REPUBLIC OF RWANDA

Ministry of Infrastructure

Aviation Accident and Incident Investigation Directorate General

Report on the serious incident to Bombardier Q400 NG with registration 9XR-WM, operated by RwandAir, involving detaching of an engine access panel during take-off at Jomo Kenyatta International Airport, Nairobi, on Dec. 26th 2020.

Ref AAID [2021-01]

The sole objective of investigations carried out by the AAID is the prevention of accidents and incidents. It shall not be the purpose of such an investigation to apportion blame or liability.

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List of abbreviations used in this report

AAIB	Air Accident Investigation Branch (United Kingdom)
AAID	Aviation Accident and Incident Investigation Directorate General (Rwanda)
AD	Airworthiness Directive
AMT	Aircraft Maintenance Technician
AOM	All Operator Message
FOD	Foreign Object Damage
KAA	Kenya Airports Authority
KGL	Three letter code for Kigali International Airport
LOC	Localiser (component of the instrument landing system)
NBO	Three letter code for Jomo Kenyatta International Airport, Nairobi
RCAA	Rwanda Civil Aviation Authority
RCAR	Rwanda Civil Aviation Regulation
SB	Service Bulletin
TCCA	Transport Canada Civil Aviation
UTC	Universal Time Coordinated
VOR	Very high frequency Omnidirectional Range (radio navigation system for aircraft)

Synopsis

During the approach of flight WB 465 for destination Kigali on Dec. 26th 2020 the wing de-icing system of the aircraft, a Bombardier Q400 NG, appeared to be inoperative. After parking it was found that the de-icing boot of the left wing showed a deep cut, while a large access panel from the left-hand engine cowling was missing. The panel had been opened during oil servicing at departure station Nairobi.
The Q400 engine access panel measures approximately 110 x 150 cm and has four quick release latches. The missing panel was later found alongside the departure runway of flight WB 465 at Jomo Kenyatta International Airport, Nairobi.
When the panel was retrieved by airport staff at Nairobi, the two middle latches were closed while the two bottom latches were found in the open position.

Apart from the incident with flight WB 465, a total of 11 similar incidents from other operators were found whereby a Q400 engine access panel detached during the take-off roll. In all cases the panel had not been closed correctly; no mechanical failure of the latches occurred.
In view of these repeated occurrences, the aircraft manufacturer and Transport Canada Civil Aviation issued a total of three safety publications comprising proposed actions of a non-mandatory nature. At the time of the incident these proposed actions had not been implemented by RwandAir.

The AAID reached the conclusion that the ergonomic design of the Bombardier Q400 engine access panel is prone to human error, this in contrast to the failsafe, intuitive configuration of its Q300 predecessor.

Further the AAID found shortcomings in the licensing and scheduling of the Aircraft Maintenance Technician involved.

The investigation has resulted in the formulation of six safety recommendations that are addressed to RwandAir, the RCAA, the aircraft manufacturer Bombardier/De Havilland and Transport Canada Civil Aviation.

1. FACTUAL INFORMATION

1.1 History of the Flight

1.1.1 General

Flight WB 465, conducted with a Bombardier Q400 NG, registered 9XR-WM, was a scheduled passenger flight from Jomo Kenyatta International Airport at Nairobi, Kenya (NBO) to Kigali International Airport, Rwanda (KGL) on Dec. 26th 2020. The flight left NBO on schedule at 02:00[1] and arrived at KGL 15 min. ahead of its scheduled arrival time of 03:50.

The cockpit crew consisted of the Captain and the First Officer (F/O). Apart from the cabin crew, also an Aircraft Maintenance Technician (AMT) travelled with the flight.

The same cockpit crew and AMT had operated the previous flight WB 464 from KGL to NBO. Prior to joining flight WB 464/465 the AMT had been scheduled for another KGL-NBO-KGL flight that was conducted with a different Q400 aircraft, carrying the registration 9XR-WL. In view of this earlier flight, the AMT had reported for duty at 15:00 UTC (17:00 LT) on Dec. 25th.

Oil servicing of Q400 aircraft needs to be done within 15 - 30 mins after engine shutdown. Since the 9XR-WM aircraft had been on the ground at KGL for two days prior to flight WB 464, the AMT planned to perform oil servicing after arrival at NBO.

1.1.2 Ground stop at NBO

The KGL-NBO leg of Flight WB 464 was uneventful. The flight arrived at time 01:20 on Dec. 26th, thus in night-time hours, where after the AMT conducted the planned oil servicing, filling one quart on both engines. In order to reach the engine oil filler cap on Q400 aircraft, it is necessary to open a large engine

[1] All times in this report are indicated in UTC unless otherwise indicated. Local time in Kigali is UTC+2, local time in Nairobi is UTC+3.

cowling panel. This panel is hinged at the top and is equipped with a total of four quick release latches, two on the sides and two at the bottom. To his recollection, the AMT closed both engine cowling panels correctly by engaging all four latches of each panel. During his servicing activities the AMT used a torch since the lighting conditions on the platform were insufficient. After completion of the oil servicing the AMT conducted a walk-around check of the aircraft, which revealed no anomalies.

As per company procedure, also the Captain conducted a walk-around check; this walk-around was done before the oil servicing took place.

1.1.3 Flight from NBO to KGL

The return flight to KGL was uneventful until, during the initial approach, the crew switched on the wing anti-ice due to some build-up of cumulonimbus clouds. Upon switching on the wing anti-ice, the amber caution light 'DE-ICE PRESS' illuminated as an indication of insufficient pneumatic pressure in one or both of the de-icing boots on the leading edge of the wings.

1.1.4 After arrival in KGL

After arrival in KGL the Captain informed the AMT about the illuminated DE-ICE PRESS light, where after the AMT did an external check of both de-icing boots. He then found a big cut in the left-hand boot. A moment later the AMT discovered that the engine access panel from the left-hand outboard engine cowling was missing, which made him realise that the damage to the de-icing boot was inflicted by the detached panel hitting the adjacent wing leading edge.

1.1.5 Aftermath of the incident

The AMT reported the damage of the aircraft to the Captain and informed the Maintenance Control Centre of RwandAir.
The Captain submitted both a Flight Report to Flight Operations and an Air Safety / Technical Incident Report to the Safety Department of RwandAir.

In the morning of Dec. 26th RwandAir informed the Aviation Accident Investigation Directorate (AAID) about the incident with the 9XR-WM aircraft.

It later transpired that staff from the NBO Wildlife Team had found the detached panel on the edge of runway 06 just before taxiway Bravo of Jomo Kenyatta International Airport during a routine runway inspection in the morning of Dec. 26th. According to the related incident report that was compiled by the Kenya Airports Authority (KAA), the panel was found in one piece with the forward and aft latches in the closed, and with the two bottom latches in the open position as is indicated by Figure 1 below:



Figure 1: Photo of the panel as found by the Wildlife Team of NBO airport.

1.2 Injuries to persons[2]

The incident did not result in any injuries to persons.

1.3 Damage to aircraft

After landing the engine access panel from the left-hand outboard engine cowling was missing, see Figure 2.



Figure 2: Missing engine access panel after arrival of flight WB 465 at Kigali.

Figure 3 below shows the panel after it had been shipped from NBO to KGL. At this stage the AAID investigation team found that the two bottom latches were in the closed position.[3]

[2] This report follows the paragraph numbering according to Appendix 1 of ICAO Annex 13. Paragraphs numbers that are not listed, are not applicable to this investigation.

[3] It is not known where and by whom the two lower latches were closed after the panel had been found. Since this aspect is not relevant for the outcome of this investigation, the AAID did not look into this matter.



Figure 3: Detached panel after arrival at KGL with the two bottom latches in the closed position.

From the picture below it can be seen that the epoxy material on the inside of the panel shows a crack running from the forward latch via an air intake to the aft side of the panel.



Figure 4: Photo showing a crack in the epoxy material on the inside of the panel.

Apart from the missing panel, damage to the left-hand wing leading edge was found, amongst others resulting in puncturing of the left-hand wing de-icing boot, see Figure 5:



Figure 5: Punctured de-icing boot on the left-hand outboard wing leading edge.

1.5 Personnel information

1.5.1 Cockpit crew

Both the Captain and the First Officer were adequately experienced, trained and licensed for the conduct of flight WB 464/465.

1.5.2 Aircraft Maintenance Technician

The Aircraft Maintenance Technician (AMT) carried a generic AMT license, issued by the Rwanda Civil Aviation Authority (RCAA) on November 21st 2018.

After completion of his training at Ethiopian Airlines, the AMT had acquired his type rating licenses, issued by the Ethiopian Civil Aviation Authority, for maintenance activities on Bombardier Q400 aircraft. These Ethiopian type rating licenses had not been validated or re-issued by the RCAA.

1.6 Aircraft information

Manufacturer	Bombardier
Type	Q400 NG
Registration	9XR-WM
Engines	Pratt & Whitney PW150A
Date of manufacture	16 June 2015
Certificate of airworthiness	Date of issue: 29 June 2020 Date of expiry: 30 June 2021

1.7 Meteorological information

Meteorological conditions were no significant factor in this incident. During the ground stop in NBO no precipitation or other adverse weather conditions prevailed.

1.16 Tests and research

1.16.1 Q400 engine access panel

The access panel that was missing from the left-hand engine cowling after arrival of the aircraft at Kigali International Airport has a size of approximately 110 x 150 cm. The panel is hinged at the top and is made from a carbon/epoxy composite material. It is normally secured in the closed position by a total of four quick release latches: two in the middle and two at the bottom end, see Figure 6.

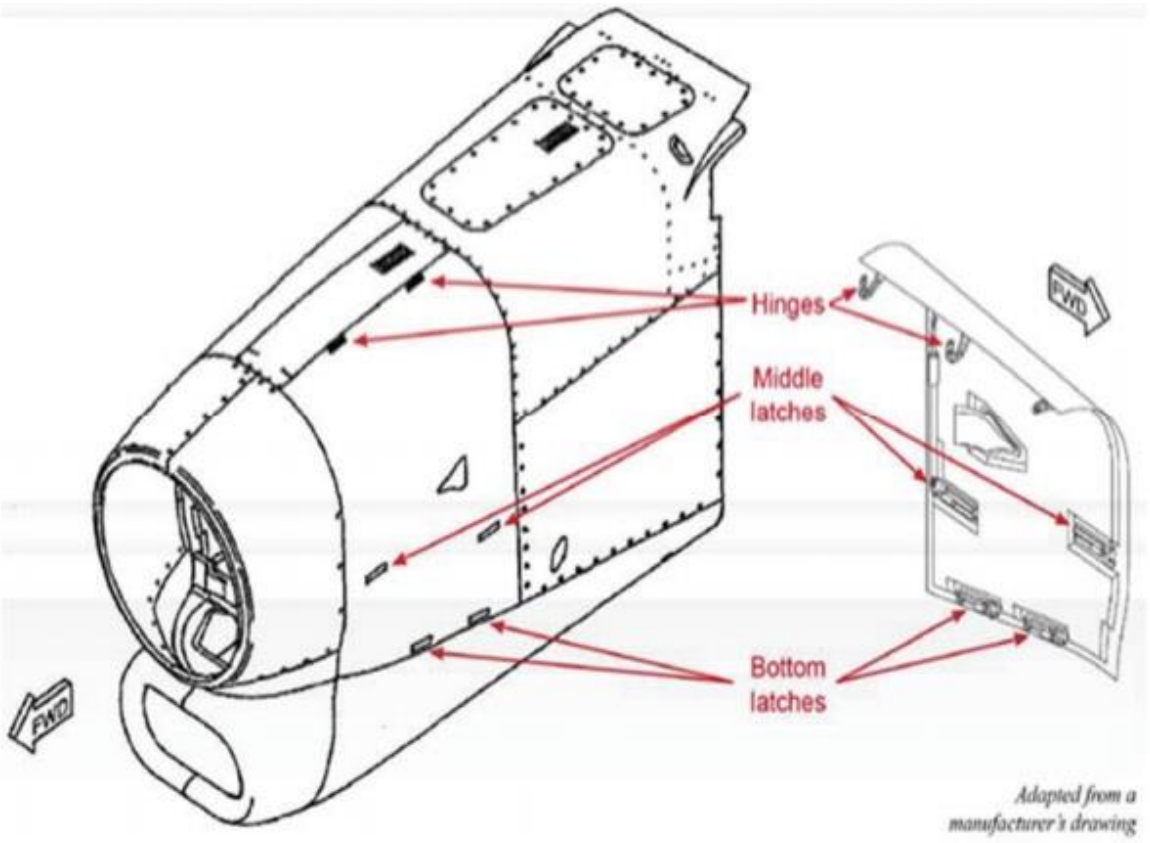


Figure 6: Access panel with hinges at the top, two middle latches & two bottom latches

1.16.2 Engine oil servicing on Q400 and Q300 aircraft

In principle the oil level of both engines is checked after each flight. On Bombardier/De Havilland Q400 aircraft engine oil checking and servicing requires opening of the entire engine access panel. To facilitate oil servicing, Q300 aircraft - the aircraft type that preceded the Q400 series - is equipped with a separate small oil servicing hatch that eliminates the need to open the entire engine access panel, see Figure 7 below:

