ACCIDENT

Aircraft Type and Registration:	1) DHC-8-402, G-JECK 2) EMB-145EP, G-SAJS
No & Type of Engines:	1) 2 Pratt & Whitney Canada PW150A turboprop engines 2) 2 Allison AE 3007/A1/1 turbofan engines
Year of Manufacture:	1) 2005 (Serial no: 4113) 2) 2001 (Serial no: 145390)
Date & Time (UTC):	16 June 2020 at 1646 hrs
Location:	Aberdeen International Airport
Type of Flight:	1) Commercial Air Transport (Non-Revenue) 2) N/A
Persons on Board:	1) Crew - 2 Passengers - None 2) Crew - None Passengers - None
Injuries:	1) Crew - None Passengers - N/A 2) Crew - N/A Passengers - N/A
Nature of Damage:	1) Damage to forward fuselage section and windscreen 2) Right engine nacelle dented
Commander's Licence:	1) Airline Transport Pilot's Licence 2) N/A
Commander's Age:	1) 31 years 2) N/A
Commander's Flying Experience:	1) 2,677 hours (of which 2,518 were on type) Last 90 days - 0 hours Last 28 days - 0 hours 2) N/A
Information Source:	Aircraft Accident Report Form submitted by the pilot and additional enquiries by the AAIB

Synopsis

G-JECK was to be flown from Aberdeen Airport to Weeze Airport, Germany. The aircraft had been in storage at Aberdeen since March 2020 and was parked on a self-manoeuvring stand which had a 1° slope. During the pre-departure checks, the chocks were removed from both the mainwheels and the nosewheels. The hydraulic pressure in the park brake system subsequently reduced to the point where the brakes could no longer prevent G-JECK from moving, and the aircraft rolled across a taxiway before colliding with G-SAJS, which was parked on an adjacent stand. There were no injuries.

Safety action has been taken by the CAA, operator of the aircraft, maintenance organisation, ground handling company and airport operator regarding the removal of wheel chocks during pre-flight preparation.

History of the flight

G-JECK had been stored at Aberdeen Airport (Aberdeen) since mid-March 2020, following the previous operator ceasing trading. On 16 June 2020, the aircraft was to be flown empty to Weeze Airport, Germany (Weeze) where it was to be placed back into storage. An organisation had been contracted by the aircraft owner to operate the aircraft for the ferry flight. This organisation provided the pilots, with ground handling services sub-contracted to another company based at Aberdeen. The commander and co-pilot for the flight had flown for the previous operator of G-JECK and were using the standard operating procedure (SOP) of that operator.

The pilots had not flown since the beginning of March 2020, so they had arranged to arrive at Aberdeen earlier than normal to provide additional time to prepare for the flight without having to rush. As the aircraft had not flown for some time, they also decided to conduct two separate and independent external and internal inspections. The commander arrived at 1230 hrs and the co-pilot at 1300 hrs, with the departure scheduled for 1600 hrs. The subsequent timeline has been derived from witness statements and a review of CCTV footage of the event.

The pilots were met by a dispatcher[1] from the ground handling company (referred to in this report as the dispatcher), who escorted them to a crew lounge where they were able to prepare some of their paperwork. The dispatcher then left before returning at about 1520 hrs, having collected a representative of the aircraft's owner (referred to in this report as the representative), whose arrival at Aberdeen had been delayed. The dispatcher then drove the pilots and representative to the aircraft, arriving at 1555 hrs. G-JECK was parked on self-manoeuvring[2] Stand 31 with the front of the aircraft facing Taxiway D (Figure 1). Parked on the opposite side of the taxiway, at Stand 11, was an Embraer EMB-145 aircraft, registration G-SAJS.

The co-pilot's luggage had been sent separately to Aberdeen but had yet to be collected and, as the pilots still needed to complete their checks, they decided to reschedule the departure to 1645 hrs. However, there were no specific time constraints, and the pilots agreed to further extend the departure time if necessary.

