Policy for allocation of work during night shift should be framed taking into account the following:

(i) Adequate staffing in relation to the anticipated work load.

(ii) Whenever the AMP is in initial or successive night shift, complex/ critical tasks should be planned earlier leaving the lighter job for the later part of the shift. Allocation of work to AMP should match the availability of time during the shift and working overtime beyond the night shift should be avoided.

(iii)Work allocation to AMP involving single or multiple type of aircraft/engines should be factored in.

Guidelines for Good Practices:

1. AMP should report for duty after being adequately rested. AMP should be counselled for sufficient uninterrupted sleep to minimize stress and to dissipate fatigue during the rest period.
2. A minimum rest period of 11 hours should be allowed between the end of shift and the beginning of the next, and this should not be compromised by overtime.
   Scheduled work hours should not exceed 48 hours in any period of seven successive days. Total work including overtime, should not exceed 60 hours for seven successive work days before a period of rest days. In fact, it is desirable that work and rest period should match each other for effective dissipation of fatigue, which builds up over the period of work. Work duration for any individual should also have consideration of their mental condition/stress level during the work and complexity/criticality involved.
3. Wherever possible AMP should be given at least 15 days notice for their work schedule.

1.18. Additional information:

Radar/SMGCS data:-

1. 9I-625 started taxi at time 00:50:54UTC.
2. 9I-625 started take-off roll at 00:56:29UTC.
3. The aircraft lifted-off between near the intersection of Runway 09/27 and 14/32 between 00:56:51 and 00:56:58UTC.
4. 01:24:15UTC 9I-625 was informed about the FOD by Mumbai Control.
5. 01:44:05UTC 9I-625 was informed by Ahmedabad control that the FOD is a part of an ATR aircraft before waypoint BUDGO.

The CCTV recording near Stand C-10 at Mumbai airport on which VT-RKJ was parked was not useful.

1.19 Useful or effective investigation techniques:-

Nil.

2. Analysis:-

2.1 Operational aspect:-

PIC was the PF operating for the sector. Both the flight crew were holding valid licenses & were imparted the requisite training for operating the type of aircraft and for executing the duties assigned to them. The subject sector from Mumbai to Bhuj was the first sector out of 04 sectors planned on the 09.02.2022 for the operating crew. The departure was as per the planned schedule (ATD: 00:46 UTC, STD was 00:45UTC).

The sunrise time on 09.02.2022 was 01:40 UTC (07:10 IST), hence at the time of aircraft walk-around inspection [pushback was at 00:46 UTC] sunlight was not present. The PIC reported to have used torch light during walk-around inspection at Mumbai, however did not report any abnormal findings.

After departure of the aircraft from Mumbai (in cruise) Mumbai ATC informed the crew of VT-RKJ about FOD found on runway at 01:24UTC. Crew reported back that all operations were normal. Shortly thereafter, the aircraft was handed over to Ahmedabad ATS control. Cockpit crew informed the on-board B1 AME about the information received from Mumbai ATC and that all parameter indications were normal.
By 01:27 UTC, Mumbai (Area Control North-Planning) got information that the recovered part was a fuselage part of 3*3 ft dimensions, RED in colour and ATR is written on it. A minute later Ahmedabad control was informed by Mumbai (Area Control North-Planning) that a fuselage part of dimensions 3*3 ft with ATR written on it has been recovered and that an Allied aircraft has departed prior to the recovery of the component and hence was likely belonging to the same aircraft. Mumbai (Area Control North-Planning) did not report the colour of the recovered component/ object to Ahmedabad control.

Upon coming in contact with Ahmedabad ATC, the crew was apprised by ATC about the ATR fuselage part found on Mumbai runway after departure of VT-RKJ from Mumbai. Upon receipt of this update, the cockpit crew called the on-board B1 AME [travelling on duty] from the cabin and informed him about the message received from ATC. The discussion between the cockpit crew members and cockpit crew with AME did not indicate that, they were aware of the loss of Engine #2 cowling of VT-RKJ. The crew informed Ahmedabad ATC that operations were normal and continued to destination.
Later Mumbai (Area Control North-Planning) informed Ahmedabad control that the retrieved component has been identified as an 'engine cowling'. Ahmedabad ATS unit did not relay the information regarding the type of component (engine cowling) retrieved at Mumbai while the aircraft was still in contact with Ahmedabad.

