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(ALL TIMES IN THIS BULLETIN ARE UTC)

SERIOUS INCIDENT

Aircraft Type and Registration:	ATR 72-202, EI-SLG
No & Type of Engines:	2 x Pratt and Whitney PW124B turboprop engines
Year of Manufacture:	1990
Date & Time (UTC):	15 March 2011 at 2130 hrs
Location:	Near Edinburgh Airport
Type of Flight:	Commercial Air Transport (Non-Revenue)
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	None
Commander's Licence:	Air Transport Pilot's Licence
Commander's Age:	45 years
Commander's Flying Experience:	TBA
Information Source:	AAIB Field Investigation

The investigation

The Air Accidents Investigation Branch (AAIB) was notified of the serious incident involving this aircraft by the Air Accident Investigation Unit (AAIU) of Ireland and an investigation was commenced under the provisions of EU Regulation 996/2010 and the Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 1996. In accordance with established international arrangements, the AAIU and the 'Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile' (BEA) of France appointed Accredited Representatives to participate in the investigation. This Special Bulletin has been published to highlight significant safety issues identified in the early stages of the investigation. The investigation is ongoing and a final report will be published in due course.

History of the flight

The aircraft had undergone routine maintenance at an engineering facility at Edinburgh Airport immediately prior to the incident flight.

Everything appeared normal during the crew's pre-flight checks, which included a full-and-free check of the flying controls. The crew were able to visually monitor the roll control surfaces and observe the spoiler operation on a cockpit indication, but could not see the empennage and the aircraft was not fitted with a flight control position indicator.

The aircraft took off at 2122 hrs from Runway 24 at Edinburgh, with the co-pilot acting as the handling pilot. After carrying out a standard instrument departure the crew climbed the aircraft to FL 230 at a speed of 170 kt with the autopilot engaged. As the aircraft levelled and accelerated through about 185 kt, the crew felt the aircraft roll to the left by about 5 to 10° and they noticed that the slip ball and rudder trim were both indicating fully right. The co-pilot disengaged the autopilot and applied right rudder in an attempt to correct the sideslip and applied aileron to correct the roll. He reported that the rudder felt unusually "spongy" and that the aircraft did not respond to his rudder inputs. Approximately 15° to 20° of right bank was required to hold a constant heading with the speed stabilised above 185 kt and a limited amount of aileron trim was applied to assist. Shortly after regaining directional control a FTL CTL caption appeared on the Crew Alert Panel (CAP) and the FLT CTL fault light illuminated on the overhead panel, indicating a fault with the rudder Travel Limitation Unit (TLU). The commander requested radar vectors from ATC for a return to Edinburgh, later declaring a PAN.

The crew carried out the required procedure from the Quick Reference Handbook (QRH). As part of the procedure they established that both Air Data Computers (ADC) were operating, before manually selecting the TLU switch to the LO SPD position. The aircraft had at this point temporarily slowed to below 180 kt. The co-pilot reported that on selection of LO SPD more roll control input was required to maintain heading and that roll authority to the right was further reduced. The commander therefore decided to return the TLU switch to AUTO and the required roll control input reduced. The green LO SPD indicator light did not illuminate.

An approach was made to Runway 24, the aircraft was established on the ILS and was normally configured for a full flap landing. The crew added 10 kt to their approach speed, in accordance with the QRH. The co-pilot had to operate the control wheel with both hands in order to maintain directional control; the commander operated the power levers in the latter stages of the final approach. The co-pilot reported that the aircraft became slightly more difficult to control as the speed reduced, but remained controllable.

The aircraft landed just to the left of the runway centreline, whereupon the commander assumed control of the aircraft and applied reverse thrust. Despite the application of full right rudder pedal during the rollout, the aircraft diverged towards the left side of the runway. The commander re-established directional control using the steering wheel tiller. The aircraft was taxied clear of the runway and back to the engineering facility for inspection.

Rudder Travel Limitation Unit

The rudder linkage on the ATR 72 is a mechanical system composed of quadrants, pulleys, rods and a cable (Figure 1). The rudder pedals are linked to a force detector rod which produces movement of the forward quadrant. A cable loop links the forward and aft quadrants. The

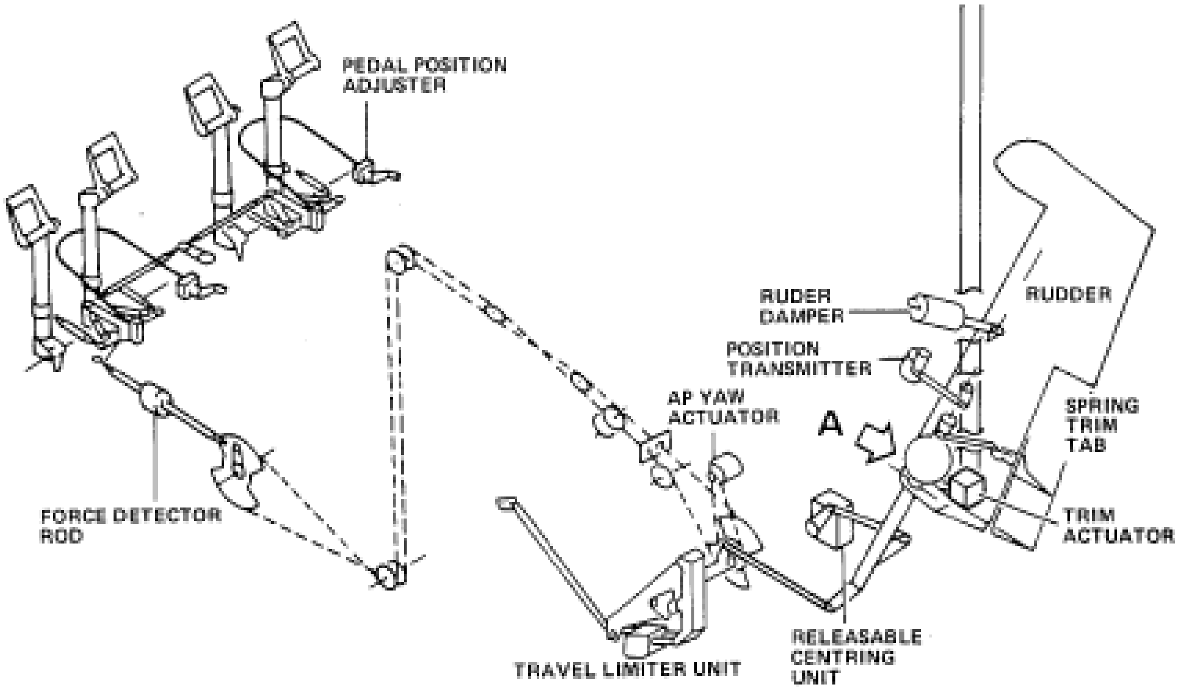

Figure 1
ATR 72 Rudder control system

rudder is operated by means of mechanical linkages connected to the rudder rear quadrant shaft.

A Travel Limitation Unit (TLU) is installed on the rear quadrant shaft; this reduces the rudder deflection when the aircraft speed is greater than 185 kt. The TLU system has two positions: in the full authority position, rudder deflection is not limited; in the reduced authority position, rudder deflection is mechanically limited.

The TLU comprises an electrical actuator with two output shafts, two vee-shaped cams mounted on the rudder rear quadrant shaft and a pivoting bracket on which are mounted two rollers. The position of the pivoting bracket and hence the rollers is a function of the actuator extension. When the actuator is retracted, each roller is positioned into the vee groove of its corresponding cam (Figure 2).

In the reduced authority position the actuator retracts, rotating the bracket about its pivot, thereby engaging the rollers in the vee cams and thus mechanically limiting the rudder deflection. In the full authority position the actuator extends, disengaging the rollers from the vee cams such that rudder deflection is no longer limited. A green LO SPD indicator light illuminates in the cockpit when the TLU is in the full authority position.

In normal operation the system is operated in automatic mode and the actuator retracts automatically when both ADCs signal that the aircraft speed is greater than 185 kt. The actuator extends automatically when at least one ADC signals that aircraft speed is less than 180 kt. The duration of the actuator stroke in automatic mode is approximately 15 seconds.

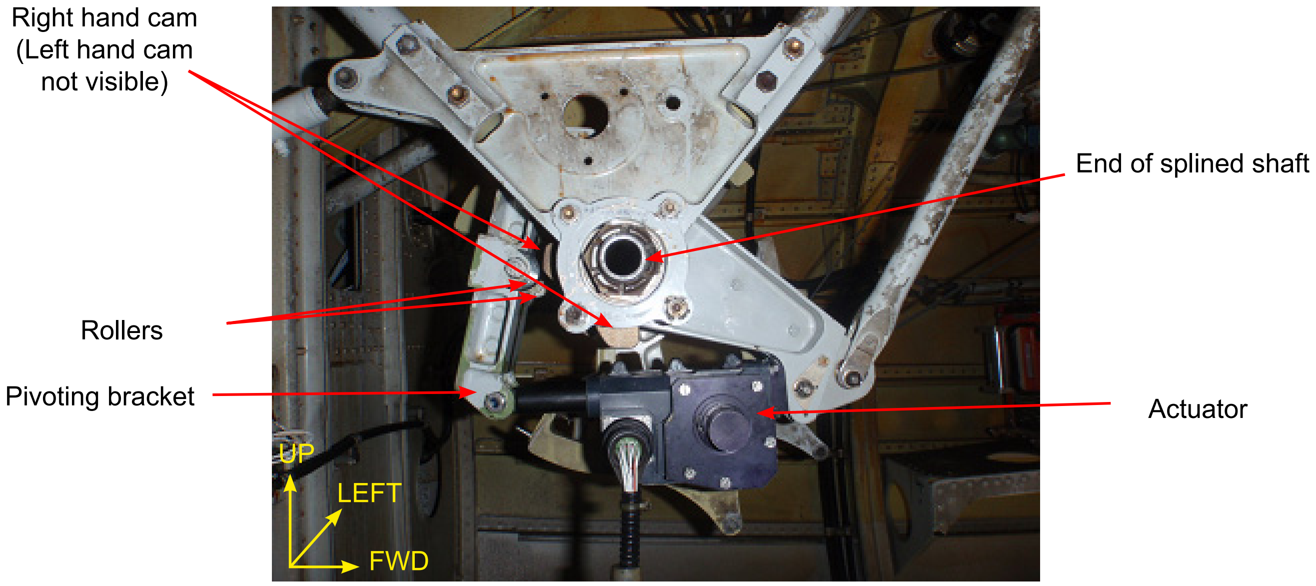

Figure 2

Rudder Travel Limitation Unit

In standby operation the actuator extension and retraction are controlled via a three-position (HI SPD/ LO SPD / AUTO) selector switch on overhead panel 25 VU. The duration of the actuator stroke in this mode is approximately 30 seconds.

Monitoring of the TLU position is performed by modules 1A and 2A of the Multifunction Computers MFC 1 and MFC 2. The monitoring logic compares the actuator position, as given by a position synchro, with the airspeed signal from the ADCs. In the case of a disagreement, the logic generates a discrete signal to illuminate the FLT CTL fault light on overhead panel 25VU (after 25 seconds have elapsed), triggers a Master Caution alert and illuminates the FLT CTL caption on the Crew Alert Panel (CAP).

Maintenance

During the maintenance input which preceded the incident flight, work was performed on the rudder system which required the disassembly of the TLU mechanism. During reassembly, the right hand cam was installed in the incorrect orientation. Neither an independent inspection nor an operational test of the TLU system was performed. The incorrect assembly was not identified until the TLU mechanism was inspected by the maintenance organisation after the incident.

The factors that led to the incorrect installation of the cam and the failure to identify this condition prior to flight are the subject of the ongoing investigation.

The rudder rear quadrant shaft on which the cams are mounted is a splined shaft; a master locating spline ensures correct alignment of all components. Teeth on the internal bore of the cams correspond to the profile of the splined shaft, with a missing tooth in the position of the master spline. During reassembly, the orientation of right hand cam was transposed through 180° (such that the inboard face of the cam was facing outboard). As the missing tooth on the cam is not located centrally between the two cam lobes, but is offset by

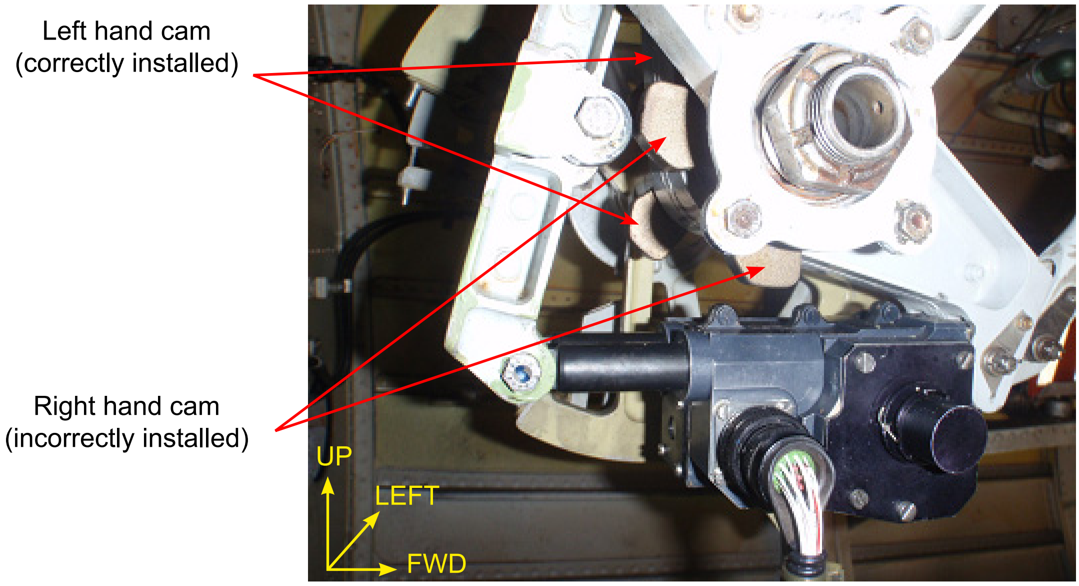

Figure 3

Travel Limitation Unit with right hand cam incorrectly installed – rudder in neutral position

(Note that the lobes of the right hand cam are not aligned with the lobes of the left hand cam and that the right hand roller is facing the upper lobe of the right hand cam)

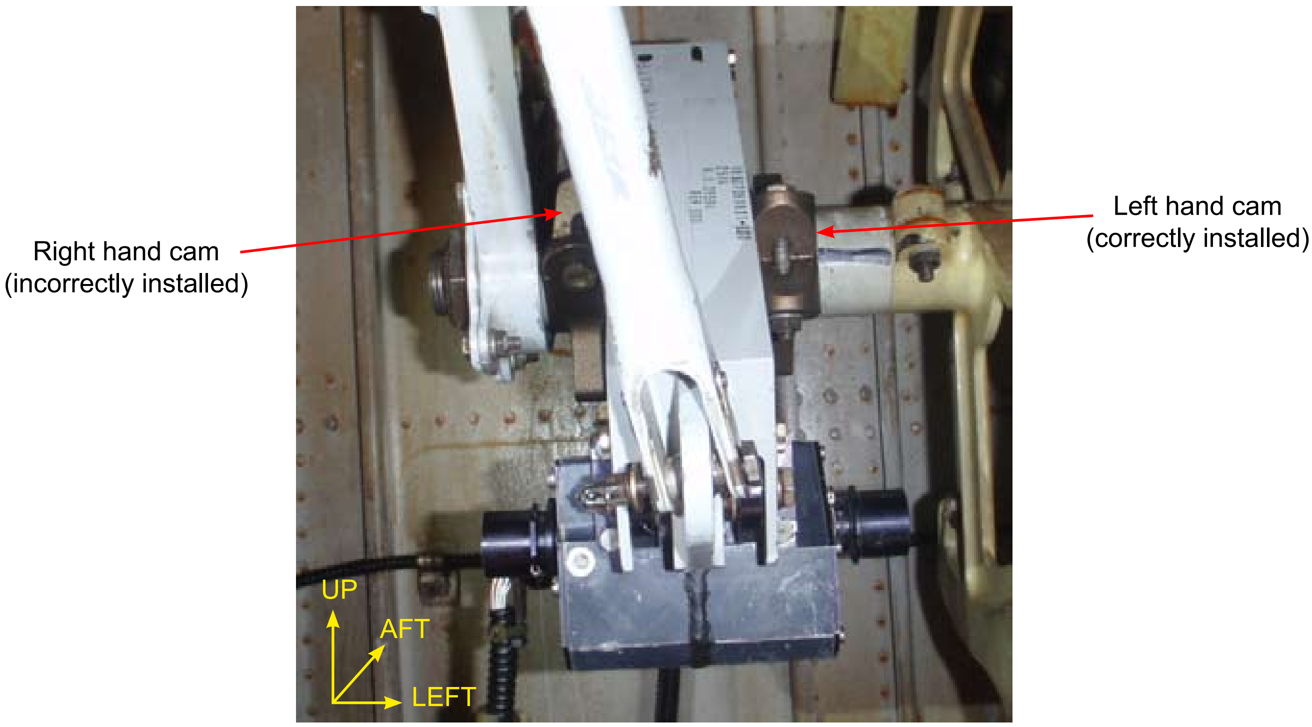

Figure 4

View looking aft on Travel Limitation Unit with right hand cam incorrectly installed - rudder in neutral position approximately 19° to one side, the incorrect installation of the right hand cam resulted in the right hand cam no longer being symmetrically aligned with the left hand cam (Figures 3 and 4).

Documentation

The Aircraft Maintenance Manual (AMM) task *'Removal and Installation of the TLU Mechanism Assembly'* does not highlight that it is possible to install the cams in the incorrect orientation. This AMM task requires an operational test of the rudder TLU to be performed following reassembly.

The AMM task *'Operational Test of the Rudder TLU'* checks that rudder pedal travel is not limited when the TLU is in the full authority position; and that rudder pedal travel is limited when the TLU is in the reduced authority position. It also checks that the TLU mechanism responds correctly to the speed signals from each ADC. A test switch in the cockpit can be selected to send a high speed signal to the TLU actuator during ground testing. When a Press-To-Test (PTT) button is depressed the TLU actuator retracts to the reduced authority position, thereby simulating the automatic activation of the TLU mechanism. Both rudder deflection and rudder pedal travel are limited accordingly.

Post-incident investigation and testing

During the investigation it was established that the cams could be fitted incorrectly on the splined shaft. Incorrect fitment of one or both cams meant that the vee grooves of the cams would no longer be aligned with the rollers on the pivoting bracket.

It was demonstrated that with the right hand cam installed in the incorrect orientation, it presented a restriction to the travel of the corresponding roller. When the TLU was activated, this situation prevented both rollers from engaging in the vee groove of the cams and caused an uncommanded rudder input and corresponding rudder deflection.

When the AMM operational test was performed with the right hand cam incorrectly installed, rudder pedal travel was found to be restricted in an asymmetric sense. A FLT CTL fault light was generated only if the PTT button was depressed for a minimum of 25 seconds. The AMM task does not state how long the test button should be depressed.

Discussion

This incident and the subsequent investigation and testing demonstrated that it is possible to incorrectly install the cams on the rear rudder quadrant shaft. In this incident, the right hand cam was installed in the incorrect orientation and neither an independent inspection nor an operational test of the TLU system was performed. The incorrectly installed right hand cam was not detected prior to releasing the aircraft to service. When the TLU system automatically activated as the aircraft accelerated through 185 kt, the right hand roller encountered resistance as it came into contact with the upper lobe of the incorrectly installed cam, rather than slotting into the vee groove. This caused an uncommanded rudder input and associated control difficulties.

Testing also demonstrated that this condition may be identified during the operational test of the TLU system as follows: (1) by detection of an asymmetric restriction of the rudder pedals and/or (2) if, after depressing the PTT button for more than 25 seconds, the FLT CTL fault light illuminates.

The manufacturer is not aware of any previous reports of the cams being incorrectly installed. The AMM does not highlight that it is possible to incorrectly install the cams.

For these reasons, the following Safety Recommendations are made:

Safety Recommendation 2011-010

It is recommended that ATR immediately informs all operators of ATR aircraft equipped with a Travel Limitation Unit that it is possible to install the cams on the rear rudder quadrant shaft in the incorrect orientation.

Safety Recommendation 2011-011

It is recommended that ATR amends all relevant Aircraft Maintenance Manual tasks to include a warning to highlight that the cams on the rear rudder quadrant shaft can be installed incorrectly.

Safety Recommendation 2011-012

It is recommended that ATR amends the Aircraft Maintenance Manual task *'Operational Test of the Rudder Travel Limitation Unit'* to state that: (1) the test should be carried out for a minimum of 30 seconds and (2) should an asymmetric restriction of the rudder pedals be detected or if the FLT CTL light illuminates, further inspection of the TLU system should be conducted.

