No. 5

British United Air Ferries Ltd., Bristol 170, Series 32, G-AMWA, accident at Guernsey Airport, Channel Islands, on 24 September 1963. Report, dated August 1964, released by the Ministry of Aviation, United Kingdom (C.A.P. 216).

1. Investigation

1.1 History of the flight

The aircraft was returning to Bournemouth from Guernsey on a passenger and vehicle service flight. The co-pilot was flying the aircraft from the left-hand seat, and the pilot-in-command was performing the duties of the co-pilot. The engines were started at 1112 hours GMT. The brakes operated satisfactorily at this time. Following a normal run-up and check of the engines and propellers, the throttles were opened slowly because of a 17 kt crosswind component. The aircraft reached a speed of 50 kt, and the rpm of the port engine began to rise. The pilot-in-command tried to control it by moving back the propeller control lever. The rpm commenced to surge and, as the aircraft's speed was then about 4 kt less than the single-engine safety speed (84 kt), the pilot-in-command ordered the co-pilot to abandon the take-off. According to the testimony of the pilot-in-command following the accident, the brakes had little or no effect, and realizing that the aircraft would overrun the runway, he pulled back both propeller pitch control levers in order to stop the engines. Shortly before reaching the end of the runway the aircraft was turned to the left to avoid the approach lights. The aircraft became airborne for about 33 yd, then passed through the boundary fence of the stopway and struck a bank surmounted by a hedge where its port landing gear collapsed. Thereafter it crossed a hedge-lined road, and the starboard landing gear was deflected rearward. Finally it slid about 60 yd on its belly and stopped near a house. The accident occurred at 1123 hours GMT.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal			
Non-Fatal			
None	3	1	

1.3 Damage to aircraft

The aircraft was extensively damaged.

1.4 Other damage

No damage was sustained by objects other than the aircraft.

1.5 Crew information

The pilot-in-command, age 40, held a current airline transport pilot's licence and an instrument rating. The licence was endorsed in Group I for

Bristol 170 aircraft. He had flown a total of 8 500 hours which included over 7 000 hours as pilot-in-command. His time on the Bristol 170 was as follows: 4 500 hours in command and 500 hours as co-pilot. He was also employed as a training captain on Bristol 170 aircraft.

The co-pilot, age 34, also held a current airline transport pilot's licence and an instrument rating. His licence was endorsed in Group 2 for Bristol 170 aircraft. He had flown a total of about 7 800 hours including 1 600 hours as co-pilot on Bristol 170 aircraft. He had flown many times with the pilot-in-command of the subject flight.

1.6 Aircraft information

The aircraft had a valid Certificate of Airworthiness which did not include a performance group classification. It also had a valid Certificate of Maintenance.

The port engine was installed on this aircraft in October 1962 and had run 1 137 hours since its last complete overhaul. During the months of June and July 1963 the records showed that surging of the port engine was reported on four occasions. On 3 July the air shutter was found to be sticking open. On 5 July the shutter box was removed from the engine during a Check A inspection. The spindles and sprocket bearings were lubricated, and the unit was reinstalled. It then operated satisfactorily.

During a Check I inspection on 16 August the shutter was again sticking open. The shutter and sprocket bearings were lubricated, and no further difficulty with the shutter was recorded.

At the time of the accident the approved maintenance schedule did not require the warm air shutter box bearings to be lubricated between overhauls.

On this flight the aircraft was carrying a payload of one passenger, one car and 1 945 kg of freight. Its total all-up weight was approximately 1 838 kg less than the permitted maximum, and the centre of gravity was within the prescribed limits.

The type of fuel being used on the subject flight was not stated in the report.

1.7 Meteorological information

The weather conditions at Guernsey Airport at the time of the accident were:

wind: 210°/18 kt, gusting to 26 kt; moderate rain;
visibility: 2 NM; cloud: 2/8 - 500 ft, 6/8 - 800 ft,
7/8 - 1 200 ft; temperature: 15°C.

1.8 Aids to navigation

Not relevant to this accident.

1.9 Communications

No information regarding communications is contained in the report.

1.10 Aerodrome and ground facilities

Runway 28 has an asphalt surface and is 4 800 ft long with a grass stopway of 300 ft. After the first 800 ft of runway there is a down gradient of 1.29% for approximately 3 300 ft; the last 800 ft is an up gradient of 1.23%.

1.11 Flight recorders

Flight recorders are not mentioned in the report.

1.12 Wreckage

The aircraft's wreckage was located 330 yd from the end of the runway and 80 yd south of the extended centre line.

The forward part of the fuselage had collapsed in the area of the freight compartment. The passenger cabin sustained little damage. All flying controls were intact. The flaps were retracted. The warm air shutter of the port engine was found jammed in the open position "WARM" and had evidently been open during the ground impacts.

1.13 Fire

There was no fire.

The inertia switches had tripped, and all fire extinguisher bottles had been discharged.

1.14 Survival aspects

The passenger seats had remained securely attached, and no one was injured.