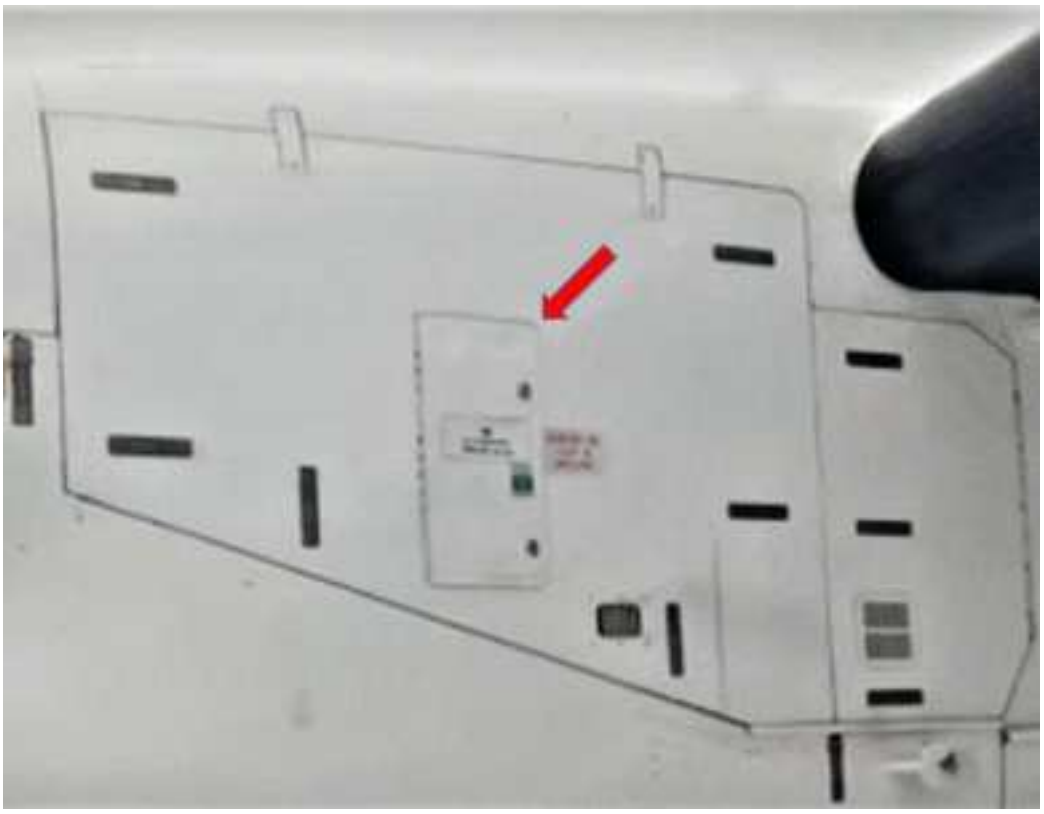


Figure 7: Separate oil servicing panel on Bombardier Q300 aircraft.

1.16.3 Q400 engine fire protection system

Each engine nacelle of Q400 aircraft is equipped with three sensors that will trigger a warning in the cockpit in case an overheat condition is detected.
A missing engine access panel will affect the correct functioning of the overheat sensors.

Additionally two fire extinguishing bottles are located in the adjacent wing leading edge. These bottles can be discharged into the engine nacelle after an engine fire warning in the cockpit has been triggered.
The fire extinguishing agent only is effective in a closed compartment. Therefore, when the engine access panel is missing, the engine fire extinguishing system will not be functional.

1.16.4 Similar occurrences

Apart from the incident involving flight WB 465 on Dec. 26th 2020, it was found that since Dec. 2005 at least 11 similar occurrences involving detached engine

access panels of Dash 8/Q400 aircraft have been documented by other operators and investigating authorities.

One of these occurrences, that has been investigated by The South African Civil Aviation Authority, concerns a Q400 flight from Cape Town to Bloemfontein in July 2014. In this case it was demonstrated that the engine access panel had detached during take-off at Cape Town International Airport because the two lower latches of the panel had not been closed after oil servicing.

The Air Accident Investigation Branch (AAIB) from the United Kingdom has investigated another significant case that occurred in December 2016, see paragraph 1.16.5 below.

The aircraft manufacturer issued a Service Bulletin (SB)[4] in June 2017, see Appendix 5.2. This SB calls for or the application of placards on the engine cowlings.
Subsequently the aircraft manufacturer issued an 'All Operator Message' (AOM) in July 2020. This AOM addresses (1) instructions for maintenance personnel, (2) installing of an improved type of placards and (3) reworking of the latch fittings. Both the SB and AOM are discussed in paragraph 1.16.6.

In September 2020 the Transport Canada Civil Aviation (TCCA) published a Safety Alert (CASA 2020-08), to raise awareness of the proper maintenance practice and recommended modifications to prevent inadvertent opening of engine access panels during flight, see Appendix 5.4.

Following the incident with flight WB 465 on December 26th 2020, the Rwanda Aviation Accident Investigation Directorate (AAID) issued a Safety Concern on January 3rd 2021, see Appendix 5.5, recommending the operator RwandAir to

[4] A Service Bulletin (SB) is issued by manufacturers of aircraft, their engines or their components to communicate modifications which can be embodied in aircraft. If an available modification is judged by the manufacturer to be a matter of safety rather than simply product improvement, then these usually are issued as an Airworthiness Directive (AD) by the appropriate Civil Aviation Authority.

implement the above mentioned All Operator Message from the manufacturer without delay.

1.16.5 Investigation by the AAIB from the United Kingdom

The British AAIB conducted an investigation of a flight with a Dash 8/Q400 aircraft whereby an engine access panel was lost on departure from Manchester, United Kingdom, on December 14th 2016. The same aircraft had been involved in a similar incident one month earlier.

In both cases all four latches of the recovered panels were found to be in the closed and latched position while the receiving fixtures on the engine cowling showed no damage.

Inspection of the aircraft after the first incident revealed damage to the left wing leading edge de-icing boot and wing skin panel.

Inspection of the aircraft after the second incident revealed puncture holes in the skin on both sides of the vertical stabiliser and damage to both VOR/LOC[5] antennas.

In their Final Report the AAIB formulated two safety recommendations.

The first recommendation relates to enhanced flight crew training on pre-departure inspections, including a demonstration on the aircraft of correctly secured main engine access panels.

The second recommendation relates to disseminating pertinent safety information to ground operations staff.

The full AAIB report is attached as Appendix 5.1.

1.16.6 Service Bulletin and All Operator Message from manufacturer

On June 12th 2017 the aircraft manufacturer Bombardier/De Havilland issued SB 84-11-46, see Appendix 5.2.

The reason for publishing this SB was formulated as follows:

[5] VOR: VHF Omnidirectional Range, a navigation system based on Very High Frequency (VHF) radio beacons.
LOC: Localiser, part of the Instrument Landing System (ILS).

"Several incidents have been reported where the nacelle forward cowl doors have departed aircraft during flight. In all cases, no physical evidence from recovered doors support latch failure.
Departing door may cause damage to aircraft structure and/or flight controls and loss of nacelle fire detection and extinguishing."

The SB calls for the installation of placards on the engine cowlings that illustrate how the engine access panels need to be closed and how an improperly closed panel can be identified by a small gap between the lower edge of the access panel and the surrounding cowling structure.
Investigation after the incident revealed that no such placards had been installed on the two Q400 aircraft that are operated by RwandAir.

In view of the repeated occurrences whereby engine access panels were lost during departure, the aircraft manufacturer issued All Operator Message No. 870 on July 17th 2020, see Appendix 5.3. This AOM addresses:

1. Adding an instruction to the Aircraft Maintenance Manual on how to properly close the engine access panels.
2. Installing of an improved type of placards, that replaces the placards from SB 84-11-46.
3. Reworking of the latch mechanism by chamfering the edges of the cowling door fittings. The reworked fittings improve the ability of the cowl doors to engage with the lower cowl structure, thereby reducing the possibility of a closed latch not engaging the fitting.
   As an alternative the AOM mentions that new fittings with chamfered edges can be supplied by the aircraft manufacturer.
   Investigation after the incident revealed that both Q400 aircraft of RwandAir were not equipped with reworked or replaced fittings according to AOM No. 870.

1.17 Organisational and management information

1.17.1 Rwanda Civil Aviation Regulation

For this investigation the following information from the Rwanda Civil Aviation Regulation (RCAR) is of importance:

- RCAR Part 4 (Airworthiness of aircraft)[6] indicates that an aircraft registered in Rwanda shall not engage in commercial air transport operation unless the aircraft has been maintained in accordance with the maintenance procedures, recommended by the aircraft manufacturer.
- RCAR Part 7 (Personnel licensing)[7] indicates that an Aircraft Maintenance Technician who performs maintenance activities for aircraft registered in Rwanda must have either a license given out by the Rwanda Civil Aviation Authority (RCAA), or must hold a RCAA validation license based on the original license given out by the Authority from another State.
- RCAR Part 4 (Airworthiness of aircraft)[8] further states that: "No person may schedule a person performing maintenance functions for aircraft for more than 12 consecutive hours of duty."

1.17.2 Information from interviews with RCAA and RwandAir

From interviews held with a RCAA safety inspector and a RwandAir quality assurance officer it became apparent that prior to the incident with flight WB 465 both the RCAA and the operator had received and were aware of Service Bulletin 84-11-46 and All Operator Message No. 870, issued by Bombardier/De Havilland.

It was also acknowledged by both the Authority and the operator that Safety Alert CASA 2020-08, issued by TCCA, the Canadian Civil Aviation Authority, had been timely received.

[6] See RCAR Part 4: 4.105 COMPLIANCE WITH THE MANUFACTURER'S INSTRUCTIONS
[7] See RCAR Part 7: 7.130 VALIDATION AND CONVERSION OF LICENCES OTHER THAN FLIGHT CREW LICENCES
[8] See RCAR Part 4: 4.215 REST & DUTY LIMITATIONS FOR PERSONS PERFORMING MAINTENANCE FUNCTIONS

2. ANALYSIS

2.1 Introduction

The incident with the 9XR-WM aircraft at NBO on December 26th 2020 is not an isolated case. Since December 2005 a total of 11 other occurrences have been documented whereby an engine access panel of a Q400 aircraft was lost.

Each of these occurrences has resulted in damage to the aircraft, has rendered the fire protection system of the related engine unserviceable, and created a risk for Foreign Object Damage (FOD) to other aircraft, since the panel is typically lost during the take-off roll and thus left behind on or near the runway.
These elements are discussed in paragraph 2.2 and 2.3.

Further it must be noted that in all cases no mechanical failures of the panel latches were found. Human factors therefore are an important element to be considered in this investigation.
Additionally, the significant number of similar incidents also raises questions with regard to the design of the engine access panel and ergonomic flaws that might play a role when closing it.
The human factors and ergonomic aspects that relate to the Q400 engine access panel design are addressed in paragraph 2.4.

Subsequently, the effectiveness of the measures, aimed at preventing improper locking of the Q400 engine access panel, as taken by the aircraft manufacturer and the Canadian TCCA, are discussed in paragraph 2.5.

The licensing, training and scheduling of the AMT who performed the oil servicing at NBO of the 9XR-XM aircraft in the early morning of Dec. 26th 2020, will be addressed in paragraph 2.6.

Lastly, paragraph 2.7 covers the timing and effectiveness of the pre-flight walk-around check.

2.2 Risks to the aircraft operation

The occurrences whereby a Q400 engine access panel was lost, have resulted in punctured de-icing boots, damage to VOR/LOC antennas, damage to the wing leading edges, the skin of the wings and the vertical stabiliser. Besides, in case of a flight with a missing panel, the fire detection and extinguishing system of the related engine is not functional.

Under adverse circumstances, like prolonged flying in icing conditions or when a nacelle overheat condition would occur, operation with a missing engine access panel could have serious additional consequences for the safety of the flight.

2.3 Risks of an engine access panel left on the runway

All documented cases indicate that an engine access panel from which the two lower latches are not, or not properly engaged, will detach from the aircraft during the take-off roll. It goes without saying that a panel with an overall size of approximately 110 x 150 cm left behind on the runway, imposes a significant FOD risk for subsequent flights that depart from the same runway.

2.4 Human factor and ergonomic aspects

In all 12 documented cases whereby a Q400 engine access panel was lost, mechanical failure of the latch mechanism was not a factor. Instead it was found that either:

a) All four latches were in the closed position, but without the locking pin(s) being engaged into the receiving fixture(s) on the nacelle side, or:
b) The two bottom latches remaining in the open position after closing the panel.

Condition (a) is described in the investigation report from the British AAIB, see paragraph 1.16.5 and Appendix 5.1. The AAIB report explains how a slightly misaligned panel may lead to a situation whereby the latches seem to be closed properly, while in fact they are not actually engaged in the locked position.
Such a situation will result in a small gap between the lower edge of the panel and the nacelle structure. This gap will be difficult to recognise, especially in night time hours and/or in case of a dark coloured engine cowling.

Condition (b) is applicable to the Cape Town incident of July 2014 that was investigated by the CAA of South Africa as well as to the incident with the 9XR-WM aircraft on Dec. 26th 2020 at Nairobi.

