No. 7

British Aircraft Corporation Ltd., BAC 111, Series 200, G-ASHG, accident at Cratt Hill, 1-1/4 miles NNW of Chiclade, Wiltshire, England on 22 October 1963. Accident Report No. EW/C/039, dated November 1964, released by the Ministry of Aviation, United Kingdom. (C.A.P. 219)

1. Investigation

1.1 History of the flight

The aircraft took off at 1017 hours GMT from runway 10, at Wisley Aerodrome on its fifty third test flight. It was to carry out stalling tests in all configurations with the centre of gravity at 0.38 SMC (standard mean chord), the furthest aft limit for which the aircraft had then been cleared. Based on the radio-telephony conversations recorded in the Wisley Tower and the flight recorders carried aboard the aircraft, the flight was reconstructed. Following take-off the aircraft climbed in visual meteorological conditions on a westerly heading to 17 000 ft while monitored by Wisley radar. At 1026 the co-pilot reported that they were about to commence tests at flight level 170. By 1035, four stalls had been completed with the undercarriage and flaps up. The co-pilot acknowledged a fix from Wisley at 1036 hours and nothing further was heard from the aircraft. The flaps were then lowered to 8^{o} to investigate the stalling characteristics in this configuration. The stall was initiated about two minutes after the last contact, when the aircraft was between 15 000 and 16 000 ft. Approach to the stall appears to have been normal. When attempting recovery, the elevators responded initially to the control movement but subsequently floated to the fully up position in spite of a large push force on the control column. The aircraft then descended in a substantially horizontal fore and aft attitude at about 180 ft/sec. During the descent it banked twice to the right and once to the left and at one stage the engines were opened up to full power. This action resulted in a large nose-up pitch which was followed by a pitch down when power was taken off. The aircraft then assumed the substantially horizontal attitude in which it made impact with the ground .

The final portion of the flight was observed by numerous eye witnesses who commented on the low level of engine noise and a sharp report from the aircraft which was heard while it was in the air. The aircraft had approached from the southwest, in a stable stalled condition, and crashed at about 1040 hours in a flat attitude. Following impact, the aircraft moved forward about 70 ft and some 15 ft to the right before coming to rest. It exploded and caught fire.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	7		
Non fatal			
None			

1.3 Damage to aircraft

Fire destroyed the fuselage and starboard wing.

1.4 Other damage

No damage was sustained by objects other than the aircraft.

1.5 Crew information

The crew was made up of the following: a pilot-in-command, a co-pilot, 3 flight test observers, an aerodynamicist and a designer.

The pilot-in-command, age 43, was deputy chief test pilot of Vickers-Armstrongs (Aircraft) Ltd., and the senior project pilot on the One-Eleven. On 20 August 1963 he flew as co-pilot on the first flight of the One-Eleven and had subsequently taken part in almost all the test flying of this aircraft, as either pilot-in-command or co-pilot. He had taken part in each of the flights during which stalls had previously been carried out. He was a Ministry of Aviation approved test pilot. He had flown a total of 5 385 hours, over 2 000 of which were flown on multi-engined aircraft and included 78 on the One-Eleven.

The co-pilot, age 46, joined Vickers-Armstrongs as a test pilot in 1953. His first flight on the One-Eleven was made on 20 September 1963 when he flew as co-pilot with the subject pilot-in-command and since that time had flown for 13-1/2 hours as co-pilot and two hours as pilot-in-command. He had flown a total of 9 648 hours. He was also a Ministry of Aviation approved test pilot.

No information was contained in the report regarding the other persons aboard the aircraft.

1.6 Aircraft information

G-ASHG was the first One-Eleven to be completed by Vickers-Armstrongs (Aircraft) Ltd. and flew for the first time on 20 August 1963. Since that time it had flown 52 test flights which involved 81 hours of flying. At the time of the accident it was carrying out a flying programme prior to obtaining a certificate of airworthiness for airline service. It was being flown under the B Conditions of the Air Navigation Order, 1960; a certificate of safety for flight had been completed on the day of the accident at 0900 hours.

The elevators of the aircraft were aerodynamically operated by tabs controlled by a duplicated cable control system. They were in two independent sections but linked through their control systems at the top of the fin and at the flight deck. A hydraulic artificial feel simulator was coupled to the right-hand elevator control circuit in the rear fuselage to give control feel in flight.