Safety action

The aircraft manufacturer intends to take the necessary actions in response to these Safety Recommendations by 22 April 2011.

Published 15 April 2011

SERIOUS INCIDENT

Aircraft Type and Registration:	Bombardier Dash 8 Q400, G-FLBE
No & Type of Engines:	2 Pratt & Whitney Canada PW150A turboprop engines
Year of Manufacture:	2009
Date & Time (UTC):	25 November 2010 at 0915 hrs
Location:	Paris Charles de Gaulle Airport, France
Type of Flight:	Commercial Air Transport (Passenger)
Persons on Board:	Crew - 4 Passengers - 60
Injuries:	Crew - None Passengers - None
Nature of Damage:	None
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	14,300 hours (of which 810 were on type) Last 90 days - 150 hours Last 28 days - 33 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and information provided by the maintenance organisation

Synopsis

During the approach, the flight crew observed an indication that the right main landing gear was not in the 'down and locked' position. After completion of the emergency checklist items, the indicator continued to show that the right main landing gear was unsafe. An emergency was declared and the aircraft made an uneventful landing. An investigation by the operator revealed that a grease nipple, released from the right main landing gear lock link assembly, had become lodged on the eye end of the landing gear downlock actuator, preventing the lock from operating correctly. As a result of this incident the operator has introduced several measures to minimise the possibility of a recurrence.

History of the flight

After selecting the landing gear to the DOWN position, on the approach to land, the flight crew observed an indication that the right main landing gear (MLG) was not in the 'down and locked' position. After confirming the warning, the flight crew initiated a go-around and entered a holding pattern. On completion of the emergency checklist items, including the use of the alternate landing gear actuation system, the indicator continued to show that the right MLG was unsafe, so the flight crew declared a MAYDAY. Observation of the main landing gear showed that both appeared to be fully deployed and there was no obvious defect with the right MLG. The flight crew briefed the senior cabin crew member on the nature of the emergency and their intentions, after which the cabin crew prepared the cabin and passengers for an emergency landing. Prior to commencing the approach, the flight crew shut down the right engine in accordance with the advice contained in the emergency checklist. The aircraft completed an uneventful landing and came to a halt on the runway where, after shutting down the left engine, a rapid disembarkation was completed.

Approximately 30 minutes after the landing, whilst waiting for transport to the terminal building, the AFRS approached the flight crew to determine if they could make the landing gear 'safe' prior to moving the aircraft. A member of the flight crew re-entered the cockpit to retrieve the landing gear locking pins. The AFRS had some difficulty in locating the correct points in which to insert the locking pins and asked the flight crew for assistance. After consulting the aircraft manuals the locking pins were eventually inserted and the aircraft towed from the runway.

Investigation

A team of engineers from the operator was dispatched to recover the aircraft and carry out an investigation into the incident. On arrival they confirmed that the right landing gear locking mechanism had not fully engaged and that the landing gear had been 'unsafe' during the landing. It was also discovered that the landing gear locking pins had not been inserted in the correct location by the AFRS and that the landing gear remained unsafe. After securing the landing gear, the engineers found that a grease nipple, covered in grease, was stuck to the eye end of the landing gear downlock actuator. This had prevented the actuator from moving through its full range of travel which resulted in the landing gear remaining unlocked and the landing gear unsafe warning observed by the flight crew. It had also prevented the alternate landing gear extension system from operating correctly. When the grease nipple was removed, the landing gear locking mechanism operated normally.

Further examination of the landing gear revealed that a grease nipple was missing from the aft lock link assembly. Two further grease nipples were found missing from the landing gear stabiliser brace assembly. The examination also found excess grease around all the landing gear greasing points and on the aft lock link assembly. It was considered that, due to its location, the grease nipple which was recovered from the downlock actuator had been released from the landing gear lock link assembly.

Following the incident, the operator initiated a fleet wide inspection of the landing gear assemblies to confirm that all of the grease nipples were present and to identify the presence of excess grease around the grease nipple locations and other areas of the landing gear. The results of this inspection showed that 50% of the fleet had one or more grease nipples missing and that 84% of the fleet had excessive grease around the grease nipples or on the lock link assembly. A review of the usage of grease nipples issued to the Dash 8 Q400 fleet showed that 500 had been issued during 2010 and 450 in 2009.

The grease nipples fitted to the Dash 8 Q400 landing gear are of a 'push fit' type. The shank of the nipple is fitted with a small barb and is an interference fit with its locating hole. During manufacture and overhaul they are cooled in liquid nitrogen before being pressed into place. Replacement of a nipple 'on-wing' requires the shank of the nipple to be coated in adhesive prior to it being tapped into position.

Actions taken by the operator

The operator is in discussion with both the airframe and landing gear manufacturer to determine if improvements to the installation procedures can be made to minimise the loss of grease nipples from landing gear units. The manufacturers have been requested to consider the introduction of threaded grease nipples.

In addition, the operator has revised its maintenance practices to prevent the use of high pressure grease guns during landing gear lubrication and to ensure that any excess grease is removed from the grease nipples and landing gear. Also, a routine inspection for the security of the grease nipples is now carried out after a lubrication task; any loose nipples are removed and recorded in the aircraft technical log to ensure that it is replaced during the next schedule maintenance input.

New procedures have also been introduced to ensure that, in the event of having to make the landing gear safe, any personnel involved are provided with clear guidance on the locations to install the landing gear locking pins.

INCIDENT

Aircraft Type and Registration:	Douglas DC-8-63F, YA-VIC
No & Type of Engines:	Four Pratt & Whitney JT3D-7 turbojet engines
Year of Manufacture:	1970
Date & Time (UTC):	11 August 2010 at 1045 hrs
Location:	Manston Airport (Kent International)
Type of Flight:	Commercial Air Transport (cargo)
Persons on Board:	Crew - 3 Passengers - 9
Injuries:	Crew - None Passengers - None
Nature of Damage:	Tail skid damage within operational limits. Damage to runway and adjacent surface, single approach light destroyed
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	55 years
Commander's Flying Experience:	15,000 hours (of which 3,000 were on type) Last 90 days - 0 hours on type Last 28 days - 0 hours on type
Information Source:	AAIB Field Investigation

Synopsis

During the takeoff the aircraft's tail skid struck the end of Runway 28 at Manston, and also the soft ground beyond. An approach light for the reciprocal runway was destroyed by the aircraft's main landing gear. Post-incident calculations showed that the aircraft weight was more than 25,000 lb above the maximum allowable takeoff weight for the prevailing conditions. The investigation highlighted a number of procedural failings by the flight crew, a lack of currency in line operations and a lack of operational oversight and control by the aircraft operator and the regulatory authority in the Islamic Republic of Afghanistan. Four Safety Recommendations have been made.

Background to the flight

The aircraft operator was based at Kabul in the Islamic Republic of Afghanistan, and operated international and domestic passenger and cargo flights. It was established in 2003 and held an Air Operators' Certificate issued by the Ministry of Transport and Civil Aviation (MoTCA). The operator had recently acquired two DC-8-63F aircraft (of which YA-VIC was one) from a cargo carrier based in the United Arab Emirates (UAE), along with two three-man flight crews. The incident occurred during a flight between Manston and Buenos Aires, which was the first commercial task for the operator's DC-8 fleet.

History of flight

The aircraft was chartered to fly a consignment of 36 polo ponies from Manston Airport in Kent to Buenos Aires in Argentina via a refuelling stop in the Cape Verde Islands. The aircraft flew from Ras Al Khaimah Airport in the UAE to Manston on the 10 August 2010, arriving at 1513 hrs. It carried two complete flight crews; the crew which was to operate the next sector from Manston to Cape Verde travelled from the UAE as positioning crew. After arrival at Manston, the flight crews left for a local hotel whilst ground crew from the airport and the chartering company began preparing the aircraft cargo hold for the ponies.

The flight crew reported for duty at 0600 hrs the next day for a planned 0800 hrs departure. The arrival of the ponies at the airport was delayed and further delays were experienced during their loading. According to ground staff, the flight crew appeared most concerned about the flight from Cape Verde to Argentina, which would be the most limiting in terms of payload. Several questions were asked of the ground crew about the mass of the penning equipment which, because the equipment was standard and frequently used, could be answered accurately. The commander was occupied away from the aircraft as he dealt with dispatch issues and tried to obtain route charts for South America. His concern was that an increase in expected payload might necessitate a refuelling stop during the onwards flight.

When the aircraft arrived at Manston, there had been a discussion between the flight engineer and refuelling staff; it was agreed that refuelling would take place in the morning, and that approximately 37,000 litres would be required. In fact, in the morning the flight engineer revised this figure to 61,000 litres, and later instructed that the refuelling should continue until the aircraft's refuel valves closed automatically. A total of 61,801 litres was delivered.

A load and trim form prepared by the flight engineer showed a total cargo weight of 43,409 lb[1]. The flight engineer also prepared a takeoff data card which was presented to the commander when he arrived on the aircraft. The aircraft's takeoff weight as shown on the load form was 335,410 lb, although the takeoff data card showed a takeoff weight of 343,000 lb, with takeoff speeds for this higher weight. No crosscheck of the flight engineer's calculations or takeoff performance figures was made by any other crew member. Later analysis would produce a calculated actual takeoff weight of 343,046 lb. Although this weight was accurately reflected on the takeoff data card, it was some 25,700 lb above the maximum (runway limited) takeoff weight.

The aircraft eventually left stand at 1028 hrs with the commander as handling pilot. On board were the three operating crew, the three positioning crew who had flown the aircraft from the UAE, and six grooms and vets who were to attend the ponies during the journey. The aircraft commenced takeoff from the beginning of Runway 28. The weather was generally fine, with a reported surface wind from 290°(M) at 7 kt. The temperature was 20°C and the runway surface was dry. The QNH was 1014 HPa.

The takeoff run was seen by several airport staff, including loaders, air traffic controllers and operations staff, who subsequently remarked that the aircraft appeared slow to accelerate. Rotation was initiated near the runway end, and a cloud of debris was thrown

Footnote

[1] Aircraft and cargo weights were reported in imperial units. Where so reported, metric units are also given.

up from beyond the runway as the aircraft climbed away. The commander later reported being aware of two jolts as the aircraft lifted off and suspected that a tail strike had occurred. Subsequent inspection showed that the aircraft had left a scrape mark on the runway, which extended into the soft ground beyond.

Manston Air Traffic Control (ATC) reported the suspected tail strike to London ATC who relayed the information to the aircraft commander. With aircraft systems appearing normal, he decided to continue the flight to Cape Verde, where the tail strike was confirmed by the evident damage to the tail skid assembly.

Runway examination

Manston Airport (also known as Kent International Airport) has a single runway, designated 10/28. The takeoff run available on Runway 28 is 2,752 m and takeoff distance available is 3,112 m. Airport elevation is 178 ft.

The runway is constructed of asphalt/concrete and is 2,752 m long and 61 m wide. At the departure end of Runway 28, a ground contact mark was visible to the left of the runway centreline, 24.6 m long and starting 35 m before the end of the paved surface. There was then a 23.8 m gap with no obvious ground marks, but containing a destroyed centreline approach light fitting. There was then a 30 m trench in the soil, up to 23 cm in depth, which continued as scoring to the grass surface. The total length of the ground marks was 117.5 m. The width and nature of the mark was consistent with contact by the sole plate of the aircraft tail skid. The light fitting was displaced from the ground mark by a distance equal to the displacement of the right main landing gear from the aircraft centreline, indicating that the right main gear had struck the light.

Aircraft examination

On arrival in Cape Verde an aircraft inspection revealed evidence of ground contact on the tail skid. The tail skid assembly contains an energy absorber which is designed to deform with any ground contact to prevent damage to the airframe; the degree of deformation can be measured to assess the severity of the contact. In this case the operator reported that the energy absorber had deformed by 7/16 inch, which was within the maintenance manual limit of 1/2 inch, and no further inspections were required. Photographs were supplied to the AAIB showing the sole plate contact marks and deformation of the shock absorber. The aircraft continued on to its final destination where the shock absorber assembly was replaced. No other damage to the aircraft was reported.

Recorded information

Takeoff technique

The aircraft operating manual (AOM) describes a takeoff technique which takes into account the extended fuselage of the DC-8 series 60 aircraft. Initial rotation is to 8° nose-up pitch attitude in about 4 seconds. After a pause of one to two seconds, the rotation was to be continued to 11 to 12°. A note warns that a tail strike will occur at 8.95° pitch attitude.

Flight data

Data from the aircraft's flight data recorder (FDR) showed that rotation was initiated at 159 kt IAS, consistent with the planned 160 kt target. Figure 1 shows a graphical plot of the data for aft control column input and aircraft pitch attitude. The graph covers about 12 seconds, from just after the start of rotation through the early climb to about 100 ft agl (the nature of the two plots reflects the different update rates for each parameter).

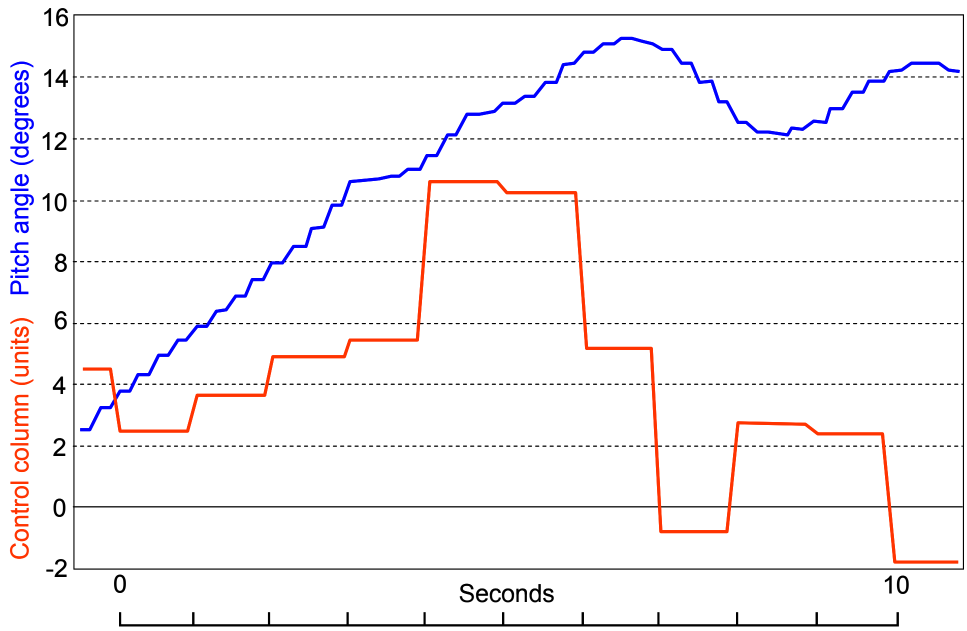

Figure 1

Aircraft pitch attitude and control column position during rotation

For the majority of the initial rotation, there was a steady aft movement of the control column (as far as can be determined, given the relatively infrequent update rate of once per second), resulting in a constant pitch rate. The aircraft reached 8° pitch in about five seconds and continued to increase at a constant rate until nearly 11°, at which point there was a marked reduction in pitch rate. A significant aft control column input was made at about this time, after which the pitch attitude continued to increase to a recorded maximum of 15.2°.

Target takeoff EPR[2] was 1.87. At 80 kt during takeoff, the target EPR was achieved on three of the four engines, with engine 4 producing a recorded 1.84 EPR. As airspeed increased towards rotation speed, only engine 3 remained at target EPR, with the other three falling to between 1.78 and 1.83 EPR. Shortly after liftoff, as pitch attitude reached maximum, all four engine EPRs increased within one second to between 1.83 and 1.91 EPR.

Footnote

[2] Engine Pressure Ratio: an indication of the amount of thrust being developed by a turbine engine.

Aircraft loading and performance

Fuel planning and uplift

The aircraft had arrived at Manston with 35,000 lb of fuel on board. A computer-generated flight plan was not immediately available when the commander agreed to the flight engineer's calculated fuel load of 120,000 lb. However, the captain of the positioning crew suggested that this figure might not be enough if the aircraft were to divert to an alternate airport. The commander agreed to load extra fuel as long as the aircraft would remain within the maximum landing mass at Cape Verde, which the flight engineer had told the commander was the most limiting performance factor. The aircraft technical log showed a total fuel load at engine start of 143,700 lb.

When the computer flight plan became available, it showed a total predicted fuel burn of 75,347 lb. Minimum required fuel was 97,661 lb, based on a payload of 60,000 lb and using an alternate airport 113 nm to the south of the destination.

Weight and balance

The cargo consisted of the 36 ponies, their feed and water, the penning equipment and aircraft items in the lower holds. At interview, the flight engineer detailed the equipment and weights used, and the chartering company confirmed that weights for penning equipment were known values.

The flight crew reported that the charter company's loading staff gave them an average weight per pony of 300 to 350 kg, while the charter company advised the AAIB that their standard weight for a pony was 450kg. This was considered a reliable figure and was that shown on the three air waybills. The cargo manifest, prepared at the cargo centre at Manston, also listed the ponies at 450 kg each. The aircraft's takeoff weight shown on the load and trim form was 335,410 lb[3], which had been calculated using a pony weight of 350 kg. Had the figure of 450 kg per pony been used, the calculated takeoff weight would have increased to 343,346 lb. Aircraft centre of gravity at takeoff was calculated at 22.8% MAC[4], which was approximately the middle of the allowable range.

Takeoff performance calculations

Using the payload as entered on the load form, a correction for the weight of the ponies and the actual ramp fuel entered in the technical log (which was 300 lb less than the load form figure), the actual takeoff weight would have been 343,046 lb.

The flight engineer completed the weight and balance form and a takeoff data card. The load form showed his calculated takeoff weight of 335,410 lb but the takeoff data card was completed using a weight of 343,000 lb. The flight crew could not provide a definite reason to account for the increased weight, other than to suggest that it was a conservative figure which would account for variations in the ponies' actual weights from assumed weights. In fact, the takeoff data card figure reflected the aircraft's actual takeoff weight if calculated using 450 kg per pony.

The speeds shown on the data card were: V_1 = 143 kt, V_R = 160 kt, V_2 = 172 kt.

The flight engineer did not refer to the runway performance analysis tables, which gave runway-limited weights for varying environmental conditions. The load form included a section "*Station Max. TO Wt*" in which the flight engineer had entered a value of 349,000 lb; it was not established how this figure had been reached. The table for Manston Runway 28 gave a runway limited maximum takeoff weight of 317,300 lbs in the prevailing conditions. Thus, at a takeoff weight of 343,046 lb, the aircraft was over 25,700 lb above the permitted maximum (runway limited) weight.

It was noted that data was available for a 'Flap 23' takeoff, which would have increased the runway limited weight by about 10,600 lb. The aircraft performed a Flap 23 takeoff in Cape Verde on the next sector.

The operator's procedures required that, where no load master was available, the first officer should complete the load form and the flight engineer should complete the takeoff data card. The commander was required to check the load form for accuracy and the first officer was required to check the takeoff data card. (These

Footnote

[3] Maximum structural takeoff weight was 358,000 lb.
[4] Mean aerodynamic chord.

procedures were the same as the crew had been using with their previous operator, and which had been adopted by the current operator.) The crew reported that no crosscheck had been made of the load form and data card prepared by the flight engineer. The crew attributed this to the commander's absence from the aircraft, distractions and time pressure.

It was noted that the takeoff performance calculations for the next takeoff in Cape Verde were based on a takeoff weight calculated using the same cargo weight as entered on the load form at Manston. The same flight engineer completed the load form for this sector. However, unlike the Manston takeoff, the data card (which on this occasion was completed by a different crew member) showed the same weight as the load and trim form, so takeoff safety speeds had been calculated using a weight which was in error by approximately 8,000 lb.

Flight crew information

General

The 55 year old commander had about 3,000 hrs on the DC-8 and in excess of 15,000 hrs total. The first officer was 60 years old, with 2,500 hrs on the DC-8 and also had in excess of 15,000 hrs total. The flight engineer was 62 years old and had 2,500 hrs on the DC-8, with 13,100 hrs total. All had held senior flight operations management posts with previous employers.

Flight crew training and licensing

The flight crew held valid licences issued by the General Civil Aviation Authority of the UAE, with type ratings for the DC-8. These had been accepted by the MoTCA's Civil Aviation Administration, which had then issued Afghan flight crew licences.

The commander's last simulator proficiency check was carried out whilst still with his previous company, on 12 April 2010. The date of his last flight on the DC-8 appeared to be in December 2009, and was certainly earlier than January 2010. He held a DC-8 Type Rating Examiner (TRE) authorisation, issued by the GCAA, and between 19 January and 8 August 2010, had conducted or taken part in a total of 22 details in the DC-8 simulator as instructor or examiner, most involving flight crews of other carriers.