Although it obviously is an omission not to engage the two lower latches after closing of the panel, it must be noted that these latches are quite far removed from the scene of the oil servicing. After checking and adding oil as required, the subsequent closing of the large panel and engaging the two middle latches, a false sense of 'the job being done' may arise.

Both condition (a) and condition (b) illustrate the inherent vulnerability of the Q400 engine access panel design. In this respect it must be noted that its Q300 predecessor was equipped with a separate small hatch, that facilitated oil servicing without the need to open the entire engine access panel, see Figure 7 in paragraph 1.16.2.
The Q300 configuration is to be considered as an intuitive, fail safe design: when the oil servicing is completed, the adjacent small hatch 'invites' the user to close it.

Therefore, when taking into account the series of occurrences whereby a Q400 engine access panel was lost in combination with the requirement to open and close the panel virtually after every flight, it seems advisable that the aircraft manufacturer considers a redesign of the current Q400 engine access panel.

2.5 Safety publications from aircraft manufacturer and TCCA

In view of the recurring incidents whereby a Q400 engine access panel was lost, the aircraft manufacturer issued a Service Bulletin (SB) in June 2017 and an All Operator Message (AOM) in July 2020, see paragraph 1.16.6.
Additionally, Transport Canada Civil Aviation (TCCA) published a Safety Alert in Sept. 2020, see paragraph 1.16.4.
These three publications are all of a non-mandatory nature and aim to prevent a situation whereby the panel latches seem to be closed properly, while in fact they are not actually engaged in the locked position.

In view of the serious consequences that detaching of an engine access panel may have, the AAID is of the opinion that a safety publication entailing an obligation to implement the measures, as suggested in the SB, AOM and Safety Alert, would have been appropriate.

Apart from that it must be noted that the above mentioned safety publications cannot compensate for the lack of intuitive ergonomics of the Q400 access panel when conducting oil servicing as compared to the more user-friendly Q300 configuration.

Both the Rwanda Civil Aviation Authority (RCAA) and the RwandAir Quality Assurance department acknowledged that they had timely received the related SB, AOM and Safety Alert. However, up to the day of the incident with the 9XR-WM aircraft, the recommended measures from these publications had not been followed up. These measures included:

- Adding an instruction to the Aircraft Maintenance Manual on how to properly close the engine access panels;
- Installing of placards that show how an incorrectly closed door can be recognised;
- Reworking of the latch mechanism by chamfering the edges of the cowling door fittings.

Even though the SB, AOM and Safety Alert are of a non-mandatory nature, their recommendations should have been implemented since RCAR Part 4 (Airworthiness of Aircraft) clearly states that that a Rwanda registered aircraft shall be maintained "in accordance with the maintenance procedures, recommended by the aircraft manufacturer".

2.6 Licensing, training and scheduling of the AMT

The AMT scheduled to perform the line maintenance activities for flight WB 464/465 carried type rating licenses, issued by the Ethiopian Civil Aviation Authority. Contrary to the requirements laid down in RCAR Part 7 (Personnel licensing) these type rating licenses had not been validated or re-issued by the RCAA.

It must therefore be concluded that the AMT was not adequately licensed for the conduct of his duties.

Although the related SB, AOM and Safety Alert publications, that were known to both the RCAA and RwandAir, primarily focus on the possibility of closing the panel latches without actually engaging them, the AAID is of the opinion that timely implementation of the recommended practices from these publications would have prevented the incident with the 9XR-WM aircraft from happening.
More specifically: these safety publications would have made the AMT aware of the repeated occurrences, whereby engine access panels were lost due to incorrect closing.
Furthermore the publications refer to a new Aircraft Maintenance Manual (AMM) task instruction[9] for proper cowl door closing, while the AMT concerned did not receive any formal training on this task instruction.

Prior to joining flight WB 464/465 the AMT had been scheduled for another KGL-NBO-KGL flight for which he had reported for duty at 15:00 on Dec. 25th.
The scheduled arrival time of flight WB 465 at KGL was 03:50 in the morning of Dec. 26th 2020, the actual on blocks time was 15 min. earlier, thus at 03:35.
The actual duty time of the AMT therefore was longer than 12 hours, whereas RCAR Part 4 (Airworthiness of aircraft) states that the maximum duty time for performing maintenance functions may not exceed 12 consecutive hours.
It must therefore be concluded that the AMT was scheduled beyond legal duty time limitations.

2.7 Timing and effectiveness of the pre-flight walk-around check

RwandAir procedures require a walk-around check of the aircraft by one of the pilots prior to each flight. The current procedures do not indicate a specific timing for the walk-around in relation to the ground handling process. In the 9XR-WM incident, the two bottom latches from the access panel of the left-hand engine remained in the open position after oil servicing. However, the protruding

[9] AMM Task 71-10-06-410-80, originally released on October 5, 2017

latch handles could not be identified by the Captain performing the walk-around check at NBO, since this check was conducted before the oil servicing took place. It therefore is advisable that RwandAir implements a procedure calling for a walk-around check after all significant ground handling activities are completed. In this way the walk-around check will be more effective in detecting any damage inflicted during the ground handling activities, any debris or materials that are left behind and any panel or (service)door that is not properly closed.

3. CONCLUSIONS

3.1 Findings

3.1.1 The access panel of the left engine of the 9XR-WM aircraft detached during the take-off roll at NBO because the two bottom latches of the panel had not been closed after oil servicing.

3.1.2 The detached panel of the 9XR-WM aircraft damaged the de-icing boot of the left-hand wing leading edge, rendering the de-icing system unserviceable.

3.1.3 After departure of flight WB 465, staff from the NBO Wildlife Team found the detached panel from the 9XR-WM aircraft alongside runway 06 during a regular runway inspection.

3.1.4 Detaching of an engine access panel on Bombardier Q400 aircraft imposes a risk for aircraft damage, renders the engine fire protection system of the related engine dysfunctional and will create a hazard for Foreign Object Damage (FOD) to other aircraft.

3.1.5 Apart from the incident with the 9XR-WM aircraft, from Dec. 2005 onwards 11 similar incidents from other operators, whereby a Q400 engine access panel was lost, are documented.

3.1.6 In view of the repeated occurrences whereby an engine access panel of Bombardier Q400 aircraft was lost, the aircraft manufacturer issued a Service Bulletin in July 2017 and an All Operator Message in July 2020. Additionally Transport Canada Civil Aviation (TCCA) published a Safety Alert on this issue in September 2020.

3.1.7 The Service Bulletin and All Operator Message from the aircraft manufacturer, as well as the Safety Alert from Transport Canada Civil Aviation, contain proposed actions and recommendations of a non-obligatory nature.

3.1.8 Although the RCAA and RwandAir acknowledged timely receipt of the Service Bulletin, All Operator Message and Safety Alert, no follow-up actions based on these safety publications were carried out.

3.1.9 Proper implementation of the proposed actions from the Service Bulletin, All Operator Message and Safety Alert most probably would have prevented the incident with the 9XR-WM aircraft from happening.

3.1.10 The total of 12 documented cases whereby a Q400 engine access panel was lost during the take-off roll demonstrate that the ergonomic design of the panel is prone to human error.

3.1.11 Contrary to the requirements laid down in RCAR Part 7, the Ethiopian type rating licenses of the Aircraft Maintenance Technician had not been validated or re-issued by the RCAA.

3.1.12 Contrary to the requirements laid down in RCAR Part 4, the operator had scheduled the Aircraft Maintenance Technician for a duty period that exceeded the maximum allowed duty time of 12 hours.

3.2 Causal factor

3.2.1 The aircraft departing while the non-closure of the two bottom latches from the access panel of the left-engine remained undetected.

3.3 Contributory factors

3.3.1 No follow-up being given by the RCAA and RwandAir after receipt of the related Service Bulletin and All Operator Message from the aircraft manufacturer as well as the Safety Alert from Transport Canada Civil Aviation.

3.3.2 The walk-around pre-flight check by the pilot being conducted before the access panel was closed after completion of the engine oil servicing.

3.3.3 The ergonomic design of the Q400 engine access panel being prone to human error.

4. SAFETY RECOMMENDATIONS

To Rwanda:

4.1 The Rwanda Civil Aviation Authority and RwandAir are recommended to ensure that Aircraft Maintenance Technicians who perform duties for RwandAir flights are licensed in accordance with the requirements as laid down in RCAR Part 7.

4.2 The Rwanda Civil Aviation Authority and RwandAir are recommended to ensure that Aircraft Maintenance Technicians are scheduled in accordance with the rest & duty limitations as laid down in RCAR Part 4.

4.3 The Rwanda Civil Aviation Authority and RwandAir are recommended to ensure that Service Bulletins and other relevant documentation from aircraft manufacturers and foreign CAA's are adequately assessed and timely implemented as laid down in RCAR Part 4.

4.4 RwandAir is recommended to implement a procedure, specifying that the required pre-flight walk-around check by the pilot should take place after all significant ground handling activities are completed.

To Canada:

4.5 Bombardier/De Havilland is recommended to modify the design of the current Q400 engine access panel, thereby:

- improving the ergonomics for latching of the panel, or
- eliminating the need to open the entire access panel for oil servicing.

4.6 Transport Canada Civil Aviation and Bombardier/De Havilland are recommended to refrain from using publications of a non-obligatory nature for issues that constitute a direct safety threat.

5. APPENDICES

Appendix 5.1:
Investigation by the AAIB from the United Kingdom

ACCIDENT

Aircraft Type and Registration:	DHC-8-402 Dash 8 (Q400), G-PRPC
No & Type of Engines:	2 Pratt & Whitney Canada PW150A turboprop engines
Year of Manufacture:	2010 (Serial no: 4338)
Date & Time (UTC):	14 December 2016 at 0624 hrs
Location:	On departure from Manchester Airport
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 4 Passengers - 27
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to engine access panel, impact damage to vertical stabiliser and VOR/LOC antennas
Commander's Licence:	Airline Transport Pilot Licence (Aeroplanes)
Commander's Age:	45 years
Commander's Flying Experience:	7,120 hours (of which 142 were on type) Last 90 days – 142 hours Last 28 days – 63 hours
Information Source:	AAIB Field Investigation

Synopsis

Following overnight maintenance work, the outboard engine access panel on the No 1 engine was incorrectly latched shut. This was not identified by the engineer completing the task, by the flight crew during the subsequent pre-departure inspection, or by the ground operations personnel dispatching the aircraft. During takeoff the panel failed at the hinge attachment points and departed the aircraft, striking and damaging the vertical stabiliser, before coming to rest on the runway and its grass verge. A previous incident, where the same engine panel was lost during takeoff, had occurred on the aircraft a month earlier. This report addresses both incidents. Safety action has been taken by the aircraft manufacturer to add labelling and amend the Aircraft Maintenance Manual (AMM), and the operator has revised its maintenance procedures. In addition, two Safety Recommendations have been made relating to flight crew pre-departure inspection procedures and dissemination of safety information to ground crew.

History of the flight

Following a day of routine flying operations on 13 December, the aircraft night-stopped at Manchester Airport and was parked on a remote stand. The operator's contracted maintenance organisation completed a routine daily check on the aircraft that evening. This included

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checking the oil content of the No 1 engine, accessed by opening the outboard main access panel on the engine nacelle. The check was concluded by approximately 2115 hrs, with the aircraft scheduled to return to service for a 0610 hrs departure the next morning. The aircraft Technical Log entry for the daily check was signed by the engineer at 0010 hrs.

The operating flight crew arrived at the aircraft at 0530 hrs and began their normal pre-flight checks. At 0550 hrs, in accordance with company procedures for the first flight of the day, the commander conducted the pre-departure inspection. As it was still dark, he used a torch to supplement the ambient airport lighting during his inspection. He did not identify any issues with the aircraft and the crew continued with their normal departure routine.

The ground crew, who were responsible for pushing the aircraft back off the stand, subsequently arrived and conducted their own walkround check of the aircraft, also identifying nothing of note. The aircraft was dispatched on time and taxied to Runway 23R for takeoff. At approximately 0624 hrs the aircraft commenced its takeoff roll and then continued on an apparently uneventful flight to Hannover, Germany, landing there at 0752 hrs.

After the aircraft had parked on the stand and the passengers had disembarked, the ground crew informed the cabin crew that a panel was missing from the No 1 engine. The message was relayed to the flight crew, who inspected the aircraft prior to contacting the operator's maintenance control department. The operator informed Manchester Airport operations staff at 0836 hrs, who then conducted an inspection of Runway 23R. The panel was recovered from a grass area to the side of the runway, approximately 440 m from the runway threshold. Sections of the panel hold-open strut were also recovered from the runway and adjacent paved areas in the same vicinity (Figure 1).



Figure 1
Location of items released from the aircraft during takeoff

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Aircraft information

The DHC-8-402 Dash 8 (Q400) is a twin-turboprop, medium-range, passenger aircraft. The main engine bay of each engine nacelle has two large forward access doors, one inboard and one outboard. These access doors are made from a carbon/epoxy composite material with integral foam-filled stiffening ribs. Each door is hinged at the top, has a single telescopic hold-open strut and is secured in the closed position by four quick-release lock pin latches (Figure 2). Each latch, when closed, engages a pin into a receiver mounted within the engine nacelle structure. The outboard door on the No 1 engine and the inboard door on the No 2 engine allow access to service the engine oil system.

