

ACCIDENT

Aircraft Type and Registration:	Jodel D117A, G-AZII	
No & Type of Engines:	1 Continental Motors Corp C90-14F piston engine	
Year of Manufacture:	1958 (Serial no: 848)	
Date & Time (UTC):	8 April 2019 at 1310 hrs	
Location:	Full Sutton Airfield, York	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Landing gear, lower engine cowl, engine and propeller damaged	
Commander's Licence:	Light Aircraft Pilot's Licence	
Commander's Age:	69 years	
Commander's Flying Experience:	632 hours (of which 235 were on type) Last 90 days - 10 hours Last 28 days - 5 hours	
Information Source:	AAIB Field investigation	

Synopsis

The aircraft landed heavily when the pilot's prosthetic adapter disconnected from the control column late in the approach. The pilot was unhurt.

The pilot has since modified the interface between the prosthetic adapter and the aircraft control column. The UK CAA has amended the medical certification pathway for pilots with musculoskeletal disability to include an engineering assessment of interface between any prosthesis and the aircraft flying controls.

History of the flight

The pilot of G-AZII is a left forearm amputee. G-AZII was operated on a Permit to Fly and had no modifications adapting it for the disability of the pilot. When operating the aircraft, the pilot used his right hand to control the throttle. To operate the ailerons and elevator, a rose jointed adapter, which was secured to the prosthesis on his left arm, was attached by an interference fit to the control column (Figure 1). All other controls were conventional.

The pilot was flying circuits at Full Sutton Airfield using Runway 04, with a wind slightly from the left and steady at 10 kt. On the fourth circuit, the pilot established G-AZII on the final approach and trimmed for 50 KIAS. At about 5 ft above the ground, while the pilot was flaring the aircraft, the prosthetic adapter became disconnected from the control column;

the aircraft reverted to its trimmed shallow nose-down attitude and subsequently struck the ground. The landing gear dug into the ground and folded back under the wings, and the nose of the aircraft pitched down further, damaging the lower engine cowl and the propeller, and shock-loading the engine.



Figure 1
Prosthetic adapter in use

The pilot was uninjured and, after making the aircraft safe, exited without difficulty using the left cockpit door.

Pilot

The pilot is a medical practitioner with extensive experience in the management and prosthetic rehabilitation of people with acquired and congenital limb loss. He had held a flying licence for almost 9 years. He had flown a Jodel D117A for almost 5 years of which he had flown more than 2 years and over 230 hours using the prosthetic adapter.

Prosthetic adapter

The prosthetic adapter was made from a length of carbon fibre/epoxy high strength precision tube, the inner diameter of which provided an interference push-fit on the control column with the handgrip removed. The tube had a high tensile 1/4" bolt with a steel washer bonded into it, attached to an aviation rose joint which threaded into a standard artificial arm wrist rotary adapter.



Figure 2
Prosthetic Attachment

The pilot had drawn upon his experience as a doctor in prosthetic rehabilitation and as a pilot to fabricate the bespoke prosthetic adapter. His approach was to modify the person rather than the aircraft, developing an adapter that would enable him to fly other aircraft of the same type. He aimed to make detachment from the control column simple and intuitive for others, such as rescue personnel, in an emergency. While there was no regulatory engineering assessment of the prosthetic adapter and its interface with the aircraft controls, the pilot had informal discussions with an LAA Inspector. The pilot also assessed the force to disconnect the adapter from the control column exceeded that required to detach the standard hand grip.

Medical assessment

The pilot held a Light Aircraft Pilot's Licence (LAPL) medical certificate with an 'APL' limitation (meaning that the medical certificate was only valid when flying with an approved prosthesis). The re-issue of the LAPL medical certificate required the pilot to undergo a medical examination, and a medical flight test (MFT). The latter is intended to assess the ability of the pilot to operate the aircraft controls fully and safely with the prosthesis, and follows the same profile as a flight test for pilots who do not use prostheses. The CAA document '*Guidance for the certification of pilots with a musculoskeletal disability for upper limb amputees*' states¹:

'Pilots often use a prosthesis which can be clamped to the yoke and in general the prosthesis does not need to be certificated by the CAA, providing that failure of the prosthesis (e.g. falling off the stump) would not result in the pilot losing complete control of the aircraft. This should be considered during any medical flight test or simulator check.'

Footnote

¹ Available at [https://www.caa.co.uk/Aeromedical-Examiners/Medical-standards/Pilots-\(EASA\)/Conditions/Musculoskeletal/Medical-certification-of-pilots-with-a-disability/](https://www.caa.co.uk/Aeromedical-Examiners/Medical-standards/Pilots-(EASA)/Conditions/Musculoskeletal/Medical-certification-of-pilots-with-a-disability/) [accessed October 2019]

The medical examination, conducted by an Aeromedical Examiner (AME), focused on the medical aspects of the amputation, and included an assessment of the prosthesis and its fitting to the limb. The MFT was carried out by a Chief Flying Instructor (CFI) and included discussions about the possibility of disconnection of the adapter and actions to mitigate the consequence of any such occurrence. Typically, this would involve taking hold of the control column with the right hand to enable the pilot to retain control of the aircraft while he re-attached the adapter before resuming normal control. The pilot demonstrated this during the MFT; the CFI noted that the prosthetic adapter was '*solid, well made with no play*'. (Subsequently, the pilot practised regaining control while flying following a disconnection of the adapter from the prosthetic on a regular basis.)