The co-pilot last flew the DC-8 in December 2009. He next underwent a simulator proficiency check in the DC-8 simulator, on 5 July 2010. This was arranged and conducted by the commander of the incident flight, in his capacity as a TRE.

The flight engineer last operated the DC-8 on 20 December 2009. Between January and early August 2010 he also recorded a number of DC-8 simulator details, most of which involved instructing or checking of other operator's flight crews. His last recorded simulator proficiency check was on 12 April 2010, also whilst still with his previous company. His flying logbook recorded a simulator 'currency check' on 6 July 2010.

Apart from the co-pilot's proficiency check, none of the crew had undergone any operational training or checking since starting work for the operator in May 2010, nor had they been given any company induction training or familiarisation. At the time of the incident, the crew had not flown the DC-8 within the previous eight months, and were not current on DC-8 line operations.

Crew duty hours

Both crews had reported for duty at 0600 hrs on 11 August. The aircraft arrived at its Cape Verde destination at 1630 hrs, a flight duty period of 10:30 hrs for the operating crew. The aircraft departed again at 1815 hrs for the flight to Buenos Aires, with the second crew as operating crew. Arrival in Buenos Aires was at 0315 hrs on 12 August. Thus the flight duty period for the second crew was 21:15 hrs. A form used by the crew to record crew duty hours and other operational data showed an incorrect start duty time of 0800 hrs with no entry for total flight duty time.

Computerised fuel planning

Computer flight plans (CFP) were examined for each of the three sectors: UAE to Manston, Manston to Cape Verde and Cape Verde to Buenos Aires. For the first two sectors, the flight crews had loaded significantly more fuel than that the minimum required - an extra 38% and 47% respectively. Aircraft weight was therefore much higher on these sectors than the weight used to generate the CFPs (which typically assume that minimum required fuel is loaded). As a consequence, the actual fuel burn figures for these sectors were in excess of that predicted on the CFP. However, the actual increases of about 28% for each sector appeared high. When the burn was corrected, using 'rule of thumb' figures, the actual burn appeared to be about 19% above expected, for both sectors.

The CFP did not contain factors to allow an accurate manual adjustment of fuel burn for aircraft weight, and the CFPs did not show any crew calculation regarding fuel burn figures. However, the load form for the incident flight did show an adjusted fuel burn figure (by about 6,600 lb - a reasonable adjustment).

The sector from Cape Verde was, according to the crew, the most limiting sector. The minimum fuel required on the CFP (146,000 lb) was loaded. As the cargo payload was less than that assumed on the CFP (by nearly 8,000 lb, even after the correct weight for the ponies is applied), the actual takeoff weight was below that assumed on the CFP on this occasion. Despite this, the actual fuel burn during the flight still exceeded the predicted burn, by some 9%. Flight levels achieved during the flight were close to those planned. The load form for the flight showed that the CFP predicted fuel burn had again been increased (by about 6,000 lb), even though the CFP takeoff weight was higher than actual.

Safety Assessment of Foreign Aircraft

The International Civil Aviation Organisation (ICAO) establishes minimum international safety standards and recommended practices for all aspects of civil aviation activity. Responsibility for ensuring that those standards are met rests with the State in which the aircraft is registered and, if different, the State in which the airline is based.

The Safety Regulation Group of the UK Civil Aviation Authority (CAA) is responsible for the safety regulation of UK-registered aircraft and UK-based airlines, but does not have regulatory responsibility for the safety of foreign aircraft and airlines. However, the UK Government's Department for Transport (DfT) takes a number of steps to ensure that airlines operating to the UK comply with international standards.

Before a permit is issued to a foreign airline to allow it to operate to the UK, the DfT checks that the airline has all the relevant approvals from the foreign government's regulatory authority and that certain other requirements are met. Where the DfT has reason to believe that an airline or aircraft may not comply with international standards it can arrange for that airline's aircraft to be inspected by the CAA in accordance with the European Community Safety Assessment of Foreign Aircraft (SAFA) programme. Where the CAA finds a matter requiring attention it will be raised with the aircraft crew, airline and/or foreign authority as appropriate.

Safety action by DfT

On 27 August 2010 the AAIB informed the DfT's International Aviation and Safety Division of its concerns about the aircraft operation from the investigation to date. As a result of information gathered from a number of sources, the DfT then notified the aircraft operator that no further operating permits would be issued in respect of the operator's DC-8 fleet until the reasons for the incident were properly understood, and that any necessary corrective actions had been put in place. As required by applicable regulation[5] the DfT similarly notified the European Community of the measures it had taken.

In subsequent action, based on this event and at least one 'ramp check' in another EC member state, the European Commission added the operator of YA-VIC to its list of aircraft operators banned from operating in European airspace. This was confirmed in the updated 'Annex A' list published on 23 November 2010 by the European Commission, which also banned all air carriers under the oversight of the aviation regulatory body in the Islamic Republic of Afghanistan.

Organisational information

During the investigation, no evidence was forthcoming to show that the aircraft operator had exercised any meaningful operational control over its newly acquired DC-8 fleet. The commander at the time of the incident was the most senior member of the six flight crew, having held the position of Flight Operations Director with their previous operator. He was not promulgated as holding any flight management position with the operator but was, for all practical purposes, the fleet manager. There was no evident supervisory structure in place, so in effect the commander reported directly to the operator's Director of Operations.

It was understood by the investigation that the crew had not been interviewed for their post with the operator, nor had gone through any other selection process. The operator had not required further training or checking of the crew before releasing them to line operations, even though none of the crew had operated the aircraft 'on the line' since late 2009. It was not clear who, if anyone, was responsible for ensuring that the crew operated within applicable duty time limitations.

Safety action by operator and regulator

The aircraft operator

The aircraft operator conducted an internal investigation into the incident and produced a report. The report identified a series of failings on the part of the crew and identified remedial and disciplinary actions. Although the report did recommend revisions to the existing Crew Resource Management (CRM) training programme[6], it did not address organisational issues such as lack of formal training, supervision and operational control of the DC-8 fleet.

In response to the actions taken by the UK DfT and a recommendation by the MoTCA (see below), the operator notified AAIB of its intention to cease DC-8 operations as soon as practicable and to dispose of the aircraft and crews.

Footnote

[5] Article 6 of Regulation 2111/2005 of the European Parliament and of the Council of the European Union.

Footnote

[6] The flight crews had not undergone any formal company CRM training.

The Islamic Republic of Afghanistan's Ministry of Transport and Civil Aviation

In a letter to the aircraft operator, dated 28 September 2010, the MoTCA observed that the operator's DC-8s were aging aircraft which, although registered in Afghanistan, were not flying under the operational control of the operator, nor under the supervision and control of MoTCA. It was recommended that the operator cease DC-8 operations and remove the aircraft from the Afghan register. The operator's Air Operator's Certificate was subsequently re-issued with the two DC-8 aircraft removed from the Operational Specifications.

In October 2010, MoTCA's Flight Safety Department notified the aircraft operator that the Afghan flight crew licences for the three operating crew were to be revoked. Additionally, MoTCA required that the operator address the identified shortfalls in its CRM training programme and that anomalies in its Pilot Proficiency Check (PPC) system be addressed, with an updated PPC system to be submitted to MoTCA for approval.

ICAO Universal Safety Oversight Audit Programme

The ICAO Universal Safety Oversight Audit Programme (USOAP) aims to promote global aviation safety through the regular auditing of safety oversight systems in Contracting States. The mandatory programme entails some 40 safety oversight audits annually, with each ICAO member State required to host an audit at least once every six years. Specifically, the USOAP audits focus on the State's capability for providing safety oversight by assessing whether the critical elements of a safety oversight system have been implemented effectively. The audit teams also determine the State's level of implementation of safety-relevant ICAO Standards and Recommended Practices (SARPs), associated procedures, guidance material and practices. However, the ICAO confirms that, due to United Nations mission travel restrictions, it has not been possible to conduct a USOAP audit in Afghanistan of the state aviation regulatory structure.

Analysis

The FDR data suggests that the initial tailstrike occurred at about 11° pitch attitude, identified by a marked slowing of the rotation rate. As the AOM warned that tailstrike would occurr at 8.95° pitch, the aircraft had probably just become airborne when the tail skid contacted the runway. After the initial tail strike the right main gear struck the raised approach light.

The aircraft then continued to rotate as a result of the increased control input, causing the tail skid to contact the soft ground beyond the runway end. A second, lesser, reduction in pitch rate is evident on the FDR data at about 13° pitch, which probably marks the second tail strike. The time interval between pitch events is about 1.5 seconds, which is equivalent to the time the aircraft would have taken to travel the distance between start and finish of the ground marks at the liftoff speed.

Therefore, the tailstrike most probably occurred because of a deviation from the correct rotation technique, probably an instinctive reaction on the part of the commander to the rapidly approaching runway end. The overweight takeoff was thus a major contributory factor, and the lack of recent aircraft handling experience is also likely to have contributed.

Collectively, the flight crew was responsible for ensuring that the aircraft met the applicable performance requirements for takeoff, but this was not done. Although lacking recent experience on type, each of the operating and positioning crew were experienced on type and familiar with the requirements. Despite this, the takeoff performance limiting weight was not checked, the allocation of tasks was incorrect and no crosscheck of the flight engineer's calculations took place. The crew cited the commander's distractions and time pressure as prime reasons, but with nearly four and a half hours between crew report and departure, and with other qualified crew members available, there should have been ample time and opportunity for the correct procedures to be followed and crosschecks to be made. The operator's observations regarding CRM training, made in their report on this incident, appear valid.

From the accounts of the flight and ground crews, it is clear the aircraft weight on the onward flight from Cape Verde was the crew's main concern. The difference between load-form weight and that used for calculating takeoff speeds exactly equates to the difference between pony weights, which strongly suggests that the crew knew the load form to be inaccurate, particularly as the correct pony weight of 450 kg was shown on the cargo manifest and air waybills. It is likely that their concerns over the next sector occupied the crew to the extent that they were diverted from the immediate task of ensuring safe takeoff performance at Manston.

The situation was exacerbated by the loading of significantly more fuel than required, even when due allowance was made for inaccurate CFP figures, which the crew seemed to be familiar with from previous experience and which probably influenced their decision.

No evidence was presented to the investigation that the aircraft operator exercised meaningful operational control over the flight. The crew had not received further training by the operator, the commander and flight engineer had not completed proficiency checks since starting employment with the operator and there was no formal supervisory structure in place. Flight support functions appear to have been vested wholly in the commander in his unoffical capacity as fleet manager. It was not clear who had responsibility for flight crew rostering and duty times, but the second crew had completed an excessively long duty period by the time the aircraft landed in Buenos Aires, with safety implications.

The MoTCA had ultimate safety oversight of the aircraft operator. However, it would appear unlikely that it exercised oversight of the introduction of the operator's DC-8 fleet, as the organisational shortcomings exposed by this incident should have been evident. Although the MoTCA susbsequently identified, in its letter to the operator, that operational control of the small and ageing DC-8 fleet was lacking, the MoTCA should have satisfied itself in this regard prior to approving the addition of the fleet to the operator's AOC. Therefore, the following Safety Recommendation is made:

Safety Recommendation 2011-006

It is recommended that the Ministry of Transport and Civil Aviation (MoTCA) review its processes for the regulatory oversight of commercial aircraft operators based in the Islamic Republic of Afghanistan.

When foreign states seek to satisfy themselves that applicable international standards have been met, they are dependent upon the regulatory authority in the State concerned exercising effective oversight of the airlines within that state. In this case, the operator was in posession of the required approvals from the MoTCA and thus there was no evident reason for UK DfT to withold an operating permit. ICAO, through its Universal Safety Oversight Audit Programme, carries out auditing of safety oversight systems in Contracting

States but, as described earlier, United Nations travel restrictions have prevented an ICAO USOAP audit in Afghanistan and a number of other States. The following two Safety Recommendations are made:

Safety Recommendation 2011-007

It is recommended that the International Civil Aviation Organisation (ICAO) establish an alternative to the USOAP (Universal Safety Oversight Audit Programme) procedure for those states, such as the Islamic Republic of Afghanistan, where security, or other, concerns prevent regular on-site auditing.

Safety Recommendation 2011-008

It is recommended that the International Civil Aviation Organisation (ICAO) conduct an aviation safety oversight audit of the Islamic Republic of Afghanistan.

As noted earlier, the operator in this case presented to the UK DfT the required approvals from the MoTCA and thus there was no evident reason for UK DfT to withhold an operating permit; this process is conducted by the DfT in the United Kingdom in a similar manner to that in other EU States. However, it is clearly less reliable as a measure of safety oversight when dealing with operators based in States where the ICAO USOAP process does not confirm an acceptable level of safety oversight. The following Safety Recommendation is made:

Safety Recommendation 2011-009

It is recommended that the UK Department for Transport (DfT) review their process for the issue of permits to aircraft operators where the ICAO auditing system does not provide an appropriate level of confidence in the State's regulatory oversight.

SERIOUS INCIDENT

Aircraft Type and Registration:	Learjet 35, N860S
No & Type of Engines:	2 Garrett TFE 731 turbofan engines
Year of Manufacture:	1976, serial number 35-086
Date & Time (UTC):	4 March 2011 at 1235 hrs
Location:	Bermuda Airport, Apron 2
Type of Flight:	Commercial Air Transport (Non-Revenue)
Persons on Board:	Crew - 2 Passengers - 2
Injuries:	Crew - None Passengers - None
Nature of Damage:	Paint abrasion on left tip tank and navigation light lens and substantial damage to winglet
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	51 years
Commander's Flying Experience:	9,000 hours (of which 2,600 were on type) Last 90 days - 170 hours Last 28 days - 89 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent enquiries by the local AAIB accredited agent

Synopsis

The aircraft taxied from the Executive Jet Centre and came into contact with a parked vehicle, sustaining damage to itself and the vehicle. The crew were unaware they had hit the vehicle until advised by Air Traffic Control when they called for clearance onto the runway. The aircraft returned to the Executive Jet Centre where it was declared unserviceable. Repairs were carried out locally and the aircraft was able to depart two days later.

History of the flight

The crew received flight plan clearance from ATC and were requested to call for taxi clearance when ready. Whilst taxiing approximately 100 ft east on Apron 2 and prior to receiving taxi clearance, the aircraft came into contact with an unoccupied airside vehicle that was parked in front of the Executive Jet Centre and was owned and operated by the ground handling agency. When the crew called for clearance to taxi to the active runway, they were advised by the tower that they had hit two vehicles while maneuvering on the ramp area and that they were to return to the Executive Jet Centre. The crew advised that they were not aware they had struck any vehicle and had felt no impact. It was later discovered that only one vehicle had been hit.

Damage to the aircraft was limited to a deformed left winglet, navigation light lens and a scrape along the left tip tank. The vehicle suffered a broken driver's side brake light lens and assembly with an indentation along its right side.

The Senior Airworthiness Inspector from the Department of Civil Aviation declared the aircraft was unserviceable. The left tip tank dorsal fin was replaced, the maintenance release signed in accordance with FAA requirements and the aircraft departed Bermuda on 6 March 2011.

ACCIDENT

Aircraft Type and Registration:	Bolkow BO 208C Junior, G-ATRI
No & Type of Engines:	1 Continental Motors Corp O-200-A piston engine
Year of Manufacture:	1966
Date & Time (UTC):	14 February 2011 at 1400 hrs
Location:	Kingsmuir Airfield, Fife
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Damage to left wing skin, nose leg, propeller and front and rear canopies
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	52 years
Commander's Flying Experience:	14,800 hours (of which 75 were on type) Last 90 days - 257 hours Last 28 days - 99 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

During the takeoff run the aircraft accelerated normally up to an airspeed of 50 kt (the takeoff speed for this aircraft is 55 to 60 kt). The pilot reported that at this point the controls started to feel "dead" and he noticed that the ASI was now reading 40 kt, despite no apparent change in the aircraft's groundspeed. He decided to abort the takeoff and braked hard; however, the aircraft overran the 620 m long runway and entered a ploughed field. The nosewheel dug into the ground, causing the aircraft to nose over onto its back. Both the occupants exited the aircraft without injury. There was a heavy rain shower shortly afterwards and the pilot attributed the accident to a sudden change in the wind direction and strength, such that the initial slight headwind became a significant tailwind during the takeoff run.

ACCIDENT

Aircraft Type and Registration:	Percival Proctor 3, G-ALJF
No & Type of Engines:	1 De Havilland Gipsy Queen 2 piston engine
Year of Manufacture:	1940
Date & Time (UTC):	30 January 2011 at 1227 hrs
Location:	Biggin Hill Airport, Kent
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Left undercarriage collapsed
Commander's Licence:	Private Pilot's Licence
Commander's Age:	76 years
Commander's Flying Experience:	3,509 hours (of which 1,047 were on type) Last 90 days - 3 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

After landing on Runway 03 of Biggin Hill Airport the pilot vacated the runway and taxied south on Taxiway A. The aircraft has a tailwheel landing gear so, when on the ground, the nose obscures the pilot's forward view, requiring 'S' turns to establish that the way ahead is clear. During one of these manoeuvres the pilot took the aircraft further to the side of the centreline than intended and the left gear contacted the warning light for the A3 hold point. The left undercarriage collapsed and the aircraft came to rest on the grass area next to the holding point. The left undercarriage attachment had failed causing damage to the undercarriage, oil tank and the surrounding wing area. Slight damage to the A3 hold warning light was reported. The pilot was uninjured.

ACCIDENT

Aircraft Type and Registration:	Pierre Robin DR400/180 Regent, G-GLKE
No & Type of Engines:	1 Lycoming O-360-A3A piston engine
Year of Manufacture:	1992
Date & Time (UTC):	9 January 2011 at 1100 hrs
Location:	Bodmin Airfield, Cornwall
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 2
Injuries:	Crew - None Passengers - None
Nature of Damage:	Propeller, front oleo, cowling, leading edge of left wing, right wing, spats and both sides of elevator
Commander's Licence:	Private Pilot's Licence
Commander's Age:	46 years
Commander's Flying Experience:	379 hours (of which 314 were on type) Last 90 days - 12 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

After takeoff the aircraft failed to accelerate and climb and hit a hedge at the end of the runway on the airfield perimeter before coming to a stop shortly afterwards. The aircraft was damaged but the pilot and passengers were uninjured and vacated the aircraft without difficulty. The conditions at the time of the flight were such that there was serious risk of carburettor icing at any power setting.

History of the flight

During the power checks, the pilot selected carburettor heat ON for several minutes and satisfied himself that there was no carburettor ice present. With the power checks complete, he taxied the aircraft to a point just off Runway 31 and conducted his pre-takeoff checks. He then lined up on the grass strip about 50 m from its start, the first part having been coned off due to the presence of soft ground. The time from the power checks being completed to being lined up was between one and two minutes.

During the takeoff roll the aircraft appeared to accelerate normally and the pilot noticed that engine rpm was normal. The rotation point was further down the runway but not unexpected since the starting point for the takeoff run was displaced. Although moving faster than the 54 kt rotate speed, the aircraft struggled to get airborne and required steadily more nose-up elevator before leaving the ground with a high nose-up pitch attitude. However, it failed to accelerate or climb away and instead “wallowed” and a wingtip struck the ground. The pilot had difficulty controlling the aircraft and it hit a hedge at the end of the runway on the airfield perimeter before coming to a stop shortly afterwards.

The aircraft suffered damage to the propeller, both wings, the undercarriage and engine cowls. However, the pilot and passengers, who were each wearing three-point lap and diagonal harnesses, were uninjured and vacated the aircraft without difficulty.

No detailed examination of the engine or engine systems was carried out, but the pilot learned that carburettor icing was experienced by other pilots at the airfield that day. The temperature and dew point were 7°C and 2°C respectively, which placed the risk of carburettor icing as ‘*Serious icing – any power*’ based on the carburettor icing probability chart in the CAA’s Safety Sense Leaflet 14.

ACCIDENT

Aircraft Type and Registration:	Pierre Robin R2160 Alpha Sport, G-SACK
No & Type of Engines:	1 Lycoming O-320-D2A piston engine
Year of Manufacture:	1997
Date & Time (UTC):	30 October 2010 at 1615 hrs
Location:	River Derwent, East Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Aircraft ditched
Commander's Licence:	Private Pilot's Licence
Commander's Age:	28 years
Commander's Flying Experience:	269 hours (of which 160 were on type) Last 90 days - 55 hours Last 28 days - 18 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The aircraft reportedly suffered an engine failure and was ditched into the River Derwent. The pilot and his passenger escaped wet but uninjured.

