No. 43

Silver City Airways Ltd., Bristol 170-32, G-ANWL, accident on 1 November 1961 at Le Clos Hoguet, 3/4 of a mile northwest of the Guernsey Airport, Channel Islands. Report, dated October 1962, released by the Ministry of Aviation (United Kingdom) as C.A.P. 187.

Circumstances

The aircraft was making a daylight scheduled vehicle and passenger public transport flight from Cherbourg, France and during an attempt to land at Guernsey in conditions of low cloud the captain missed his approach. He opened up the engines to go round again, but the aircraft failed to gain height. Veering to the right it flew a short distance with the starboard propeller rotating slowly until the starboard wing struck the ground, and the aircraft cartwheeled. The passenger cabin broke away from the main wreckage which caught fire. Both pilots were killed. The steward and all 7 passengers aboard were seriously injured. The accident occurred at 1426 hours GMT.

Investigation and Evidence

The Aircraft

Its certificate of airworthiness was valid at the time of the accident.

The engines had been maintained in accordance with an approved maintenance schedule, and both had undergone a Check II inspection on 11 October 1961.

An engine ground run, including a check of the operation of the propeller auto-coarsening system, was carried out on the morning of the day of the accident.

When the aircraft took off from Cherbourg on its last flight it carried a payload of 3 cars and 7 passengers and sufficient fuel for the flight. At the time of the accident the total all-up weight was approximately 1 050 kilos less than the permitted maximum, and the position of the centre of gravity was within the prescribed limits.

The Crew

The captain held a valid airline transport pilot's licence endorsed in Group I for Bristol 170 aircraft and a current instrument rating. He was approved as a type rating examiner for Bristol 170 aircraft and as an instrument rating examiner. He had flown a total of 8 143 hours of which 471 had been on Bristol 170 aircraft during the six months prior to the accident.

The first officer was also well-qualified and had flown a total of 3 315 hours of which 486 had been as co-pilot on Bristol 170 aircraft during the six months prior to the accident.

The Flight

The crew were carrying out a series of flights between Cherbourg, France and the Channel Islands. Departure from Cherbourg was at 1344 hours and ten minutes later the aircraft reported crossing the French coast at 2 000 ft. The Guernsey controller cleared the flight to descend to 1 000 ft on the aerodrome QFE and gave the visibility as 3 NM with slight drizzle, 4/8 cloud at 300 ft and 8/8 at 500 ft. The captain was also reminded that the radar was unserviceable and was asked to report when over the non-directional beacon. Shortly thereafter the captain advised that he was flying in broken cloud and requested and received clearance for a visual approach.

The controller offered assistance with radio bearings, and a series of QDMs was

commenced. At 1410 hours the controller heard the aircraft overhead, and one minute later the captain radioed that he would go round again since he had descended to his critical height and "couldn't see a thing".

He then received the latest Jersey weather report (for 1400 hours) which was:-

surface wind	240°M, 14 kt
visibility	13 miles
cloud	2/8 at 800 ft, 8/8 at 1 000 ft.

Shortly after commencing his second approach, the captain asked for the height of the water tower situated one mile east of the aerodrome near the extended centre-line of the runway. He was told "six zero feet above the airfield". (An aircraft on a 3° approach slope would clear this tower by 300 ft).

As the Guernsey weather conditions had deteriorated, the controller, at 1422 hours, advised the captain as follows:

visibility 1 600 yd
cloud 5/8 at 100 ft
8/8 at 200 ft

One minute later the captain reported that he had crossed the coast (about 2 to 3 miles from the aerodrome). It is evident from the subsequent QDMs that the aircraft then veered to the north of the normal approach path, and it is considered that this was a deliberate manoeuvre by the captain to maintain visual contact with the ground.

Shortly before 1425 hours the captain reported that he had the aerodrome in sight, and no further QDMs were requested or given.

The runway on which the aircraft was to land is 4 800 ft long and is aligned 100/280°M with high intensity bi-directional and low intensity omni-directional lighting. At this time all of the approach lights were at 30% brilliance, and the runway lights were at 100%.

The controller first saw the aircraft when it was northeast of the aerodrome and making an "S" turn in an attempt to line up with the runway. At a height of about 30 ft the aircraft began to flare out as if to touch down. However, when it reached a position about 1 400 ft along the runway, the engines were opened up and the controller cleared the aircraft to climb ahead to the aerodrome beacon. Almost immediately the aircraft swung to the right and flew slowly towards the northwest without gaining height. Its flight continued straight and level for about 1/2 mile, and witnesses north of the aerodrome noted that its starboard propeller was rotating slowly. It then banked steeply to the right, and the starboard wing struck the ground.

Examination of the wreckage

Examination of the wreckage revealed that the flaps were in the retracted position, and all trims were approximately neutral. There was no evidence of fire in the air. The marks on the ground and inspection of the power units showed that at the time of impact the port propeller was rotating under power while the starboard propeller was almost stationary. The port propeller was set to an angle of 28°, a pitch angle consistent with take-off power, and the starboard propeller was in the feathered position. The master switch for the automatic pitch coarsening system was in the "on" position and 'caged'.

The engine and propeller control quadrant had been distorted on impact, and the boost and rpm levers were in the fully forward position immediately before impact.