The on-board B1 AME and the crew did not make any attempt for assessing the aircraft from the cabin windows w.r.t aircraft part recovered at Mumbai, as reported by ATC. The inboard

lateral hinged cowling is visible from the aircraft cabin. The cabin windows were reported to have been down/ closed and passengers were asleep.
The flight crew was not aware of the engine cowling getting dislodged at Mumbai till receipt of information from AME after Post flight inspection at Bhuj.

2.2 Serviceability of the aircraft:-

The aircraft was having a valid Certificate of Registration issued by DGCA-INDIA and its last ARC was issued on 24.07.2021 valid till 25.07.2022. The last major inspection was '1C' check completed on 05.10.2020 at TSN/CSN: 4932:03 hrs/ 4497 cycles. The last '2A' check was completed on 16.08.2021 at TSN/CSN: 6409:20 hrs/ 6029 cycles. The aircraft had accumulated a total of 7096:57 hrs since new, as on date of the incident.

On the date of incident, the aircraft was scheduled to operate 08 sectors. The first sector operated was from Mumbai to Bhuj, the aircraft chocks off time from Mumbai was 00:46 UTC. There was no defect reported prior to departure for the incident sector.

2.2.1 Engineering Man Power Management and Human Factors:-

The AIESL line maintenance base at Mumbai had a total of five (05) authorised B1 certified AME's as on date of incident to cater for maintenance of one ATR 72-600 aircraft which normally operates from Mumbai.

Allocation of the AME's is done in three shifts. The AME's are also daily required to travel on the on-board aircraft to some of the stations (Bhuj, Sindhudurg, Diu) for carrying out pre-departure checks, due to non-availability of certifying personnel at these stations.
On 08.02.2022, the involved B1 AME was the only B1 AME performing engineering duties for ATR fleet at station (Mumbai) and also for flight duties as on-board AME (for ATR 72 flights operated from Mumbai). Based on available evidences, no man power augmentation was performed by AIESL for appropriate completion of the maintenance activities by taking into consideration the human limitations.

On 08.02.2022 the involved B1 AME was allocated for 1st shift (05:00 IST -13:00 IST and 02 flight duty in the finalised roster [which was corrected as 03:00 IST -11:00 IST+ 2 flight duty (to Bhuj and Sindhudurg)]. Also he was allocated for second shift for 01 flight duty on 08.02.2022 to Diu (9I-623/624). The B1 AME performed transit inspection and cleared the aircraft for the flight 9I-657 (Mumbai to Goa), the aircraft departed at 13:28 UTC. His duty period ended after the departure of aircraft at 19:30IST/14:00UTC.

The aircraft (VT-RKJ) had arrived at Mumbai on 08.02.2022 after operating sector 9I-658 (Goa-Mumbai) at 16:59 UTC. The aircraft (VT-RKJ) was scheduled to undergo Night Halt (NH) inspection at Mumbai after its arrival from Goa (9I-658) on 08.02.2022 and before its departure to Bhuj (9I-625) on 09.02.2022.

The involved B1 AME who had performed 2nd shift on 08.02.2022 and was only relieved of his duties by 19:30IST/14:00UTC on 08.02.2022, he was further assigned for night halt inspection of the aircraft. The B1 AME allotted for the Night Halt inspection did not report for duty as per roster time for the Night halt inspection of VT-RKJ. He instead advised the technician for inspection of the aircraft and engines from the B1 perspective and monitored the Night halt tasks over telephone, which included check of engine oil level and oil filter impending by-pass indicator for both engines. The technician opened the inboard lateral hinged cowlings for check of the engine oil of Engine#2 as the oil level and oil filter impending by-pass indicator are visible from the inboard side for Engine#2. The technician reported to have completed the task and closed the cowling but there was no supervision of the tasks being performed by the technician.

The B1 AME after arrival on stand, prior to departure of 9I-625 on 09.02.2022 signed necessary paper work for Night halt [in which time is recorded as 2315 UTC (08.02.2022), 0445 IST (09.02.2022)] & pre-departure checks of VT-RKJ (00:12 UTC, 09.02.2022). He reported that a torch light was not used during aircraft inspection. The B1 AME continued on-board for Flight duty to Bhuj.

For scheduled Night Halt check as per the 'Master Service Agreement' made between Alliance Air Aviation Ltd. and AIESL, the turn around time (TAT days/ Hours) is 04 hours. The involved B1 AME had reported for duty at the airline dispatch office at 0000 UTC.