History of the flight

After a while spent flying aerobatics at about 2,500 ft, the pilot flew a practice forced landing. He reported that, at about 1,000 ft during the subsequent climb out, the aircraft engine started to run rough and then failed. Attempts to restart the engine were unsuccessful, so he selected a suitable field next to the River Derwent in which to land. He reported that his landing options were limited because the aircraft was so low, but also that he was too high to land in his selected field, even using full flap.

The pilot hoped to land in the next field, across the river. However, the aircraft was ditched in the river between the fields, during which it sustained damage to one wing tip. The pilot and his passenger vacated the aircraft as it filled with water and adopted a nose low attitude. With some difficulty, the pilot and passenger were able to reach the bank.

A friend of the pilot had reportedly been filming the aerobatics from the river bank, and was on hand to assist. The aircraft occupants were taken to hospital by air ambulance and were found to be uninjured.

Additional information

A passer-by was reported to the AAIB as commenting to those involved in the aircraft salvage effort on the level of aerial activity on the immediate area. It was reported that the same aircraft had recently been seen flying low-level passes along the river whilst a person on the river bank took photographs. The aircraft on that occasion was described as being the same as was involved in this accident. An inquiry at the flying club which operated the aircraft revealed that the same pilot was flying G-SACK at the time reported.

AAIB comment

The accident area, being generally flat and agricultural, would appear to offer much better alternatives for a forced landing than the River Derwent. The pilot described being forced to overshoot his intended field in favour of the next field, beyond the river. There would presumably have needed to be some positive manoeuvring in order to align the aircraft's track with the river, which would appear inconsistent with being unable to reach the field immediately beyond.

ACCIDENT

Aircraft Type and Registration:	Piper PA-28-161 Cherokee Warrior II, G-BNOE
No & Type of Engines:	1 Lycoming O-320-D3G piston engine
Year of Manufacture:	1987
Date & Time (UTC):	28 January 2011 at 1415 hrs
Location:	Walton Wood Airfield, near Pontefract, West Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to nosewheel, propeller, lower engine cowling and wing tips
Commander's Licence:	Private Pilot's Licence
Commander's Age:	53 years
Commander's Flying Experience:	118 hours (all on type) Last 90 days - 2 hours Last 28 days - 1 hour
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

A first attempt at takeoff was aborted when it became apparent to the pilot that the aircraft was not achieving flying speed. The aircraft came to a halt at the end of the runway, but assistance was required to recover it to the taxiway. A second attempt was made on the reciprocal runway after the pilot had off-loaded his passenger. The flaps were set at 25º on this occasion; however the aircraft once again failed to achieve flying speed and the takeoff was aborted. The pilot was unable to halt the aircraft before the end of the runway, with the result that it came to rest in a shallow ditch in a field beyond. It is possible that the soft nature of the ground was a significant factor in both takeoff attempts.

Circumstances of the accident

The pilot's intention was to conduct a flight to Sherburn in Elmet from Walton Wood Airfield. He was familiar with Walton Wood and had flown in there earlier in the day, landing without any problems. After completing the power and pre-takeoff checks, the aircraft lined up on Runway 06. The pilot applied full power, although approximately 7 seconds elapsed before the aircraft started to move; the pilot attributed this to a combination of a slight incline and the soft nature of the ground. After covering around 500 m and having failed to reach liftoff speed, the pilot aborted the takeoff, with the result that the aircraft came to rest at the end of the runway, with the nosewheel resting in a shallow furrow. The pilot called up Walton Wood radio, advised of his situation and requested assistance. The on-airfield maintenance organisation responded to this request and pushed the aircraft back onto the taxiway. The engineers then checked for any visible damage and also for any evidence of the brakes having been partially seized on; both checks were negative.

The pilot subsequently contacted the flying club Sherburn in Elmet and asked for advice on how best to proceed, including taking off on Runway 24. The advice he received included allowing adequate remaining runway in the event that the takeoff needed to be aborted once again.

Prior to the next attempt, the pilot off-loaded his passenger in order to reduce the aircraft weight. He also decided to follow a suggestion from the personnel who had helped recover the aircraft, that he use 10º flaps for the initial takeoff roll, with 25º to be applied subsequently.

The pilot did not have immediate access to the Pilot's Operating Handbook (POH) for this aircraft. However, Section 4 of the POH, 'NORMAL PROCEDURES, SOFT FIELD, NO OBSTACLE' states that flaps should be set at 25º, together with the advice to:

> *'Accelerate and lift off nose gear as soon as possible. Lift off at lowest possible airspeed. Accelerate just above ground to best rate of climb speed, 79 KIAS. Flaps; slowly retract.'*

For 'NORMAL PROCEDURES, SOFT FIELD, OBSTACLE CLEARANCE' the additional advice is to:

> *'Accelerate just above ground to 52 KIAS to climb past obstacle height.'*

After completing the pre-takeoff checks the pilot commenced his takeoff on Runway 24, noting that the engine was developing 2,300 rpm. He selected 25º flaps after covering 250-300 m; however, the indicated airspeed failed to increase above 43 kt, and, after approximately 500 m, the pilot decided to abort the takeoff and applied the brakes. It became apparent that the aircraft would not come to a halt before the end of the runway, so the pilot turned the aircraft to the right in an attempt to extend the distance available. The aircraft then entered a shallow ditch and slewed further to the right before coming to rest in a field beyond the end of the runway. The pilot was not injured, although some damage had occurred to the aircraft.

The pilot subsequently commented that he did not act on all the advice given to him in that he ought to have planned an abort point and abandoned the takeoff earlier.

The airfield guide used by the pilot noted that Walton Wood can be closed in winter, due to water-logging. Whilst the airfield was not closed in this case, it is possible, in the absence of any evidence of a loss of engine power, that the soft nature of the runway surface was a significant factor in preventing acceleration of the aircraft.

ACCIDENT

Aircraft Type and Registration:	Stampe SV4C (Modified), G-BIMO
No & Type of Engines:	1 de Havilland Gipsy Major 10 Mk 2 piston engine
Year of Manufacture:	1946
Date & Time (UTC):	10 July 2010 at 1640 hrs
Location:	Near Rotherfield Peppard, Oxfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Fatal) Passengers - 1 (Fatal)
Nature of Damage:	Aircraft destroyed
Licence:	Private Pilot's Licence
Age:	41 years
Flying Experience:	About 179 hours (of which 95 were on type) Last 90 days - at least 8.5 hours Last 28 days - Not known
Information Source:	AAIB Field Investigation

Synopsis

The aircraft entered an inverted spin during an unsuccessful attempt to perform a rolling aerobatic manoeuvre and impacted the ground, causing the two occupants to receive fatal injuries. No technical defects were found that could have contributed to the accident.

History of the flight

The aircraft departed White Waltham Airfield at about 1530 hrs for a local flight. The owner, who was PPL-qualified, was seated in the front cockpit and a friend of his, also PPL-qualified, was seated in the rear. The majority of the flight and the entire accident sequence were recorded by a digital video camera mounted on the owner's helmet. The history of the flight was reconstructed from a combination of the video evidence, eyewitness statements and recorded radar data. Despite the video evidence, it was not possible to determine who was flying the aircraft.

The aircraft departed to the west of White Waltham, climbing steadily to a peak recorded altitude of 3,650 ft as indicated by the front cockpit altimeter. After making various gentle climbing turns, the aircraft tracked in a generally southerly direction. It then conducted a 180° level turn to track approximately north.

Video evidence of the accident manoeuvre shows that the aircraft pitched nose-down and accelerated to 110 kt at 3,400 ft, before pitching nose-up. The attitude was stabilised with the nose above the horizon. The aircraft then commenced a slow roll to the right, with the nose remaining above the horizon until the aircraft had rolled past the inverted. The roll continued, but the aircraft's flight path then became 'spooned', resembling the helical profile of a barrel roll. The aircraft appears to have departed controlled flight during the roll, with the departure developing into an inverted spin which continued for eight turns until the aircraft entered the tree canopy, some 37 seconds after commencing the roll. Both occupants received fatal injuries in the ground impact. Several eyewitnesses observed the aircraft's uncontrolled descent.

Aircraft information

The Stampe SV4C is a two-seat biplane of predominantly wooden construction which has been used extensively for aerobatics. G-BIMO was built in 1946 and was placed on the UK civil register in 1981. In 1995 it underwent a major modification involving replacement of the original Renault engine with a De Havilland Gipsy Major 10 Mk 2 engine and a Hoffmann wooden propeller.

In addition to the two tandem pilots' seats, the fuselage incorporated a locker, with a hinged forward door, positioned under the curved upper decking aft of the rear seat. Small items of loose equipment could be placed therein and were retained by the closed door. The fuel system incorporated a single tank positioned in the centre of the upper wing. This location is close to the empty longitudinal centre of gravity (CG) of the aircraft. G-BIMO utilised a 'flop tube' fuel pick-up arrangement to ensure that fuel could be drawn from the tank irrespective of aircraft's attitude or direction of acceleration.

Accident site

The wreckage of the aircraft came to rest in woodland. The on-site evidence was consistent with the aircraft having struck the treetops at a very steep flight path angle, with its longitudinal axis orientated beyond the vertical. The aircraft was structurally complete at the initial impact with the trees. The extent of the damage sustained by the aircraft in its passage through the trees and the ground impact was consistent with a relatively low descent speed. The four wing surfaces were relatively lightly damaged and were geometrically disposed in approximately their correct relative positions. A considerable proportion of the wooden forward fuselage had been destroyed.

Damage to the wooden propeller, and horizontal slash marks on a vertical tree trunk, indicated that the engine was turning at a low rpm, but was delivering some power during the impact sequence. Substantial quantities of loose items associated with the aircraft and items of clothing were recovered from the accident site.

Detailed wreckage examination

The aircraft wreckage was recovered to the AAIB facilities for detailed examination. The flying controls were found to be correctly connected, except where obvious impact damage had occurred. No evidence of control restriction was found.

External examination of the fuel system and strip examination of the engine revealed no evidence of pre-impact failure. The aviation-related items and clothing recovered from the vicinity of the site were collected and were found to be capable of all being securely stowed simultaneously within the fuselage locker on another aircraft of the same type.

There was no evidence available to allow the quantity of fuel on board the aircraft at the time of the accident to be established.

Weight and balance

A weight and balance calculation was performed by the AAIB using the empty weight and CG position established when the aircraft was weighed in 1995. The post-mortem occupant weights were used, together with the total mass of the loose items, all of which were assumed to have been placed in the locker behind the rear seat. As the fuel contents at the time of the accident were unknown, various possibilities were considered.

In general, it appeared that with the tank more than approximately half-full, the CG would have been within specified limits, but the total weight would have exceeded the maximum aerobatic limit. With a low fuel load the CG would have been further aft and could have been close to, or just beyond, the specified aft limit.

Pilot experience

The owner and his friend had completed PPL courses at the same flying school during 2008. The flying school had retained their training records, which showed that they had made good progress throughout the course. Both had around 200 hours total flying experience.

According to the owner's flying logbook, he gained his PPL after approximately 73 hours. He then undertook differences training on the Stampe with a qualified flying instructor, who was approved to teach aerobatics. He completed his differences training after approximately 15 hours.

According to the instructor, the owner undertook aerobatics training with him and had reached the stage where he was competent to perform aileron rolls and loops solo. The instructor had demonstrated stall turns, half-Cubans and barrel rolls to the owner, but the owner was reportedly not yet competent in performing these.

In total, the owner's logbook had 21 entries referring to some form of aerobatics, mainly loops and rolls and almost all with him recorded as pilot in command. Although the instructor had checked out the owner on flying the Stampe from the rear seat, the owner was legally permitted to fly the aircraft from either seat.

Shortly after qualifying for his PPL, the owner's friend purchased a share in a Jungmann. During his differences training, his instructor had demonstrated some basic aerobatic manoeuvres to him. It is believed that the owner's friend had completed about 23 hours on the Jungmann; his most recent flight in it was August 2009. The majority of the remainder of his flying had been in 'club' type aircraft, with the exception of about 14 hours in a Harvard, in October 2009. He had maintained his tailwheel currency on a Piper Cub.

Medical information

The owner and his friend held current JAA Class 2 medicals. A specialist aviation pathologist conducted post-mortem examinations on both. He reported that that there was no evidence of significant natural disease. The toxicology results for the owner showed the presence of drugs related to the emergency medical treatment following the accident. The results showed both occupants blood alcohol concentration to be below the 20mg/100ml legal limit for flying in the UK.

Survivability

The owner initially survived the accident and was extracted from the aircraft wreckage by the emergency services while still conscious and able to talk.

However, he had sustained multiple internal injuries and his condition quickly deteriorated, despite rapid and intensive medical intervention. He was declared deceased at 1900 hrs on the day of the accident. Given the high impact forces he experienced, it is unlikely that he would have survived, even with additional protective equipment.

Both occupants were wearing Kevlar helmets with leather covers. The owner's helmet was labelled with his name and was fitted with a foam liner and featured a 'Velcro' patch on the right ear muff for the attachment of the helmet-mounted video camera.

The owner's friend was wearing a helmet of identical design and construction as the owner's. It was labelled with the same serial number and had an engraved brass plate on it. However, this helmet did not have the foam liner fitted. A helmet bag recovered from the aircraft wreckage contained a range of sizes and thicknesses of foam inserts intended to fit within the Kevlar shell of the helmet. These are designed to allow the helmet to be fitted to different head sizes and to provide a compressible layer to reduce the peak deceleration experienced by the head during an impact. The pathologist who conducted the post-mortems reported that:

> *'Using the helmet without the liner would significantly reduce the protection the helmet would afford against impact-related deceleration, although it is uncertain as to the effect on survivability this would have had in this particular accident.'*

Meteorology

The London Heathrow METAR for the time of the accident gave reported conditions of: wind less than 10 kt, no cloud, greater than 10 km visibility, surface temperature of 28°C and a QNH of 1016 mb.

UK aerobatics regulations

There is currently no requirement in the UK for pilots to have completed any formal training in aerobatics before being permitted to conduct them as pilot in command. However, the CAA recommends that pilots receive such training before conducting aerobatics. The Aircraft Owners & Pilots Association (AOPA) publishes training syllabi for Basic, Standard and Intermediate level aerobatics. The Basic course comprises a minimum of eight hours of dual flying tuition with an approved instructor and eight hours of ground school. CAA Safety Sense Leaflet 19 entitled '*Aerobatics*' refers to the AOPA course.

EASA Proposal

On 26 August 2010, the European Aviation Safety Agency published a proposal to the European Commission for a harmonised regulation on Flight Crew Licensing (FCL). These proposals will become law in 2012. An aerobatic rating is included within the proposals, as outlined below:

> ***'FCL.800 Aerobatic rating***
>
> *(a) Holders of a pilot licence for aeroplanes, TMG or sailplanes shall only undertake aerobatic flights when they hold the appropriate rating.*
>
> *(b) Applicants for an aerobatic rating shall have completed:*
>
> *(1) at least 40 hours of flight time or, in the case of sailplanes, 120 launches as PIC in the appropriate aircraft category, completed after the issue of the licence;*

(2) a training course at an ATO (Approved Training Organisation), including:

(i) theoretical knowledge instruction appropriate for the rating;

(ii) at least 5 hours or 20 flights of aerobatic instruction in the appropriate aircraft category.

(c) The privileges of the aerobatic rating shall be limited to the aircraft category in which the flight instruction was completed. The privileges will be extended to another category of aircraft if the pilot holds a licence for that aircraft category and has successfully completed at least 3 dual training flights covering the full aerobatic training syllabus in that category of aircraft.'

CAA Safety Sense Leaflet 19

CAA Safety Sense Leaflet 19 recommends the wearing of lightweight helmets and states that parachutes may be the only way to avoid a fatal accident following failure to recover from a manoeuvre. It further states:

*'you **must** now become familiar with entry to and recovery from a fully developed spin since a poorly executed aerobatic manoeuvre can result in an unintentional spin.'* (Original bold)

and:

'Know the spin characteristics of the aircraft even though you may have no intention of entering a spin. Know also the different symptoms of erect and inverted spins and the appropriate recovery drills for each type of spin.'

Analysis

It was evident from the helmet camera video recording that an unsuccessful attempt was made to perform a rolling aerobatic manoeuvre. The aircraft entered the rolling manoeuvre at an appropriate speed, however, in executing the manoeuvre, the aircraft departed from controlled flight into an inverted spin from which it did not recover.

The inverted spin commenced at a height from which recovery was theoretically possible for a pilot with the appropriate experience or training. However, an inverted spin is highly disorientating and it would be very difficult for a pilot with limited aerobatic experience to recognise the spin orientation and achieve a successful recovery.

The owner normally flew the aircraft from the rear seat. It was not possible to determine why he was seated in the front on this flight, but he was legally permitted to fly the aircraft from either seat. There was insufficient evidence available to determine which pilot was handling the aircraft during the flight.

It is not known whether the use of the liner would have prevented the owner's friend from receiving fatal injuries.

Conclusions

The accident resulted from an unsuccessful attempt to perform a rolling aerobatic manoeuvre, which led to the loss of control of the aircraft.

The CAA recommends that pilots become familiar with the symptoms of and recovery techniques for erect and inverted spins. In practice, successful recovery from an inverted spin entered at a height of around 3,500 ft would be very difficult for a pilot with limited aerobatic experience.

The EASA aerobatics rating requirement will come into effect in 2012.

ACCIDENT

Aircraft Type and Registration:	Cyclone AX2000, G-BYJM
No & Type of Engines:	1 Rotax 582-48 piston engine
Year of Manufacture:	1998
Date & Time (UTC):	10 November 2010 at 1415 hrs
Location:	Caunton Airfield, Nottinghamshire
Type of Flight:	Private
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Landing gear collapsed
Commander's Licence:	Private Pilot's Licence (Microlight) with Instructor and Examiner ratings
Commander's Age:	50 years
Commander's Flying Experience:	7,000+ hours (of which 900+ were on type) Last 90 days - about 70 hours Last 28 days - about 20 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB

Synopsis

During a simulated engine failure after takeoff the student pilot reduced the throttle rapidly and did not immediately lower the nose of the aircraft. The examiner took control and increased the power to full but his actions were too late to prevent a heavy touchdown.

History of the flight

The Cyclone AX2000 is a high-wing three-axis microlight aircraft with tricycle landing gear. It has side-by-side seating with a single control stick mounted in the centre. It has a high thrust-line configuration with its engine mounted on a strut forward of the wing leading edge. The purpose of the flight was to conduct a 'General Skills Test' (GST). The student pilot was in the left seat and the examiner (pilot-in-command) was in the right seat. Following successful completion of the Oral Test the examiner briefed the student on the GST. The student was told to expect to be asked to perform a simulated engine failure after takeoff (EFATO) and that this might be requested during the first takeoff. The examiner expected the student to retard the throttle when the simulated EFATO was called for and then to land straight ahead.

After carrying out the pre-flight and pre-takeoff checks the student lined up on Runway 29 (grass) which was 450 m long and 15 m wide. The wind was from the north-west at about 10 kt. After a normal takeoff, and at a height of about 100 feet, the examiner called "Engine Failure". The examiner reported that at this point the student closed the throttle "very abruptly" and did not lower the nose of the aircraft. The aircraft decelerated and, when the examiner realised that the student was not performing the correct recovery procedure, he took control of the aircraft and increased the power to full. However, his actions were too late to prevent a heavy touchdown, causing the landing gear to collapse.

Student's comments on the accident

The student said that he recalled having practised the EFATO on two previous occasions, both of which were using the longer runway. He agreed that he had not lowered the nose quickly enough, but also commented that as it was the first manoeuvre of the test he had not yet had a chance to get settled.

Examiner's comments on the accident

The examiner stated that in a teaching situation he would always cover the controls with his hands in case a student made an error but that, in a GST in an aircraft with a single control stick, he cannot easily do this as he needs to give the student full control of the aircraft. He also said that he called for the EFATO on the first takeoff because the wind was due to increase and because the student had performed a good takeoff. He stated that with the benefit of hindsight it might have been better to have done the EFATO later in the test sequence. He also noted that the aircraft's high thrust line meant that the aircraft had a tendency to pitch up when power was reduced.

