ACCIDENTS INVESTIGATION BRANCH
Department of Trade and Industry

HFB 320 Hansa D–CASY
Report on the accident off Blackpool Airport, Lancashire, England, on 29 June 1972

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Department of Trade and Industry
Accidents Investigation Branch
Shell Mex House
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9 October 1973

The Rt Honourable Peter Walker MBE MP
Secretary of State for Trade and Industry

Sir,

I have the honour to submit the report by Mr G M Kelly, an Inspector of Accidents, on the circumstances of the accident to HFB 320 Hansa D–CASY which occurred off Blackpool Airport on 29 June 1972.

I have the honour to be
Sir
Your obedient Servant

V A M Hunt
Chief Inspector of Accidents

Accidents Investigation Branch
Civil Aircraft Accident Report No 15/73
(EW/C415)

Aircraft:	HFB 320 Hansa D–CASY	
Engines:	2 x General Electric J 610–1	
Owner and Operator:	Intercity Flug	
Crew:	In Command Captain D van Laak	– Killed
	Co-pilot F/O P Bing	– Killed
Passengers:	Five	– Killed
	One	– Seriously injured
Place of Accident:	Off Blackpool Airport	
Date and Time:	1710 hrs 29 June 1972	
	All times in this report are GMT	

Summary

After an uneventful acceleration during an attempted take-off on Runway 28 at Blackpool, the aircraft did not rotate and continued in a level attitude at high speed down the runway. Although brake marks were found on the last 300 metres of the runway, the aircraft failed to stop and crossed the intervening 360 metres of grass area to the aerodrome boundary, where its nosewheel collided with some railway lines and broke off. The aircraft continued into a holiday camp immediately bordering the airport, demolished six masonry chalets, damaged several others, and caught fire.

The two crew members and five of the six passengers on board were killed. The aircraft was destroyed. The other passenger was seriously injured.

The report concludes that the accident was due to a failure to unstick, most probably because the elevator gust lock had not been removed during the pre-flight checks. The take-off was abandoned at too high a speed for the aircraft to be brought to rest before colliding with obstructions.

1. Investigation

1.1 History of the flight

The aircraft was one of a number of aircraft of this type used for the carriage of company employees and goods for Messerschmitt-Bolkow-Blohm GMBH. A twice-weekly charter service was operated from the Federal Republic of Germany to Warton aerodrome in the United Kingdom or, alternatively, to Blackpool civil airport.

D–CASY left Munich on the morning of 29 June 1972 and landed at 0904 hrs at Blackpool, as Customs facilities were not available at that time at Warton. During the day the aircraft remained on the ground at Blackpool and for most of the time the captain and co-pilot were with it. At 1520 hrs six of the eight passengers to be carried on the return trip to Germany arrived at Blackpool airport and, as it was raining, sat in the aircraft, the Auxiliary Power Unit (APU) of which was running. Two more passengers were expected. A flight plan was prepared for Munich via Rotterdam and filed at 1530 hrs.

The two passengers did not turn up at the appointed time and the APU was shut down while the passengers and crew waited in the aircraft. About 1630 hrs word was received that the two extra passengers were not coming. This meant that extra fuel could be accommodated and a new flight plan direct to Munich could be prepared. It was filed by the first officer, while the captain carried out the pre-flight check. The captain then started the APU and sat in the left hand seat with the first officer in the right hand seat and, according to the passenger who survived the accident, indicated that the first officer should operate the aircraft in command under supervision.

The aircraft taxied out and lined up and the surviving passenger saw the right hand wing slat extended when the first officer applied power with the brakes 'on' at the start of the take-off. The port side wing slat and the flaps were outside this passenger's field of view.