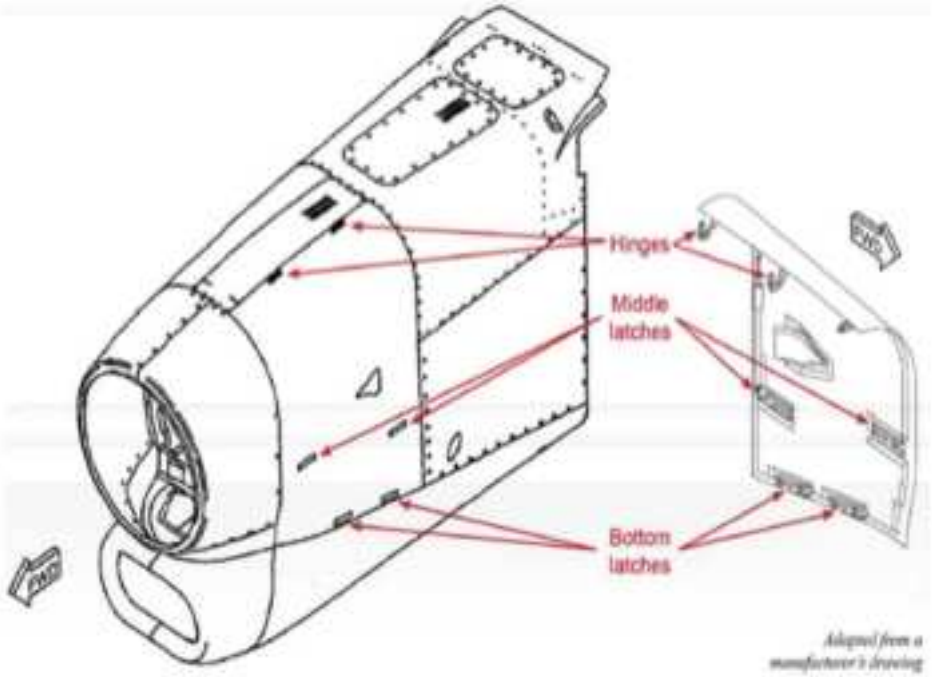


Figure 2

Forward engine bay access panel

Aircraft examination

On inspection of the recovered panel all four latches were found to be in the closed and latched position. There was no damage to the latch bolts or the receiving fixtures on the nacelle (Figure 3).

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Figure 3
Engine access panel and nacelle

Inspection of the aircraft vertical stabiliser showed puncture holes in the skin on both sides, with impact marks also present on the leading edge de-icing boot. There was also impact damage to both VOR/LOC antennas.



Figure 4
Damage to vertical stabiliser (similar damage occurred on both sides of the vertical stabiliser)

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Previous incident on the same aircraft

On 9 November 2016 the No 1 engine access panel was found missing from G-PRPC.

On the day before, it had arrived at Belfast City Airport at 2145 hrs following a day of routine operations. Engineers from the operator's subsidiary maintenance company met the aircraft and completed a routine daily check on the aircraft, which included checking the engine oil contents of both engines. After topping up the No 1 engine with oil, the engineer closed the access panel and completed the remaining parts of the aircraft check. The Technical Log for the aircraft was signed at approximately 0030 hrs.

Later that morning the flight crew arrived to prepare for the first flight of the day. At 0609 hrs the aircraft commander carried out a pre-departure inspection of the aircraft, which did not identify any issues. The ground crew responsible for departing the aircraft arrived at 0615 hrs and also conducted a walkround inspection. At 0643 hrs, the aircraft departed from Runway 22 for a flight to Glasgow Airport.

At 0700 hrs the flight crew from another departing aircraft from the same operator reported a foreign object on the runway. An inspection of the runway was carried out by Airport Operations at the request of Air Traffic Control and an engine access panel was recovered some 300 m from the threshold of Runway 22.

G-PRPC landed at Glasgow at 0715 hrs, at which time the ground handling personnel informed the flight crew that the No 1 engine access panel was missing from the aircraft. Further inspection also identified damage to the left wing leading edge de-icing boot and wing skin panel. The recovered access panel showed that all four latches were closed. There was no damage to the nacelle where the latching bolt receiving features were located.

Following this incident, on 29 November 2016, the operator issued Notice to Engineers (NTE) 22 requiring that:

> *'Following completion of all work either an independent person carries out a walkround inspection to verify all access panels are fitted/secure, or the certifying engineer must return after a notable period of time for a double check of the security of the disturbed panel security. The independent person could be a technician or a pilot, or the notable period of time could be after completion of paper work.'*

The NTE did not require the additional walkround inspection to be recorded in the maintenance paperwork or the aircraft Technical Log.

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CCTV footage

Airport CCTV footage was recovered showing the commander's pre-departure inspection, which was done with the aid of a torch. The torch beam could be seen on various parts of the aircraft as the commander went to the nose of the aircraft first, then to the tail, followed by the No 2 engine and the landing gear. The commander then inspected the No 1 engine and the torch light could be seen on the access panel area. The inspection had a total duration of 3 minutes.

No CCTV footage was available for the period when the maintenance check was carried out on the No 1 engine.

Previous incidents on the global fleet

The manufacturer reported that there have been nine other incidents of engine access panel loss in-flight across the worldwide Q400 fleet. In each case there was no damage to the airframe latch bolt receiving fixture, suggesting that the panel latches had been closed incorrectly.

January 2017	Nacelle door detached
November 2015	No 1 nacelle outboard door detached
July 2015	Outboard door detached
August 2014	Nacelle door detached
July 2014	No 2 nacelle inboard door detached
December 2012	No 2 nacelle inboard door detached
April 2010	No 2 nacelle inboard door detached
July 2008	No 1 nacelle - outboard door detached
December 2005	No 1 nacelle inboard door detached

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Human factors

Engineering

The maintenance carried out on the aircraft on the evening of 13 December was conducted by a third party maintenance provider under contract to the operator. Following the incident, the maintenance provider's staff based at Manchester Airport stated that they were unaware of the existence of NTE 22 at the time the work was carried out, so had not conducted any additional post-maintenance inspection to check the security of the latches and panels. The operator's safety investigation established that, unlike the operator-owned maintenance subsidiary, there was no procedure in place for contracted maintenance company staff to read and sign NTEs.

The routine daily check requirement was laid out in a set of task sheets where each task, once completed, required sign off by an engineer licensed on type. The list of the tasks commenced with checks to internal systems and components, identified as tasks 1 to 14. The first external check was task 15, which required a full external walkround of the aircraft checking for damage, leaks and panel security. Checking the engine oil content of each engine was listed as tasks 26 and 27. These tasks were highlighted as safety critical and had a requirement for an independent check of the oil cap (or repeat inspection after a period of time, in the case of a licenced engineer completing the task). There was no similar instruction regarding the closing of the panel. Whilst the task stated the oil contents check should be in accordance with the Aircraft Maintenance Manual (AMM), a subsequent review with the aircraft manufacturer confirmed that, at the time of this event, the AMM did not contain any instructions on opening or closing the engine access panel.

The operator's expectation was that each item on the daily check task sheet would be signed for. The individual pages would then be certified complete and an entry would be added to the aircraft Technical Log, stating that the daily check had been completed. The signed hard copies of the task sheets and Technical Log pages should then have been posted to the operator's HQ in accordance with their procedures. The operator's safety investigation identified that the contracted maintenance company was not certifying the individual tasks or task sheet pages, but was just adding an entry directly into the aircraft Technical Log. The hard copy documents were also not being sent to the operator.

Interviews with the engineers involved in both the first and second incidents identified a common technique used to secure the engine access panel. This involved closing the two upper latches first, followed by the two lower ones. Practical assessment of this technique showed that occasionally, as a result of a slight misalignment of the panel, it did not close correctly into the gap in the engine nacelle. Given the height of the panel and shorter distance to the hinge line, it was difficult to apply the necessary force to fully engage the panel at the level of the top latches, when compared to applying a similar force at the bottom of the panel. This could result in the top latches being closed, without the panel being properly located. As a consequence, the locking pin would not be engaged in the receiving fixture on the nacelle side, but the latch would externally look and feel as if it was properly closed. Once the upper latches were closed in this manner, the panel would rest on the

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upper latch pins. Significant force could then be applied to the bottom of the panel while the lower latches were closed, but the pins would not engage in their receiving fixtures. The only external visual confirmation of the incorrect closure of the panel, was a small gap between the access panel and the surrounding nacelle panels (Figure 5).



Figure 5

Panel gap resulting from an incorrectly latched panel (viewed from the ground under similar lighting conditions to both incidents)

The engineers in both incidents involving G-PRPC were standing on steps to access the engine which meant once the access panel was closed, they were looking downwards at the panel and using a head torch to supplement the ambient lighting on the stand. Figure 6 shows how the perspective of the gap in the panel changes, when viewed under these circumstances. This would have been further exacerbated on the incident aircraft as the surrounding panels were painted purple rather than white, providing much less contrast to the shadow cast by the access panel.

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Figure 6

View of the panel gap following incorrect closure, from the perspective of the engineer conducting the task.

The operator subsequently revised NTE 22 post-incident to introduce a procedure where a sticker is placed over the bottom of the panel, when it is closed post-maintenance. This provides visual and tactile confirmation to the engineer that the panel is correctly closed and secured.

Flight operations

The airline procedures for pre-departure inspection of the aircraft were documented in the Operator's Operations Manual Part B4 section 2.5.8 '*External Inspection*,' which stated:

> *'The external checks are normally performed walking clockwise around the aircraft starting at the front passenger door. Crews shall not open any panels as part of the external inspection, unless there is a specific reason to believe that a security threat exists, or the Crew is pre-selecting a refuel figure. Particular attention should be made to ensure that all panels, equipment bay doors, engine cowlings are properly closed and secure and all pitot and static ports are not damaged or obstructed.'*

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The inboard and outboard engine access panels were also highlighted as a specific check item in the pre-departure inspection checklist. The operator provided information on what initial and recurrent training was provided for flight crew with respect to the pre-departure inspection. Guidance was provided at several points through the training which was delivered whilst walking around the aircraft:

- During an initial ground school hangar visit
- During base training
- During line training
- Assessed on final line check and then bi-yearly line check.

Following the first access panel loss in November 2016, the operator's Flight Operations department issued Notice To Air Crew (NOTAC) 146/16 - '*Engine Cowling and Hatches Inspection*', to request extra vigilance whilst conducting pre-departure inspections. The aircraft commander from the second incident on G-PRPC confirmed that he had read this document prior to the flight, but commented in interview that as he had previously been a flight engineer it did not contain any information that was new to him.

The commander stated that he was aware that a daily maintenance check had been signed for in the aircraft Technical Log and that this involved opening the engine access panels. When asked how he would normally assess that the access panel was secure, he stated that the latches would be flush. He advised that this was taught to him during his recent Q400 type conversion course, and was shown to him during the hangar visit and during his line training. (The commander had joined the operator five months earlier.)

Whilst the co-pilot had not been present during the pre-departure inspection prior to the accident flight, he stated that the securing of panels, including engine access panels, had been a classroom discussion on his Q400 type rating course. He had not had the opportunity to see a securely closed panel during the course hangar visit, as they had been open for maintenance at the time. He added that he had been shown the pre-departure inspection procedure by a co-pilot during his line training, who had not specifically highlighted the engine access panels as a check item.

Two further NOTACs (63/16 and 64/16) have subsequently been issued by the operator, to provide specific guidance in identifying correct panel and door closure during the pre-departure inspection and to highlight the engineering requirement to use a sticker over the engine access panel to confirm correct closure.

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Ground operations

Ground operations personnel usually work for a company contracted to provide a service for the airport and facilitate the 'push back' procedure for aircraft parked on stands. This consists of using an aircraft tug to reposition the aircraft from the stand to a location where the flight crew can safely start the aircraft engines and taxi away under their own control. Typically a two-man team is used, one to drive the tug and a second who connects a headset to the aircraft intercom, allowing them to communicate with the flight crew and coordinate the process. They are not required to have any technical qualifications and often work on numerous different types of aircraft.

Before the aircraft dispatch process commenced, ground operations personnel were required to complete a final walkround check of the aircraft. Guidance for the task was provided in their Ground Operation Manual section 3.4.3.1:

> *'Before pushback can commence a final walkround and external visual inspection of the aircraft must take place. This should include an inspection of the condition of the apron including the removal of any FOD[1]; confirmation that all hold, passenger and service doors, panels and latches are closed and secure; chocks and ground equipment are removed from the aircraft and there are no other obstructions preventing the aircraft pushback onto the taxiway.'*

Ground operations staff did not receive copies of the operator's NOTAC or NTE. The ground handler during the second incident had completed headset training in April 2014. This training included pre-departure checks. The training certificate from this course listed different aircraft types that were covered by the training, but did not include the Q400. The headset training did not specifically refer to the Q400 type, but did include a generic reference to checking that panels and engine cowlings were closed.

Aircraft manufacturer's response

Advisory label

The aircraft manufacturer has commenced development of a modification to add an advisory label to the access panel which provides pictorial guidance on how to ensure the panel is correctly closed and latched (Figure 7).