Longitudinal trim was effected by a variable incidence tailplane powered by duplicated hydraulic motors. The range of the tailplane setting was from 3° leading edge up to 12° leading edge down.

Lateral control was by means of servo-tab operated ailerons supplemented by hydraulically operated spoilers which also acted as air brakes when deflected symmetrically.

Special test instruments shown to the pilot included elevator angle indicators which showed the position of both the port and starboard elevators. There was also an angle of incidence indicator which gave the aircraft's body incidence. A vane on the side of the fuselage provided the sensing unit and the indicator was calibrated in accordance with the results of wind tunnel tests. The scale on its dial read from 20° to -10°, but the instrument was capable of indicating to 25°. It is not known how the instrument would have behaved when body incidence exceeded 25°.

The aircraft's gross weight was 70 125 lb, i.e. below the maximum permissible of 73 500 lb. As stated, the centre of gravity was 0.38 SMC, the furthest aft position for which the aircraft had been cleared. The design range of the centre of gravity was 0.11 to 0.41 SMC.

The aircraft carried 2 200 gal of kerosene.

1.7 Meteorological information

Weather conditions had no bearing on the accident.

1.8 Aids to navigation

Not relevant to the accident.

1.9 Communications

Communications between the aircraft and Wisley tower were recorded. The co-pilot was in contact with the tower up until 1036 hours, i.e. about 4 minutes prior to the accident.

1.10 Aerodrome and ground facilities

Not relevant to the accident.

1.11 Flight recorders

The following types of flight recorders had been installed in the aircraft for accident investigation purposes:

1) a Midas Type CMM/24/7S/E; and

2) a Colnbrook Instruments Development Ltd. (CID) Type 02E

The Midas is a magnetic tape recorder capable of dealing with 270 inputs and on this occasion was being used to record 59 parameters. It was installed in the top starboard side of the rear fuselage. The associated amplifiers were fitted to one of the special bulkheads in the cabin. The recorder was a cassette type, designed to eject automatically when subjected to heat or immersion in water; the ejection mechanism was to be fired electrically by power supplied from special batteries. The sampling rate was once per three seconds for most of the parameters, but five were sampled every half second. Aircraft heading was intended to be recorded but for this flight no serviceable heading source was available. This recorder broke loose from its attachment upon impact with the ground, owing to the high inertia forces. It fell through a split in the rear fuselage onto the ground and was recovered about 15 ft behind the tail of the aircraft, untouched by the fire.

The CID recorder was fitted in the cabin inside a steel fireproof box. It recorded photographically on paper and gave continuous recording of 10 inputs, including altitude, indicated airspeed, normal acceleration (g), and elevator, aileron and rudder angles. It had no automatic ejection mechanism but relied upon its structural integrity to survive fire and crash. This recorder had been in the heart of the fire and much of the trace information was lost, but the elevator angle trace remained legible.

1.12 Wreckage

At impact the aircraft was on a heading of 324° magnetic, almost level fore and aft, banked about 3° to the left and skidding slightly to the right. The accident occurred on level ground at about 700 ft amsl.

The marks on the ground and the wreckage distribution showed that the rate of descent had been very high and the forward speed low. There was no evidence that any part of the aircraft became detached in the air.

1.13 Fire

Fire broke out following impact and destroyed the fuselage and the starboard wing.

1.14 Survival aspects

The inspector who completed the certificate of safety assisted both pilots to fasten their safety harnesses and ensured that everyone had a parachute which was properly adjusted.

Two emergency escape exits had been provided for the crew, one at the forward freight loading aperture on the lower starboard side of the fuselage and the other using the rear ventral passenger entrance situated in the aft end of the fuselage.

For the first a special door was made and was kept in position by 38 explosive bolts. A vertical tunnel led to the door from the cabin floor. The tunnel structure was spring-loaded to exert an outward pressure on the door. The explosive bolts were connected to their own battery and could be fired by a switch on the pilots' centre pedestal or from a similar switch situated at the entrance to the tunnel. It was intended that if the bolts were fired, the door should fall away allowing the tunnel structure to slide down until its upper end was level with the cabin floor and its lower end protruded into the airstream, thus providing the crew with an escape chute. Following the accident the forward freight-hold door and the remains of the door frame were found in the wreckage, both partially melted and burned. The door was not in its frame, and was inverted and trapped between the fuselage and the ground. All the explosive bolts recovered had been detonated. It is considered they were fired by action of the crew rather than by the heat of the fire, because the latter could not have resulted in the door being jettisoned and inverted and a careful search of the ground beneath the door failed to reveal any sign of the bolt heads.