The pilots, dispatcher and representative were met at the aircraft by three engineers from a Part 145[3] approved maintenance organisation (AMO) that had been maintaining the

Footnote

1 In this report, the dispatcher ground handler was the person providing ramp services, which included the removal of the aircraft wheel chocks.
2 A stand at which an aircraft enters and departs under its own power.
3 Commission Regulation (EU) No 1321/2014 on the continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval of organisations and personnel involved in these tasks Annex II Part 145.

aircraft under the control of a continuing airworthiness management organisation (CAMO) whilst it was at Aberdeen. Following a brief conversation with the pilots, the engineers returned to their vehicle parked on the adjacent Stand 30.

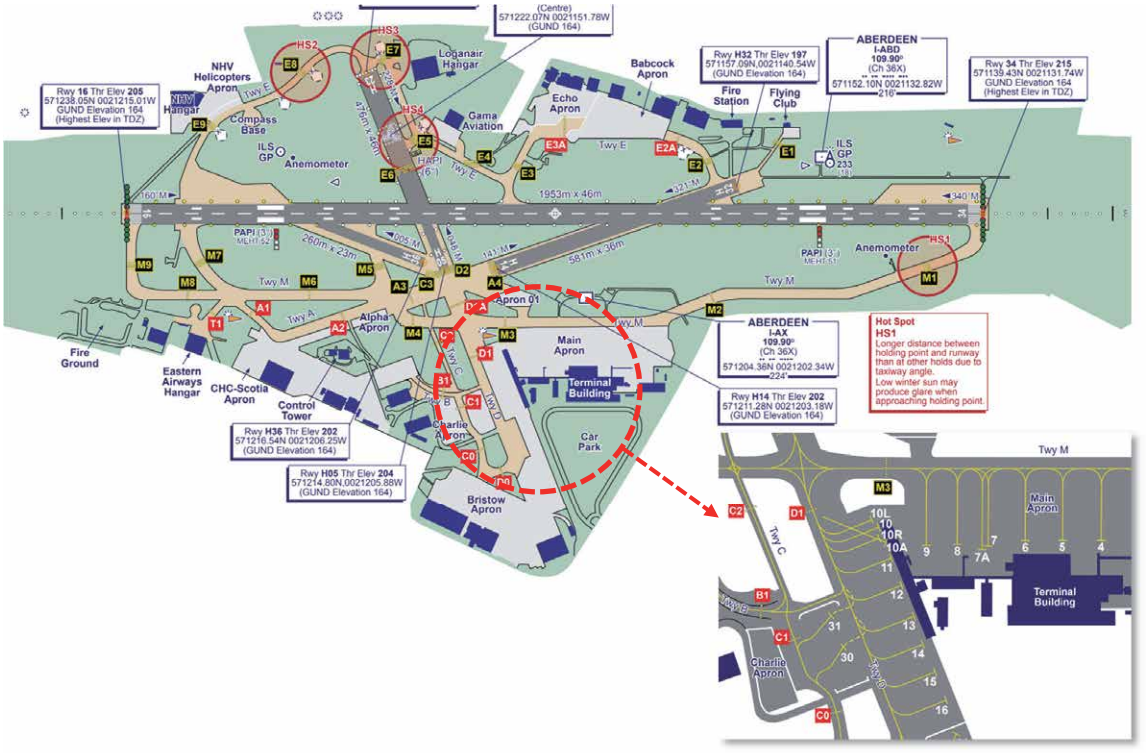

Figure 1

Aberdeen Airport (Stands 31 and 11 shown in inset)

Prior to boarding the aircraft, the pilots had checked that wheel chocks were fitted to the mainwheels and nosewheels. In the cockpit, the parking brake lever was confirmed as being set to the PARK position and whilst the commander reviewed the aircraft technical log, the co-pilot started the APU. The pilots checked the cockpit multi-function display (MFD) and noted that the fluid quantities of the hydraulic systems were adequate. Neither pilot noticed what the park brake hydraulic system pressure was indicating on the MFD, but this was not required to be checked until the end of the aircraft power-on checks and prior to starting the first engine.