Although DGCA AAC 05 of 2019 and AIESL-MOE and EPM manuals recommends at least 15 days notice to be given for their work schedule wherever possible to the AMP, the duty roster for February 2022 for AME's on ATR fleet was not be generated by AIESL due to shortage of adequate number of AME's. The roster was being prepared only a day or at the most a couple of days in advance due to the limited number of certifying staff. The DGM LM is the authority responsible for preparation of duty rosters as per the EPM of AIESL.

As per DGCA requirements and the organisation's policy for duty limitations, Scheduled work hours should not exceed 48 hours in any period of seven successive days. Total work including overtime, should not exceed 60 hours for seven successive work days before a period of rest days, whereas the actual work hours in last seven consecutive days for the involved B1 AME, prior to the incident was about 81 hours.

The periods of duty attended by the B1 AME were 18 hours 30 minutes and 16 hours 30 minutes on 07.02.2022 and 08.02.2022 respectively. The available period after duty on 07.02.2022 was 05 hours 30 minutes and after duty on 08.02.2022 was 07 hours 30 minutes. Tiredness and fatigue are known factors which adversely affect human performance. Excessive hours of duty and shift work, particularly with multiple shifts / additional overtime are known to lead to fatigue resulting in an impaired performance.

This indicates that safety risk assessment was not performed by AIESL during planning/ allocation of the maintenance tasks with the limited man power availability and that no mitigation action was taken.

The AIESL Shift-In-Charge did not evaluate the engineering man power availability for the night shift of 08.02.2022. Though he was responsible for monitoring of aircraft under his

jurisdiction / and planning of the accomplishment of required maintenance as per maintenance standards, he did not ensure the availability of an authorised B1 AME for the Night Halt checks scheduled for VT-RKJ at Mumbai on 08.02.2022.

In-view of the multiple factors as detailed above including the accumulated excessive hours of duty & shift work, particularly with multiple shifts, flight duty to outstations and additional overtime led to fatigue resulting in impaired performance and increased risk-taking by the involved B1 AME. This eventually led the AME in taking a decision to advise the technician for inspection of the aircraft and engines from the B1 perspective while he was not available at the aircraft during scheduled Night Halt inspection. The technician reported to have completed the task and closed the cowling but there was no supervision of the tasks being performed by the technician.

The B1 AME failed to ensure proper supervision and accomplishment of the scheduled Night halt tasks.

From the above factors and the observations of ATR it is likely that the locking of the cowl was not done properly/ ensured prior to departure and the airflow during takeoff roll ripped the inboard lateral hinged cowl from the nacelle.

3. Conclusion:-

3.1 Findings:-

1. The aircraft was having a valid Certificate of Registration and Airworthiness Review Certificate at the time of incident. The last ARC was issued on 24.07.2021.
2. The aircraft was maintained in accordance with the certified aircraft maintenance program. The applicable Airworthiness Directive, Service Bulletins were complied with.
3. The maintenance of the Alliance Air aircraft has been outsourced by the AOC holder to AIESL which is a DGCA approved CAR 145 maintenance repair organisation.
4. The operating cockpit crew members were having valid licences and ratings for operating the aircraft.
5. Night halt check was planned for VT-RKJ as per scheduled inspection at Mumbai prior to departure to Bhuj on 09.02.2022.
6. Duty rosters were not prepared by AIESL for its AME's on ATR fleet in advance for the month of February 2022 due to limited number of certifying staff. The duty roster was being prepared a day in advance.
7. On 08.02.2022 only 01(one) B1 AME was available for aircraft maintenance at the Mumbai base of AIESL.
8. The weekly rest was not provided to the involved B1 AME since start of duty pattern from 21.01.2022. The last off duty/ rest day for the involved B1 AME was 18 days prior to the incident (last off was on 21st Jan 2022).
9. The actual duty hours in last seven consecutive days for the involved B1 AME, prior to the incident were about 81 hours. Whereas, the total duty including overtime, should not exceed 60 hours for seven successive work days before a period of rest days.
10. The recommended minimum rest period of 11 hours between the end of shift and the beginning of the next was not planned and provided for the involved B1 AME on 07.02.2022 and 08.02.2022.
11. Safety risk assessment was not performed by AIESL while planning maintenance tasks / while scheduling of the certifying staff for training with the limited man power availability on 07.02.2022 and 08.02.2022.
12. The AIESL Shift-In-Charge did not evaluate the engineering man power availability for the night shift of 08.02.2022 and did not ensure the availability of an authorised B1 AME for the Night Halt checks scheduled for VT-RKJ at Mumbai during night shift on 08.02.2022.
13. The involved B1 AME was allocated the task of Night halt inspection. However, he was not present for the scheduled Night halt inspection and the technician performed the relevant tasks based on telephonic instruction of the involved B1 AME, including check of engine oil levels and oil filter impending bypass indicator of engine#2 by opening the inboard later hinged cowling.
14. The B1 AME failed to ensure proper supervision of the night halt tasks carried out by the technician.