The CAA has since introduced a '*Limb Prosthesis Assessment Form*²', to be completed by an applicant's prosthetist, to assess the suitability of the prosthesis itself.

Support organisations

Light Aircraft Association

The LAA is a representative body for amateur-built and vintage light aircraft, providing airworthiness services under direct delegation from the UK's Civil Aviation Authority. Its network of instructors and inspectors is able to provide guidance to pilots wishing to modify the interface with the aircraft controls.

Specialist organisations

Specialist organisations, such as Aerobility, formerly known as the British Disabled Flying Association, have relevant experience, including in modifying aircraft for pilots with limb amputations.

Analysis

The heavy landing occurred because, when the prosthetic adapter detached from the control column, the pilot was unable to regain control of the aircraft before it hit the ground.

The pilot met the requirements which existed at the time to regain his medical category and be cleared fit and capable to fly.

There was no mechanical connection between the adapter and the control column other than the interference push-fit. Accordingly, the pilot has added a Velcro strip attaching the prosthetic adapter and control column, making the interface more secure but still easy to disconnect in an emergency.

Footnote

² Available at [https://www.caa.co.uk/Aeromedical-Examiners/Medical-standards/Pilots-\(EASA\)/Conditions/Musculoskeletal/Musculoskeletal-guidance-material-GM/](https://www.caa.co.uk/Aeromedical-Examiners/Medical-standards/Pilots-(EASA)/Conditions/Musculoskeletal/Musculoskeletal-guidance-material-GM/) [accessed October 2019]

Medical assessment process

Medical examination of an amputee is carried out by an AME with the requisite medical competence, and the MFT enables the CFI to assess the pilot's ability to control the aircraft using the prosthesis. However, a CFI may not be competent to assess the robustness of the interface between the prosthesis and the aircraft and the *Limb Prosthesis Assessment Form* does not fulfil this role.

In these circumstances the critical interface is that between the prosthesis and the aircraft controls. Currently there is no requirement for an individual with appropriate engineering competence to assess this interface and to consider the forces involved, the robustness of the arrangement, maintenance requirements, security, and ease of disconnection in the event of an emergency.

The CAA stated that it will amend the MFT form to include an engineering assessment of the prosthesis for general use in the aircraft and its interface with the flight controls.

Modifications

The nature of any disability resulting from an amputation is specific to the individual. The pilot's approach was to modify the prosthesis rather than the aircraft, by fabricating a suitable adapter. Accordingly, the adaption was not viewed as a modification to the aircraft. While the adapter gave the pilot the articulation and control required to fly the aircraft, there was no formal assessment by an individual with engineering competence of the magnitude and direction of the forces involved.

An alternative approach would be to consider modification of the aircraft with an adapter that fits the needs of the individual. While limiting the pilot to being able to fly only the adapted aircraft, this approach would have the advantage of engaging existing regulatory oversight of the required modifications.

Conclusion

The aircraft landed heavily when the prosthetic adapter detached from the control column late in the approach and the pilot was unable to regain control before touchdown.

The pilot met the requirements for medical fitness to fly, but there was no engineering assessment by a suitably qualified individual of the interface between the prosthesis and the aircraft controls. The lack of a secondary device securing the prosthetic adapter to the control column meant that its security was solely reliant upon the interference fit.

Safety action

The following Safety Actions have been carried out:

The pilot has added a velcro strip, which attaches to the prosthetic adapter and the control column, providing added security to the interface in the axial plane while retaining ease of disconnection in the event of an emergency.

The Civil Aviation Authority of the United Kingdom has reviewed the medical certification pathway of pilots with a musculoskeletal disability and is amending the Medical Flight Test form to implement a 3-stage process involving:

- an assessment by the prosthetist relating to the manufacture and fitting of the prosthetic with regard to use in general in an aircraft, eg flight control system forces and movements;
- assessment of the prosthetic interface with the aircraft control(s) in an aircraft engineering context by a suitably licenced engineer or inspector;
- the conduct of a general medical flight test by a CFI staff examiner or single pilot aircraft senior examiner, either of whom must be designated by the Authority for this purpose, to:
 - (a) assess the ability of the pilot to fly and control the aircraft through the use of the prosthetic and operate equipment in normal operations and emergencies including ingress/egress from the aircraft and
 - (b) consider how to ensure control of the aircraft is retained in the event of a failure.

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