The engine fuel and oil systems' cocks were "on", the fuel cross feed cock was "off", and the idle cut off levers were set to "run". Samples of fuel taken from the starboard fuel collector tank were clear and free from water and sediment.

No evidence of defect or of malfunction was found during the examination of the airframe and flying controls.

Subsequent examination by the manufacturers of the propeller and its constant speed unit and of the starboard engine revealed no evidence of any failure or malfunction.

The Automatic Pitch Coarsening System

In order to reduce the drag of a propeller in the event of an engine failure during take-off a system is installed in the Series 31 and 32 Bristol 170 type aircraft which automatically moves the propeller blades of a failed engine to the fully coarse position. The system incorporates two units, one for each engine, which are known as engine cut out switches. Each unit is activated by a microswitch which is operated by a diaphragm. The diaphragm is sensitive to the difference between the dynamic pressure produced in the propeller slipstream and that due to the speed of the aircraft. The system functions only when the boost and rpm levers are at or close to the maximum power take-off position.

When the engines are run each unit takes up one of two positions -

a) 'High differential' whenever the excess of propeller slipstream pressure rises to a value equivalent to 4.5" H_2O or more.

b) 'Low differential' whenever the excess of propeller slipstream pressure falls to a value equivalent to 2.5" H_2O or less. A tolerance of $\pm$ 0.5" is permissible.

During a take-off, values of pressure differential well in excess of the nominal 4.5" are normally present thus ensuring that both units are at 'high differential'. Automatic pitch coarsening will then take place if one of the units falls to the 'low differential' position.

The auto-coarsening system also incorporates an on/off master switch. The flight manual of the subject aircraft states that the switch is normally wired to the 'on' position. In fact a guard (or cage) provided the necessary security. The Company's operations manual prescribes a pre-flight check of the operation of the auto-coarsening system and requires that if a fault in the system becomes apparent the master switch should be switched 'off'. Neither document imposes any restriction on the use of the system after take-off.

Further examination - the starboard engine cut out switch unit

Tests carried out on the unit showed that it was not operating within the prescribed limits. The pressure required to move the switch to the high differential position varied between 5.1" and 5.9" H_2O whilst the switch moved to the 'low differential' position at 3.8". It is considered unlikely that these discrepancies could be detected during the functional tests prescribed by a Check 'A' inspection.

Strip examination disclosed the presence of a small amount of glutinous matter impregnated with metallic swarf. There was also evidence of 'pick-up' between the moving parts of the mechanism. The backing spring of the unit was found to be non-standard in dimensions and rating and had been adapted from a longer spring by cutting and filing, leaving one end improperly finished. Also, the microswitch was fitted with a rubber cowl contrary to the manufacturer's drawing. It was not possible to ascertain when or by whom these were fitted

Observations - automatic pitch coarsening

The propeller auto-coarsening system is designed to operate during the take-off phase when the boost and rpm levers are set for maximum power. Both units are then at 'high differential', the system is electrically armed by the position of the control levers and in the event of an engine failure auto-coarsening takes place when one unit falls to 'low differential'.

Auto-coarsening could occur, however, under other circumstances. During an

approach to land, when the engines are throttled back, the decrease of propeller slipstream would result in both units falling to the 'low differential' position. A baulked landing procedure subsequently initiated late in the approach sequence near the ground, or in an emergency, might require rapid selection of maximum power and rpm. In such circumstances the chance of both units returning to 'high differential' simultaneously is remote, and the risk of inadvertent auto-coarsening would be present. Operation of either unit outside its specified range, or sluggishness, would increase this risk.

On the subject flight, there is little doubt that the captain initiated a baulked landing procedure, possibly with some degree of urgency. The relevant material evidence is that the engine and propeller controls were at the maximum power position at the time of the accident and that the starboard auto-coarsening unit was functioning outside the prescribed differential values. It is, therefore, considered that auto-coarsening of the propeller occurred when the captain opened up the engines. The captain would have had no indication that this was not the result of engine failure.

Some 520 000 hours have been flown by the Bristol 170 Series 31 and 32 aircraft and until this accident nothing had occurred to suggest that there was any inadequacy in the maintenance schedule requirements or of the operating techniques. This accident, however, has shown changes to be desirable. - See follow-up action.

Control Speeds

According to the Flight Manual the minimum control speed on or near the ground was 79 kt, and the take-off safety speed was 90 kt.

During the landing flare of the subject aircraft the airspeed should have been decreasing from about 84 to 65 kt and since the engines were opened up while the flare was in progress the airspeed at that time was probably in the region of 70 kt. When the loss of thrust from the starboard engine occurred, therefore, the captain was not only unable to maintain directional control, but he also had insufficient height to put the nose down in order to accelerate to a speed at which control could be regained.

Probable Cause

The accident was due to the malfunctioning of the automatic pitch coarsening unit of the starboard propeller. This deprived the captain of the necessary degree of control of the aircraft at a critical stage of the flight.

Follow-up Action

A Special Recommendation Maintenance (No. 80) detailing an overhaul procedure for the pressure differential (engine cut out) switches, and a flight manual amendment requiring the system to be switched "off" after the take-off for the remainder of the flight have been issued by the Air Registration Board to prevent any risk of a repetition of this type of accident.

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ICAO Ref: AR/740