During the take-off run the aircraft reached its normal rotation speed in the usual distance. However, although the aircraft was travelling fast enough, rotation did not take place and it did not become airborne. The surviving passenger saw the first officer's hand holding the throttles fully open and wondered why the aircraft did not take-off. Then he saw a gesture from the captain indicating that the take-off should be abandoned. The first officer immediately closed the throttles. Observers on the aerodrome heard the engine noise die down approximately 300 metres from the end of the runway. Subsequently brake marks were found commencing in the same area. Braking was not effective, however, and the aircraft left the end of the runway at high speed, in a level attitude with its nosewheel and main wheels in contact with the ground. Shortly before the first impact the surviving passenger noticed the captain's hand on the controls and saw aileron movement.

The first collision occurred when the starboard wing tip struck and severed a post supporting one of the airfield runway approach lights. The aircraft continued, colliding with and badly distorting the double track railway lines at the edge of the airfield. The nosewheel of the landing gear was broken off by this impact and some structural damage was done to the underside of the fuselage. Almost immediately beyond the railway lines the aircraft broke through a wall and collided with a row of single storey masonry chalets in the adjacent holiday camp, demolishing six of them and setting them on fire. The wings were broken off during this impact, spilling fuel over the area, but the main part of the aircraft continued its progress, sustaining further structural damage as it did so. The forward part of the fuselage, including the flight deck, was twisted to starboard and progressively destroyed. The final impact brought the aircraft to rest against a second row of chalets which were also badly damaged. The wreckage caught fire and was destroyed. The crew of two and five of the six passengers on board were killed. The sixth passenger, although thrown clear, was seriously injured.

1.2 Injuries to persons

Injuries	*Crew*	*Passengers*	*Others*
Fatal	2	5	–
Non-fatal	–	1	–
None	–	–	–

1.3 Damage to aircraft

The aircraft was destroyed.

1.4 Other damage

Airport approach lighting installations and British Railway's fences and permanent way were damaged by impact. Several holiday camp buildings and their contents were destroyed.

1.5 Crew information

Captain D van Laak, aged 34, held a current German Commercial Pilot's Licence endorsed for command of HFB 320 type of aircraft. His most recent certificate of test was dated 18 May 1972 and his last medical examination was on 16 May 1972. At the time of the accident his total flying experience was 4,936 hours of which 910 were in command of HFB 320 aircraft. He had flown 71 hours within the preceding 28 days and had 11 hours off duty before reporting on the day of the accident. Pilots who had flown with Captain van Laak said that he made frequent use of the gust locks in the HFB 320 even when the aircraft was only on the ground for a short period.

First Officer P Bing, aged 33, held a current German Airline Transport Pilot's Licence endorsed for second pilot on HFB 320 type of aircraft. His most recent certificate of test was dated 7 May 1972 and his last medical examination was on 9 May 1972. At the time of the accident his total flying experience was 1,615 hours which included 869 hours as co-pilot, all on HFB 320 aircraft. He had flown 73 hours within the preceding 28 days and had 11 hours off duty before reporting on the day of the accident.

1.6 Aircraft information

1.6.1 *History and maintenance*

The aircraft was constructed in 1967 and first registered in February 1969. The airframe had completed a total flying time of 2,274 hours and the port and starboard engines a total running time since overhaul of 126 and 760 hours. The certificates of airworthiness and maintenance were valid at the time of the accident and all maintenance had been carried out in accordance with approved schedules.

1.6.2 *Elevator controls*

The elevator controls were manually operated and of conventional pattern. In the cockpit a duplicated pantographic assembly provided for horizontal fore-and-aft movement of both the captain's and co-pilot's control horns. The resultant fore-and-aft movement was taken downwards under each control assembly and the assemblies were rigidly interconnected beneath the cockpit floor. Locking either set of cockpit controls therefore locked the entire system. From under the cockpit floor the movement was taken by torque shaft via two gear boxes to a push/pull rod in the vertical stabiliser and thence to the right hand elevator, the right and left hand elevators being inter-connected by a yoke assembly in the tail. The rigging and trim were such that unless the elevators were deflected at 'rotation' speed the aircraft would not leave the ground.