15. On 09.02.2022, the B1 AME reported at company dispatch in Terminal 3 at 00:00 UTC (05:30 IST). After his arrival at stand (00:15 UTC, 09.02.2022) the B1 AME was briefed by the technician who had performed Night halt tasks, in absence of the AME on the aircraft. The B1 AME then signed all the documents w.r.t Night Halt inspections with time mentioned as 2315 UTC (08.02.2022). There were no defects reported prior to the occurrence sector or any items under MEL. The aircraft was released for flight operations by the involved B1 AME.
16. PIC was the Pilot Flying and the First Officer was the Pilot Monitoring for the incident flight sector. PIC performed the walk-around pre-flight inspection and did not report any abnormalities.
17. Flight Duty Time of both the crew members was within the specified limits.
18. The planned departure time from Mumbai for 9I-625 was 0045 UTC, chocks off time from Mumbai was 0046 UTC.
19. The aircraft departed from Mumbai (Bay C10) on schedule (0046 UTC) and took off at 0056 UTC.
20. The locking of the cowl was not ensured / not done properly prior to departure and as the aircraft started takeoff roll, the airflow ripped the inboard lateral hinged cowl from the nacelle.
21. Mumbai ATC informed VT-RKJ about FOD on runway, during climb out from Mumbai at 01:24UTC (about 28 minutes after departure), cockpit crew checked parameters of flight and reported to ATC that operations were normal. Crew informed about the information received from Mumbai ATC to on-board B1 AME and that all parameter indications were normal.
22. During cruise phase, when the aircraft was in contact with Ahmedabad control, Ahmedabad ATC relayed Mumbai ATC message that, ATR fuselage part was found on Mumbai runway after departure of VT-RKJ and crew confirmed all operations were normal.
23. The B1 AME (travelling on-board on duty) was called to the cockpit after the information was received from Ahmedabad ATC. Since parameters were normal flight was continued to destination.
24. First officer inspected the visible portion of wings from the cockpit. Only the outer portion of wing (from wing tip till propeller) is visible from the cockpit. The crew or the AME did not make any attempt to inspect the visible portions of the aircraft from the cabin.
25. The flight crew was not aware of the engine cowling getting dislodged at Mumbai till receipt of information from AME after Post flight inspection at Bhuj. The information made available to the operating crew from the ATC was not clear as it did not include specific information regarding the colour of the part, nature/ type of component.
26. There was no fire or secondary damage due to the dislodged engine cowling.

3.2 Probable cause:-

The probable cause of the incident was improper locking of the inboard lateral hinged cowling of engine#2 prior to departure of the aircraft.

The following factors (of AIESL) contributed to the incident:-

a) The B1 AME failed to ensure proper supervision of the night halt tasks carried out by the technician.

b) The accumulated excessive hours of duty and shift work particularly with multiple shifts and additional overtime led to fatigue, resulting in impaired performance and increased risk-taking by the involved B1 AME due to inadequate man power planning by AIESL for the scheduled maintenance tasks.

c) Lack of supervision by the Shift In-Charge of AIESL w.r.t allotment of maintenance tasks and ensuring availability of appropriately authorised B1 AME for the scheduled Night Halt task of VT-RKJ.

4. Safety Recommendations:-

1. AIESL may ensure that safety risk assessment is performed prior to planning/ allocation of the maintenance tasks whenever there are major changes to the available manpower (as in case of subject incident) and necessary mitigation action shall be taken by the Line Maintenance Manager.

2. Necessary action may be taken by DGCA w.r.t AIESL for non-adherence to DGCA guidelines and the DGCA approved manuals of AIESL w.r.t man power allotment disregarding Human factors and DTL as detailed in findings #8 to #11.

3. Necessary corrective action including training may be considered in-view of findings #12, #13 and #14.

12/10/2023

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

Date: 12.10.2023
Place: New Delhi