Footnote

[1] Foreign Object Debris.

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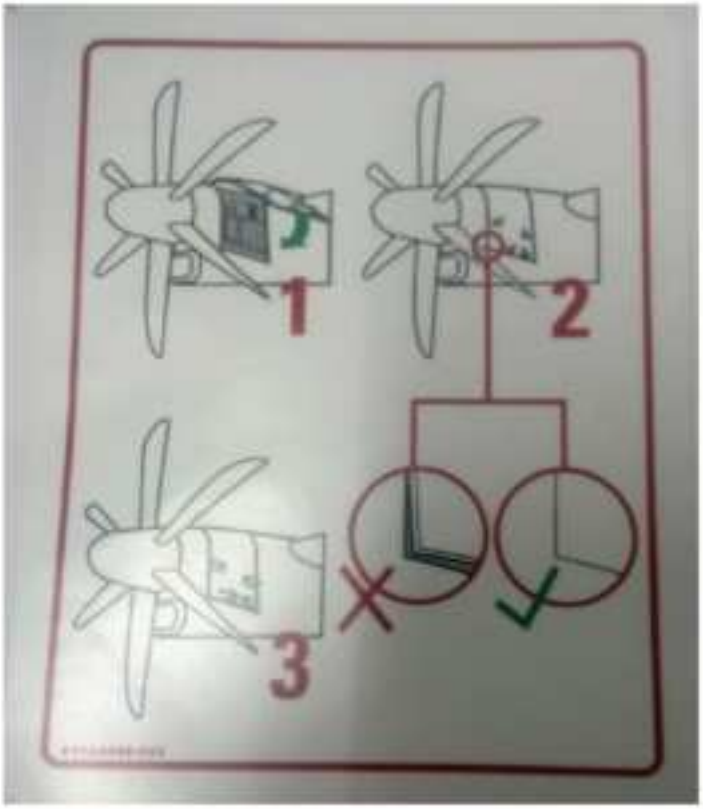


Figure 7
Advisory label modification

AMM Temporary Revision

Since this incident the aircraft manufacturer has issued AMM Temporary Revision 71-197, which includes instructions on how to correctly close the engine nacelle access door.

Analysis

On two separate occasions the outboard engine access panel on the No 1 engine on G-PRPC detached during takeoff. In both cases, the inspections of the panels and aircraft following the event showed that the locking bolts on the panel latches and the bolt receiving features on the nacelle had not failed or been damaged. In addition, the latches on the panels were confirmed to have been fully closed when the panels were recovered. As such, in both events the only explanation for the panels departing the aircraft during takeoff was that the bolts had not engaged in the receivers on the nacelle when the latches were shut. In this event, the aircraft sustained limited damage which did not compromise its ability to

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complete the flight safely. However, there is the potential for more serious damage to occur and the departure of such a large panel from the aircraft could also endanger people on the ground.

Engineering

The engineers conducting the maintenance daily check prior to both incidents were experienced and well trained staff, who had safely completed the same task many times during the years preceding these incidents. They came from different companies, with separate training organisations and operated at different airports. No significant contributing factors were identified which differentiated these two incidents from any previous occasions that they had completed the same task successfully. The only apparent common links were the technique used to close the panel, the physical positioning of the engineer as this was done and the lighting conditions at the time.

The technique of closing the top latches first, when combined with an access panel which may not immediately fit into its correct position without additional adjustment, appears to have created the conditions for a sequence of events which allowed the engineer to close the latches believing that they had correctly engaged the locking bolts, when in reality this was not the case. The fact that the engineers were then looking down on the panel, which was predominantly illuminated by the beam from a head torch, meant that the main indication of the gap at the bottom of the panel was only visually identifiable by the shadow that was cast. As the surrounding panels were painted purple this may not have been obvious, particularly considering that the engineer was not expecting the panel to be open once the latches were closed, was not specifically checking for the presence of a shadow, and may not have appreciated the implication of the presence of a shadow in this position.

Aircraft manufacturer's safety action

The manufacturer's addition of an advisory label on the panel will assist in raising awareness of the implications of a gap/shadow around the panel. At the time of this accident the AMM did not contain a procedure for opening/closing the panel. Evidence from this investigation suggested that using the technique of shutting the top latches first could, in some circumstances, increase the likelihood of the panel being closed incorrectly and not being secured. It would therefore have been beneficial for an approved technique for closing the panel to be included in the AMM. The aircraft manufacturer has since published Temporary Revision 71-197 to the AMM to introduce these instructions.

Operator's safety action

The operator has modified the daily check task sheet to introduce a final check of engine access panel security. This includes the requirement introduced by the revised NTE 22 to place a security sticker over the panel edge to confirm that there is no gap present. The sticker acts as an additional visual confirmation for flight crew that the panel has been correctly secured. The operator has also introduced a requirement for subcontract maintenance organisations to receive copies of NTEs.

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Flight operations

The operator's Operations Manual provides clear guidance on how a pre-departure inspection should be completed, which highlights the need for the security of the engine access panels to be checked. However, there is a degree of inconsistency in the way in which this is taught practically to flight crew during their type training. The results of this were shown in the CCTV footage of the pilot's inspection prior to the first incident, which did not follow the Operations Manual process. It was also identified by the co-pilot's response when questioned about his training experience. If flight crew are not shown the difference between correctly and incorrectly closed panels, misunderstandings such as the belief that closed latches confirm the panel is secure can become accepted custom and practice, and incidents such as this may continue to occur. The improved NOTAC issued by the operator should help to increase awareness amongst their existing flight crew community, but introducing improved and consistent training will provide an opportunity to increase awareness amongst flight crew converting to the Q400. The following Safety Recommendation is therefore made:

Safety Recommendation 2017-014

It is recommended that Flybe Ltd introduces defined and consistently delivered flight crew training on pre-departure inspections for the DHC-8-402 (Q400), compliant with the inspection procedure documented in its Operations Manual. This should include a practical element on the aircraft and a demonstration of correctly secured main engine access panels.

Ground operations

Whilst walkround checks by ground operations crew represent a final opportunity to identify issues such as obviously open access panels, the personnel involved are not technically qualified on type in the same way that engineers and flight crew are. The operator has no control over the quality and content of their training and the service may be provided by multiple companies across all the airports that the operator flies to. As such, their inspection of the aircraft should only be considered a gross check and cannot be relied upon to address issues such as closed but incorrectly secured panels. However, there is potentially some benefit to the operator in increasing general awareness using specifically targeted guidance information relating to safety issues. The following Safety Recommendation is therefore made:

Safety Recommendation 2017-015

It is recommended that Flybe Ltd considers introducing a means of disseminating pertinent safety information to ground operations staff in an appropriate format.

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Conclusion

Following overnight maintenance work, the outboard engine main access panel on the No 1 engine was not securely closed by the engineer, due to the latch bolts not engaging in the nacelle receiving features when the latches were closed. Contributory factors may have been a slight mismatch in the closure of the panel and the technique used by the engineer of closing the top latches first. The resulting gap around the panel was not identified by the engineer completing the task, possibly as a consequence of the angle at which he was looking down on the closed panel and the lack of contrast of the shadow cast on the dark coloured engine nacelle.

The aircraft commander did not identify the incorrect closure of the panel during his subsequent pre-departure inspection, neither did the ground operations crew dispatching the aircraft. During the next takeoff, the panel failed at the hinge attachment points and departed the aircraft striking and damaging the vertical stabiliser, before coming to rest on the runway and its grass verge. The investigation identified a lack of consistency in the way flight crew were instructed on completing pre-departure inspections during their training.

A previous accident, where the same engine panel was lost during takeoff, had occurred on the aircraft a month earlier. The circumstances and investigation findings for both accidents were the same. Safety action has been taken by the aircraft manufacturer to add labelling and amend the AMM and the operator has revised its maintenance procedures. In addition, two Safety Recommendations have been made relating to flight crew pre-departure inspection procedures and dissemination of safety information to ground crew, with the intention of preventing recurrence.

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Appendix 5.2:

Service Bulletin 84-11-46 Bombardier/De Havilland

BOMBARDIER

deHAVILLAND DASH 8

SERVICE BULLETIN

Customer Support

ATA SYSTEM: 1124 NUMBER: 84–11–46

SUBJECT: Placards and Markings – Retrofit – Exterior Label Installation – Nacelle Cowl Door Closing Procedures – ModSum 4–459662

1. PLANNING INFORMATION

A. Effectivity

Aircraft Affected:

In–Service: DHC–8 Aircraft Models 401 and 402 Serial Numbers 4001, 4003 thru 4554.

NOTE: The instructions in this service bulletin are only applicable to the systems and parts installed at the time of delivery on the aircraft or as changed by Bombardier Aerospace Service Bulletin(s). Before you do this bulletin, examine all STC or equivalent action changes to make sure this bulletin can be completed.

Spares Affected:

None

B. Reason

Problem: Several incidents have been reported where the nacelle forward cowl doors have departed aircraft during flight. In all cases, no physical evidence from recovered doors support latch failure.

Departing door may cause damage to aircraft structure and/or flight controls and loss of nacelle fire detection and extinguishing.

Cause: Cause of problem is attributed to human errors of failure to ensure all the door latches are engaged and that the door fully touches the door seals after the doors are closed when the maintenance is completed.

Solution: This service bulletin introduces ModSum 4–459662. The ModSum adds two new exterior labels for cowl door closing procedures to prevent the incorrect closure of the cowl doors. New labels are placed on both LHS and RHS nacelles, on the inboard and outboard cowl doors.

C. Description

The procedures in this service bulletin give the instructions to do the tasks that follow:

- aircraft electrical power is removed
- the nose landing gear lock is engaged
- the main landing gear lock pins are installed through each main gear and main gear door mechanism
- access is gained to the left and right hand side of each nacelle
- new labels are installed
- close out.

D. Compliance

Bombardier Inc. highly recommend that ModSum 4–459662 be incorporated at the earliest opportunity unless otherwise directed by the operator's airworthiness authority.

E. Approval

The technical content of this service bulletin has been approved under the authority of the Transport Canada Civil Aviation (TCCA) Design Approval Organization No: DAO #93–Q–02.

This service bulletin does not affect Airworthiness Limitations (AWLs) or Damage Tolerance Inspections (DTIs).

F. Manpower

It will take an estimated 2.00 man–hours to complete this service bulletin. The breakdown of the man–hours is shown in the table that follows:

TASK	MAN–HOURS
Job Set–Up	0.25
Procedure	1.50
Test / RTS	0.00
Close–Out	0.25

This estimate is for direct labour done by an experienced crew and it does not include, planning, familiarization, cure time, part fabrication, tool acquisition or lost time.

G. Material – Price and Availability

The ModKit(s) required to do this service bulletin is/are listed in the table below:

Kit Number	Description
8MK4811–001	Retrofit Kit – Q400 Exterior Label Inst – Nacelle Cowl Door Closing Procedures

Operators should submit a purchase order through the Customer Response Center (CRC) to the Customer Accounts Service Team (CAST) at Bombardier Aerospace Commercial Aircraft division specifying aircraft serial number(s) to:

Bombardier Aerospace
Customer Accounts Services Team (Mail Stop N11–32)
123 Garratt Blvd.
Toronto
Ontario
Canada M3K–1Y5
E–mail addresses:
International: cast.international@aero.bombardier.com
European: ps_emea@aero.bombardier.com

Americas East: cast.americaseast@aero.bombardier.com
Americas West: cast.americaswest@aero.bombardier.com
Telephone:
North America:Toll Free +1–844–CRC–CRC0 (+1–844–272–2720) or direct +1–514–855–8500
Facsimile:
International: (416) 373–5966
Americas East: (416) 373–5964
Americas West: (416) 375–5965

H. Tooling – Price and Availability

None

I. Weight and Balance

Not affected

J. Electrical Load Data

Not affected

K. Publications Affected

Aircraft Illustrated Parts Catalog ..... PSM 1–84–4

ModSums Manual ..... PSM 1–84–12

L. References

The initial issue of this service bulletin was prepared to the engineering drawings and related data that follows:

DRAWING	SHEET	REV
8MK4811	1	– –
8Z9984	1	– –

ModSum 4Q459662 Rev. 'A'

ModSum 4–459662 Rev. 'B'

ModSum 4Q903468 Rev. 'A'

PCA 46357 Revision 0 (for internal reference only)

2. MATERIAL INFORMATION

A. Parts Required Per Aircraft

(1) Modification Kit 8MK4811–001

(2) Detailed Kit Content:

Quantity Per Kit –001	Part Number	Description	Remarks
2	81153440–103	Sym –Cowl Door Closing Procedures (LHS Inboard, RH Outboard)	
2	81153440–101	Sym –Cowl Door Closing Procedures (LHS Outboard, RH Inboard)	
1	8Z9984	Retrofit – Exterior Label Inslt Q400 (Nacelle Cowl Door Closing Procedures)	Drawing Only
1	8MK4811	Kit	Drawing Only

NOTE: No drawings will be provided with this kit. Drawings will be distributed concurrently with the service bulletin.

Listed drawings that are required to complete the kits above can be requested by writing to the following e–mail address:

qseriesdwgrequest@aero.bombardier.com

(3) In addition to the above part(s), the following material(s) are required for the completion of this service bulletin and may be procured as single items from Bombardier Aerospace Commercial Aircraft or purchased directly from industry sources.

