

No. 11

ALITALIA, Savoie Marchetti, 95B aircraft, I-DALO,  
crashed 8 kilometres north of Civitavecchia, Italy on 17 January 1951.

Circumstances

The aircraft departed from Le Bourget, Paris at 1016 hours en route for Ciampino, Rome, carrying 12 passengers and a crew of 5. At 1436 the aircraft reported that it was directly above the Civitavecchia beacon at an altitude of 6,500 feet. Immediately afterwards the aircraft was observed in flames and descending rapidly, following which it violently struck the ground. Four of the crew and nine passengers were killed outright (one of the surviving passengers died six days later) and the aircraft was destroyed.

Investigation and Evidence

Examination of the wreckage revealed that the left wing, the tip of which was first to strike the ground, was completely shattered, parts being found scattered over a 40 metre stretch of ground. The left wing tip which had broken off near the last rib was found intact but bearing numerous traces of electric discharges which had caused the metal to melt. Traces of molten metal were more evident near rib No. 56 on the two upper longitudinal plate-lightening discharges. Other minor traces of fusion were found on and near the upper plate opposite rib No. 58 and on part of the left wing aileron. The fabric covering of some pieces of the wing was burned.

Examination of the air-screws indicated that at the moment of impact the engines were running at reduced speed; no traces of fire were discernible on the engines. The right wing was completely destroyed by fire. The controls of engines 3 and 4 were in the "stop" position, but the levers for feathering the propellers did not appear to have been operated; the fuel switches for all four engines were approximately at the "wide-open" position, while those for the propellers were set at minimum pitch. No appreciable degree of magnetism was found present in the fuselage. The wire antenna was found still unwound.

Statements from survivors and the record of radio communications between the aircraft and Rome Area control confirm that the flight which was carried out partly IFR and partly VFR was normal until the time of the accident, except for a slight turbulence which half an hour prior to the accident had prompted the captain to order the passengers to fasten their belts. Following transmission of its last acknowledged message at 1436 hours the aircraft must have descended very rapidly with the urgent intention of finding a suitable place for an emergency landing.

Investigation revealed that following receipt of the aircraft's message at 1436 hours on frequency 122.1 Mc/s, ATC authorized the aircraft to change over to 118.1 Mc/s as the approach frequency of 119.1 Mc/s was not reliable. Immediately thereafter the aircraft attempted to establish R/T contact with Ciampino control tower on 118.1 Mc/s but the call was scarcely audible. At or about the same moment the aircraft called Area control twice on 122.1 Mc/s, however, Area control failed to establish contact and, therefore, concluded that the aircraft's radio had failed. This assumption on the part of Area control was strengthened by the fact that the aircraft failed to reply to the numerous calls initiated by Area control, Approach control, the Tower and DF services. It appears logical to assume that the last two calls from the aircraft were not routine calls but were prompted by the necessity of reporting the occurrence of trouble on board. The fact that no further contact with the aircraft was established following these two last calls leads one to believe that the trouble experienced by the aircraft had rendered the radio unserviceable.

A study of the weather situation prevailing at the time of the accident revealed that the area in which the accident occurred was experiencing a pre-frontal edge of a cold occlusion of moderate intensity which was moving in an easterly direction. Freezing level was at approximately 1,200 metres, the wind direction was south with speed 14 knots. At 1,400 hours weather reports indicated a total cloud amount of 8/8 stratocumulus in the area, with low cloud 6/8 - 8/8 stratocumulus, fractocumulus and nimbostratus, the base of low cloud varying between 450 and 750 metres. At this time there was light or moderate rain present. One hour later the cloud amount was 8/8 with the base of low cloud down to 450 - 600 metres with rain continuing to fall.

In view of the rapid change which takes place in cloud amount with this type of weather situation it was not found possible to accurately determine the number and thickness of layers of cloud which were present in the area at the time of the accident. It is reasonable, however, to assume that there were several cloud layers in the area; that the base of the first layer fluctuated between 450 and 750 metres with top from 1,500 - 1,600 metres;

that the base of a second layer was about 2,000 metres with top from 3,000 - 3,200 metres and that this second layer at times merged with the first. Visibility at the time of the accident was between 500 and 1,000 metres. In addition, the steward stated that the aircraft was flying through hail 15 minutes prior to the accident.

It was determined from evidence and from statements made by survivors and ground witnesses that the crash must have occurred at 1440 hours and that prior to the crash the aircraft was on fire. Furthermore, in view of the wooden construction of the wings it was decided that the outbreak of fire could not have taken place more than three or four minutes before the aircraft struck the ground. A violent electrical discharge in the area is known to have taken place some three or four minutes prior to the crash. Traces of this electrical discharge were found on the railroad tracks about  $1\frac{1}{2}$  kilometres from the scene of the accident and on the wing of the aircraft itself.

From the evidence available it would appear that the following sequence of events took place: a sudden occurrence of fire between the two port engines followed by intense flames; explosion and bursting of part of the plywood covering; breakdown of radio communications; change in engine speed; rapid descent for an emergency landing; execution of a heavy bank to the left and finally impact with the ground.

In all probability the electrical discharge in the atmosphere either directly set the aircraft on fire when passing through it, or indirectly originated the fire by producing a strong inductive charge with consequent discharges or sparks. With regard to the explosion of the wing covering and subsequent conflagration either of the following two explanations are possible:

- 1) The occurrence of an electrical discharge between two cloud layers or between clouds and the ground when passing through the wing of the aircraft ignited and exploded a mixture of air and petrol fumes inside the wing sections or in a fuel tank.
- 2) Ignition of a mixture of air and petrol fumes in one of the wing sections produced by a spark originating near a break in the bonding system resulting from heavy electrostatic voltages.

In respect of the second explanation mentioned above it was noted that following previous cases of electrical discharges to aircraft of the same type (four cases had previously been recorded), the "Registro Italiano

Aeronautico" took measures to improve the bonding generally and the outer lightning protective frame in particular. Following a similar type of accident which occurred to the subject aircraft on 17 May 1949 (part of the plywood covering of the right wing tip was blown off), the duraluminum outer frames of the wings were replaced by ones of copper extended to the edges of the wings, to provide greater conductivity and to facilitate welding. This lightning protective frame was in good order when last inspected on 19 December 1950. No evidence of fused metal was observed on the frame conductors, and of the many copper strips recovered only those near the tips of the wings showed signs of molten metal. In view of the foregoing and since it was extremely difficult to check whether there was any break in the bonding or not, the possibility that there may have been some gap in the lightning protective system which in itself would explain the origin of the sparks and fire cannot be excluded.

#### Probable Cause

The probable cause of the accident was fire in flight, due to lightning striking the wing frame of the aircraft and igniting a mixture of air and petrol fumes in one of the wing panels or fuel tanks.

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Note.- As a result of this accident the Board of Investigation recommended the temporary withdrawal of all mixed construction type aircraft, pending thorough examination and modification of their bonding systems as necessary.