ACCIDENT

Aircraft Type and Registration:	Pegasus Quantum 15, G-BZVJ
No & Type of Engines:	1 Rotax 582 piston engine
Year of Manufacture:	2001
Date & Time (UTC):	8 January 2011 at 1400 hrs
Location:	Tain Airfield, Ross-Shire, Scotland
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Wing, front of pod and landing gear
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	44 years
Commander's Flying Experience:	104 hours (of which 54 were on type) Last 90 days - 6 hours Last 28 days - 3 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and subsequent AAIB enquiries

Synopsis

The aircraft's engine stopped without warning at a height of approximately 700 ft during the climb after takeoff. The pilot attempted to land back on the grass runway in the direction of takeoff, but there was insufficient height remaining to make the final turn and so he landed across the threshold, perpendicular to the runway. On realising that the aircraft was likely to collide with a fence, he pushed the control bar forward to become airborne again and clear the fence. The back wheels of the trike struck the top of the fence as the aircraft passed over it and the aircraft dropped into the adjacent field, coming to rest on its side. The pilot considered that the most likely cause of the engine failure was either carburettor icing or ice in the fuel line.

History of the flight

The pilot had completed a number of circuits at Tain Airfield earlier in the day, followed by a 45 minute flight in the local area with a passenger. After a short break for refreshments he decided to undertake another local flight. After takeoff from grass Runway 34, the engine stopped without warning at approximately 700 ft. The pilot attempted to select a suitable field in which to conduct a forced landing, however all the fields ahead had livestock in them. He commenced a left turn back towards the runway and planned to conduct a downwind landing. He subsequently realised he was too high to make a successful landing in the runway length remaining, and so continued his turn through the centreline to reposition to land on Runway 34.

However, there was then insufficient height remaining to make the final turn and he landed across the threshold, perpendicular to the runway. The pilot realised that he would be unable to stop the aircraft before it reached an approaching fence line, so he pushed the control bar forward to become airborne again and clear the fence. The back wheels of the trike contacted the top of the fence as the aircraft passed over it and the aircraft dropped into the adjacent field, coming to rest on its side. The pilot was uninjured and was able to exit the aircraft unassisted.

The weather was reported as fine and sunny with surface wind from 230° at 6 kt, visibility 10 km, scattered cloud at 4,900 ft, temperature -1ºC, dew point -3ºC and sea level pressure 989 mb.

Discussion

There were no engine problems noted during the earlier flights or during the pre-flight checks immediately prior to the take off. Engine indications were normal prior to the loss of power and sufficient fuel was available in the fuel tank. Subsequent examination of the engine by the pilot did not determine the cause of the engine failure. The pilot considered that the most likely cause was either carburettor icing or ice in the fuel line.

The weather conditions were conducive to carburettor icing at cruise or descent power settings, however the event occurred at the takeoff power setting. A carburettor heater system is not fitted as standard to this aircraft. The Pegasus Quantum 15 Operator's Manual indicates that while these systems are rarely necessary on Quantum aircraft fitted with two-stroke engines, such as the Rotax 582, a carburettor heater is available as an optional modification.

ACCIDENT

Aircraft Type and Registration:	Pegasus Quik, G-XJJM
No & Type of Engines:	1 Rotax 912ULS piston engine
Year of Manufacture:	2007
Date & Time (UTC):	2 March 2011 at 1205 hrs
Location:	Near Manchester Barton Airport, Cheshire
Type of Flight:	Training
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Minor) Passengers - 1 (Serious)
Nature of Damage:	Severe structural damage
Commander's Licence:	Private Pilot's Licence
Commander's Age:	45 years
Commander's Flying Experience:	6,911 hours (of which 2,870 were on type) Last 90 days - 52 hours Last 28 days - 12 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

During a training detail on practice forced landings, the student pilot operated the control bar of the weight shift microlight aircraft in the opposite direction to that required for the go-around and pitched the aircraft nose-down. The instructor was unable to arrest the high rate of descent in time to prevent the aircraft from striking the ground at high speed. The nosewheel assembly failed and the aircraft turned over and it was severely damaged. The student pilot suffered serious injuries and was airlifted to hospital. The instructor sustained minor injuries. Both occupants were wearing helmets and lap straps.

History of the flight

The student had completed approximately six hours of training on weight shift microlight aircraft and had, five years previously, completed approximately 20 hours of flying training on fixed wing light aircraft. Prior to this lesson, the student had worked a night shift in their job as a firefighter and had reported for duty at 1800 hrs the day before. The shift finished at 0900 hrs on the day of the accident. A period of rest from 0000 hrs to 0700 hrs was scheduled, subject to operational demands. During the rest period, the student was called out in the early hours of the morning to a serious incident that involved finding and rescuing a person from a burning building and was later deployed to another incident. After finishing the shift, the student went home, had a meal and rested before the lesson which commenced at 1100 hrs.

The airfield was approximately 15 minutes away from home. On arriving at the airfield the student reported feeling fine, but a bit more fatigued than normal.

The instructor was aware the student had worked a night shift prior to the lesson and was therefore a little tired. The lesson progressed well and after a demonstration by the instructor, the student completed the first approach and go-around without incident. The second approach was without incident until the instructor called for a go-around to be flown from around 100 ft agl. The student applied full power with the foot throttle and pulled back on the control bar instead of pushing it forward. Despite telling the student to relax their grip, the instructor was unable to push hard enough on the training bars to arrest the descent before the aircraft stuck the ground.

Discussion

The student's incorrect control input may have been due to reverting to a previously learnt response appropriate for a fixed wing aircraft, or as a result of a simple error. The student's performance on the day may have been seriously affected by the lack of sleep and the nature of the work activities undertaken the previous night.

Pilots and instructors should be alert to the effects of fatigue and stress on performance and be prepared to take appropriate mitigating actions. CAA Safety Sense Leaflet 24, '*Pilot Health*', gives advice on the subjects of stress and fatigue and provides a basic checklist for pilots to use in assessing their fitness to fly.

ACCIDENT

Aircraft Type and Registration:	SZD-24-4A Foka 4, G-DBZZ
No & Type of Engines:	N/A
Year of Manufacture:	1966
Date & Time (UTC):	8 August 2010 at 1410 hrs
Location:	Bicester Airfield, Oxfordshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - None
Injuries:	Crew - 1 (Fatal) Passengers - N/A
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Gliding Certificate
Commander's Age:	25 years
Commander's Flying Experience:	226 hours (of which 2.5 hours were on type) Last 90 days - 3.7 hours Last 28 days - 1.3 hours
Information Source:	AAIB Field Investigation

Synopsis

During the second winch launch of the day, the wings of the glider separated from the fuselage. The pilot sustained fatal injuries in the resulting impact. The investigation determined that when the aircraft was rigged, the lower bevel bolt of the wing main fitting had not fully engaged with the lower lug stack of the main spar joint and it was not possible to detect this condition. As a consequence, when the glider became airborne, the partially secured joint was unable to sustain the wing bending moments associated with the winch launch and the lower bevel bolt failed. This allowed the lower attachment lugs to disengage and the wings to fold upwards and separate from the fuselage. Two Safety Recommendations have been made as a result of the investigation.

History of the flight

General

A gliding club at Bicester Airfield had organised a week of gliding activity for 60 students from universities around the country. Four friends, including the accident pilot, had each brought a glider from Scotland to take part. The owner of G-DBZZ was not attending the event, but the pilot involved in the accident flight had flown the aircraft before and had observed the owner rig and de-rig the glider. The pilot had recently taken out an insurance share in order to operate it as part of a syndicate arrangement. The owner conducted a verbal briefing on the handling of the aircraft with the accident pilot in the presence of an instructor and also provided some notes on operating the glider. The accident pilot had also taken the Flight Manual home and studied it.

Pre-launch activity

The friends arose at about 0700 hrs on the morning of the accident and rigged two of the four gliders before attending the daily flying briefing at 0800 hrs. Following the briefing and completion of documentation, the pilot and friends re-read the flight manual Section 7.1 'Wing assembling' and commenced the rigging of G-DBZZ and the other glider. The fuselage was withdrawn from the trailer and placed on the rigging support. This was designed to maintain the glider in an upright position but one of the straps had broken, so one person held the tail fin whilst the others withdrew the wings and laid them out on the ground. One wing was placed in position first, with the accident pilot supporting the wingtip and another person (Pilot A) the wing root. Pilot A inserted the spar root into the fuselage cutout and ensured that the leading and trailing edge spigot bearings were positioned over the bevel pins on the fuselage. Having done this he placed a trestle part way along the wing.

Another pilot joined them and the other wing was placed in position and a trestle placed under it. The person (Pilot A) who had inserted the first wing spar then operated the horizontal rotating bar which operated the forward bevel pins and was mounted on a bulkhead behind the pilot's seat. This pushed the wings apart and so he returned it to its original setting with the wings flush with the fuselage. He then took over from the person holding the fin, who went to assist with rigging another glider. Another pilot (Pilot B) came to assist and he took the left wingtip, with the accident pilot holding the right wingtip; Pilot A supported the fin whilst another pilot (Pilot C) operated the wing main fitting locking mechanism using the speed brace and a rigging tool provided in the rigging tool box.

As none of the pilots had rigged the glider before, the accident pilot, and those assisting, spent some time consulting the Flight Manual. When Pilot C felt resistance, they stopped and adjusted the position of the wingtips until the mechanism moved more freely again before continuing. Pilot C was concerned that there was no way of checking the mechanism had reached full travel. The accident pilot and Pilot A then located Section 7.8 'Assembly sequence', which contained a requirement for '40 half turns' of the mechanism to be made, which they pointed out to Pilot C. It was decided that they would slacken completely the wing main fitting mechanism and start again. This was carried out, during which Pilot C, who was operating the mechanism, felt no resistance and carefully counted that the full 40 half turns required by the Flight Manual were completed. As there was no resistance felt, it suggested to them that the holes were properly aligned. Pilot C made an additional four to six half turns before feeling resistance, at which point he then stopped.

The speed brace and tool were removed and the T-wrench was inserted into the main fitting and the upper fuselage cover for the mechanism access hole was locked in place. The tailplane and control linkages were secured by Pilot A and the accident pilot carried out a duplicate inspection to ensure this had been done correctly. A final check was made of the forward bevel pin adjustment bar, which could not be moved; the pilots assumed this indicated that the bevel pins were at their maximum travel. Having taped over any joints, the accident pilot carried out a daily inspection and was assisted by another pilot whilst carrying out the positive control checks. The gliders were towed to the launch point and the accident pilot tried to contact the owner to ensure they had carried out the rigging correctly. The owner did not answer the call and so a message was left for him.

The first launch

The weather at Bicester was good with the surface wind variable at less than 5 kt, visibility in excess of 10 km and cloud scattered at 4,500 ft. Runway 36 was in use and the pilot of G-DBZZ was planning to attempt a distance flight of 317 km over a set route. For this reason, the glider logger was operating.

The glider was moved forward to the launch point and the duty instructor asked the pilot what type of glider it was. The pilot told him and added that it launched like an 'Astir'. The instructor was not familiar with the type and so instructed the winch driver to launch it like a 'K8'. After a short ground run the glider lifted off and adopted a climbing attitude. Shortly after, the nose was lowered, which was the signal to the winch driver to increase the launch speed, which he did. The glider continued to climb and released from the cable. The pilot had not achieved the hoped for height from the launch and was unable to locate any thermals. Following four orbits, the glider was flown around the circuit and established on the final approach. As the airbrakes were extended, the canopy opened and moved forward on its rails. The pilot held onto the canopy with one hand, to prevent it opening further, and controlled the glider with the other hand. As a consequence, the glider was landed with the airbrakes extended but the touchdown was without incident. The pilot was shaken by the experience but was happy to continue flying, so the glider was towed back to the launch point.

At this point the owner returned the accident pilot's call and they discussed the rigging and the canopy coming open. The pilot and friends had some light refreshments before preparing the glider for a subsequent launch. The owner telephoned a second time to suggest that the canopy opening may have been associated with the opening of the airbrakes. As a result of the two telephone conversations, the pilot was reassured that they had followed the correct rigging procedure and understood that providing the forward bevel pin adjustment mechanism could not be moved anymore, the bevel pins were fully extended in the spigot bearings.

Second launch

The duty instructor checked what type of launch was required and the pilot responded that the climb would be at 60 kt and similar to an 'Astir', but gently initially for the ground roll. The pre-flight and control checks were performed and the canopy checked for security. The launch cable with the correct weak link was attached and the launch initiated following a radio call to the winch driver. The acceleration and rotation into the climb appeared normal although, as the aircraft climbed, some witnesses thought it appeared fast. The glider yawed to the right but it was not clear if this was the commencement of the yawing signal to slow down. The winch driver reduced power, as he normally would, and the glider continued the climb a little steeper and faster than normal. Witness estimates of the height at which the next sequence of events occurred varied between 600 ft and 1,000 ft, but the described sequence was generally similar.

The glider was still on the launch when the left wing bent up approximately 20° and the aircraft banked slowly to the left. The right wing then bent up by a similar amount. The glider appeared not to have released from the winch cable at this point but the wings separated from the fuselage, remaining attached to each other at the main spar joint. The fuselage adopted a steep nosedown attitude before striking the ground. The wings descended at a slower rate falling to the ground short of the fuselage. A number of persons were very quickly on the scene but the accident was not survivable.

Pilot information

The pilot started gliding in July 2001 and up until the accident flight had accumulated 226 hours and 19 minutes total flying time in 531 flights. This was broken down into; 75 hours 49 minutes on single-seat gliders, P1 multi-seat gliders10 hours 53 minutes and P2 multi–seat gliders 139 hours 37 minutes.

The pilot held A and B British Gliding Association (BGA) certificates issued in September 2002 and a BGA Bronze award in September 2003, with a qualifying cross-country in April 2004. The pilot also held a BGA Silver award, completing the height element in May 2004, distance in August 2004 and duration in November 2004.

The first flight on the Foka 4 was on 19 June 2010 and in four flights a total of 2 hours 30 minutes were flown.

Medical and pathological information

A post-mortem examination revealed that the pilot had no medical history which would have been relevant to the accident and there was no evidence of significant pre-existing natural disease. Toxicology revealed no evidence of drugs or alcohol. It concluded that the pilot died of multiple injuries which were caused when the glider struck the ground.

Aircraft description

The SZD 24-4A Foka 4, a single-seat standard class sailplane, was designed and manufactured by Szybowcowy Zaklad Doswiadczalny (SZD) Bielsko in Poland in the 1960s. The type is no longer in production and the Type Certificate for the aircraft is currently held by a Polish aircraft manufacturer.

The Foka 4 is of predominantly wooden construction, with a fibreglass composite forward fuselage section. The ailerons, elevator and rudder are fabric covered and the wings are of stressed skin laminated plywood construction. The wings do not have a conventional spar; however a root spar allows connection of the wing to the fuselage.

Wing attachment philosophy

There are three attachment points for the wings of the Foka 4 glider: the wing root main attachment fittings, which form the main spar joint and resist wing bending loads; trailing edge fixed bevel pins, and leading edge movable bevel pins, which resist torsional loads.

Wing to wing attachment

The aircraft has a shoulder wing configuration. A spar cutout in the fuselage, behind the cockpit, accommodates the wing root spars. Two latches on the forward wall of the spar cut-out engage catches on the wing roots, allowing each wing half to be mounted separately thereby reducing the number of people required to rig the aircraft. The latches have no structural significance.

The left wing has a single upper and a lower horizontal attachment lug at the root spar. The right wing has a double set of upper and lower attachment lugs. The attachment lugs of each wing meet in the centre of the fuselage forming an upper and lower lug stack. Correct alignment of the lugs in the upper lug stack is achieved using an 'L-shaped' tool. This tool is inserted through a small access hole in the top of the fuselage and into the upper lug stack. It is 'joggled' until the lugs come into alignment. The spar joint is then secured by expanding the bolts of the wing main fitting, which is mounted on the end of the right wing root spar, between the attachment lugs. Figure 1(a) and 1(b) refer.

Figure: 1 (a)

Right wing root with Wing Main Fitting

Figure: 1(b)

Fuselage spar cut-out, right wing installed; access hole visible in top of fuselage

The wing main fitting (Figure 2) is a double expanding bolt arrangement consisting of two tapered steel bevel bolts, mounted between aluminium guide plates, which travel upwards and downwards into the lug stacks on a hollow threaded screw. The fitting is operated by means of a special tool, referred to in the Flight Manual as a 'T-wrench'. This is inserted into the bore of the threaded screw, and turned by hand in a clockwise direction. Vertical slots, or keyways, machined along each side of the bevel bolts, engage with the edge of the guide plates, such that as the threaded screw rotates, the bevel bolts are restrained from turning and instead travel along the screw threads and into the lug stacks. The central collar of the threaded screw (Figures 3a and 3b) is restrained in a central position between two stops on the guide plates such that symmetrical expansion of the bolts takes place. The attachment lugs are taper-reamed to match the taper profile of the bevel bolts. To expand the bolts fully it is necessary to ensure the wings are correctly aligned and the T-wrench is operated for approximately 40 half turns. It may be necessary to oscillate the wingtips up and down to achieve correct alignment of the lugs.

Full expansion of the upper bevel bolt can be visually confirmed through the access hole above the wing main fitting – as a minimum, the 8 mm tapered lead-in of the bolt should protrude above the upper lug on the right wing (Figure 4a). It is not possible to verify the position of the lower bevel bolt.

The mechanism is locked in position by inserting the T-wrench such that the bent arm engages with one of four holes cut in the top of the spars (Figure 4b.) A sprung access panel is then placed in the access hole.

Wing to fuselage attachment

Two fixed and two movable horizontal bevel pins are mounted on the fuselage in the area of the wing root and these are positioned to engage with self-aligning spigot bearings (Items 8 and 9, Figure 5) on the wing root ribs when the wings are offered up to the fuselage. The rear set of bevel pins are fixed (Item 5, Figure 5). The forward set of bevel pins (Item 3, Figure 5) are movable and are extended and retracted by means of a horizontal bar with a sprung rotating handle (referred to as a 'screw wrench' in the Flight Manual) (Item 10, Figure 5.) This bar is mounted on the bulkhead behind the pilot's seat (Figure 6). Rotation of the bar drives the bevel pins outboard to engage with the spigot bearings, thereby reducing any gaps between the wing and fuselage and eliminating unnecessary loading in the

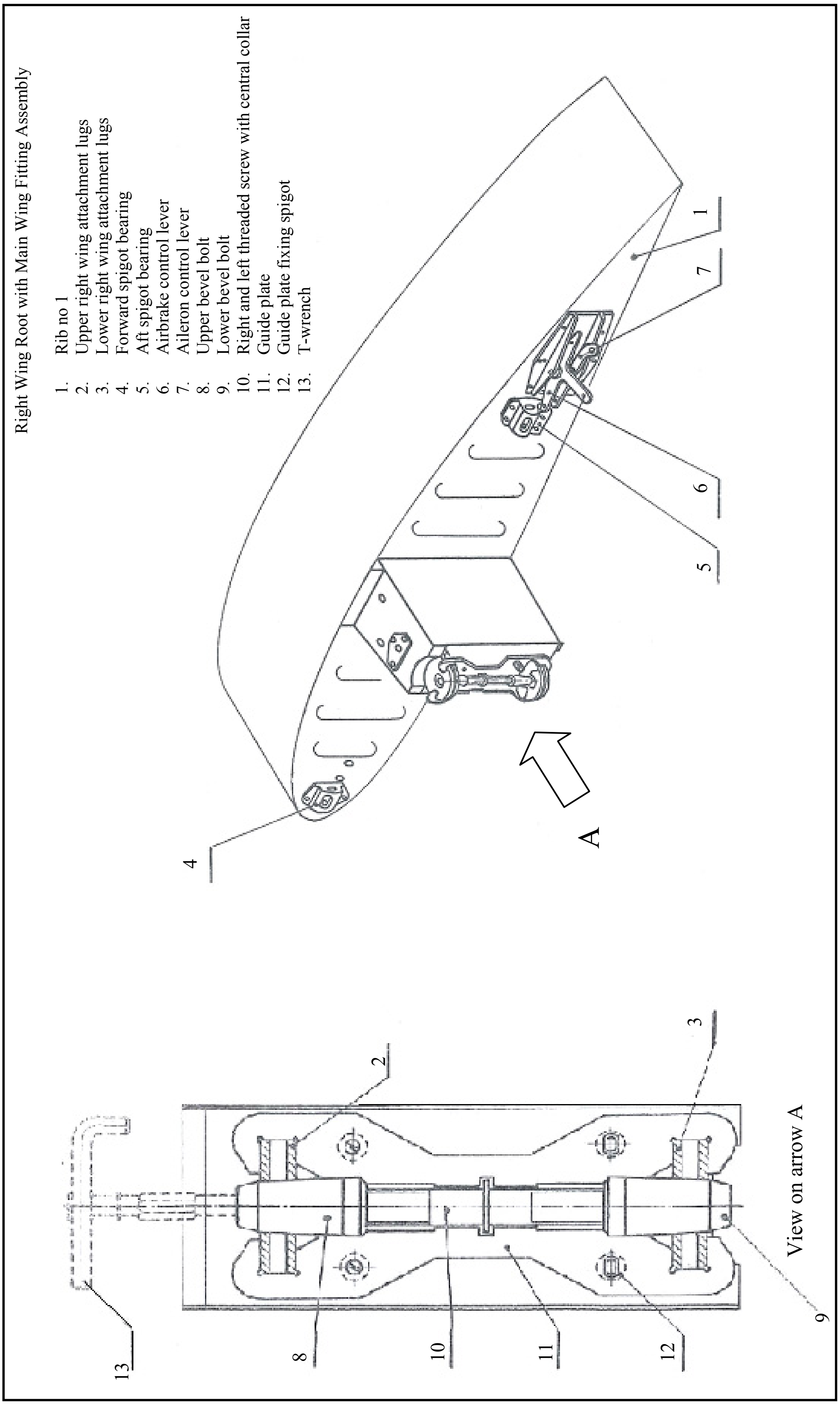

Figure 2

Right wing root with Wing Main Fitting Assembly

Figure: 3 (a)