Shortly after the pilots had boarded the aircraft, the dispatcher and representative briefly stood near the front of the aircraft, where the representative reported that a brief conversation[4] took place concerning the removal of the chocks. The dispatcher then went to the left landing gear to remove the four wheel chocks. As the dispatcher walked towards the landing gear, the representative removed the four chocks placed around the nosewheels. The dispatcher returned to the front of the aircraft carrying the four left landing gear chocks, by which

Footnote

[4] The representative and dispatcher had differing recollections of the content of this conversation which the AAIB investigation was unable to resolve.

time all of the chocks had been moved clear of the nosewheels by the representative; two chocks were positioned to the right of the nosewheels and one positioned about 0.5 m in front of the left nosewheel.

The representative, carrying the remaining, fourth chock, walked with the dispatcher to the right side of the aircraft nose where they placed the chocks on the ground a few metres away from the aircraft. The dispatcher then walked to his vehicle and reversed it to nearer the aircraft. As he did this, the representative moved the three chocks that had been placed close to the aircraft nosewheels and placed them with the others next to the aircraft. The dispatcher, assisted by the representative, then removed the four chocks from the right landing gear wheels before loading all 12 chocks into the vehicle. The pilots, onboard the aircraft, had not seen the chocks being removed.

The co-pilot's luggage was then collected and loaded into the aircraft, after which the dispatcher returned to the front of the aircraft where he attached a headset to the receptacle near the nose gear in preparation for engine start.

About 15 minutes after the chocks had been removed, the commander exited the aircraft to start his walkaround inspection. This included visual checks of the nosewheel tyres and the park brake accumulator pressure gauge, which indicated about 500 psi. The commander completed his walkaround after about ten minutes, at which point two of the engineers in the nearby vehicle came across to the aircraft to answer queries from the commander. Whilst the commander spoke with the engineers, the co-pilot then carried out a walkaround inspection.

The procedures used by the pilots required one walkaround but, as neither had flown for some months, they agreed to make independent inspections. After about ten minutes, the co-pilot completed his walkaround and returned to the cockpit. The commander also returned to the cockpit shortly afterwards, whilst the two engineers went back to their vehicle. Neither pilot had authorised the removal of any wheel chocks, and neither noticed that all the wheel chocks had been removed.

The park brake accumulator pressure had been checked, but the pilots had yet to reach the part of the checklist that called for the park brake hydraulic system pressure to be checked on the MFD.

As the pilots completed the load sheet, the dispatcher boarded the aircraft via the forward left cabin door and stood near the cockpit entrance. Standing on the ground near the cabin door was the representative. About 45 minutes had elapsed since the chocks had been removed, at which point the representative noticed that the aircraft was starting to move forward and shouted to the dispatcher who alerted the pilots. Both pilots applied the toe brakes and the commander moved the park brake lever OFF and back to PARK twice, but the aircraft continued to roll forward. The commander recalled that, as the aircraft had started to move, he had noticed that the park brake hydraulic system pressure on the MFD was 0 psi. The commander also tried to steer using the tiller, but the aircraft did not respond.

Having seen the aircraft start to move, the three engineers left their vehicle and ran to the adjacent right landing gear, where they tried to stop the aircraft by pushing and pulling against its main strut. As the representative ran to the vehicle to get some chocks, the dispatcher jumped from the cabin door and moved to the left gear where he pushed against its strut. However, the aircraft continued to gather speed as it crossed Taxiway D whilst heading towards the parked and empty aircraft, G-SAJS. The dispatcher then ran to the front of the aircraft, where he was joined by one of the engineers, who tried to slow the aircraft by pushing against the aircraft nose. A few second later, the engineers and dispatcher ran clear of G-JECK as it approached G-SAJS.

At a ground speed of about 5 kt, G-JECK struck the underside of G-SAJS's No 2 engine, causing its right landing gear to be lifted clear of the ground. G-JECK came to a stop with the No 2 engine of G-SAJS resting on top of its forward fuselage (Figure 2). There were no injuries. The pilots of G-JECK shutdown the aircraft and disembarked as the RFFS arrived.

Figure 2
G-JECK and G-SAJS

Airport information

Aberdeen Airport (Figure 1) had two self-manoeuvring stands, numbered 30 and 31. There was a downward slope from Stand 31 to Stand 11 of just less than 1°.