The rear escape exit was a modification to the rear ventral entry door. After opening the rear pressure bulkhead door, the crew could jettison the ventral door by means of a foot-operated lever.

However, although two emergency escape exits were available and each occupant had a parachute, no one escaped.

1.15 Tests and research

The Board of Inquiry examined what theoretical and wind tunnel investigations into the stalling characteristics of the One-Eleven had been made and the extent to which they gave warning of the possibility of difficulty at high angles of incidence. In this connection the Royal Aircraft Establishment analysed the aerodynamic characteristics of the aircraft and the results of BAC wind tunnel tests, and applied the results of these analyses to the flight test data obtained from flight recorder information.

Prior to the commencement of flight testing, wind tunnel tests which were conducted into the variation of lift and pitching moment with incidences for the range 0° to 28° revealed that the stalling behaviour of the aircraft was characterised by a fairly sharp drop in lift coefficient at about 19° incidence.

The onset of the stall extended over the range 15° - 19° and towards the end of this range the aircraft's pitching moment showed a marked nose down tendency; the latter however was not very large or long-lived in terms of persistence with increase of incidence. On the contrary, by 25° incidence, there was evidence of a pitch-up tendency in the pitching moment characteristics of the aircraft.

It should be remembered that subjecting an aircraft to a sudden loss of lift is equivalent to an instantaneous decrease of normal acceleration (referred to as the g-break) which in turn leads to an increase downwards in the normal component of velocity and thus an increased incidence. It is thus possible for the incidence to increase with little or no rotation of the aeroplane. Other changes will occur in the flight condition arising from changes in drag and pitching moment but these are more indirectly related to incidence than is the g-break.

Exploration of the stalling characteristics of the aeroplane was begun in earnest of Flight 47, on 16th October, with a forward CG position. The pilot-in-command of the fatal flight was co-pilot on Flight 47. The briefing sheet for this flight gave an incidence for each of the five configurations in which stalling was to be conducted. These were:-

Configuration	Incidence
Clean	16°
8° flap, undercarriage up	15°
18° flap, undercarriage down	14°
26° flap, undercarriage down	13°
45° flap, undercarriage down	12°

The pilot's report repeated these figures, referring to them as the "limiting incidence". Twelve stalls were carried out and the pilot's report indicated the maximum incidence angles reached in the five configurations were 23°, 19°, 21°, 20° and 17°. Examination of the flight test data shows that the actual maximum figures recorded were 21°, 20 1/2°, 23 1/2°, 26° and 16° respectively. The pilot stated that he exceeded the limiting incidence figures for he considered that at the limiting figures, information gained on the flight would be small and that, in order to produce the king of data required, greater angles of incidence would have to be achieved. He believed that he had to get to, or close to, the stall in order to get any useful and necessary data on the recording film.

He therefore reached indicated angles that were considerably in excess of the limits. On none of the stalls did he have any serious qualms about the behaviour of the aeroplane, nor any difficulty in recovering.

Following Flight 47 it was pointed out that the limits set for the angles of incidence were conservative and made no allowance for scale effect which would delay the onset of changes in the flow (e. g. incidence for the maximum lift coefficient of the wing: C_L max.) by some 3° to 4° of incidence full scale compared with the wind tunnel tests.

Flight 48 was made on 18 October to measure C_L max. The pilot-in-command of that flight was the same as on Flight 53. Twenty five stalls were carried out in the same five configurations and with a forward position of the centre of gravity. According to the pilot's report the incidence angles reached were 21°, 21°, 20°, 19° and 16° respectively, whereas the flight test data showed maximum angles of 22°, 23°, 25°, 23° and 21° with the minimum speeds very much as they had been on the previous flight. The differences between the two sets of figures are explained from the fact that pitch and incidence would continue to increase by one or two degrees due to dynamic overshoot after initiation of recovery action and that the figures in the pilot's reports were readings of a small dial which was not graduated beyond 20°; the co-pilot who made the readings was also engaged in observing and recording other matters. The pilot-in-command commented in his report that apart from those with 45° flap, when the right wing drop appeared to be a limiting factor, he gained the impression in the other configurations "that it should be perfectly possible to fight one's way through the wing drop".