Wing Main Fitting, bevel bolts fully retracted

Figure: 3(b)

Wing Main Fitting, bevel bolts fully expanded and T-wrench inserted

Figure: 4 (a)

Tapered portion of bevel bolt protruding, indicating upper bevel bolt fully expanded

Figure: 4(b)

T-wrench locked in position

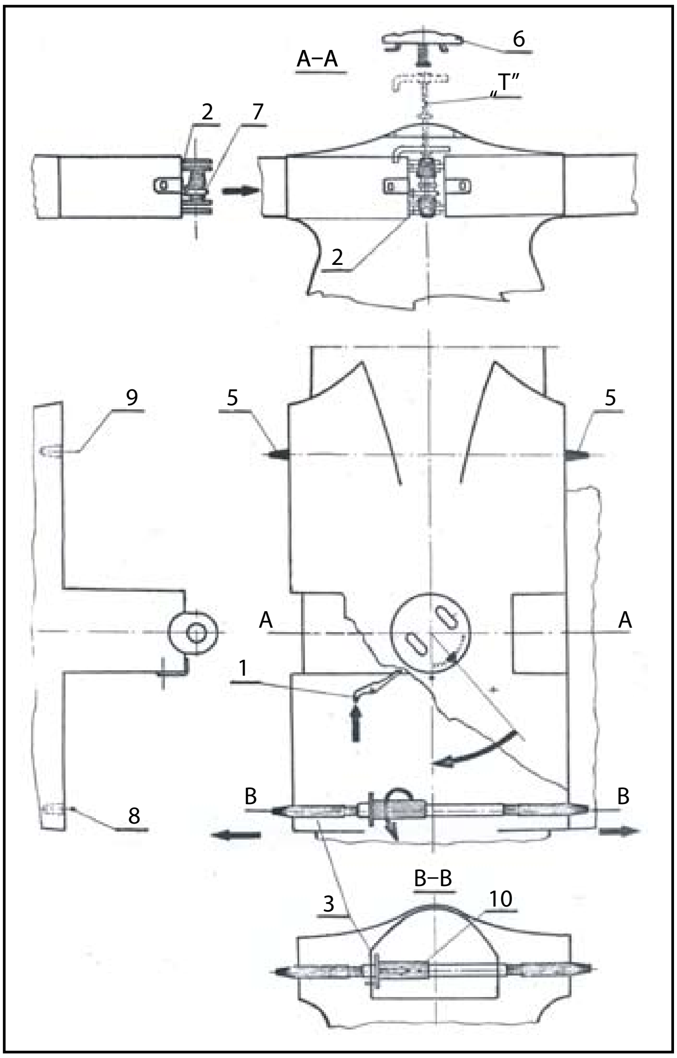

Figure 5

Wing attachment philosphy

Figure: 6

Horizontal bar ('screw wrench') which operates forward bevel pins wing to fuselage joints. Full tightening of the forward bevel pins can be facilitated by oscillating the wingtips forward and aft. A securing spigot engages a locking disc mounted on the rotating handle to lock the forward bevel pins in position (Figure 6).

The Aircraft Flight Manual (AFM)

The Aircraft Flight Manual contains the information and limitations for the operation of the glider. Section 7, '*Assembling and Disassembling',* explains the rigging/de-rigging of the glider and is broken down into a number of sub-sections.

Paragraph 7.1, '*Wing assembling',* provides a technical description of the assembly of the wings to the fuselage. It refers to numbered components shown on an engineering drawing and explains how the various components fit together, as well as what actions are needed to operate the assembly mechanisms. It does not contain any specific sequence of assembly, cautions or methods of assuring proper alignment of the attachment lugs for the bevel bolts. This information is provided two pages later in Paragraph 7.8.

Paragraphs 7.2 to 7.7, cover '*Horizontal tailplane fitting', 'Tools', 'Auxiliary items', 'Assembly team', 'Assembly time' and 'Disassembly time'* respectively.

Paragraph 7.8, '*Assembly sequence*', provides detailed instructions for attaching the wings to the fuselage and the relevant extract is set out below:

'1. Open the canopy and inspection panels on fuselage top, remove the top covering, remove tail cup.

2. Clean and cover with technical Vaseline all working surfaces of fittings, bolts, pins, seats and of control drive joints.

3. Unlock the screw handle of the front bevel bolts in the fuselage /3 fig. 9 /[refer to Item 3, Figure 5]*, and pull the bolts together by turning the screw handle in the right direction till stop /looking from left wing half/ i.e. in direction opposite to marked arrow.*

4. Pull together the bevel bolts in the fitting of spar root of right wing half by turning with "T" wrench in left direction till stop, i.e. in direction opposite to marked arrow. Remove "T" wrench from the fitting.

5. Insert any wing half into fuselage and attach provisionally the spar root by means of lock 1/ fig. 9/ [refer to Item 1, Figure 5]*, which is accessible from upper luggage compartment. Insert in the same way the other wing half.*

6. Align accurately fitting holes by means of duralumin "L" wrench. Insert "T" wrench /fig. 9/ [refer to Figure 5] *and put apart the bevel bolts. Turning of the wrench to the right, in accordance with marked arrow. Obtain full tightening of bevel bolts by unloading the wing tips and performing small oscillations. Check the play /if any/ by finger pressing to the upper bevel bolt. After full tightening of bolts set*

> *the "T" wrench so as to insert the end of bent handle into hole in the fitting. Put the upper inspection disc and set it according to red marks.*
>
> *Caution:*
>
> *The "T" wrench is to be handled by hand only not by tools! The operation is facilitated by hand holding the wrench flange with left hand. Full pushing apart of the bevel bolts requires ca.40 of half-rotations.*
>
> *7. Unlock the screw handle of front bevel bolts in the fuselage and take bolts apart by turning of handle to the left /looking from the left wing half/ i.e. in direction indicated by arrow. Full tightening may be facilitated by horizontal loading of wing tips in rearward direction /hold on the fuselage/. Secure the handle. Check the play of the connection by observing a gap between fuselage and wing when the wing tips are loaded horizontally.*
>
> *Caution:*
>
> *The handle is to be operated by hand only, without any tools!*
>
> *Overstressing of handle causes shearing-of of safety pin. A new safety pin is to be made from soft steel wire Ǿ 2 mm /steel SP 1A/.'*

Recorded data

An 'EW microRecorder' unit was recovered from the accident site. The unit was designed to automatically start and stop recordings depending on speed and altitude changes. The start criteria were such that the ground run of a takeoff would be captured. The trigger to stop the recording was if the altitude and speed did not vary by more than 50 m or 5 km/hr, respectively, in the last 90 minutes.

The recorder captured the complete flight prior to the accident flight. The recording stopped 19 minutes after landing, indicating that the unit was manually switched off rather than automatically stopped. The technology is such that had the unit been switched back on, appropriate date/time stamped data would have been present in the memory of the unit even if power had subsequently been lost. There was no such data relating to the accident flight, indicating that the unit had not been switched on before the accident flight.

Accident site and wreckage examination

Wings

Examination of the wreckage showed that wings had become detached in flight and had fallen separately from the fuselage, coming to rest inverted to the right of Runway 36.

The wings (Figure 7), which were still attached to each other, were largely intact except for a 2.15 m section of the left wing inboard trailing edge, which had detached on impact with the ground. Examination of the wing root fitting in the as-found inverted position, revealed that the lower bevel bolt was only partially engaged in the lower right wing attachment lugs and the lower left wing attachment lug was disengaged from the lug stack (Figures 8a and 8b).

After turning the wings over into their correct orientation, examination revealed that although the upper attachment lugs of the right wing had splayed apart, the wings had remained connected by the upper lug stack and bevel bolt. The T-wrench was still installed in the internal

Figure 7

G-DBZZ Wing assembly (inverted)

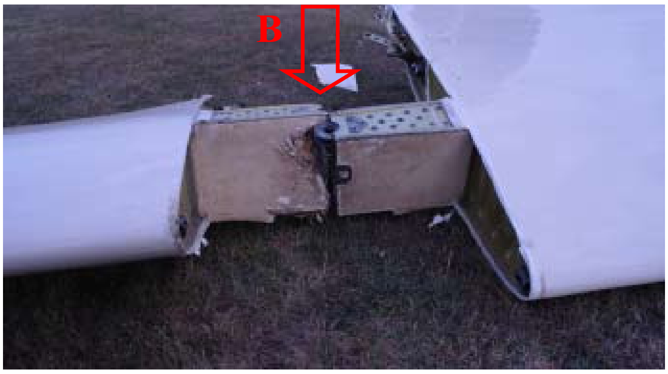

Figure 8 (a)

View on Arrow A from Figure 7

Figure 8 (b)

View on Arrow B from Figure 8 (a)

diameter of the threaded screw and locked in position (Figure 9). Both the T-wrench and the threaded screw of the wing main fitting were distorted where they passed through the upper bevel bolt and lug stack.

It was noted that the upper and lower bevel bolts had not expanded symmetrically along the threaded screw and the central collar of the threaded screw had been dislodged from the cut-out in the guide plates.

Figure 9
Wing main fitting in correct orientation

The self-aligning spigot bearings on the left and right wing root ribs were examined. All displayed evidence of fresh damage around the edges of the bearing housing, consistent with the bevel pins being dislodged from their seats under considerable load. This indicates that the bevel pins were engaged at the time the wing separated from the fuselage.

Fuselage

The fuselage struck the ground inverted and at high speed, approximately 160 m forward of the wings, in the direction of the launch. The fuselage structure forward of the wing was severely disrupted in the impact. The tail section remained attached until ground impact. It was found adjacent to the fuselage, remaining connected via the elevator and rudder cables. The fuselage wreckage was oriented on an approximate heading of 349º. The front skid from the underside of the fuselage was firmly embedded in the in the ground. These facts, together with the absence of any ground marks leading up to the wreckage, indicate a near vertical impact.

The rear fixed bevel pins had remained attached to the fuselage structure, and were protruding approximately 16 mm. The forward bevel pins on the rotating horizontal bar were also intact and were protruding 17 mm. The rotating bar was bent, and the securing spigot was not engaged in the locking disc. A small witness mark was evident where the spigot had contacted the face of the locking disc. The wooden bulkhead on which the rotating bar was mounted was largely intact; however, the surrounding fuselage structure had been disrupted.

The winch cable

The winch cable, drogue and associated linkages were located approximately 40 m forward, and to the left of the location of the wings. All components in the winch cable arrangement were intact and in good condition. A Tost No 4 blue weak link and a Tost No 1 black weak link were found to be connected in series, between the launch strop which attached to the aircraft and the cable parachute, by means of a quick release hook and ring.

The wreckage was removed the following day for detailed examination at the AAIB's facility in Farnborough.

Detailed examination of wing main fitting

Detailed examination of the wing main fitting using Computed Tomography (CT) images, determined that there was no damage to the threads of the threaded screw or bevel bolts, which may have prevented symmetrical expansion of the bevel bolts.

A specialist company, under the supervision of the AAIB, conducted a detailed metallurgical examination of the wing main fitting, the fractured portion of the lower bevel bolt, the wing attachment lugs and the guide plates.

Bevel Bolt Fracture Surfaces

The fractured portion of the lower bevel bolt was approximately 8 mm in length and was observed to be elliptical in shape, having been deformed during the failure. It exhibited a fracture surface on one face and a machined finish on the other indicating that it was the 8 mm tapered lead-in at the bottom of the bolt which had been fractured.

Detailed examination of the fracture surface by a Scanning Electron Microscope (SEM) showed that the majority of the fracture surface exhibited shear dimples, indicating a failure in shear. Some mechanical damage was also evident and was most likely the result of contact with the lugs or contact between the opposing fracture surfaces during the failure. Both the shear dimples and mechanical damage indicated that the direction of failure was across the minor diameter of the ellipse.

It was noted that the inner diameter of the sheared section exhibited an area of mechanical damage (Figure 10), which is consistent with contact with the end of the T-wrench during the failure of the bevel bolt.

The fracture surface of the lower bevel bolt (Figure 11) was found to be positioned flush with the top face of the bottom lug in the lower right wing lug stack. In this position, the left wing lower lug could not have disengaged, therefore it was concluded that the threaded screw, and hence both bevel bolts, must have moved downwards by approximately 8 mm after the lower left wing lug separated from the lug stack.

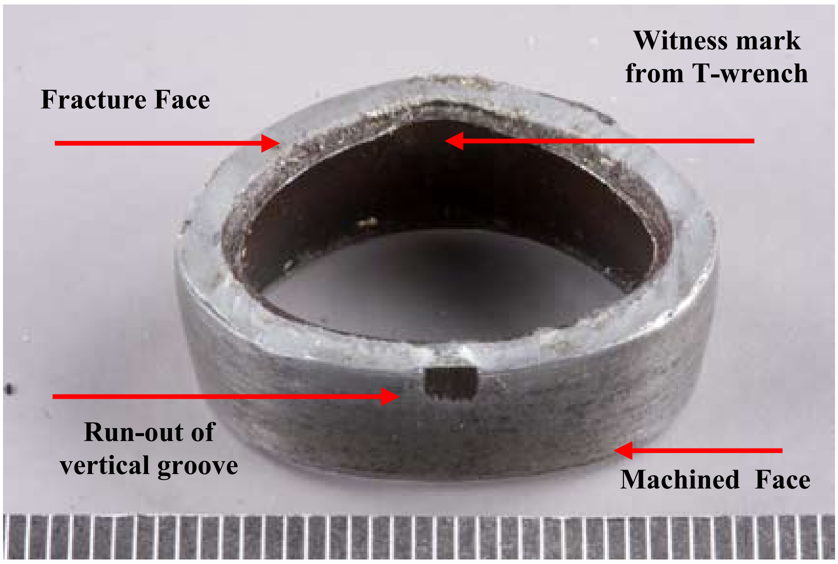

Figure 10

Fractured section of lower bevel bolt

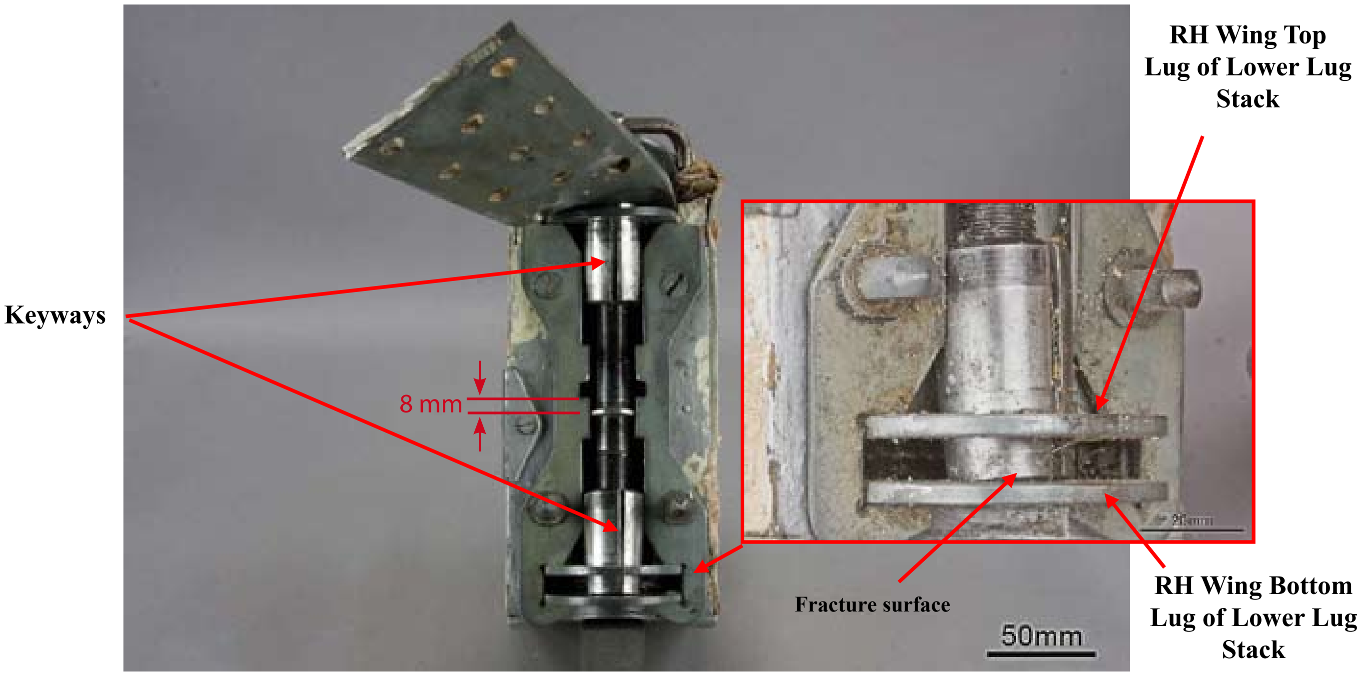

Figure 11

Wing Main Fitting

The central locating collar of the threaded screw was not in its correct position within the guide plate recess. The lower face of the collar was approximately 8 mm below the lower land of the recess. The keyways of both the upper and lower bevel bolts were disengaged from the guide plates (Figure 11). The ends of the bevel bolt keyway (Figure 10) were observed on the sheared portion of the lower bevel bolt at approximately diametrically opposite sides of the minor diameter of the ellipse. It was therefore concluded that the keyway of the lower bevel bolt was not engaged in the guide plates at the time the left lower lug pulled out of the lug stack.

There were 28 threads showing on the upper part of the threaded screw but only 17 threads visible above the lower bevel bolt. This suggests that the lower bevel bolt disengaged from the guide plate approximately 11 turns before the upper bevel bolt disengaged.

Dimensional checks were carried out on the upper bevel bolt and key dimensions are shown on Figure 12. A witness mark on the bolt indicated where it normally came into contact with the upper lug stack. Both bolts are assumed to be identical.

The depth of the keyway on both bolts was measured as 2.3 mm within the cylindrical section, running out to 0.5 mm at the end of the middle taper section. The dimension between the flats of the keyways on the cylindrical section of the bolts was therefore 24.1 mm.

The width between the guide plates was measured between the limits of vertical movement of the upper and lower bevel bolts and noted as varying between 28.1 mm and 29.1 mm in the region of the upper bevel bolt and between 28.9 mm and 28.5 mm in the region of the lower bevel bolt. The guide plate spacing was therefore greater in places than the maximum diameter of the bolts and the distance between the keyways.

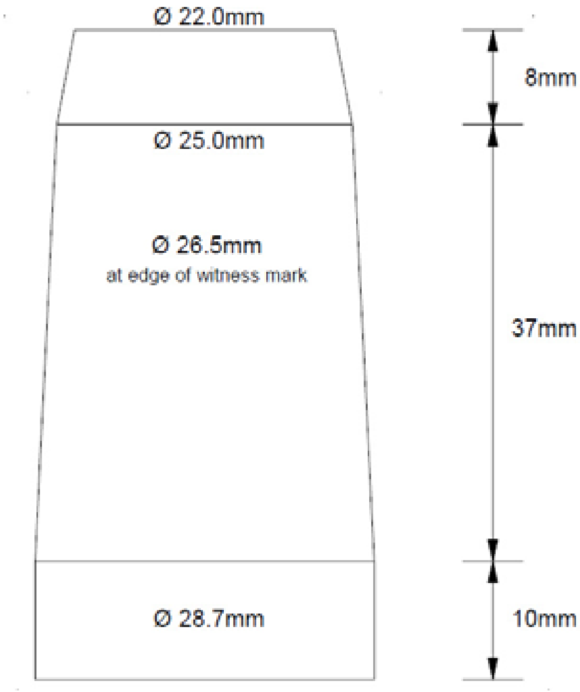

Figure 12

Dimensions of the bevel bolts

The guide plates are secured to the inboard end of the right wing root spar with two screws (upper attachment point) and two locating spigots (lower attachment point.) Spacer washers are used under the guide plate on each fastener. At the upper fastener position the stand-off was measured as 5.1 mm and 4.8 mm for the forward and aft plates respectively; at the central position 6.7 mm (forward) and 5.9 mm (aft); and at the lower fastener position 4.2 mm (forward) and 6.4 mm (aft).

