

SERIOUS INCIDENT

Aircraft Type and Registration:	AW189, G-MCGV	
No & Type of Engines:	2 General Electric Co CT7-2E1 turboshaft engines	
Year of Manufacture:	2017 (Serial no: 92008)	
Date & Time (UTC):	7 January 2022 at 1622 hrs	
Location:	Lydd Airport, Kent	
Type of Flight:	Training	
Persons on Board:	Crew - 4	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Collapsed heating duct, contamination of cockpit and cabin by insulation particles	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	51 years	
Commander's Flying Experience:	5,823 hours (of which 963 were on type) Last 90 days - 79 hours Last 28 days - 14 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

Synopsis

A heating duct failed in flight releasing fragments of duct insulation material into the cabin and cockpit, causing respiratory irritation to the occupants. The aircraft landed safely. Similar heating duct failures had previously occurred in several of the operator's other AW189 aircraft and were investigated by the AAIB (AAIB Bulletin 4/2022 report AAIB-27128 refers). As a result of those failures the aircraft manufacturer had published a service bulletin to inspect and modify the installation of the heating duct and this had been embodied on G-MCGV.

At the time of publication of this report, the aircraft manufacturer has stated its intention to publish a revision to its service bulletin to make the installation of the existing duct configuration more robust, as an interim solution. In parallel, the duct manufacturer is redesigning the heating duct.

The operator has also taken action to replace the heating ducts on those aircraft in its fleet which had not already experienced a duct failure.

History of the flight

Following completion of a SAR training sortie involving winching operations, the cabin and cockpit heating was selected ON for the return transit to the helicopter's base at Lydd.

Approximately 6 nm from Lydd, the rear crew seated in the cabin alerted the flight crew to the presence of ‘fibres floating in the air’ which were causing respiratory irritation. The flight crew selected the heating and ventilation system to OFF and donned PPE face masks, which were carried in the cockpit. Given the proximity to Lydd, the commander elected to expedite the approach and perform a running landing. During the approach the non-flying pilot experienced some mild respiratory irritation, but the commander who was pilot-flying reported that he was not noticeably affected. Upon landing, the cabin doors and storm windows were opened for ventilation and to clear the contamination.

Subsequent examination showed that the aft heating duct had failed, allowing duct insulation material to be drawn into the heating and ventilation system.

Previous events

General

The operator had experienced several previous heating duct failures on its AW189 fleet. Two of these failures, occurring on G-MCGU on 4 March 2021 and G-MCGT on 17 April 2021, were the subject of an AAIB investigation. AAIB report AAIB-27128, published in AAIB Bulletin 4/2022 refers¹.

Previous investigation findings

The failed ducts from G-MCGU and G-MCGT were subject to detailed examination at the aircraft manufacturer’s laboratory which determined that failure occurred due to nonuniform adhesion on the bonding surfaces between the rigid and flexible duct sections. The details are reported in AAIB-27128. The collapse of the duct led to fragments of duct insulation material being discharged through the cabin in cockpit heating vents, causing respiratory irritation to the occupants and, in the case of G-MCGU, the presence of smoke which necessitated an emergency landing.

Previous safety action

On 23 July 2021, the aircraft manufacturer published service bulletin (SB) 189-296 ‘ATA 21 – Heating duct rear avionics bay inspection’ requiring operators to perform a one-off inspection of the heating duct and to modify the duct installation. Any findings made during the inspection were to be notified to the aircraft manufacturer and could result in an instruction to replace the duct. The modified installation involved repositioning an existing ‘P-clamp’ at one of the bonded joints and introducing an additional fixing at another joint. This requirement applied irrespective of whether the duct was replaced following inspection. The compliance instructions required embodiment of the SB within 400 flight hours or 12 months from date of publication, whichever occurred first.

The SB was intended as an interim solution, while the aircraft manufacturer worked with the duct manufacturer to achieve a permanent solution.

Footnote

¹ <https://www.gov.uk/aaib-reports/aaib-investigation-to-leonardo-aw189-g-mcgu> [accessed December 2022].

SB 189-296 was embodied on G-MCGV on 30 October 2021. The inspection did not reveal any findings but the duct fixings were modified in accordance with the SB instructions. G-MCGV subsequently experienced a duct failure on 7 January 2022, 71 flying hours earlier after embodiment of the SB. G-MCGV's heating duct had failed in a similar manner to those from G-MCGU and G-MCGT.

Aircraft information

The AW189 heating and ventilation system is described in AAIB-27128. Figure 1 shows the heating duct.