Trim tabs on both elevators were operated either mechanically or hydraulically from the cockpit. Rotation of the trim wheel on the cockpit pedestal was transmitted by torque tubes, cables, chains and levers to provide the requisite motion at the trim tabs. Hydraulic actuation of the trim tabs was electrically controlled by the trim switches on the control wheels or, by the automatic pilot. A runaway trim could be stopped, and further hydraulic trimming inhibited, by operating either electric trimming switch in the opposite direction. Mistrimming could be overpowered by the elevator controls.

A stick pusher was incorporated as part of the stall protection system. However the pusher was inoperative with the gear down and depressed, and was not armed during take-off until the first retraction of the wing slats.

1.6.3 *Gust lock system*

The control surfaces of the HFB 320 could be locked by a flight deck locking system when the aircraft was parked. This gust lock system consisted of a pair of webbing straps, a 'T' shaped metal fitting and a light alloy tubular rod which were normally connected together by cord. When in use the webbing straps were fastened over the control wheel horns to provide aileron protection, the rudder was held by inserting the 'T' shaped metal fitting through a hole in the cockpit floor into a matching hole in the rudder operating mechanism and, when the light alloy rod was located on two spigots on opposite corners of the pantographic elevator control assembly, the elevator was locked in a neutral position. (See Appendix 2). The manufacturer specified that the gust locks should always be fastened together. Notwithstanding these instructions they were sometimes separated for ease of installation of the elevator lock and were reported to have been separated on D–CASY. When it was installed as the manufacturer intended, the complete gust lock system caused sufficient hindrance of access to the pilot's seat to provide a safeguard. However this hindrance was associated with the aileron straps and was lost when the elevator gust lock, disconnected from the rest of the apparatus, was installed. Since there was no interconnection between this type of gust lock and the throttles, it was possible to obtain take-off power with the locks in place. If the elevator gust lock was dislodged from its bottom spigot only, it was noted that while the control column could be moved fully forward (elevator down) fouling of the aircraft structure by the lock strut prevented any degree of rearward movement (elevator up) being achieved. A stowage compartment for the gust locks was provided behind the co-pilot's seat on the flight deck and they could also be stowed in a receptacle under the forward passenger seat on the port side of the aircraft.

1.6.4 *Aircraft loading*

The aircraft loading was satisfactory for flight and the centre of gravity was within the prescribed limits.

1.7 Meteorological information

The weather was good and although there had been some previous rain, the runway state was 'dry' at the time of the accident rather than 'wet'. An anemograph reading at the time gave a surface wind of 020°M at 03 knots. The accident happened in daylight.

1.8 Aids to navigation

Not applicable.

1.9 Communications

VHF radio communications between Blackpool Tower and the aircraft on frequency 118.4 MHz were normal. Because of an error in switching the recorder, transcripts could not be made. However, witnesses' evidence indicate that communications were normal.

1.10 Aerodrome and ground facilities

Runway 28 at Blackpool, which had a bitumen surface, was 1,829 metres long and 37 metres wide with 360 metres of grass overrun between its west end and the aerodrome boundary. The field elevation was 10 metres and the runway had no significant slope.

A transverse bar of 11 approach lights on wooden poles was situated in the grass area 300 metres from the end of the runway and equidistant either side of its extended centre-line. The aircraft collided with the most southerly of these lights during its overrun.

The airport boundary was marked by a post and rail fence which separated the aerodrome from the British Rail double track permanent way beyond.

1.11 Flight recorders

A 'SFIM' film type Flight Data Recorder was fitted to the aircraft and was recovered from the wreckage. During the accident the recorder – which was of a type not protected against fire – had been subjected to prolonged heat which badly affected the recording medium and no data readout was possible. It had been fitted when the aircraft was delivered. More recent Federal German Regulations require that, where flight data recorders are fitted, they should be capable of providing a useful readout even after being subjected to severe shock or fire. No cockpit voice recorder was fitted.