Each consumable product listed in the table below is given its own unique Product ID Number. The number is used to identify a particular recommended product, the specifications and the trade names any of which can be used unless specified otherwise (refer to PSM 1–84–18 Consumable Products Manual).

Consumable Product ID Number	Qty. Per Aircraft	Description	Remarks
06–01A	A/R	Sealant, Temperature Resistant, Integral Fuel Tanks, High Adhesion	DHMS S3.01

B. Parts Required to Modify Spares

None

C. Special Tools and Equipment Required

Reference	Designation
3M Co. PA–1, Blue or Gold	Plastic Squeegee
3M Co. SA–1	Low Friction Sleeve
3M Co. RBA–1	Rivet Brush
3M Co. Air Release Tool 391X	Pin or Sharp Round Pointed Tool
Razor Blade with a Safety Holder	Cutting Tools
2 in. (50.80 mm) (3M P/N.75–5410–0401–8)	Rubber Hand Roller (RHR)

D. Existing Parts Accountability

None

3. ACCOMPLISHMENT INSTRUCTIONS

A. Job Set-Up

WARNING: MAKE SURE YOU INSTALL THE LOCKPINS ON THE MAIN LANDING GEAR. MAKE SURE YOU ENGAGE THE NOSE GEAR LOCK. IF YOU DO NOT DO THIS, THE LANDING GEAR CAN ACCIDENTALLY RETRACT. THIS CAN CAUSE INJURIES TO PERSONS AND DAMAGE TO THE EQUIPMENT.

WARNING: MAKE SURE YOU INSTALL THE LOCKPINS IN THE DOOR MECHANISMS OF THE MLG AND NLG. THE DOOR MECHANISMS CAN ACCIDENTALLY CLOSE THE LANDING GEAR DOORS. THIS CAN CAUSE INJURIES TO PERSONS AND DAMAGE TO THE EQUIPMENT.

(1) Placard and select all aircraft electrical power to OFF. Obey all relevant WARNINGS and CAUTIONS (refer to AMM TASK'S 24-00-00-861-802 and 24-00-00-910-801).

(2) Make sure that lock pins are installed through each main gear and main gear door mechanism.

(3) Make sure the nose gear ground lock is engaged.

(4) Set wheel chocks in front and behind the landing gear tires.

(5) Set up the work platforms or ladders as required to gain access to the left and right side of each nacelle. Make sure the work platforms or ladders are electrically grounded.

B. Procedure

(1) Install label 81153440-101 and label 81153440-103 on the LH nacelle as shown (refer to Figure 1, Figure 2, Figure 3 and AMM TASK 20-00-16-400-801).

NOTE: Make sure highest standard of fit, form and function is maintained. Only if required, it is permissible to notch, slit and trim edges of labels on installation, however, text and the graphics must remain undisturbed.

(2) Seal the edges of all labels with sealant 06-01A (refer to AMM TASK 51-23-00-390-801).

(3) Install label 81153440-101 and label 81153440-103 on the RH nacelle as shown (refer to Figure 1, Figure 4, Figure 5 and AMM TASK 20-00-16-400-801).

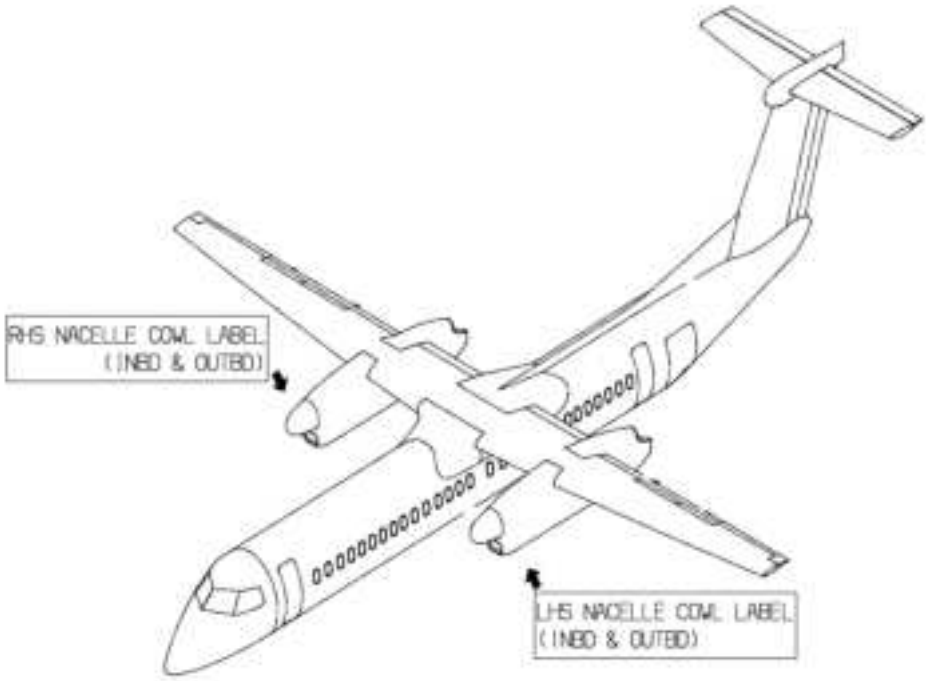
NOTE: Make sure highest standard of fit, form and function is maintained. Only if required, it is permissible to notch, slit and trim edges of labels on installation. however, text and the graphics must remain undisturbed.

(4) Seal the edges of all labels with sealant 06-01A (refer to AMM TASK 51-23-00-390-801).

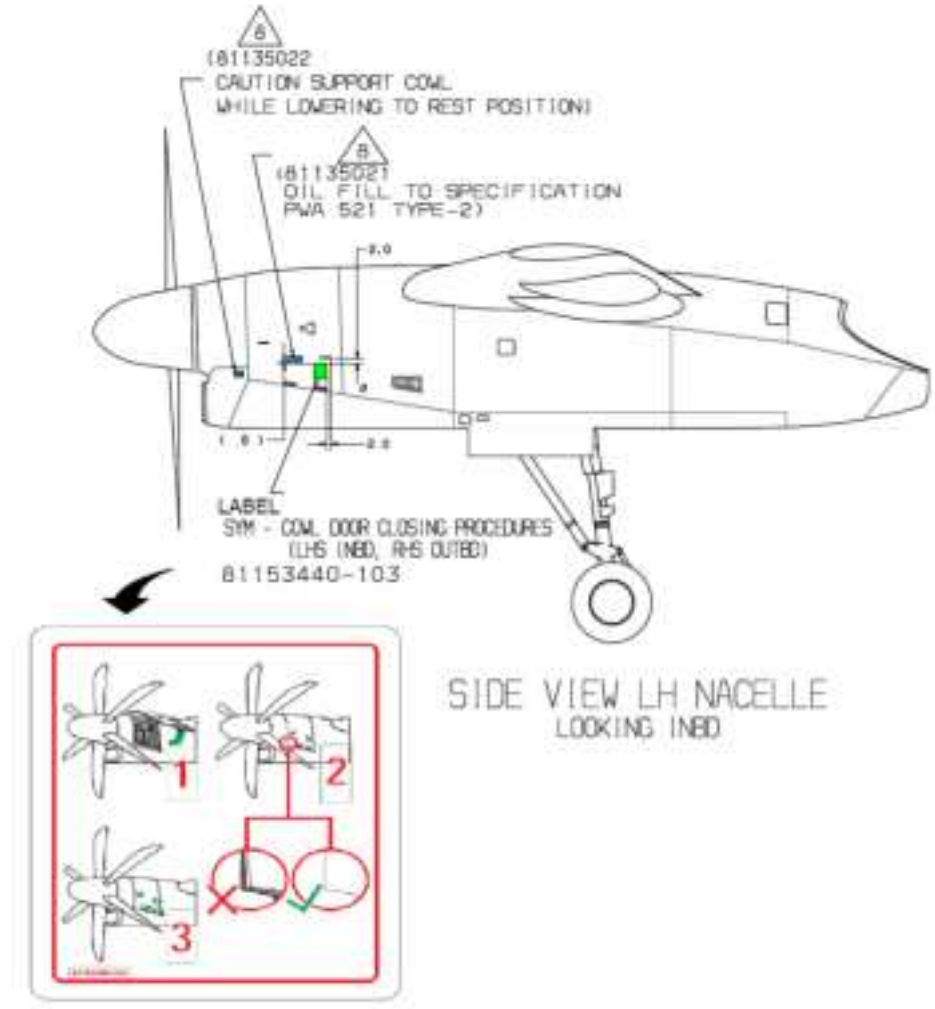
C. Close Out

(1) Remove all tools and equipment from the work area.

(2) On incorporation of this ModSum, make an entry that conforms to local regulatory requirements in the applicable logbook(s). Enter component serial numbers if applicable. Enter this ModSum number only after complete and functional incorporation of all work defined in this service bulletin.



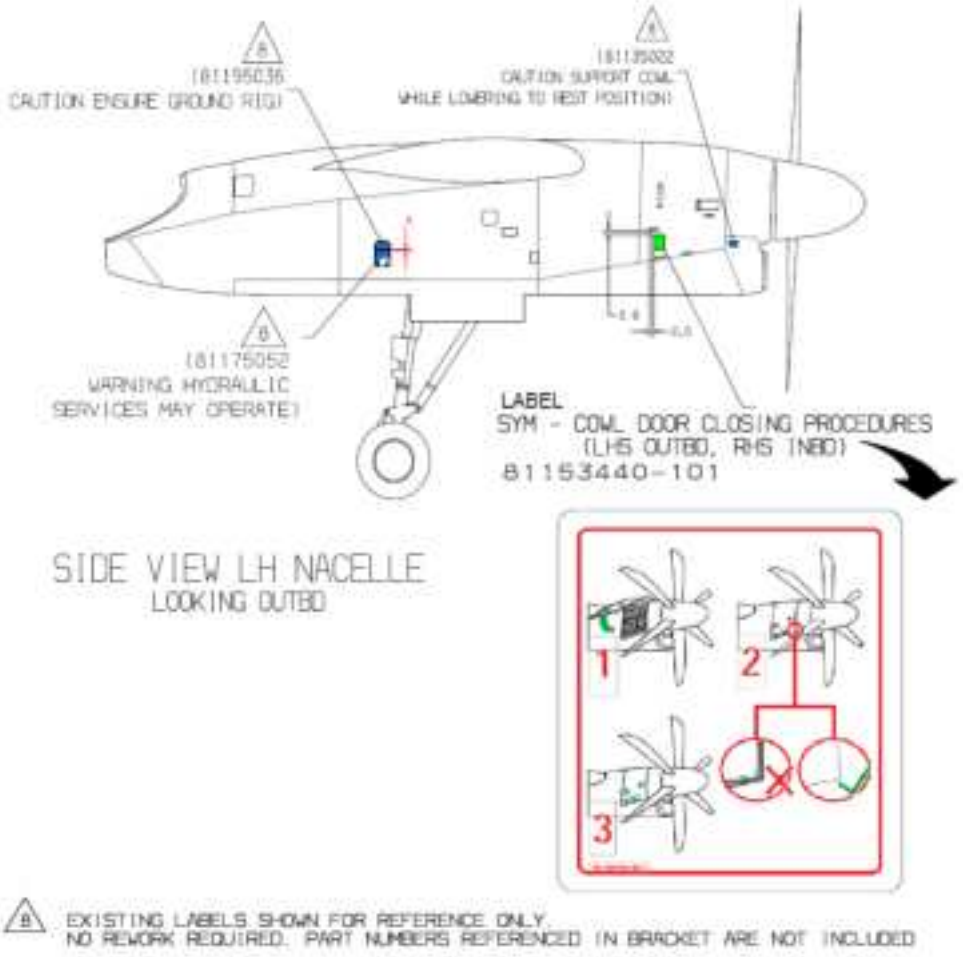
Location of Nacelle Cowl Label Installation
Figure 1