Personnel information

The dispatcher had worked in his current role for more than ten years and had not been recently furloughed due to COVID-19. The company that employed the dispatcher provided training to its staff every three years on airside safety and the dispatcher had last attended this course in September 2019. The course included a module on chocking wheels that included a practical session on an aircraft. The training material stated that, for a propeller aircraft, the mainwheel chocks should be removed before the dispatcher carried out the walkaround inspection. The training material did not refer to the removal of chocks from the nosewheels.

The representative had worked in the aviation industry for more than ten years and had been a licensed aircraft engineer. He had previous experience of chocking and un-chocking aircraft, and movements of aircraft on self-manoeuvring stands.

Aircraft examination

A photograph taken a few hours after the accident and before both aircraft were moved, showed that G-JECK's brake accumulator pressure was about 500 psi (Figure 3).

A specialist recovery team using airbags separated the aircraft (Figure 4). The upper fuselage skin, cockpit emergency escape hatch and cockpit window of G-JECK, and the No 2 engine nacelle of G-SAJS, were damaged.

Figure 3

Brake accumulator pressure after the accident

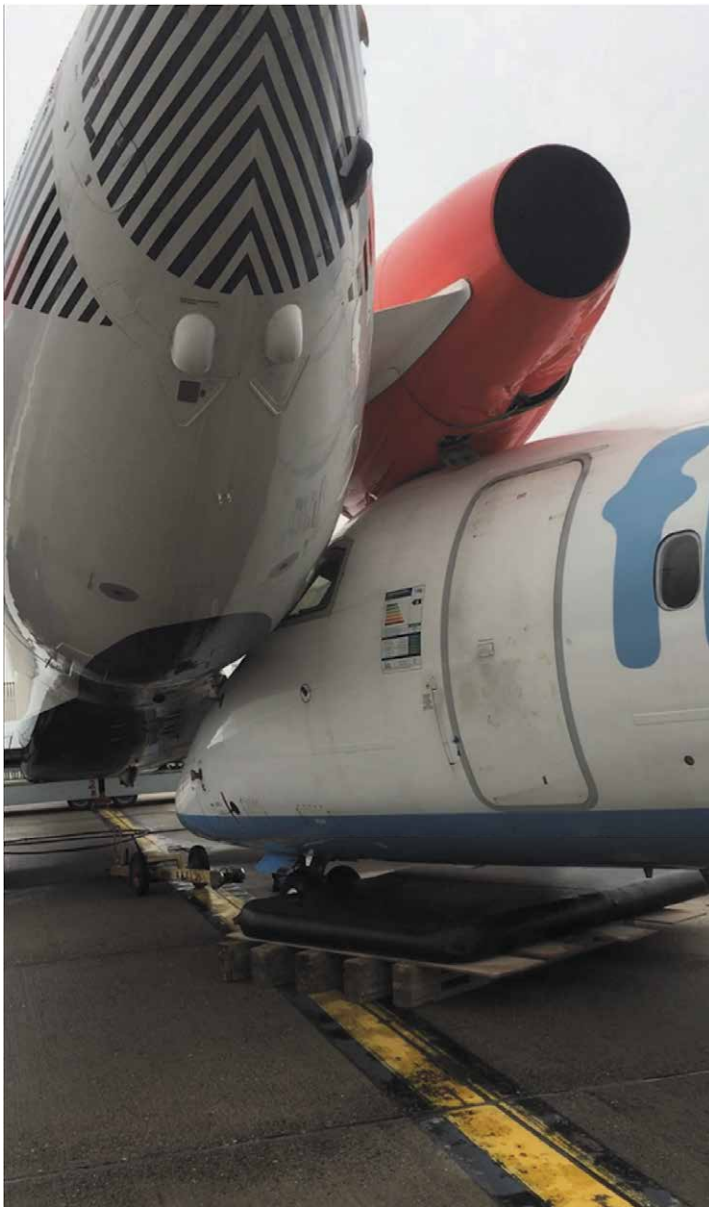

Figure 4
G-JECK and G-SAJS during recovery

Chocking of wheels when self-manoeuvring

The procedures used by the pilots stated that on arriving at the aircraft, they were to confirm that chocks were fitted, and the park brake was applied.