1.12 Wreckage

1.12.1 *Examination of the scene of the accident*

Inspection of the runway, the overshoot area and the site of the accident showed that the complete aircraft had run through the grass overshoot area at the end of the runway, across a railway track, and into a row of brick chalet bungalows forming part of a holiday camp. The impact tore the wing structure away and the aircraft caught fire. The landing wheels had at no time left the ground. Tyre marks on the runway indicated that heavy braking had been used at a late stage of the attempted take-off run.

1.12.2 *Examination of wreckage*

Examination of the wreckage showed that the aircraft had been complete when it struck the railway lines, and according to the position of the quadrant gears in the front and rear elevator control boxes, the flight deck flying controls had been in the neutral position. The cockpit, which had been twisted to the right and almost inverted during the accident sequence, had been badly affected by the subsequent fire. However, it was possible to establish that the control yoke on the captain's side had been broken off in an upwards and forward rotating direction. The gust lock attachment spigot on the forward yoke of the captain's control assembly was found to be bent in a manner consistent with the elevator gust lock strut having been in position at the time the aircraft collided with the railway track. There was no impact mark or other damage to account for the bend in this spigot. The control assembly on the first officer's side had broken up whilst in the neutral position and the absence of impact marks on either set of control assembly stops indicated that they had not been 'hammered' at any time during the break up.

The only remnant of the gust lock equipment found was the steel, tee-handled, rudder locking pin. It was noted that the steel split ring, by which the aileron straps and elevator gust lock were attached to the rudder locking pin, was missing.

Other evidence that came to light during the wreckage examination showed that the flaps were at the take-off setting and the speed brakes were out. The landing gear was selected up and the braking parachute was unlatched with only its drogue chute extended. The crash switch had been operated.

1.13 Medical and pathological information

No pre-existing disease was discovered during the post-mortem examination of the pilot or co-pilot and the unequal distribution of carboxyhaemoglobin ruled out the possibility of cockpit contamination by carbon monoxide before the crash. Examination of the two flight deck crew members failed to reveal any hand injuries that could be attributed to gripping the control column at the time of impact and there was, therefore, no medical evidence to suggest which pilot was at the controls at the time of the accident.

No medical evidence came to light as to the cause of the accident.

1.14 Fire

The extensive fire, which had started when the aircraft collided with the first row of chalets, rapidly developed and destroyed some of the buildings and most of the aircraft structure. The airport Fire Service saw the accident from their watchroom and set off to the airport boundary immediately.

The first appliances thus arrived at the scene within two minutes but were slightly delayed in laying their hoses by a train on the railway. Outside emergency services were redirected to the accident site through the main entrance of the holiday camp and were in attendance by 17.16 hrs. The fire was progressively brought under control and by 17.45 hrs it was possible to account for the last of the passengers and crew. The three appliances from the Airport Fire Brigade were assisted by eleven appliances from the Blackpool and Lancashire County Fire Service under two Divisional Officers and an ADO.

1.15 Survival aspects

One of the passengers was thrown clear of the wreckage and suffered severe injuries. For the remaining occupants the accident was not survivable.

1.16 Performance and tests and research

1.16.1 *Take-off*

According to the performance figures contained in the flight manual in the conditions and aircraft configuration prevailing at the time of the accident the aircraft would have reached 'rotation' speed (130 knots) within 1,170 metres (3,831 feet) and lifted off at 1,240 metres (4,061 feet) from the start of the take-off run. Energy calculations were made by a computer programmed with aircraft aerodynamic co-efficients, engine thrust information, aircraft dimensions, runway dimensions, and the weather conditions at the time. The results of these calculations agree closely with the flight manual figures and indicate that the aircraft would have reached rotation speed (V_R) after 31 seconds (1,100 metres) from the commencement of the take-off run. The calculations also showed that the aircraft continued accelerating for a further 6 seconds (425 metres) after attaining V_R, and achieved a maximum speed of 149 knots before the thrust levers were closed and the brakes applied. In all, the aircraft was travelling at or above rotation speed for 9 seconds or 600 metres of runway length. (See Appendix 1).