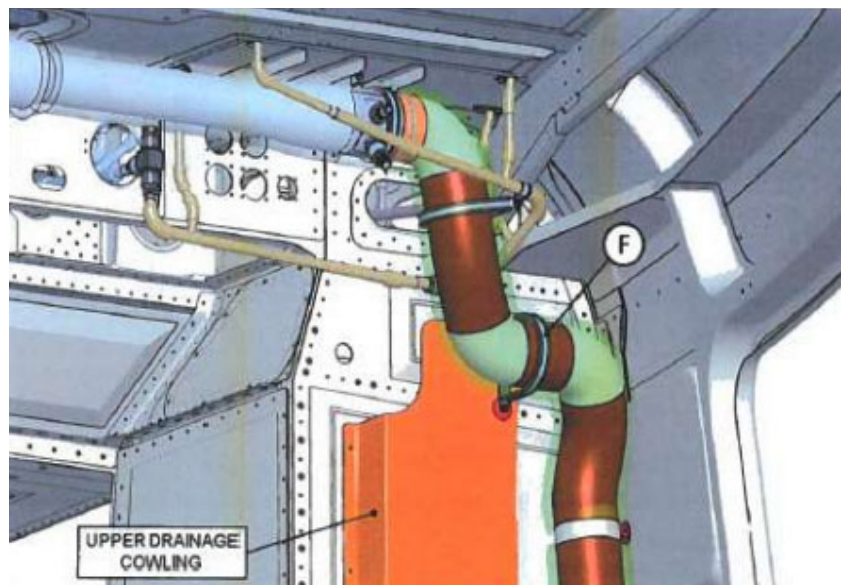


Figure 1

Heating duct on AW189 showing flexible sections in brown and rigid sections in green (Circle 'F' indicates a securing 'P-clamp')

Component examination by duct manufacturer

Following the aircraft manufacturer's laboratory examination of the failed ducts from G-MCGU and G-MCGT, they were sent to the duct manufacturer for further examination along with the failed duct from G-MCGV. The duct manufacturer determined that the relevant manufacturing processes and procedures were followed and the ducts met the applicable drawing specification. It also reviewed the bonding of the duct joints, the manufacturing instructions, the aircraft installation and the qualification test data for the ducts. While recognising that non-uniform adhesion of the bonded joints was evident on the failed ducts, the duct manufacturer considered that it did not mean this was the single causal factor resulting in the failure of the ducts. It indicated that redesign considerations would take account of improving the strength of the bond between the flexible and rigid sections of duct, reducing the number of joints and relocating clamping positions to rigid duct elements, thereby reducing the ability of the duct to creep along the clamp over a number of flight cycles.

The duct manufacturer commented that the same duct type is used on the AW139 and AW169 helicopters and it was qualified for use on the AW189 by similarity with the AW139, without further testing. The duct manufacturer was not aware of any duct failures other than those on AW189s within this operator's fleet. It commented that the air pressure and flow rate through the heating duct were higher on the AW189 than on the AW139/AW169 which may have contributed to failure of the bonded joints on the duct.

Safety actions

Aircraft manufacturer and its suppliers

As a result of the duct failure on G-MCGV, the aircraft manufacturer plans to publish Revision A of SB189-296 in the fourth quarter of 2022, to provide further instructions on the installation of the heating duct. Revision A will require removal of the duct from the aircraft and reinforcement of the duct joints by the application of aramid lacing tape and silicon covered glass cloth tape. It will also require additional fixing points to be added and will introduce a change to the sequence of the duct installation instructions to avoid introducing any pre-load on the duct. The intention is that helicopters already compliant with the original issue of SB 189-296 must also comply with Revision A.

The aircraft manufacturer considers that SB 189-296 Revision A will be an interim solution to make the present duct configuration more robust. In parallel, the heating duct is being redesigned by the duct manufacturer as a long term solution. At the time of publication of this report, the installation drawings for the redesigned duct are undergoing approval and qualification/testing for the new design of duct is planned to take place throughout the remainder of 2022. The aircraft manufacturer intends to issue a separate SB for replacement of the present duct configuration with the new design in 2023.

Operator

Separately, following the duct failure on G-MCGV, in March 2022 the operator issued an internal Technical Directive requiring replacement of the heating duct on the remaining AW189s in its fleet that had not previously had the duct replaced following a duct failure. The ducts will be replaced on applicable aircraft at the next annual inspection and the replacement programme will be complete by January 2023. The aircraft manufacturer requested the removed ducts to be returned to the duct manufacturer so that their condition can be assessed against aircraft operating hours.

Discussion

Following the duct failures on G-MCGU and G-MCGT, reported in AAIB-27128, the aircraft manufacturer issued SB 189-296 to inspect and modify the duct fixings, with the intention of reducing the likelihood of future duct failures, while it worked with its suppliers to achieve a permanent solution. The subsequent duct failure on G-MCGV demonstrated that SB 189-296 did not achieve the intended effect.

The heating duct did not undergo specific qualification testing for use in the AW189 heating and ventilation system, having been qualified by similarity to the AW139. The function and geometry of the duct is similar on all three helicopter types, but on the AW189 the duct experiences higher pressure and flow rates, which likely places increased loading on the bonded joints. To date, all reported duct failures have occurred within one SAR operator's fleet. It is not fully understood why this is the case.

The safety actions currently in progress by the aircraft and duct manufacturers are intended, firstly, to reinforce the strength of the bonded duct joints and improve the installation. It is ultimately intended to introduce a more robust duct design. Qualification testing on the redesigned duct is planned to take place in conditions representative of in-service environmental conditions.

Conclusion

The heating duct on G-MCGV failed despite having been subject to a service bulletin intended to improve the installation of the duct. As a result of this and previous duct failures, the duct is being redesigned to strengthen the bonded joints between the flexible and rigid portions of the duct. In the interim, the aircraft installation of the existing duct configuration will also be modified to improve the routing and restraint of the duct, thereby reducing the loading on the duct joints.