Following these remarks on the lateral control characteristics in turbulence on the approach, a modification to the aileron tab/spoiler linkage was made before Flight 52 to provide for only one degree of aileron movement from neutral instead of four degrees before the commencement of spoiler movement. This resulted in improved lateral control at small deflection, but the maximum rolling moment available remained essentially the same.

After the accident, more extensive wind tunnel tests were made by RAC from which lift and pitching moment coefficients over the incidence range of 0° to 45° were obtainable. The behaviour of the servo-tab-operated elevator control system was studied over the same range. From these tests a number of important deductions have been possible relating to the behaviour of the aircraft in its final stall.

The basic factor in the final pitch-up tendency displayed by the pitching moment curves is the loss of effectiveness of the tail as aircraft incidence is increased. This is accompanied by a loss of elevator effectiveness, which is sufficiently large to render recovery from an excursion into the post-stall region difficult.

An analysis of the hinge moment characteristics of the elevator shows that as body incidence is increased the up-floating tendency of the elevators increases and at large incidence (about 40°) can reach a stage when it is no longer possible to prevent the elevators moving into an up position even though the tab is held in its fully up position.

Fron static considerations it was concluded that there was insufficient elevator power to maintain a nose-down pitching moment beyond about 36° incidence and that therefore beyond this figure recovery would not be possible even with full down elevator. Furthermore at some incidence in the region of 45° with fully down elevator, and 50° with elevator fully up, it was evident that the aeroplane would "lock in" to this incidence. This latter deduction was consistent with the behaviour of the aeroplane as shown by the flight recorders.

The preceding discussion on elevator effectiveness applies to the aircraft configuration as at the time of the accident and is to a large extent independent of the type of longitudinal control used within the same tailplane geometry. As mentioned, the elevator hinge moment is appreciably affected by incidence. This effect is such that, although the amount of down-elevator that can be held by full up tab decreases progressively with increase of incidence beyond 27°, it is still possible to hold some down-elevator to somewhere in the neighbourhood of 40° incidence.

The type of longitudinal control, therefore, is a feature which does not in itself prevent recovery, but coupled with the pitching moment characteristics makes recovery more difficult. In particular if the stick is held centrally (near zero stick force), then, under static conditions, the elevator would assume an upward deflected position. Furthermore just beyond the limit of incidences reached in Flights 47 and 48, that is beyond 25°, the angle assumed by the elevator would be quite large. However in view of the much reduced elevator effectiveness this up-elevator would have a relatively small effect on the rate of build-up of incidence.

2. Analysis and conclusions

2.1 Analysis

Examination of the wreckage revealed that the landing gear and flaps were fully retracted, the tailplane at a setting of 1°33' leading edge up (i.e. trimming the aircraft nose down), the elevators up and the engines rotating at idling speed at impact. No evidence was found of:

- jamming or fouling of the elevators at their hinge points;
- pre-crash damage or defects of the servo and gear tabs, hydraulic gust dampers, aileron and rudder control system, elevator control circuit and engines.

In analysing the flight recorder traces of the final stall in the light of the results of the theoretical considerations discussed in paragraph 1.15 it must be emphasized that the recordings are open to a certain amount of variation in interpretation, largely because the sampling rate of the elevator stick force and the servo-tab angles was once every three seconds: further, the incidence recording stopped at 25°. A continuous trace of the all-important elevator angle was, however, available. A time-history for the 140 seconds before ground impact based on Midas recorder data supplemented by that from the CID recorder is shown in Figure 5. Relevant portions of this have been plotted to a time base with a zero for an incidence of the order of 16° to 17°, as shown in Figure 6.

On all the runs of this flight the elevator deflections are generally more oscillatory than on previous occasions. A number of factors would contribute to this, the pitching moment variation with incidence for incidence beyond 20° or so, the greater sensitivity of the aircraft at an aft centre of gravity and the fact that incidences where hinge moment changes were taking place were being reached just before or during recovery.

The attempt by the pilot to recover is shown by the change in direction of elevator movement at around 9 seconds on the time scale (see Figure 6). A number of things may have prompted this action and it is by no means clear what, for example, was the tab position or the stick force just previous to this. He may have been faced with an unexpected up-elevator position or he may have been alerted by the incidence meter. Whatever was the exact sequence of events it is certain that incidence would have continued to increase during the recovery attempt. According to the analysis of the hinge moment data an incidence of about 40° or more was reached, since it will be seen that at about 13-14 seconds the elevator "up-floats" to reach a fully up position shortly after.