The main exit door was jammed. However, the passenger and the cabin attendant left the aircraft through an emergency exit on the starboard side of the passenger cabin. The pilot-in-command and the co-pilot left the aircraft through the exit in the cockpit roof.

The fire and rescue vehicles of the airport fire service were already on the move when the aircraft left the runway and reached the scene of the accident within two minutes of the aircraft's coming to rest.

1.15 Tests and research

The port engine had only received superficial damage. Its constant speed unit and propeller pitch change mechanism were tested and found to be serviceable. The engine was then installed in another aircraft to determine whether the propeller surge could be reproduced during ground running.

The air intake system is operated by an electric actuator and controlled by a three-way switch which permits either of the following to be selected:

"RAM",	(air intake unit)
"FILTER", or	(air cleaner chamber)
"WARM",	(warm air shutter box)

Housed in the air intake,a rotary shutter serves to put either the "RAM" or the "FILTER" entry of the intake into communication with the warm air shutter box main passage to the carburettor, or to blank off both entries and, at the same time, open a flap type shutter thereby admitting warm air from the engine compartment. The system is not designed to permit a combination of "RAM and WARM".

Since the warm air shutter was jammed in the open position, a serviceable shutter box was installed and arranged so that alternative selection of "RAM" or "WARM and RAM" could be selected. The engine was run and tested with each selection in turn.

The results of the first test showed that the engine response to a slight rearward movement of the pitch control lever was as follows:

i) with "RAM" selected - dead beat no surge
ii) with "RAM and WARM" selected - surge of 200 - 250 rpm

A mixture tuning check was then made and showed that the engine was slightly "rich" - an increase of 15 rpm being obtained instead of the specified decrease of up to 40 rpm. A rig test of the injector confirmed the richness which was due to a particle of foreign matter which partially blocked the normal bleed orifice. After cleaning, the injector was reassembled, and further tests produced acceptable figures of flows and pressures.

Further engine tests were made to determine to what extent the rich mixture may have contributed to the engine surge. The results showed that with "RAM and WARM" selected, a slight rearward movement of the pitch control lever then produced only 100 rpm of surge.

The tests determined that the engine surging was contributed to by -

a) the warm air shutter sticking open and causing turbulence in the air intake, and

b) the rich mixture.

Examination of the shutter box revealed that the cadmium-plated shaft collars of the shutter shaft were seized in the oil retaining type bushes of the shutter box casing. It was concluded after laboratory examination that the plating on the shaft collars was not capable of withstanding the corrosion and fretting to which the parts had been subjected. The build-up of the resultant product, iron oxide, partially closed the pores of the bush and cut off the lubricant.

2. Analysis and conclusions

2.1 Analysis

Since the aircraft's Certificate of Airworthiness did not include a performance group classification, the flight manual did not contain performance data to calculate the distance covered during an abandoned take-off.

It was not possible to determine precisely the distance required for the aircraft to be accelerated to 80 kt and then stopped in the conditions which existed at the time of

the accident. Although it was possible to calculate the distance covered up to the point where the decision was made to abandon take-off, it was not possible to establish reasonably accurately the distance travelled before full deceleration action could be initiated. The brakes could not be applied as soon as take-off was abandoned as this would result in a nose-down moment. The speed of the aircraft was well in excess of its stalling speed. Any attempt to put the tail down would have resulted in the aircraft becoming airborne or in reduction of the main wheel loading to an extent where the braking force would be significant. Therefore, speed had to be lost and elevator application had to be gradual. Also, since the aircraft was at a small angle of incidence, with no flap extension, drag was low and considerable runway distance would be used while the speed decreased sufficiently for the tail to be lowered and full braking applied. Other indeterminate factors were:

1) the effect on braking distance of the wet runway of varying gradient;

2) the braking force of propellers;

3) the time taken for the engines and propellers to assume idling; and

4) the precise actions of the pilot.

In the existing circumstances it appears that the aircraft could not have been accelerated to 80 kt and then brought to a stop on the runway.

Although the measures taken on 5 July to rectify the defects in the port engine were considered satisfactory at that time, the reoccurrence of the same defect on 16 August should have alerted the Operator's maintenance organization to the need for a more thorough investigation in order to eliminate the defect.

2.2 Conclusions

Findings

The crew were properly licensed.

The documentation of the aircraft was in order.

The aircraft was maintained in accordance with an approved maintenance schedule.

The rpm surge of the port propeller was due to a combination of the effects of a rich mixture and the jamming of the warm air shutter intake in the open position.

The pilot-in-command's decision to abandon the take-off was a correct one.

Cause or Probable cause(s)

The pilot-in-command abandoned the take-off due to a malfunction of the port power unit but was unable to bring the aircraft to a stop on the runway remaining.

3. Recommendations

Although recommendations do not appear in the report, some were made by the suppliers of the "oilite" bushes, and the manufacturer of the hot air shutter box took the following action:

1) Collars are to be used in a plain unplated condition.

2) Adequate lubrication is to be given by provision of a hole in the shutter body.

3) Introduction of a revised lubrication maintenance period.

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