The ground handling procedures of the previous operator of G-JECK for self-manoeuvring stands stated that approval from pilots shall be obtained before removing chocks. The mainwheel chocks were to be removed once pilots indicated they were ready to start the engines whereas the nosewheel chocks were to remain in place until after engine start and permission had been given to remove them. This contrasts with the procedure if not self-manoeuvring for which, once a tug has been attached and permission given by the flight crew, all chocks can be removed.

The ground handling company had not been provided with a copy of the previous operator's procedures. However, the dispatcher indicated that in lieu of this, a generic procedure had been used for G-JECK. This was based on the dispatcher's experience of procedures used by other operators at Aberdeen. Discussions with the dispatcher indicated that the procedures were consistent with those of the previous operator of G-JECK regarding the nosewheels, which were to remain chocked until after engine start.

Removal of mainwheel and nosewheel chocks from G-JECK

The statements of the commander, dispatcher and representative differed concerning the removal of the chocks. The AAIB investigation was unable to resolve these differences.

Commander

The commander stated that he had not given permission[5] to remove any of the wheel chocks.

Dispatcher

The dispatcher stated that when they had initially arrived at the aircraft, the commander had referred to preparing the aircraft for departure. The dispatcher had understood this to mean that he could proceed with removing the chocks from the left and right mainwheels. He further stated that he had not instructed anyone to remove the nosewheel chocks and, had he noticed they had been removed, that he would have refitted them.

Representative

The representative stated that he had offered to assist the dispatcher in removing the chocks and asked him if he wanted the nosewheel chocks removed, which he said that the dispatcher had acknowledged. The representative further stated that he assumed that the park brake was applied because of the response he had received from the dispatcher, but that he had checked, when the last chock was removed from the mainwheels, that the aircraft did not move.

Aircraft information

The De Havilland Canada Dash 8-402 is a high-wing, two pilot, transport category aircraft, with seating for up to 78 passengers and powered by two turboprop engines. The aircraft is fitted with an APU that provides electrical power.

Brake system

The DHC-8-402 brake system is powered by two hydraulic systems that have a nominal working pressure of 3,000 psi. Each system is pressurised by a pump driven by the No 1 and No 2 engines respectively. The No 1 system supplies the normal brake system that is operated using the toe pedals, and the No 2 system supplies the parking brake (Figure 5) which is applied using a lever in the cockpit.

Footnote

[5] The co-pilot also stated that he had not given permission.