After dismantling the guide plates, it was found that different thickness washers had been used on the lower fasteners of the forward (0.55 mm) and aft plates (1.9 mm) (Figure 13).

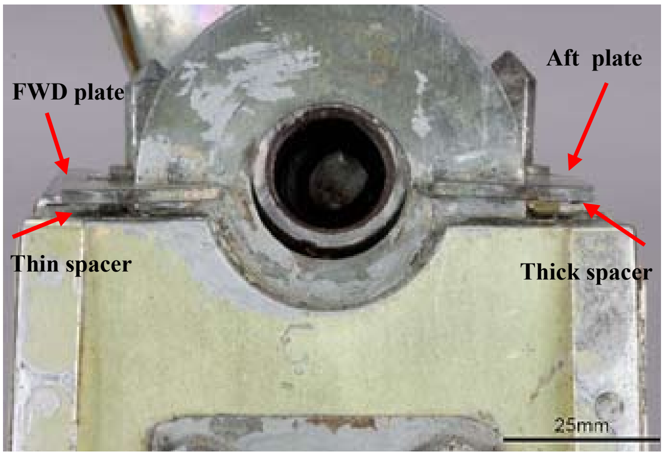

Figure 13

Difference in stand-off between forward and aft guide plates

The wear marks from sliding contact between the bevel bolt keyways and the edges of the forward and aft guide plates were examined. The contact depth appeared to vary from approximately 2.2 mm - 2.4 mm towards the centre of the plates, to 1.2 mm -1 .4 mm at the ends. However, there was very little evidence of a witness mark on the lower end of the back face of the aft guide plate, suggesting minimal engagement of the guide plate with the keyway of the lower bevel bolt. There also appeared to be some edge rounding (Figure 14).

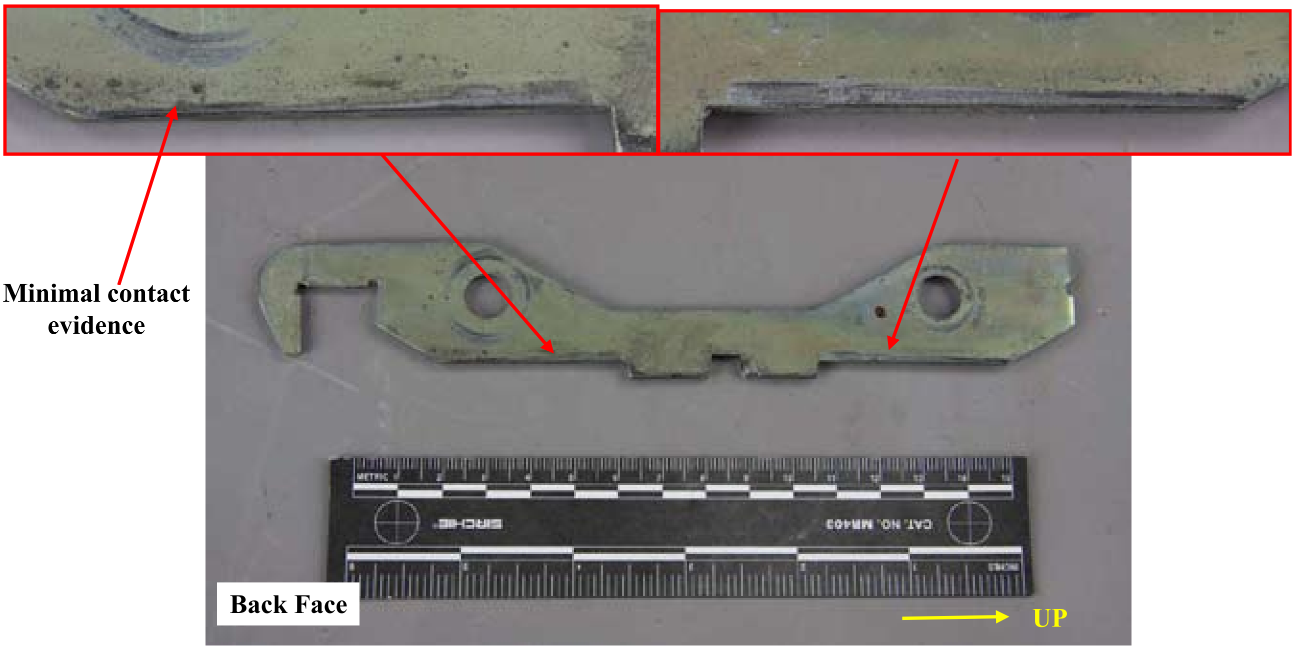

Figure 14

Wear marks on back face of aft guide plate

Damage to guide plate and central collar

Examination of the guide plates showed that mechanical damage was present on the edge of the back face of the forward and aft guide plates over a length of 8 mm from the lower land of the central recess.

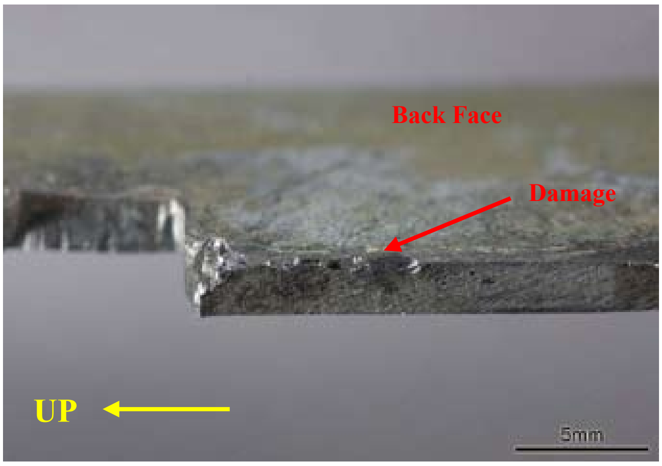

Figure 15

Forward guide plate below recess
(Aft guide plate exhibits similar damage)

This corresponds to the position in which the central collar of the threaded screw was found. However, the first 1 - 2 mm of damage on both forward and aft plates is consistent with rotational movement of the collar (horizontal scoring) rather than vertical movement of the collar. This indicates that the collar had been damaging the lower edge of the guide plate recess on both forward and aft guide plates while the mechanism was being operated (Figure 15).

Mechanical damage was also evident above the guide plate recess. Unlike the damage below the recess, which occurred only on the back face edge, the damage above the recess was evident on both the visible and back face edges for a distance of approximately 5 mm from the upper land of the recess. The mechanical damage resulted in horizontal scoring of the plate, consistent with rubbing against the collar during rotation (Figures 16 and 17). Examination of the collar showed similar horizontal scoring (Figure 18), which is consistent with the collar moving up out of the recess as the T-wrench was turning.

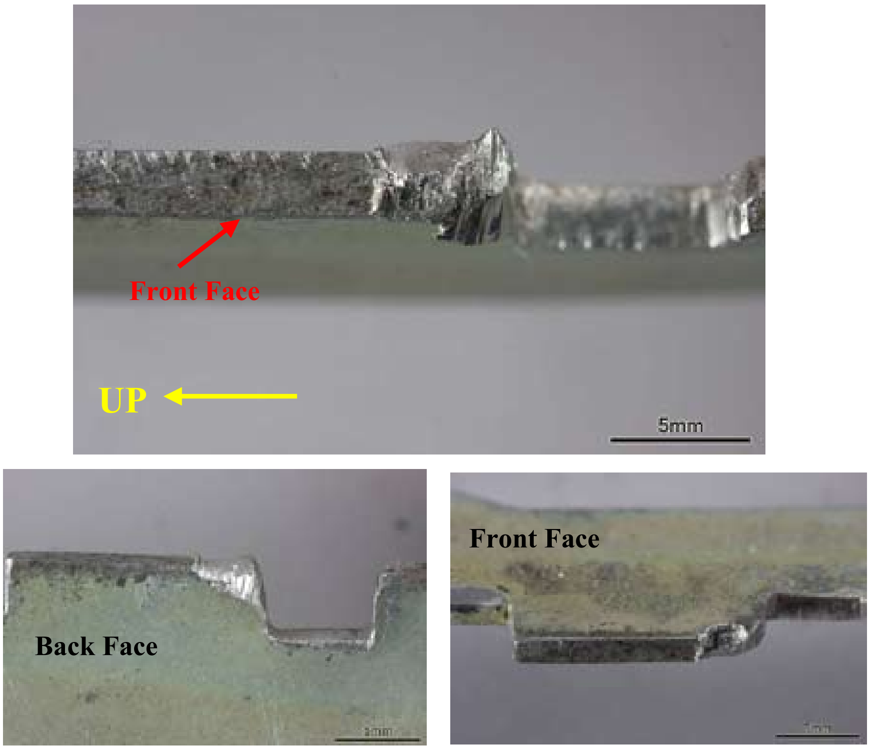

Figure 16

Forward guide plate above recess

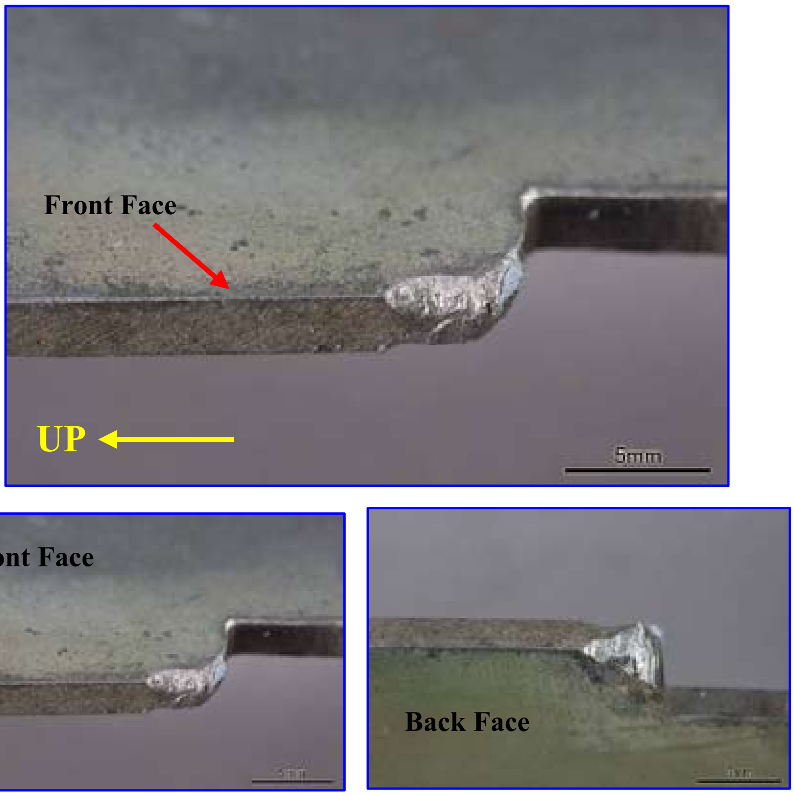

Figure 17

Aft guide plate above recess

Figure 18

Mechanical damage observed on surface of collar

Wing attachment lugs

Damage was observed on the upper surface of the upper right hand lug (Figure 19). The damage was circumferential for a width of approximately 2 mm at the edge of the LH side of the hole.

The left hand (centre) lug exhibited a semi-circular witness mark on the upper surface approximately 6 mm from the right hand edge of the hole (Figure 20) as well as radial scoring from the hole.

The remaining damage observed on the lugs was consistent with scoring damage caused as the bevel bolt sheared and the left hand lug disengaged.

The majority of the damage on the upper and lower right hand lugs was consistent with damage caused as the lower bevel bolt sheared and the left hand lug pulled out of the lug stack. The semi-circular damage on the upper surface of the left hand (centre) lug is consistent with contact with the lower surface of the lower bevel bolt indicating that the bolts were expanded while the left hand lug was not fully aligned in the lug stack.

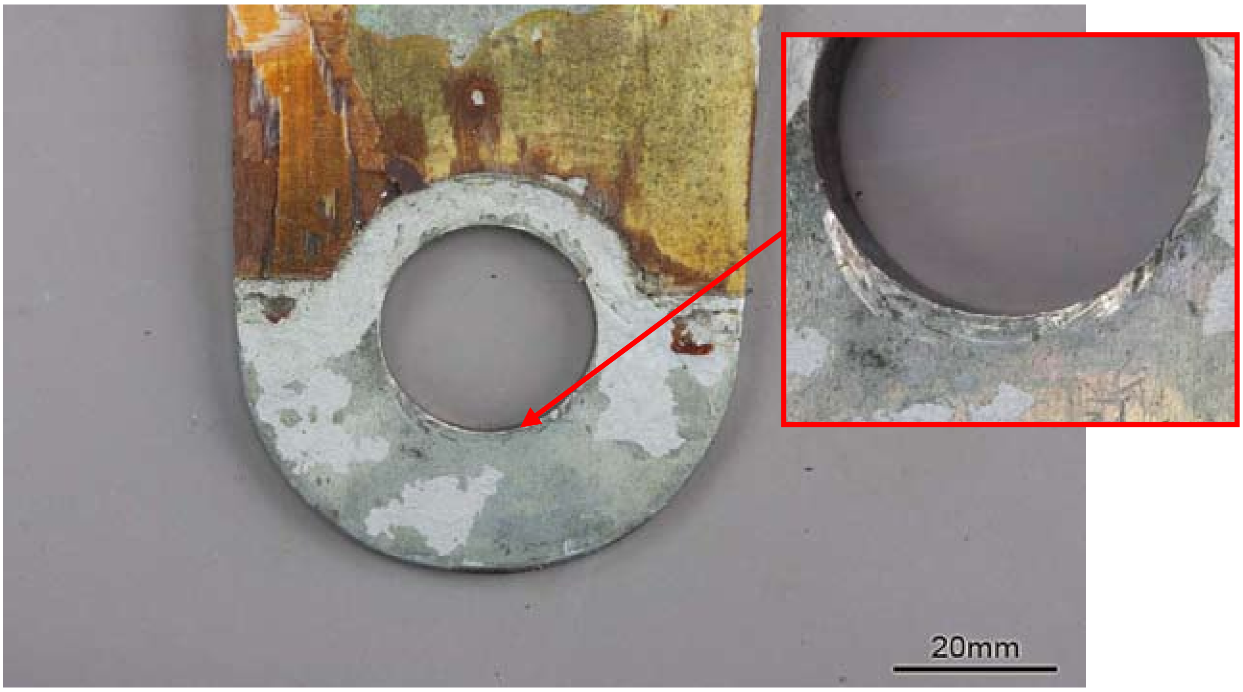

Figure 19

Mechanical damage observed on upper right hand lug

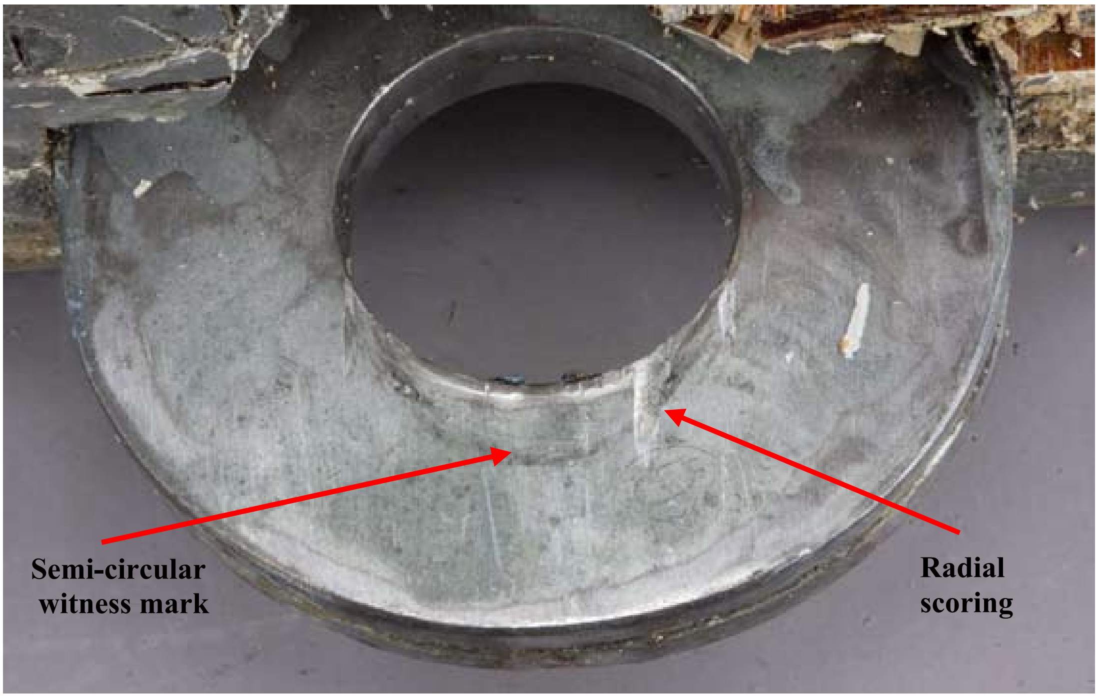

Figure 20

Mechanical damage on upper surface of the left hand (centre) lug

Weak links

Weak links are commonly used in glider winch cable arrangements to prevent structural overloading of the airframe during winch launching. The weak link is designed to fail if an overload situation arises, thus disconnecting the winch cable from the glider. Weak links come in a variety of colours, with each colour being rated to a certain load. For each type of glider a specific colour of weak link is recommended. The recommended weak link for the SZD-24-4A Foka 4 is a blue weak link, which is rated to a load of to 600 deca Newtons (daN) +/- 10%.

The blue weak link recovered from the winch cable used to launch G-DBZZ, when tested, failed at a tensile load of 621.7 daN. A control specimen was also tested and this failed at tensile load of 620.9 daN. These were within the rated load.

A black weak link, rated to 1,000 daN was also found in the G-DBZZ winch cable arrangement. However as both weak links were connected in series, the blue weak link would have failed first.

Rigging tools

The rigging tools recovered from the aircraft's trailer were examined. These included the T-wrench and L-shaped tool described in the AFM. In addition, there was a speed brace and a straight drive. On inspection, the straight drive tool appeared to have been manufactured by welding the straight section of a T-wrench to a hexagonal-drive, such that it could be used in conjunction with a standard speed brace. The Type Certificate holder confirmed that this was not a manufacturer approved tool. This tool and the speed brace had been included with the rigging tools when the owner purchased the aircraft.

Rigging experience

When the owner acquired the aircraft, the previous owner had provided some notes on rigging; these referred to using the speed brace. Consequently, the owner routinely used the speed brace and modified tool to operate the bevel bolts of the wing main fitting. His experience of rigging the aircraft was that considerable care was required to ensure the wing attachment lugs were properly aligned. Little force was required to operate the speed brace on the wing main fitting when the lugs were fully aligned. Upon expanding the bevel bolts, if any resistance was encountered he considered it imperative to stop and wind the bolts back in, before attempting to realign the lugs. The process could then be commenced again, with the appropriate number of turns being counted. Given the limited visibility of the wing main fitting, the primary indicator of whether the rigging was progressing as expected was the mechanical 'feel,' or feedback, through the rigging tool. The owner believed that the T-wrench was to be used only as a locking mechanism to secure the wing main fitting at the end of the rigging process. When he had demonstrated the rigging of the aircraft to the accident pilot, it was in accordance with his normal practice. The owner had anticipated that in the initial stages of the syndicate arrangement they would jointly be rigging the glider. The accident pilot, as a member of the syndicate, was entitled to take the glider to Bicester.

Aircraft service bulletins

Service Bulletin BE-005/75 'Foka 4'

In 1975 the manufacturer issued Service Bulletin (SB) BE-005/75 'Foka 4' – '*Introducing the Annex Nr 1 to Technical Service Manual concerning the extended range of glider periodic inspections'*, which introduced additional maintenance requirements on the basis of in-service experience. This SB included requirements to inspect the wing main fitting for ovalisation of the bevel bolts, non-linearity of the cone-generating line and surface contact between the bevel bolts and attachment lugs. The annex also included instructions on how to remove any observed defects in accordance with the overhaul manual.

Service Bulletin BE-06/4A/80 'Foka 4'

The Foka 4 Service Manual, issued at the time of aircraft manufacture stipulated that the first overhaul was due at 650 hours or within 5 years and indicated that further overhaul periods were to be defined subsequently based on operational experience.