1.16.2 *Stopping*

Figures obtained from the Flight Manual indicate that, in the prevailing conditions and configuration, the aircraft would have required 580 metres (1,900 feet) to have stopped from V1 (which, in this case, was 130 knots, the same as V_R). This distance was made up of 60 metres decision distance and 520 metres braking distance. Thus the total distance required to accelerate to V_R and then to stop after abandoning the take-off was 1,750 metres. This is within the limits of the paved area of Runway 28 at Blackpool. As the aircraft would normally be in the air after attaining V_R, accelerate/stop figures are not available for higher speeds.

The computer energy calculations on the deceleration performance were based on the speeds and acceleration that, according to the evidence, occurred in the accident. The aircraft accelerated for 1,525 metres before the engines were throttled and the brakes applied. There remained 300 metres of paved area during which the speed decayed from 149 knots to 112 knots before the aircraft ran on to the wet grass where the braking effect was greatly reduced. At the point of collision with the railway lines the calculated speed was 95 knots.

1.17 Operations manual and check lists

The Aircraft Flight Manual recommends the use of the gust locks when the aircraft is parked for any length of time in the open.

The duties and responsibilities of the flight personnel are dealt with in section 2.2 of the Flight Operations Manual. Section 2.2.4, which applies to the captain, states that the check lists carried in the aircraft must be used when carrying out the checks before, during, and after flight and that the captain must ensure that the pre-flight check has been completed prior to flight. In the following section (2.2.5), the first officer's duties include the instruction to carry out the pre-flight checks.

The check lists carried in D–CASY were destroyed in the accident. A similar set of check lists, supplied by the operating company, contains no reference to the pre-flight check nor any direct reference to the removal of the control locks. Reference to the flying controls in these check lists consists of two entries in the 'before starting engines' check. Item 17 calls for a check on the function of the stick shaker and pusher and item 41 requires a check of the flight controls for 'FREE MOVEMENT'.

2. Analysis and Conclusions

2.1 Analysis

The evidence from the pathological report and the surviving passenger indicates that the pilots were making control movements and were not apparently incapacitated in any way during the attempted take-off. No evidence of defect or malfunction that could account for the failure to rotate was found during the investigation. However the fracturing of the captain's handwheel in an upwards and forwards direction and the breaking, in neutral, of the elevator control assembly on the first officer's side, indicated that the cockpit elevator controls were in a neutral position when the first impact occurred. Furthermore, the results of the computer calculations and the observed performance of the aircraft indicated that the associated elevator control surfaces were also in neutral throughout the take-off run. The lack of impact marks or damage to any of the control stops on either the captain's or co-pilot's controls indicates that they were not forcibly struck at any time in the accident sequence. Damage to these stops would certainly have resulted had the cockpit controls (which are normally freely hinged) been free to move.

The gust lock attachment spigot on the forward yoke of the captain's control column was found to be distorted in the way it would have been distorted had the gust lock been in position when the accident occurred. There was no other related impact damage or apparent reason to account for the bending of this spigot. Although the gust locks should have been attached to one another and should therefore have been stowed together after removal prior to take-off, only the rudder locking part of the gust lock assembly was found during the search of the wreckage. The aileron straps had most probably been destroyed in the fire but since there was only slight damage to the rudder fitting it was to be expected that the remainder of the assembly would also have survived. The absence of a split ring on the part that was found indicated that the components had not been fastened together despite the maker's recommendation that they should be. The cockpit area had been twisted and partially inverted before the fire developed. If the elevator gust lock rod had been in position it is very unlikely that any trace of it would have been found.