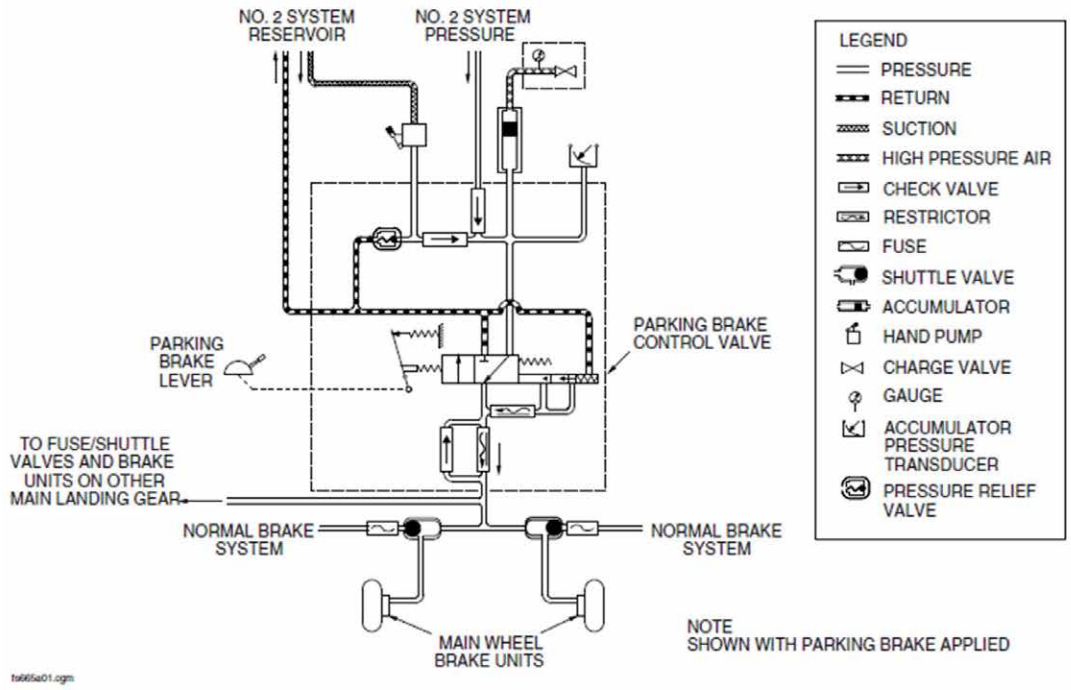

Figure 5

Park brake system schematic

When the park brake lever is set to PARK, the parking brake control valve applies hydraulic pressure that operates shuttle valves to close the inlet ports from the normal brake system. This enables pressure from the parking brake hydraulic system to be applied to the brake units fitted to the main landing gear wheels.

The park brake system is fitted with an accumulator that is pre-charged by nitrogen gas to a pressure of 500 (+/-25) psi. When the No 2 engine driven pump is running, the accumulator gas is pressurised to the normal system pressure of 3,000 psi by the hydraulic fluid. After the No 2 engine has stopped, a check valve closes, and the pressure is stored by the accumulator. The park brake system may also be used in an emergency, such as when normal braking is no longer available. When fully charged, the accumulator provides capacity for six full applications of the parking brake.

When the aircraft is parked, the hydraulic pressure in the park brake system may gradually reduce. The aircraft maintenance manual (AMM) stated that from an initial accumulator pressure of 3,000 psi, the permitted loss was 1,900 psi over two hours. The AMM did not specify a loss rate for periods of more than two hours or a minimum pressure to be retained beyond this period. A hand pump was fitted to the No 2 system that enabled the park brake system pressure to be manually increased when the aircraft was on the ground.

The nitrogen gas pressure in the brake accumulator is read from a gauge fitted in the right wing root, and the park brake hydraulic system pressure is displayed on the MFD in the cockpit. When the park brake system pressure is more than the brake accumulator pre-charge pressure, the pressure displayed on the accumulator gauge and the MFD will be

similar. However, if the park brake hydraulic system pressure reduces below the pre-charge pressure of the accumulator, the accumulator gauge will show the pre-charge pressure of about 500 psi and the MFD would need to be checked to establish the park brake hydraulic system pressure.

Nosewheel steering

The nosewheel steering system required the No 2 hydraulic system to be at its normal operating pressure of 3,000 psi.

Minimum brake pressure prior to engine start

The procedures used by the pilots and the AMO engineers stated that, if the No 1 engine was to be started first, the park brake hydraulic system pressure should be a minimum of 1,000 psi or, if the No 2 engine was started first, the minimum pressure was 500 psi. The check of the park brake hydraulic system pressure on the MFD by the crew is done at the end of the aircraft power-on checks and prior to starting the first engine.

The aircraft manufacturer advised the AAIB that a park brake system pressure of 400 psi would be sufficient to maintain the aircraft position (with no wind) on an asphalt surface with either a forward or reverse slope of about 7°.

G-JECK maintenance history

Whilst in storage at Aberdeen, the AMO had carried out routine maintenance. This included weekly engine runs and checks of the hydraulic systems. The AMO had also maintained several other DHC-8-402 aircraft in storage at Aberdeen. Discussions with the AMO engineers and the CAMO indicated that it was not unusual for the park brake system pressure of some of the aircraft in storage to reduce to less than 500 psi between weekly checks[6]. However, it was not possible to confirm if G-JECK was one of these aircraft as there was no requirement to record this.

In preparation for the flight to Weeze, a return to service check was carried out. This took several days to complete and included an engine run and test of the park brake system on 12 June 2020, four days before this event.