As has been noted, beyond an incidence of about 36° a fully down elevator does not provide a sufficiently large nose-down pitching moment contribution to result in an overall pitching moment in the recovery sense. Hence, even if the elevator had been maintained in a fully down position, recovery from the flight conditions prevailing would have been ruled out. In fact with the elevator virtually locked in its up position the incidence will increase further till the aircraft reaches the stable equilibrium state at about 50° incidence.

The time history in Figure 5 indicates that as the aircraft entered the stall there was a tendency to a wing drop which was corrected by the pilot. Subsequently during the deep stall the aircraft banked successively right, left, then right again. At the high incidence conditions prevailing during the descent the aileron rolling effectiveness would fall off to such an extent that the ailerons become of little value as a roll control. Nevertheless, since the tab, aileron and spoiler movements are consistent, it can be concluded that the pilot was moving his lateral control deliberately; but it should be remembered that some movement of the ailerons would result from the incidences induced by the aircraft's motion and, in the absence of wheel and rudder pedal force records, this tends to obscure the picture. However, the movement of rudder and ailerons is not inconsistent with an attempt by the pilot to regain control by putting the aircraft into an appreciable asymmetric flight condition. At impact minus 50 seconds when the pitch angle was 4° nose-down, full power was applied from both engines and maintained for about 15 seconds. This application of power was accompanied by a rapid pitch-up reaching 17° nose-up; power was then reduced by the pilot apparently to prevent continuation of the pitch-up.

Whilst there is some lack of evidence on the pilot's intentions in this stalling test, the traces, taken together with the pilot's remark after previous stalling tests that it should be possible to fight one's way through the wing drop, are not inconsistent with an attempt to reach a stall as defined by the British Civil Airworthiness Requirements. As a result, the aircraft penetrated further into the post-stall region than it had been taken previously and reached the stable stalled condition from which recovery was not possible.

Possible contributory factors to the accident were examined as follows:

a) were the design and wind tunnel investigations carried sufficiently far:

b) were the flight tests organised and conducted with sufficient prudence to obviate unnecessary risk: and

c) were additional safeguards warranted having regard to the nature of the tests undertaken.

a) There was evidence in the wind tunnel tests of a fairly sharp drop in the lift coefficient associated with the onset of the stall, and a nose-down tendency in the pitching moment. It was expected that in flight there would be a pronounced nose-down pitch at the stall, providing the approach to the stall was gradual. The evidence of a pitch-up tendency which was appearing by 25° incidence in the wind tunnel tests was not interpreted as a matter demanding special precaution; the VC. 10 technique which it had been decided should be used in exploring the One-Eleven stalling characteristics was considered to be sufficiently cautious to avoid difficulty. Against this background it cannot be said that the design and wind tunnel investigations should have been carried further than they were.

b) The technique followed in the VC. 10 stalling programme consisted of taking the aircraft up to or just beyond the angle of incidence at which wind tunnel tests had shown C_L max to occur so that experience and information would be built up gradually. During the initial stalling tests (Flight 47) of the One-Eleven, however, the angles of incidence based on wind tunnel tests, which were provided as a guide to the test pilots, were considerably exceeded, but as explained, no allowance for scale effect had been made when establishing these incidence values. Nevertheless if the VC. 10 stall investigation technique had been closely followed in this case the One-Eleven stalling tests would not have been taken so far, so fast. The apparent lack of concern after Flight 47 appears to have been based on the expectation that a pronounced nose-down change of pitch would occur and also on the innocuous stalling behaviour reported by the pilots after that flight. Since no steps were taken either to warn them of the special features revealed at angles above 25° during the wind tunnel tests or to lay down new "limiting" angles as a guide or to fit a new incidence meter, the pilots may well have interpreted the position as one in which the stall could be explored not only at the higher angles then reached but even beyond. It appears that the pilots themselves were under the impression that an increase of incidence would be associated with a visible pitch-up which would give them adequate warning to recover; they had probably not appreciated that not only would incidence continue to increase after the g-break with no visible pitch-up but that it would increase at a much higher rate than previously. But although the pilots had not been warned that if incidence reached a sufficiently high angle a stable stall was a real possibility and recovery therefrom most unlikely, there was some knowledge among them and the aerodynamicists of difficulties that had occurred during stalling tests of military aircraft with T-tails. It seems reasonable to conclude, therefore, that as by 25° in the wind tunnel tests the nose-down tendency in the pitching moment gave way to a nose-up tendency, and as the firm had a general background knowledge of stalling problems which had arisen with T-tail aircraft, stalling tests should have been more cautiously approached, more closely controlled and more carefully correlated with wind tunnel and flight recorder data.