The captain was known to make frequent use of the gust locks and since the aircraft had been standing all day it is most probable that they were in position on this occasion. The departure was delayed and a new flight plan made as a result of the absence of two of the prospective passengers. According to the evidence of the survivor, the pre-flight check was carried out by the captain. The only item on the check list carried in the aircraft that referred specifically to proving the freedom of the flying controls was in the 'before starting engines' check. This could easily have been overlooked had the captain's check been interrupted. It is considered unlikely that the first officer would have duplicated the check which had already been carried out by the aircraft commander. The elevator portion of the gust lock was inconspicuous when installed and did not interfere with access to the seats or the operation of the aircraft in any way other than the locking of elevators.

The pilots would normally have been concerned in copying their clearance and preparing the aircraft for take-off during taxying out. Since manipulating the control column could interfere with this activity and since there was no check list requirement to do so in the 'before take-off check', the controls were probably not exercised before the start of the take-off run. It is common practice on public transport aircraft for the freedom of the flying controls to be checked after the engines have been started, during the 'before take-off check'. This is to guard against the possibility that one of the control locks might still be engaged or that free movement of the controls is inhibited.

In the absence of any interconnection between the gust locks and the thrust levers in HFB 320 aircraft at the time of the accident, it was possible to obtain full power from the engines with the lock in place. Later HFB 320 aircraft have been modified so that it is no longer possible to obtain take-off power from the engines with any of the gust locks engaged.

The design and performance of the HFB 320 is such that, with the elevator gust lock in position, the aircraft is incapable of unsticking.

The considerable period between the aircraft attaining rotation speed and the subsequent decision to abandon the take-off is of some significance. Once a malfunction had become apparent to the pilot it is reasonable to assume that he would abandon the take-off promptly. However the effect of the elevator gust lock in the control system would not necessarily be apparent until rotation speed, and it is likely that some confusion as to why the controls were not operating would delay corrective action by the pilot. The take-off was abandoned while the aircraft was still on the runway and the deceleration initially achieved on the concrete surface may have given the pilots the impression that the action thus far taken was enough to stop the aircraft within the confines of the aerodrome. It may be that it was not immediately apparent when the aircraft went on to the grass overrun that the deceleration was now considerably reduced and the brakes alone would not suffice. But whatever the reason for the delay the braking parachute was not unlatched and the undercarriage not selected up until it was too late for them to operate effectively and reduce the speed of impact.

2.2 Conclusions

(a) *Findings*

(i) The documentation of the aircraft was in order and it had been properly maintained.

(ii) The pilots were properly licensed and adequately experienced for the flight.

(iii) There was no pre-crash failure or malfunction in the aircraft, its engines, systems, or flying controls.

(iv) The elevator, aileron, and rudder gust lock components were not fastened together as required by the manufacturer of the aircraft, thus eliminating the safeguard against attempting a take-off with the controls locked.

(v) There was no requirement in the check list carried on the aircraft for the controls to be checked for freedom after the engines had been started.

(vi) It was possible to obtain full power from the engines with the elevator gust lock still in place.

(vii) The aircraft failed to unstick and the take-off was abandoned. The braking parachute was not deployed, nor was the landing gear retracted until it was too late to avoid colliding with obstructions.

(viii) The condition of the flying controls and the elevator gust lock attachment spigot was consistent with the elevator gust lock having been in place at impact.

(ix) The aircraft design was such that it was not capable of unsticking with the elevator gust lock in position.