Recorded information

The event was captured by three CCTV cameras. The recordings provided a complete view of G-JECK, the movement of people around it, and its subsequent roll of 70 m into G-SAJS.

The recordings showed that at 1639 hrs a Sikorsky S92 helicopter had taxied past G-JECK, whilst a refuelling vehicle also manoeuvred nearby (Figure 6). At 1644:30 hrs, G-JECK started rolling forward. The aircraft's ground speed gradually started to increase and by 1645:23 hrs it had travelled about halfway across Taxiway D (Figure 7). At 1645:35 hrs, G-JECK struck G-SAJS (Figure 8) whilst travelling at a ground speed of about 5 kt.

Footnote

[6] As previously stated, the AMM did not specify a loss rate for periods of more than two hours or a minimum pressure to be retained beyond this period.

Figure 6

Position of G-JECK and G-SAJS

Figure 7

G-JECK as it rolled across Taxiway D

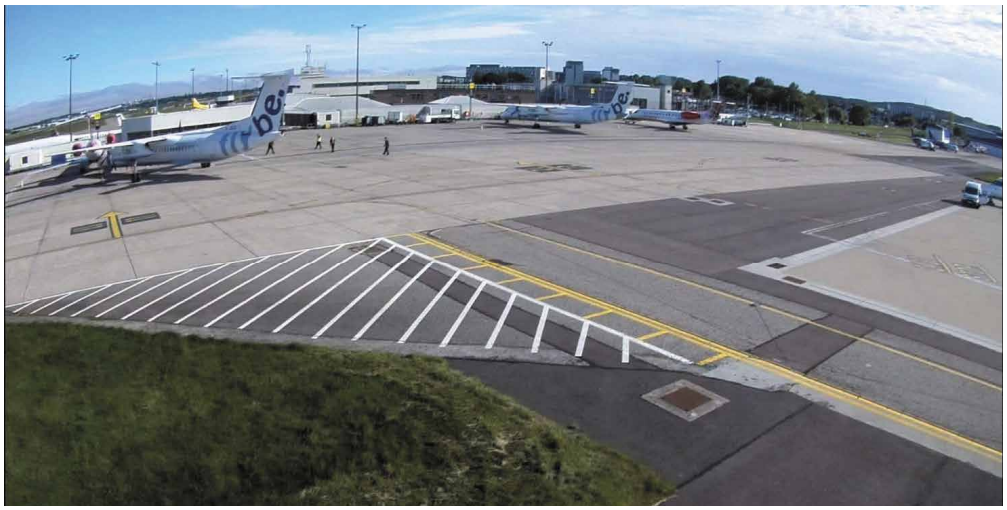

Figure 8

G-JECK as it collided with G-SAJS

Tests and research

The park brake and normal braking systems of G-JECK were tested after the accident. No defects were found.

Analysis

Removal of chocks

The evidence indicates that a misunderstanding led the dispatcher to believe that clearance had been given by the commander to remove the chocks from the mainwheels. The dispatcher was aware that the nosewheels were to remain chocked until after the engines had been started. However, following the representative's offer of assistance to the dispatcher, a miscommunication appears to have led to the nosewheel chocks being inadvertently removed. Both pilots stated that no permission for chock removal had been given.

The removal of the chocks went unnoticed by the pilots, and the dispatcher also did not realise that the chocks had been removed from the nosewheels.

Upon arrival at the aircraft, the pilots followed their normal procedure of checking that the wheels were chocked and, unsighted by them, the chocks were then removed. The pilots' subsequent walkaround inspections did not require them to check the chocks and so their attention would not have been drawn to them. The pilots had allowed themselves plenty of time to conduct duplicate checks of the inside and outside of the aircraft and to avoid missing any checklist items. Being aware of their reduced currency and that the aircraft had not flown for some time, their focus would have been predominantly on ensuring that no checklist item was omitted. This may have left less capacity to notice anything additional that they were not specifically looking for or expecting.