A EXISTING LABELS SHOWN FOR REFERENCE ONLY.
NO REWORK REQUIRED. PART NUMBERS REFERENCED IN BRACKET ARE NOT INCLUDED

NOTE: ALL DIMENSIONS ARE IN INCHES

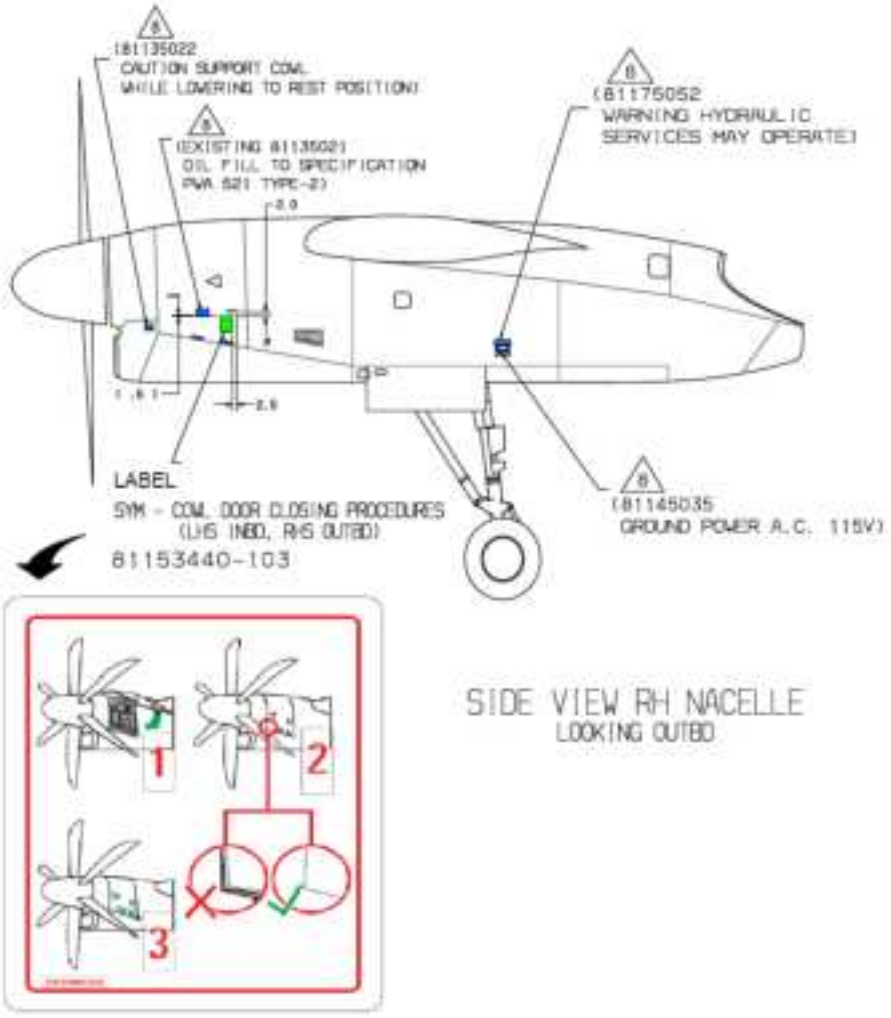
Label Installation – LH Nacelle – Looking Inboard
Figure 2



EXISTING LABELS SHOWN FOR REFERENCE ONLY.
NO REWORK REQUIRED. PART NUMBERS REFERENCED IN BRACKET ARE NOT INCLUDED

NOTE: ALL DIMENSIONS ARE IN INCHES

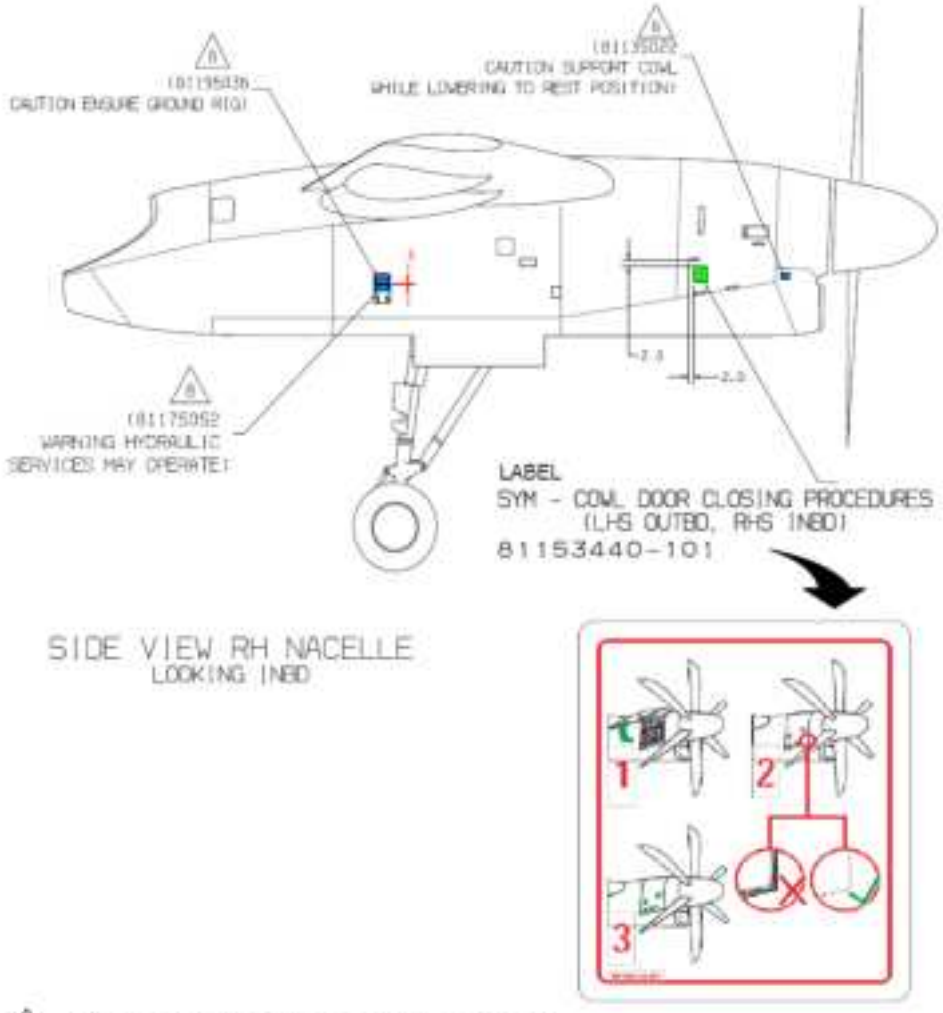
Label Installation – LH Nacelle – Looking Outboard
Figure 3



EXISTING LABELS SHOWN FOR REFERENCE ONLY.
NO REWORK REQUIRED. PART NUMBERS REFERENCED IN BRACKET ARE NOT INCLUDED

NOTE: ALL DIMENSIONS ARE IN INCHES

Label Installation – RH Nacelle – Looking Outboard
Figure 4



EXISTING LABELS SHOWN FOR REFERENCE ONLY
NO REWORK REQUIRED. PART NUMBERS REFERENCED IN BRACKET ARE NOT INCLUDED

NOTE: ALL DIMENSIONS ARE IN INCHES

Label Installation – RH Nacelle – Looking Inboard
Figure 5

Appendix 5.3:

All Operator Message No. 870 Bombardier/De Havilland

DE HAVILLAND AIRCRAFT OF CANADA LIMITED

DE HAVILLAND AIRCRAFT OF CANADA LIMITED
123 GARRATT BLVD
TORONTO, ON, CANADA M3K 1Y5
TEL: 1-514-855-8500 or North America: 1-844-272-2720
ihd@dehavilland.com
www.flybombardier.com

DE HAVILLAND Dash 8-400

All Operator Message No. 870

ATTN: Director/Manager of:
Maintenance
Engineering
Quality Control
Flight Operations
Procurement/Spares

DATE: 17 July 2020

ATA: 7100 MODEL: DASH 8-400

SUBJECT: Nacelle Fwd Cowl Door, Improper Closing and Latching

REFERENCE:
//A// AMM Task 71-10-06-410-801
//B// SB 84-11-46
//C// IS-ModSums IS4Q7100024 and IS4Q7100025
//D// MODSUM 4Y124550 and 4V184175

The following message is being sent to all DE HAVILLAND AIRCRAFT OF CANADA LIMITED Operators and DE HAVILLAND AIRCRAFT OF CANADA LIMITED Field Service Representatives.

This message contains information requiring attention and/or action. Please ensure timely and appropriate distribution within maintenance and flight operations departments.

DISCUSSION:

DE HAVILLAND AIRCRAFT OF CANADA LIMITED has received reports of Nacelle Fwd Cowl Doors P/N 87144003 and 87144004 (412AL, 422AL) departing the aircraft during takeoff. To date, all investigations have been attributed to the release of aircraft for flight with improperly latched doors. On some aircraft the latches were closed before the door was fully shut. The latches did not engage the fittings on the nacelle lower cowl. On other aircraft, the latches were never closed after performing maintenance.

To reduce the likelihood of improper latching, the following actions have been taken:
- AMM Task 71-10-06-410-80, originally released on October 5, 2017 provides instructions for proper closing the cowl doors.

- SB 84-11-46 has been issued to install a placard (P/N 81153440) on the doors showing correct and incorrect closing of the cowl doors. If the doors are closed correctly, then the surface of the

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door will sit tight to the surrounding structure. If the doors are closed incorrectly, then the surface of the door will have a gap along the lower edge.



Figure 1 Cowl Door Closed but not engaged, latches not shut

Figure 1 shows door closed, and latches not closed, with a gap at the bottom of the door. The gap at the bottom of the door is indicative that the door has not engaged the latch fittings. Note the red paint on the underside of the latch is used to improve indication that the latch is not closed.

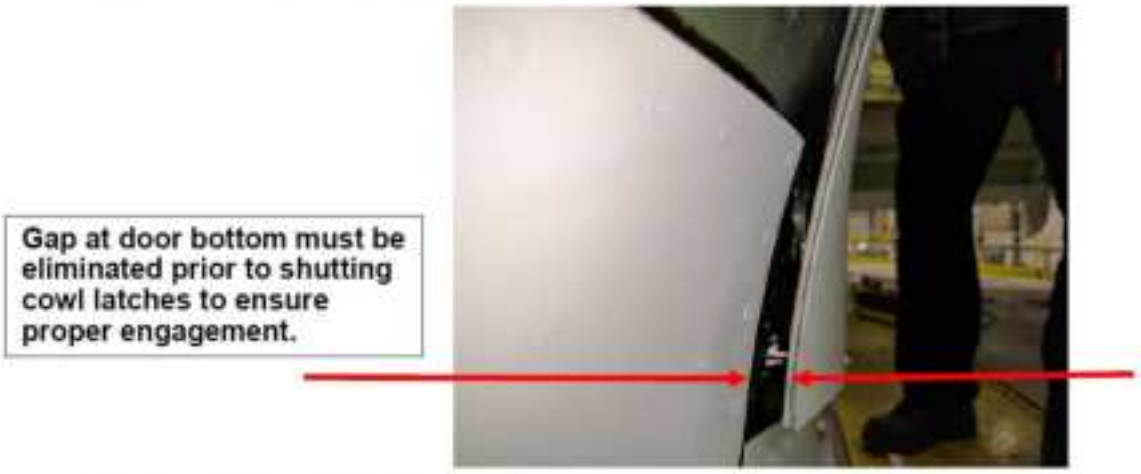


Figure 2 Gap at bottom of door if latch fittings are not properly engaged, view looking aft

Figure 2 looking aft at the bottom of the door shows the gap if the door is closed, but not flush. For proper engagement of the door with the latch fittings, the door must be manipulated to ensure flushness prior to closing the latches.

A production (only) MODSUM (4Q903562) will be issued for a revised simplified placard shown in Figure 4 with a wide hatched red border. The MODSUM is intended to include a one-way interchangeability statement, which will drive AIPC changes. Whenever a placard is changed on in-service aircraft, the old-style placard shown in Figure 3 may be installed until depletion of stock, after which the new style placard shown in Figure 4 can be purchased. Only the new style placard will be available from Material Services.