c) The safety devices which were provided or could have been provided aboard the aircraft were discussed:

Tail Parachute Consideration had been given in the case of the One-Eleven, as in that of the VC. 10, to the fitting of a tail parachute. The matter was being kept under review and no final decision had been made, although it had been intended that a parachute should be fitted before the aircraft made a dynamic stall, thus significantly exceeding the stalling incidence. The retention of the matter under review and deferring of a decision to fit were influenced by the time that would be taken for such a modification and acceptance that the policy of 'gradualness' in relation to stalling would ensure safety. Wind tunnel tests carried out by BAC since the accident indicate that with the elevators in effect locked up and with the aircraft in a stable stall, a tail parachute of the type it was intended to fit would not have given sufficient pitching moment to provide for recovery.

Incidence Meter As mentioned previously, the presentation of body incidence to the pilot was achieved by means of a small dial and pointer. Although the graduated range of the instrument was from 20° to -10° the pointer was free to move to a position equivalent to 25°, where it might either have stopped of flicked to some spurious reading quite unrelated to the vane position. It seems probable that the pilots were unaware of this characteristic of the instrument; the possibility that they were misled by its reading cannot therefore be dismissed although the evidence suggests they were not working to an incidence limitation but were attempting to reach a clearly defined stall. Incidence in excess of the maximum reading of the instrument had been recorded during Flights 47 and 48 and it should have been clear that the range of indication provided was insufficient to present the pilots with a means of monitoring the incidence reached during stalling trials. It would consequently have been prudent to replace the incidence meter used by one capable of registering appreciably higher incidence, irrespective of whether there was any intention of exploring this region immediately.

Escape Two emergency escape exits were provided in the aircraft and each occupant had a parachute, nevertheless, no-one escaped.

Although it may be expected that there was considerable alarm at the rapid loss of height, it seems reasonable to accept that no question of abandoning the aircraft arose until all possibilities of recovery, culminating in the application of full power, had been attempted. When this had been done the aircraft was probably at just under 5,000 feet with less than 30 seconds to go before impact. There is evidence that some attempt was made to abandon the aircraft at a very low height, probably far less than 5,000 feet, since

(i) witnesses heard a sharp report, which could have been the firing of the explosive bolts on the forward escape exit, when they estimated the height of the aircraft to be a few hundred feet; after the crash the door was found trapped between the fuselage and the ground in an inverted position still partly covering the door opening and two of the occupants were near this exit;

(ii) although the rear ventral door (second escape exit) was in position, two of the occupants were some distance towards it.

In test and experimental flying there must at times be a degree of hazard, and a pilot will continue to investigate an unusual or difficult situation while any possibility of recovery exists. Nevertheless the chance of escape might have been improved if emergency drills had been laid down and practised since this could have led the pilot to order at least some members of the crew to abandon the aircraft at an earlier stage and perhaps have enabled any escape attempt to be carried out with greater prospect of success.

Exchange of Information During the investigation consideration was given to the extent of exchange of information between research establishments and the aircraft industry, and among constructors themselves. It emerged that no formal action had been taken in respect of the experience which had accumulated from stalling problems encountered in aircraft with T-tails, although there had been some informal liaison. In respect of this particular accident the British Aircraft Corporation announced almost immediately its intention to make known to manufacturers both in this country and overseas the results of its investigations so that the knowledge gained would be of lasting benefit to the safety of aviation. It appears, nevertheless, that knowledge gained from other incidents and accidents may not always be so applied owing to the lack of effective formal or standing arrangements, and that a more regular basis for the exchange of experience among aircraft constructors and research establishments on new problems affecting safety encountered during aircraft development would have considerable value.

2.2 Conclusions

Findings

The aircraft was flying in accordance with the B Conditions of the Air Navigation Order, 1960; it had been certified as safe for the flight, and was properly loaded.

The pilots were appropriately licensed and were experienced in experimental flight test work.

There was no evidence of any pre-crash structural failure.

The nose-down pitching moment (elevator neutral) just beyond the stall was insufficient to rotate the aeroplane at the rate required to counteract the increase of incidence due to the g-break.

During the fifth stall the angle of incidence reached a value at which the elevator effectiveness was insufficient to effect recovery.

Cause or
Probable cause(s)

During a stalling test the aircraft entered a stable stalled condition recovery from which was impossible.