In 1980 the manufacturer published SB BE-06/4A/80 'Foka 4' – '*Changes of repair time periods and further operation'*. As a result of prolonged observation, technical inspections and the results of a wing fatigue test on Foka 4 aircraft, new overhaul periods were introduced at 1,300 hrs and 1,900 hrs. These replaced the previous overhaul periods described in the Service Manual.

This SB required that SB BE-005/75 be carried out and in addition that the wing main fitting and spar root was inspected for the presence of cracks. The SB indicated that a further extension to the life of the glider would have to be endorsed by the Type Certificate Holder and the 'authority' based on the results of the inspection. The SB also introduced certain operational limitations for gliders with more than 1,900 hrs.

Aircraft maintenance history

G-DBZZ, serial number W-308 was manufactured in 1966, and transferred onto the British register in 1967. The aircraft was acquired by the current owner in July 2007, at which point it had accumulated 1,913 flight hours and 1,353 launches. One flight was undertaken in October 2007, and after that the aircraft was not flown until it was transitioned to a non-expiring EASA Certificate of Airworthiness in June 2008. The work required to complete the transition was carried out by the owner who was an approved British Gliding Association (BGA) Inspector. At the time the aircraft was transitioned the owner could not find any information relating to the life of the glider, and assumed it to be 12,000 hrs, which is a standard life for wooden gliders.

The subsequent Airworthiness Review Certificate (ARC) renewal was carried out in August 2009, by which time the aircraft had 1,924 hrs and 1,373 launches. In the intervening period the owner had become aware of the requirement for a Life Extension inspection to be carried out at 1,900 hrs, in accordance with SBs BE-064A/80 and BE-005/75. As the aircraft had already passed 1,900 hrs, the owner grounded the aircraft until the inspection could be completed. The necessary work was carried out coincident with the ARC renewal. Negligible ovalisation of the bevel bolts and lugs was noted and the contact between the bolts and lugs was within the limits quoted in the SB. All the components of the wing main fitting were observed to be in good condition. Following the inspection, the wing main fitting was reassembled and mounted on the wing in accordance with the instructions in the SB.

The next ARC renewal was carried out on 2 August 2010, by which time the aircraft had accumulated 1,940 hours and 1,390 launches. This included a visual inspection of the main spar joint. No findings were noted.

Examination of other similar aircraft

Another Foka 4 glider was examined and rigged in the course of the investigation and a number of observations were made.

When the bevel bolts of the wing main fitting were fully retracted there were no threads visible in the upper section of the threaded screw however five threads were visible on the lower portion.

It took approximately 62 half turns of the T-wrench to achieve full expansion of the bevel bolts rather than the 40 half turns quoted in the flight manual. With the bolts fully expanded, there were 30 threads visible below the upper bevel bolt and 37 threads visible above the lower bevel bolt. The upper and lower bevel bolts protruded from the lug stack by 12 mm and 13.5 mm respectively.

Additionally, it was noted that the aircraft had been modified to incorporate an access hole, which would allow inspection of the position of the lower bevel bolt with a torch and inspection mirror. This enables positive identification that the lower bevel bolt is fully engaged in the lug stack during rigging.

Previous accidents

In March 2007 an SZD-36-A 'Cobra' aircraft, registration N6SZ, crashed in the USA after in-flight separation of the wings from the fuselage, fatally injuring the pilot. The Cobra employs the same wing rigging philosophy as the Foka 4, albeit with some dimensional differences of the key components. As with G-DBZZ, misalignment of the lower attachment lugs during rigging prevented full expansion of the lower bevel bolt.

The US National Transportation Safety Board (NTSB) conducted an investigation into the circumstances of the accident (NTSB reference ATL07LA066 refers). The probable cause was cited as:

> *'The pilot's improper installation of the left wing attachment pin, which allowed it to disengage during cruise flight, resulting in wing separation.'*

There were no safety recommendations resulting from the investigation.

This accident prompted the owner of a UK registered Cobra to inspect his aircraft, and his findings led to the BGA issuing an awareness item on their Technical News Sheet (reference 02/2007), advising owners of Foka and Cobra gliders that damage incurred during rigging could cause failure of the wing main fitting. A possible cause was noted as holding the wings too high during rigging.

In June 1968 an SHK 1 glider, registration BGA 1390 crashed, fatally injuring the pilot, at Doncaster Aerodrome, UK. During rigging the bevel bolts jammed against the lugs of the opposite wing due to misalignment; this was at less than the requisite number of turns on the operating mechanism. The wings separated from the fuselage during the subsequent winch launch.

Analysis

General

From the aircraft examination and the detailed metallurgical investigation, it is apparent that the lower bevel bolt of the wing main fitting had not fully engaged with the lower lug stack during rigging. This significantly reduced the load-carrying capability of the joint. As a consequence, when the glider became airborne the partially secured joint was unable to sustain the wing bending moments associated with the winch launch and the lower bevel bolt failed in shear. This allowed the lower attachment lugs to separate and the wings to fold upwards and detach from the fuselage.

Rigging of the aircraft

In order to fully expand the bevel bolts of the wing main fitting it is imperative that correct alignment between the attachment lugs of the left and right wings is achieved, and that the T-wrench is operated for the required number of turns. Correct alignment of the upper attachment lugs is facilitated by using the L-wrench tool and can be verified visually, however alignment of the lower lugs cannot. If the wings' tips are held too high or if the wing is trestled too close to the root, this may cause the lower lugs to be misaligned. Misalignment of the lugs may therefore only become apparent when the bevel bolts are being expanded. Therefore, when operating the T-wrench to expand the bevel bolts, it may be necessary to unload the wingtips and perform small oscillations to progressively achieve correct alignment.

If the lugs are not correctly aligned it is possible for the expanding bolts to foul against the left wing (centre) lug and not expand fully into the lug stack. The primary indications of any such misalignment would be resistance encountered while operating the T-wrench, in particular if the T-wrench stopped rotating prior to the requisite number of turns.

Incorrect tooling

When operating the approved T-wrench, using only hand force, any resistance is likely to be immediately evident. The flight manual emphasises the importance of using only hand force to turn the T-wrench. The required number of turns is quoted in half turns, because articulation of the wrist is limited to a half turn at a time. The effect of using the speed brace with the modified tool was that the tactile feedback would have been reduced. Additionally, because of its cranked shape, the speed brace would have provided significant mechanical advantage when turning the bevel bolts and it would have been much easier to overcome any resistance encountered using, what would seem to the operator, as a very light force.

The precise history of the modified rigging tool and speed brace are unknown, however they were provided with the aircraft and routinely used to operate the wing main fitting. This suggests that many successful riggings had previously been performed using these tools.

Experience of individuals

The rigging team was not experienced in rigging this particular type of glider nor gliders with a similar rigging philosophy. The accident pilot had observed the aircraft being rigged by the owner, but the extent to which the pilot participated in this rigging is not clear. During this demonstration the owner used the speed brace and modified tool to expand the bevel bolt and used the T-wrench only as a locking tool. The pilot is therefore likely to have considered this to be the correct rigging method.

The owner's experience of rigging the aircraft was that care was required to ensure the wings were correctly aligned and that the rigging process should be stopped immediately if any resistance was encountered. It is not clear if, or to what extent, this experience was communicated during the rigging demonstration.

Despite having previously read the flight manual, the accident pilot experienced some difficulty in locating the correct rigging information within the manual on the morning of the accident. However, when the information was correctly located, the instructions (with the exception of the rigging tool) were followed. The rigging team did not have any experience base for what was 'normal' for this aircraft or what potential rigging issues may be encountered. In particular, the person operating the speed brace had not participated in the previous rigging and therefore would not have had any 'feel' for what might be considered a normal amount of resistance and / or force required to operate the tool.

Although the pilot attempted to call the owner to verify that the aircraft had been rigged correctly, the main concern was relating to the operation of the rotating bar that adjusted the forward bevel pins rather than the main fitting itself. By the time the pilot established contact with the owner, the first circuit had already been completed and although the rigging was briefly discussed, the pilot was by that time somewhat preoccupied by the fact that the canopy had opened and this became the focus of the conversation.

Interpretation of flight manual

While translation of the flight manual from Polish into English has resulted in the manual being difficult to read in places, all the information necessary to rig the aircraft is largely present. The manual is however laid out in such a way that the information on 'Wing assembly' and 'Assembly sequence' is split between two different sections and this evidently caused some confusion during the rigging. The manual is however emphatic about the use of hand force only to operate the T-wrench.

No specific guidance is given on how to verify full expansion of the bevel bolts other than the statement '*Check the play if any by finger pressing to the upper bevel bolt'*. Additionally the manual contains no reference to the fact that it is possible for the upper bolt and lug stack to appear correctly assembled while the lower joint is not.

Observations made during the rigging of another Foka 4, which required 62 half turns of the T-wrench to achieve full expansion of the bevel bolts, would suggest that the figure of 40 half turns quoted in the flight manual can be considered an approximate figure only. It is likely that some variation can be expected between individual aircraft to account for manufacturing tolerances, age and wear in the lugs. However, in the case of G-DBZZ, the rigging team carefully counted 40 half turns and when it became apparent that the tool was still rotating, added a few additional turns until it stopped. The fact that the required number of turns had been accomplished would have given them confidence that the spar joint was correctly assembled.

Sequence of events

Witness marks on the lower lug stack indicate that the expansion of the bevel bolts was performed while the lower left hand (centre) lug was not correctly aligned in the lower lug stack. The lower bevel bolt contacted the upper surface of the left (centre) lug in the lower stack which stopped it from moving further down into the lower stack.

The resistance encountered by the lower bevel bolt under continued rotation of the rigging tool caused the wing main fitting assembly to be pushed upwards. This caused the central collar of the threaded screw to disengage from the guide plate cut-out and move upwards past the upper land of the recess, leading to the mechanical damage that was observed on the edges of the guide plate. The rotational scoring in this area and on the collar indicates that the rigging tool was being operated when this damage was caused.

As the collar had moved out of the recess, this is likely to have forced the guide plates slightly apart allowing the lower bevel bolt keyways to disengage from the guide plates. It is not clear whether the difference in stand-off between the forward and aft guide plates, due to the thicker spacer washer at the lower fastener position and / or the reduced contact noted between the aft guide plate and lower bevel bolt keyway, may also have been contributing factors to this.

With the central collar out of the recess, the bevel bolts would no longer have expanded symmetrically. With one or both bolts disengaged from the guide plate, the bolts would have turned with the threaded screw rather than travel along it.

The relative positions of the bolts on the threaded screw indicated that both bolts did not disengage from guide plates at the same time. The lower bolt disengaged approximately 11 turns prior to the upper bolt. It is only possible to give an approximate indication as it is not known whether any threads were visible when both bolts were fully retracted. The upper bolt would therefore have continued to travel along the threaded screw for some time, and this may explain why the upper bolt would have appeared to be correctly located.

As rotational scoring was present above the recess on both the front and back faces of the guide plates, it is considered possible that the direction in which the rigging tool was being turned was reversed (ie in an attempt to retract the bolts) which could have caused the collar to damage the opposite face of the plate.

At the time of failure, the bottom of the lower bevel bolt was flush with the upper surface of the lower right lug. As the lower bevel bolt is considered to have fouled initially on the upper surface of the left lug, there must have been some re-alignment of the lugs to allow the lower bevel bolt to move through the left lug into its final failure position.

When found after the accident, the fractured end of the bevel bolt was flush with the upper surface of the lower right hand lug. Therefore, it is evident that the whole wing main fitting assembly moved downwards by approximately 8 mm during the wing separation sequence and / or impact with the ground.

Failure of the joint

As a minimum, the lower 8 mm lead-in taper of the bevel bolt should protrude from the lug stack when correctly assembled. Given the position of the bolt in the lug stack when it failed, it can be concluded that the lower bevel bolt was at least 12 mm short of its intended position. It is also considered that the upper bolt was not in its fully expanded position. As neither bevel bolt was in the correct position, the diameter of the bevel bolts would have been smaller than the diameter of the lugs, so there would have been some play in the wing main fitting. The lower bevel bolt failed in single shear. If correctly assembled, it should have resisted the wing root bending loads in double shear. Because of the tapered profile of the bevel bolt the wall thickness at the point of failure was less than it would have been if the bolt had been fully inserted. The lower joint, in this condition, had less than half the normal shear strength of a correctly assembled joint.

The lower joint resisted the wing bending loads during the first launch and circuit, which indicates that the loads experienced during first launch must have been within capability of the compromised joint. However, it is not possible to say what, if any damage to the fitting was caused during this launch. The second launch, at the pilot's request, was faster and therefore increased wing bending loads would have been encountered which exceeded the capability of the compromised joint.

Identification of correct rigging

The design of the wing main fitting is such that correct assembly can only be checked by visual inspection of the top joint. It is not possible to verify correct assembly of the lower joint, neither visually nor by feel; rather this must be assumed by reference to the top joint.

The upper bevel bolt was installed to the satisfaction of the rigging team. It is evident however from this accident, and by reference to previous similar accidents, that misalignment during rigging can cause the lower bevel bolt to jam, while the upper bevel bolt provides a false indication of correct assembly.

Although the wing main fitting was damaged during rigging due to improper alignment of the lower lugs and use of a non-approved tool, this accident may have been prevented had there been a means of positively and independently verifying the correct assembly of the lower joint. Examination of another Foka 4 aircraft revealed that it had been modified by the addition of an access hole below the position of the lower bevel bolt in order to do this.

The following Safety Recommendations are therefore made to EASA:

Safety Recommendation 2011-003

It is recommended that the European Aviation Safety Agency require that the Type Certificate holder of the Foka 4 introduce a means of determining that the lower bevel bolt is fully engaged in the lower lug stack during rigging.

Safety Recommendation 2011-004

It is recommended that the European Aviation Safety Agency require that the Type Certificate holders of aircraft with a similar wing attachment philosophy to the Foka 4 ensure that there is a means of determining that both the bevel bolts are fully engaged in the lug stack during rigging.

Safety action

As a result of the preliminary findings of this investigation the BGA issued a Safety Alert on

2 September 2010 to raise awareness of potential rigging issues among owners of aircraft with a similar rigging mechanism to the SZD-24-4A Foka 4. Those aircraft include, but are not limited to, the SZD Cobra, Bocian and Jaskolka together with the Schempp-Hirth SHK, Austria Series. The Safety Alert reiterated the importance of following the Flight Manual guidance and only using approved tools. The alert also advised that if any resistance was experienced during expansion of the wing main fitting, then the rigging should be stopped immediately in order to establish the reason for the resistance.

ACCIDENT

Aircraft Type and Registration:	Thruster T600N 450, G-PSUK
No & Type of Engines:	1 Jabiru Aircraft PTY 2200A piston engine
Year of Manufacture:	2004
Date & Time (UTC):	22 February 2011 at 1200 hrs
Location:	Balado Park Airfield, Kinross
Type of Flight:	Training
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Damage to nosewheel, pod and tail
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	58 years
Commander's Flying Experience:	510 hours (of which 42 were on type) Last 90 days - 14 hours Last 28 days - 7 hours
Information Source:	Aircraft Accident Report Form submitted by the commander

The commander was teaching circuits to the co-pilot, who was an experienced flex-wing microlight pilot. Following two well-flown circuits, the co-pilot landed the aircraft and back-tracked Runway 25, in preparation for a further takeoff. The weather conditions were reported as being CAVOK, with no significant wind. The commander reported that, after a takeoff roll of 330 m and with the ASI reading 55 kt, the co-pilot pulled back sharply on the control column, causing the aircraft to unstick and decelerate. The aircraft drifted right of the runway, with the right wing low. The co-pilot reduced power and the aircraft touched down on the right mainwheel, before pitching forward onto its nose and overturning. Both occupants were uninjured and were able to release their four-point harnesses before leaving the aircraft via the cabin doors, without further incident. The commander commented that the single central control column made it difficult to shadow the co-pilot's control movements whilst instructing on this aircraft type.

ACCIDENT

Aircraft Type and Registration:	X'Air 582(1), G-BZLT
No & Type of Engines:	1 Rotax 582/48-2V piston engine
Year of Manufacture:	2000
Date & Time (UTC):	19 March 2011 at 1200 hrs
Location:	Portadown, Northern Ireland
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Front fuselage and nosewheel
Commander's Licence:	National Private Pilot's Licence
Commander's Age:	52 years
Commander's Flying Experience:	83 hours (of which 19 were on type) Last 90 days - 0 hours Last 28 days - 0 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

Whilst in the cruise at 1,000 ft, the engine suddenly stopped. Following a series of engine restarts and subsequent stoppages, the pilot carried out a forced landing into a grass field. During the rollout, the aircraft's nosewheel dug into soft ground. The aircraft tipped forward and came to rest upside down. The pilot and passenger were uninjured and vacated the aircraft unaided. The cause of the engine failure was not identified.

History of the flight

The pilot planned to make a local flight, before returning to a private airfield near Portadown, Northern Ireland. The aircraft had been parked in a hangar since its last flight in December 2010. During the pre-flight inspection, the fuel tank, which contained approximately ten litres of fuel, was uplifted with 20 litres of fuel. The engine was started without incident and as the aircraft had not been flown for several months, the pilot extended his normal period of engine ground running before completing his pre-flight checks, which included a power run. The takeoff appeared normal, and at 1,000 ft, the pilot levelled the aircraft and reduced the engine rpm for the cruise.

Approximately eight minutes later, the engine suddenly stopped. The aircraft was in straight and level flight and the pilot recalled confirming that the fuel selector switch was in the correct position and both engine temperature and pressure indications had been normal.

The pilot trimmed the aircraft for a glide approach before attempting to restart the engine. It restarted almost immediately and the pilot made a shallow 180° turn to position back towards the airfield, which was to the north. The reported wind was from the south at 8 kt. The engine initially operated correctly, responding to throttle commands, but then stopped again. The aircraft was now at about 600 ft. After two further attempts, the engine briefly restarted for about 10 seconds before stopping. Following a further unsuccessful attempt to restart the engine, the pilot looked for an appropriate landing site. The pilot stated that the optimal site was a large grass field directly ahead of the aircraft and, although he would be landing with a tailwind, the field offered the safest possible landing area as there were limited options to the left and right of his track. The touchdown appeared normal, but after approximately 80 m the aircraft entered an area of soft ground where the nosewheel dug into the ground, tipping the aircraft forward until it came to rest inverted. Both the pilot and passenger were wearing full harnesses and exited the aircraft uninjured. The forward fuselage and nose wheel were damaged.

A post-accident examination of the fuel and engine electrical system revealed no signs of blockage or failure, although the fuel tank was found to contain some small particles of debris. However, it could not be determined if the debris had entered the tank following the accident. The pilot advised that he had not carried out a water drain check of the fuel system during his pre-flight inspection.

FORMAL AIRCRAFT ACCIDENT REPORTS ISSUED BY THE AIR ACCIDENTS INVESTIGATION BRANCH

2009

3/2009 Boeing 737-3Q8, G-THOF
on approach to Runway 26
Bournemouth Airport, Hampshire
on 23 September 2007.

Published May 2009.

4/2009 Airbus A319-111, G-EZAC
near Nantes, France
on 15 September 2006.

Published August 2009.

5/2009 BAe 146-200, EI-CZO
at London City Airport
on 20 February 2007.

Published September 2009.

6/2009 Hawker Hurricane Mk XII (IIB), G-HURR
1nm north-west of Shoreham Airport, West Sussex
on 15 September 2007.

Published October 2009.

2010

1/2010 Boeing 777-236ER, G-YMMM
at London Heathrow Airport
on 28 January 2008.

Published February 2010.

2/2010 Beech 200C Super King Air, VQ-TIU
at 1 nm south-east of North Caicos Airport, Turks and Caicos Islands, British West Indies
on 6 February 2007.

Published May 2010.

3/2010 Cessna Citation 500, VP-BGE
2 nm NNE of Biggin Hill Airport
on 30 March 2008.

Published May 2010.

4/2010 Boeing 777-236, G-VIIR
at Robert L Bradshaw Int Airport
St Kitts, West Indies
on 26 September 2009.

Published September 2010.

5/2010 Grob G115E (Tutor), G-BYXR
and Standard Cirrus Glider, G-CKHT
Drayton, Oxfordshire
on 14 June 2009.

Published September 2010.

6/2010 Grob G115E Tutor, G-BYUT
and Grob G115E Tutor, G-BYVN
near Porthcawl, South Wales
on 11 February 2009.

Published November 2010.

7/2010 Aerospatiale (Eurocopter) AS 332L Super Puma, G-PUMI
at Aberdeen Airport, Scotland
on 13 October 2006.

Published November 2010.

8/2010 Cessna 402C, G-EYES and
Rand KR-2, G-BOLZ
near Coventry Airport
on 17 August 2008.

Published December 2010.

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