The CCTV showed the representative assisting the dispatcher to remove the chocks from the right landing gear wheels and helping to load the 12 chocks into the vehicle. The dispatcher did not remove the nosewheel chocks and stated that he did not expect them to be removed by anyone else, so he had no reason to focus attention on them at this point in time. The fact that 12 chocks, rather than 8, were loaded into the vehicle did not register as being at variance to these expectations. After the chocks had been loaded into the vehicle, his attention was likely to be focussed on his next task, which was the completion of the load sheet by the pilots.

Brake system

The park brake system had been pressurised to 3,000 psi when the engines had been operated four days before the accident. However, it was not unusual for the pressure to reduce over time whilst DHC-8-402 aircraft were parked; the AMM states that in two hours, the pressure could reduce by as much as 1,900 psi.

The evidence from the pilots' walkarounds and photograph of the brake accumulator taken after the event, showed that the park brake hydraulic pressure could not have been more than the accumulator pre-charge pressure of about 500 psi. Therefore, to establish the hydraulic pressure in the park brake system it would have been necessary to have checked

the MFD, but the pilots were not required to do this until the end of the aircraft power-on checks and they were ready to start the engines.

The aircraft was parked on a slope of just less than 1° and, following the initial removal of the wheel chocks, it did not roll forward. This indicates that there was residual pressure in the park brake hydraulic system at this time, but that it could have been less than the 400 psi required to hold the aircraft on a 7° slope. About 45 minutes later, the aircraft started to roll forward, at which point the commander noticed that the park brake hydraulic system pressure on the MFD indicated 0 psi.

There was no evidence of an external effect, such as a gust of wind or airflow from a nearby manoeuvring aircraft, that caused the aircraft to start to move. Therefore, the movement of the aircraft appears to have been coincidental with the brake pressure reducing to zero.

As neither the No 1 or No 2 hydraulic systems were pressurised, the application of the park brake and operation of the normal braking and nosewheel steering systems were ineffective in stopping or altering the path of the aircraft.

Risk of injury

No one was injured during this accident; however, the outcome could have been different. The engineers and dispatcher placed themselves at risk when trying to stop the aircraft and could have been struck by it. Nearby manoeuvring aircraft and their pilots and passengers were also at risk, with a Sikorsky S92 helicopter having taxied past shortly before G-JECK rolled across the taxiway. It was also fortunate that no persons were onboard G-SAJS and that the pilots of G-JECK were not injured.

Conclusion

G-JECK rolled across Taxiway D from its parking position and struck G-SAJS because the nosewheel chocks had been inadvertently removed, and the hydraulic pressure in the park brake accumulator had depleted over several days to the point where it was unable to prevent the aircraft from moving on the 1° slope.

Safety action

Following this event, safety action has been initiated by the following organisations:

The organisation that provided the pilots for the flight and sub-contracted the ground handling services has:

Reminded its sub-contracted ground handling companies that permission must be obtained from the aircraft commander before removing chocks.

Reiterated that chocks are to remain fitted until either a tug had been attached to the aircraft or, when self-manoeuvring, that nosewheel chocks remain fitted until permission has been given to remove them.

Recommended that pilots check during their walkaround that chocks had not been inadvertently removed.

The CAMO:

Circulated a tutorial, and included it in recurrent training, to all staff within its organisation to raise awareness of the circumstances of this event.

The organisation contracted to provide ground handling for G-JECK has:

Updated its training of dispatchers to ensure that third parties undertake only those duties for which they have been explicitly briefed and trained to carry out.

Aberdeen Airport has:

Issued an airside safety alert at Aberdeen, Glasgow and Southampton Airports highlighting the need to obtain permission before removing chocks.

Undertaken to carry out audits of ground handling companies operating at Aberdeen to better understand chocking procedures and training.

Requested airside operations to audit chocking procedures on the ramp area, with particular attention to self-manoeuvring stands.

Undertaken to share safety lessons with ground handling companies via the ramp safety committee at Aberdeen.

The UK CAA:

On 27 July 2020, the UK CAA published Safety Notice, SN-2020-013[7] - *Returning Aircraft to Service from 'Extended Parking',* which highlights threats associated with this report.

Footnote

[7] http://publicapps.caa.co.uk/docs/33/SafetyNotice2020013.pdf [accessed 27 July 2020].