3. Recommendations

Although no specific recommendations were contained as such in the report paragraph 2.1 "Exchange of information" contains recommendations.

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Test flight
En route
Stall
Airframe - Flight controls

ICAO Ref: AR/863

ACCIDENT TO BAC 111, G-ASHG, OF BRITISH AIRCRAFT CORP. LTD., AT CRAT HILL, WILTSHIRE, ENGLAND. 22 OCTOBER 1963.

TIME HISTORY FOR THE 140 SECONDS BEFORE GROUND IMPACT BASED ON FLIGHT RECORDER DATA

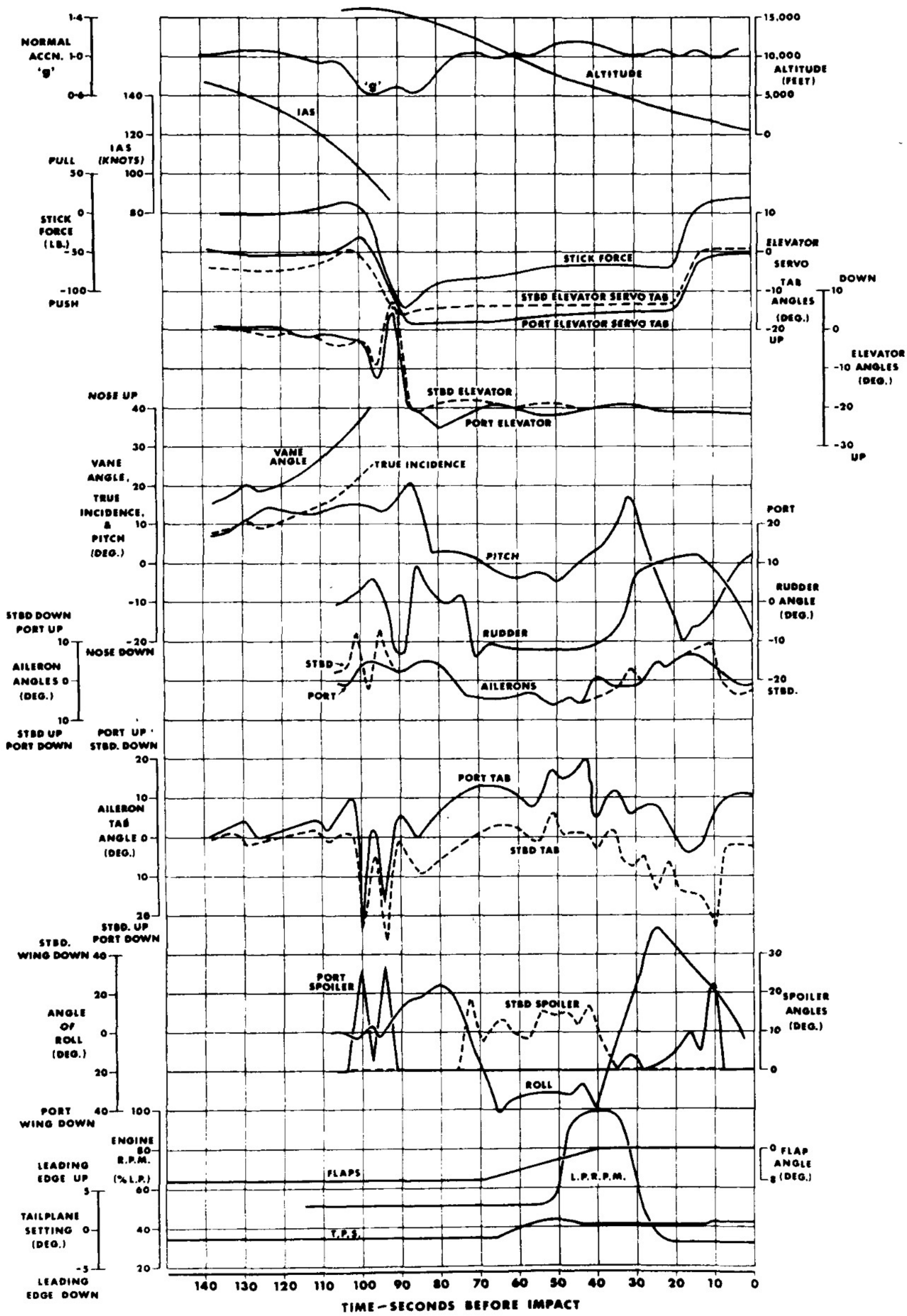

FIGURE 5

ACCIDENT TO BAC 111, G-ASHG, OF BRITISH AIRCRAFT CORP. LTD., AT CRAT HILL, WILTSHIRE, ENGLAND. 22 OCTOBER 1963.