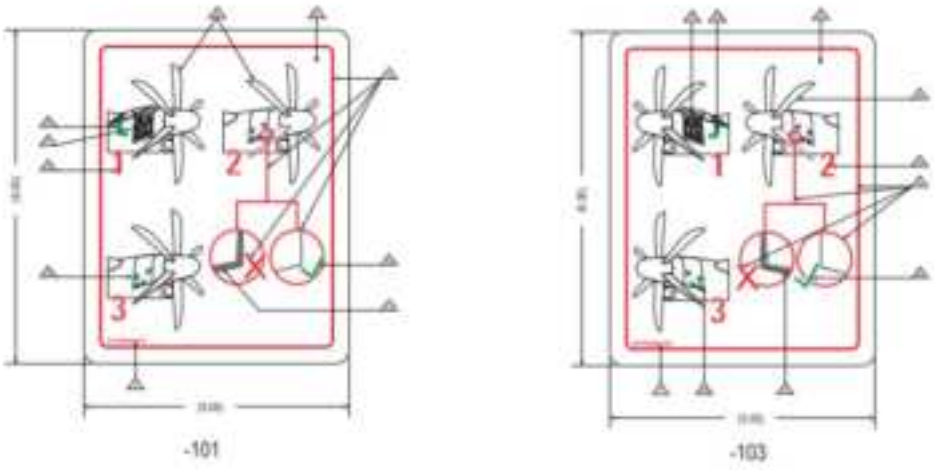


Figure 3 Old Cowl Door Labels – Drawing 81153440

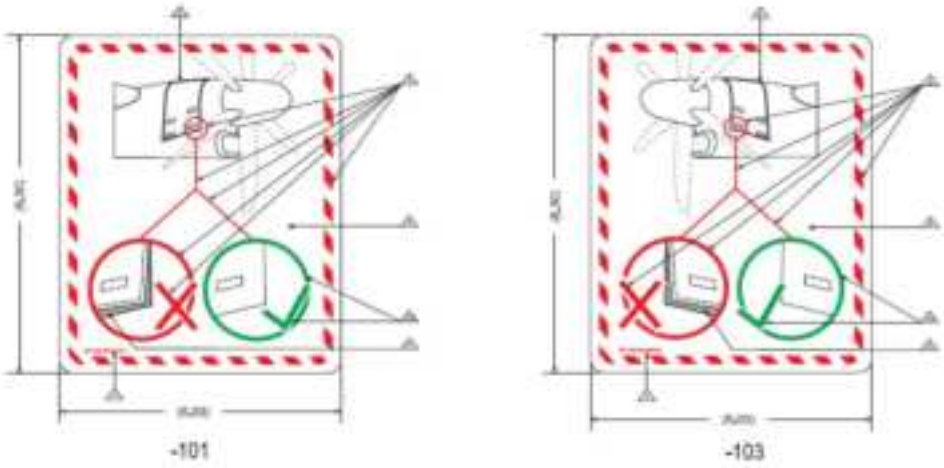
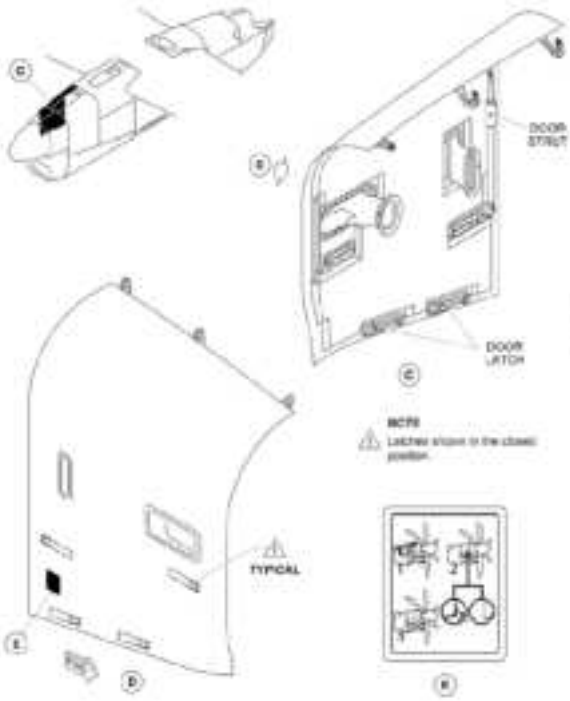


Figure 4 New Cowl Door Labels – Drawing 81153441

- Generic IS-Mods IS4Q7100024, IS4Q7100025 and Production Rework Mod 4Y124550 (Cut in at A/C S/N 4590) and production Mod 4V184175 were developed to chamfer the edges of the nacelle door fittings P/Ns 87144058 and 87144059 as well as the nacelle firefloor door latch fittings P/N 87144131. The reworked fittings improve the ability of the cowl doors to engage with the lower cowl structure, thereby reducing the possibility of a closed latch not engaging the fitting.

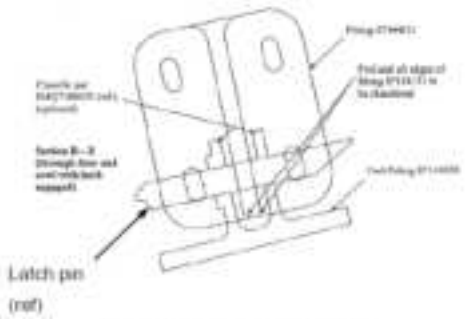
The above reworks are highly recommended on all aircraft. All doors lost in flight have been attributed to human factors. Cowl doors lost in flight can cause damage to aircraft including, but not limited to, puncture of the leading edges, damage to the systems within the leading edges, scuffing of the upper wing skins, and puncture of the vertical tail skins.



Forward Side Doors - Opening/Closing

Ref SB 84-11-46

Figure 5



Chamfering of fittings per IS4Q7100024 and IS4Q7100025 (ref, only)

Figure 6

If desired, the new labels drawing 81153441-101/103, and the latch fittings with chamfered edges, part numbers 87144058-103/104 and 87144059-103/104 as well as the nacelle firefloor door latch fittings with chamfered edges P/N 87144131-103/104 can be ordered directly from DH Material Services.

Please direct responses and inquiries regarding the content of this AOM to your DE HAVILLAND AIRCRAFT OF CANADA LIMITED Field Service Representative or the Technical Help Desk in Toronto at telephone 1-514-855-8500 or Toll Free North America 1-844-272-2720 or e-mail: thd@dehavilland.com.

Douglas Caldwell, Manager, In Service Engineering and Technical Support and Jason Rahaman, Director of Dash-8 Technical Services, DE HAVILLAND AIRCRAFT OF CANADA LIMITED.

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Appendix 5.4:

Transport Canada Civil Aviation Safety Alert 2020-08

Transport Canada / Transports Canada

Document No. /Document nº : CASA 2020-08
Issue No. /Numéro d'édition : 01
Date : 2020-09-10
Page : 1 of/de 3

CIVIL AVIATION SAFETY ALERT

ALERTE À LA SÉCURITÉ DE L'AVIATION CIVILE

ATTENTION:

OWNERS,OPERATORS AND MAINTAINERS OF DE HAVILLAND AIRCRAFT OF CANADA LIMITED DASH 8-400 SERIES (Q400) AEROPLANES

À L'ATTENTION DE :

PROPRIÉTAIRES, EXPLOITANTS ET SPÉCIALISTES DE LA MAINTENANCE D'AVIONS DASH-8 SÉRIE 400 (Q400) DE DE HAVILLAND AIRCRAFT OF CANADA LIMITED

DASH 8-400 (Q400) FORWARD COWL DOOR DEPARTURE FROM THE AIRCRAFT ON TAKE-OFF

PERTE DU CAPOT AVANT DU DASH-8-400 (Q400) AU DÉCOLLAGE

PURPOSE:

The purpose of this Civil Aviation Safety Alert (CASA) is to raise awareness of the proper maintenance practice and recommended modifications to prevent the forward cowl door on the engine nacelle from departing the aeroplane during take-off.

OBJET :

La présente alerte à la sécurité de l'Aviation civile (ASAC) vise à faire connaître les pratiques d'entretien adéquates et les modifications recommandées afin de prévenir la perte du capot avant de la nacelle moteur au décollage de l'avion.

BACKGROUND:

There have been a number of reported occurrences of the forward cowl door departing from the aeroplane on take-off following maintenance access to the powerplant area. Loss of the cowl door has resulted in damage to the aeroplane's wing leading edge, wing skin and vertical tail structure.

Inspections of the cowl doors recovered at the departure airports revealed that all occurrences were attributed to unsecured cowl doors. In some events, the latches on the door panel were not in the closed and latched position, indicating that the cowl doors were not latched after performing maintenance. In other events, the latches on the door panel were in the closed position, indicating

CONTEXTE :

Un certain nombre d'incidents ont été rapportés concernant la perte du capot avant au décollage de l'avion après l'accès par les techniciens d'entretien à la zone du groupe motopropulseur. La perte du capot a entraîné des dommages au bord d'attaque de l'aile, au revêtement de la voilure et à la structure de l'empennage vertical de l'avion.

L'inspection des capots récupérés aux aéroports de départ a révélé que tous les incidents étaient liés à des capots non sécurisés. Dans certains cas, les loquets sur le panneau du capot n'étaient pas en position fermée et verrouillée, ce qui indique que le capot n'avait pas été verrouillé après les travaux d'entretien. Dans d'autres cas, les loquets sur le panneau du capot étaient en position fermée, ce qui

that the latches were closed before the cowl doors were shut, preventing the locking pin of latches from engaging in the receiving fitting on the nacelle lower cowl.

In order to prevent reoccurrence, De Havilland Aircraft of Canada Limited has issued an All Operator Message (AOM), No. 870 on 17 July 2020, to bring attention to a new Aircraft Maintenance Manual (AMM) task instruction for proper cowl door closing, the Service Bulletin 84-11-46, a new modsum which introduces placards for illustrating the proper closing of the cowl door, and new rework modifications to improve the ability of latch engagement.

RECOMMENDED ACTION:

Transport Canada Civil Aviation recommends that owners, operators and maintainers of Dash 8-400 aeroplanes familiarize themselves with De Havilland's AOM No. 870 and follow the improvement actions outlined in the AOM for maintenance instructions, placard addition and rework to the latch mechanism.

CONTACT OFFICE:

For more information concerning this issue, contact a Transport Canada Centre; or Zhiwei Wang, Continuing Airworthiness in Ottawa, by telephone at 1-888-663-3639, facsimile at 613-996-9178 or by e-mail at cawwebfeedback@tc.gc.ca.

indique que les loquets avaient été fermés avant que le capot soit refermé, empêchant la goupille de verrouillage des loquets de s'engager dans le trou prévu pour la recevoir sur le capot inférieur de la nacelle.

Pour éviter que la situation ne se reproduise, De Havilland Aircraft of Canada Limited a émis le message à tous les exploitants nº 870 en date du 17 juillet 2020 pour les informer d'une nouvelle instruction relative à une tâche du manuel d'entretien de l'aéronef (AMM) concernant la fermeture correcte des capots, du bulletin de service 84-11-46, d'une nouvelle Modsum qui introduit des affichettes illustrant comment bien fermer le capot, et de nouvelles modifications de réusinage visant à faciliter l'engagement des loquets.

MESURE RECOMMANDÉE :

Transports Canada, Aviation civile, recommande que les propriétaires, les exploitants et les spécialistes de la maintenance d'avions Dash-8-400 prennent connaissance du message à tous les exploitants nº 870 de De Havilland et qu'ils mettent en œuvre les améliorations qui y sont mentionnées relativement aux instructions d'entretien, à l'ajout d'une affichette et au réusinage du mécanisme des loquets.

BUREAU RESPONSABLE :

Pour davantage de renseignements à ce sujet, veuillez communiquer avec un Centre de Transports Canada ou avec Zhiwei Wang, Maintien de la navigabilité aérienne à Ottawa, par téléphone au 1-888-663-3639, par télécopieur au 613-996-9178 ou par courriel à cawwebfeedback@tc.gc.ca.

ORIGINAL SIGNED BY/ORIGINAL SIGNÉ PAR

Rémy Knoerr
Chief, Continuing Airworthiness | Chef, Maintien de la navigabilité aérienne
National Aircraft Certification | Certification nationale des aéronefs

THE TRANSPORT CANADA CIVIL AVIATION SAFETY ALERT (CASA) IS USED TO CONVEY IMPORTANT SAFETY INFORMATION AND CONTAINS RECOMMENDED ACTION ITEMS. THE CASA STRIVES TO ASSIST THE AVIATION INDUSTRY'S EFFORTS TO PROVIDE A SERVICE WITH THE HIGHEST POSSIBLE DEGREE OF SAFETY. THE INFORMATION CONTAINED HEREIN IS OFTEN CRITICAL AND MUST BE CONVEYED TO THE APPROPRIATE OFFICE IN A TIMELY MANNER. THE CASA MAY BE CHANGED OR AMENDED SHOULD NEW INFORMATION BECOME AVAILABLE.	L'ALERTE À LA SÉCURITÉ DE L'AVIATION CIVILE (ASAC) DE TRANSPORTS CANADA SERT À COMMUNIQUER DES RENSEIGNEMENTS DE SÉCURITÉ IMPORTANTS ET CONTIENT DES MESURES DE SUIVI RECOMMANDÉES. UNE ASAC VISE À AIDER LE MILIEU AÉRONAUTIQUE DANS SES EFFORTS VISANT À OFFRIR UN SERVICE AYANT UN NIVEAU DE SÉCURITÉ AUSSI ÉLEVÉE QUE POSSIBLE. LES RENSEIGNEMENTS QU'ELLE CONTIENT SONT SOUVENT CRITIQUES ET DOIVENT ÊTRE TRANSMIS RAPIDEMENT PAR LE BUREAU APPROPRIÉ. L'ASAC POURRA ÊTRE MODIFIÉE OU MISE À JOUR SI DE NOUVEAUX RENSEIGNEMENTS DEVIENNENT DISPONIBLES.

Appendix 5.5:

Safety Concern issued by AAID

Subject: AAID Safety Concern 2021-1

Shortly after take-off of flight WB 464, conducted with a Q400 aircraft registered 9XR-WM, at Jomo Kenyatta International Airport Nairobi, a cowling panel from the left-hand engine separated from the aircraft. Subsequently the detached panel caused damage to the de-icing boot of the left wing. The panel concerned had been opened and closed for oil servicing during the ground stop of flight WB 464 at Nairobi.

Preliminary investigation by the AAID revealed that at least 11 similar incidents have been documented by other Dash 8-400 (Q400) operators. This series of incidents has resulted in the issuance of a 'Civil Aviation Safety Alert' (CASA 2020-08) by the Canadian Civil Aviation Safety Authorities on Sept. 10th 2020, see attachment.

CASA 2020-08 calls for strict adherence to the All Operators Message (AOM) No. 870 from the aircraft manufacturer, De Havilland Aircraft of Canada Limited. AOM No. 870 was issued on July 17th 2020 and addresses required maintenance instructions, placard addition and rework to the latch mechanism.

In view of the above, and pending the full investigation of the incident with the 9XR-WM aircraft, the AAID has formulated the following recommendation:

The Rwanda Aviation Accident Investigation Directorate recommends that RwandAir implements De Havilland's All Operators Message No. 870, issued on July 17th 2020, without delay and refrains from operating their Q400 aircraft until this implementation has been completed.

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