DATA OBTAINED FROM MIDAS AND C.I.D. FLIGHT RECORDERS AT THE STALL

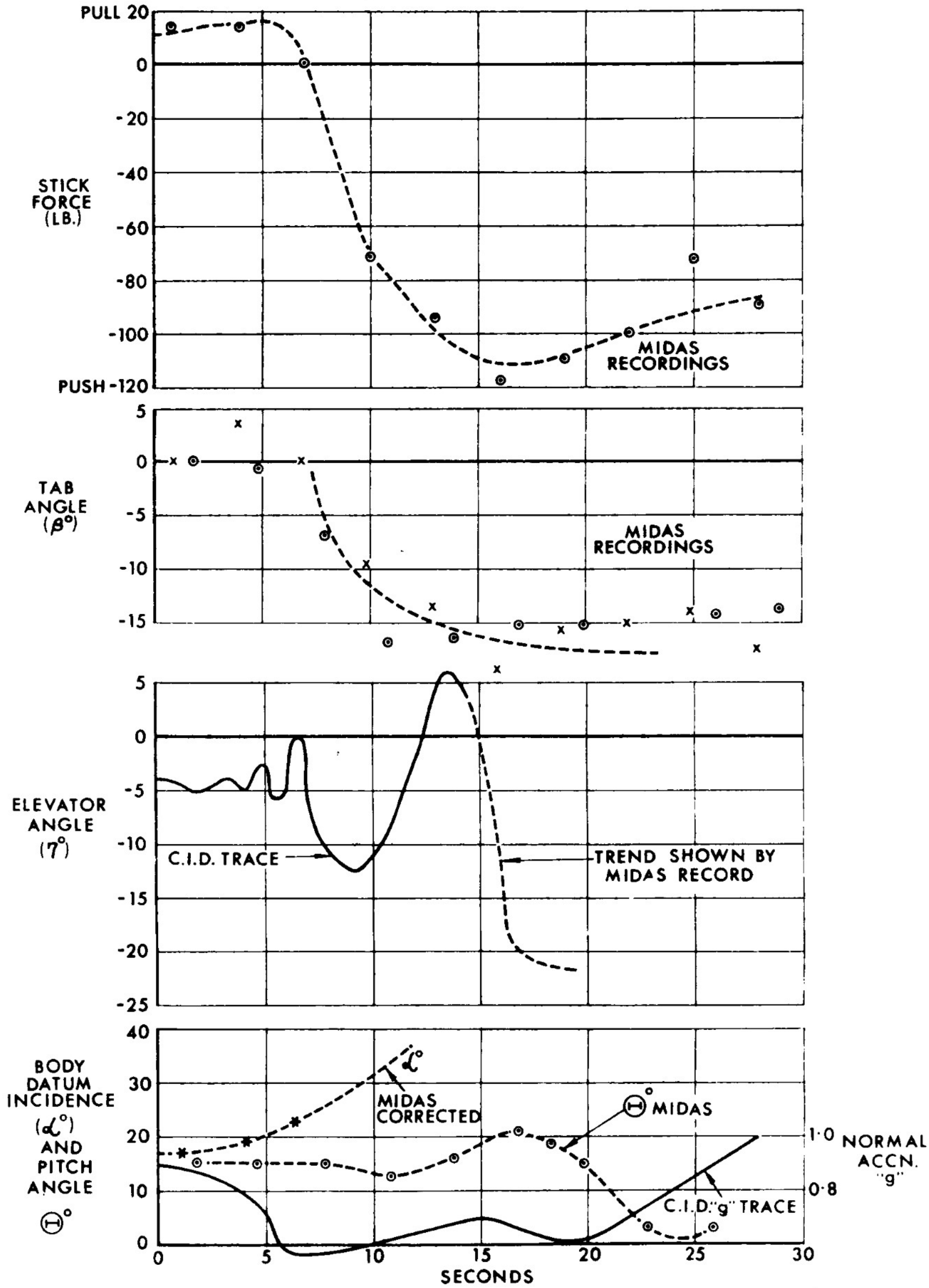

FIGURE 6