(b) *Cause*

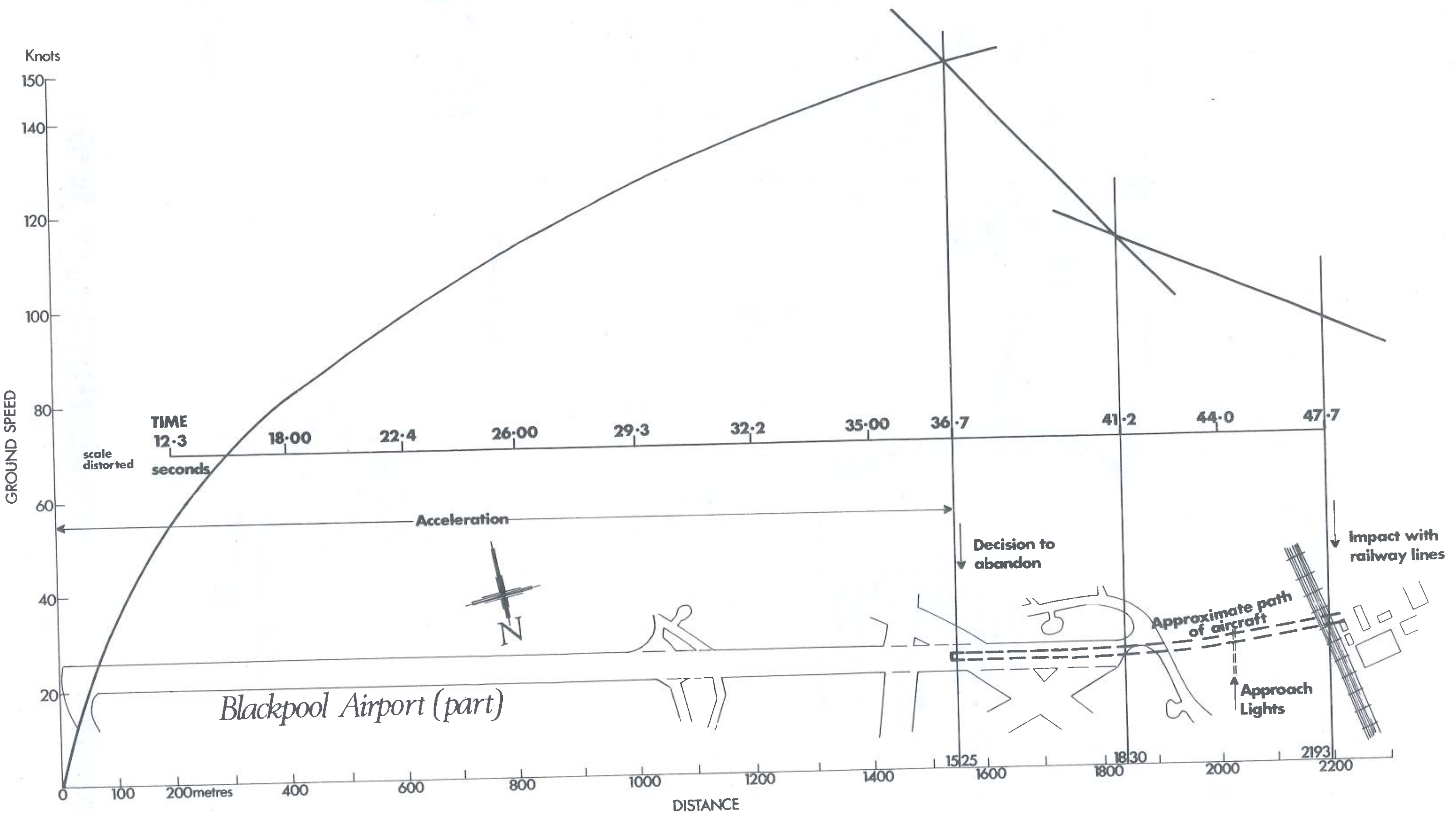
The accident was the result of a failure to unstick at the appropriate speed, most probably because the elevator gust lock was still in position. The take-off was abandoned at too high a speed for the aircraft to be brought to rest before colliding with obstructions.

G M Kelly
Inspector of Accidents

Accidents Investigation Branch
Department of Trade and Industry
October 1973

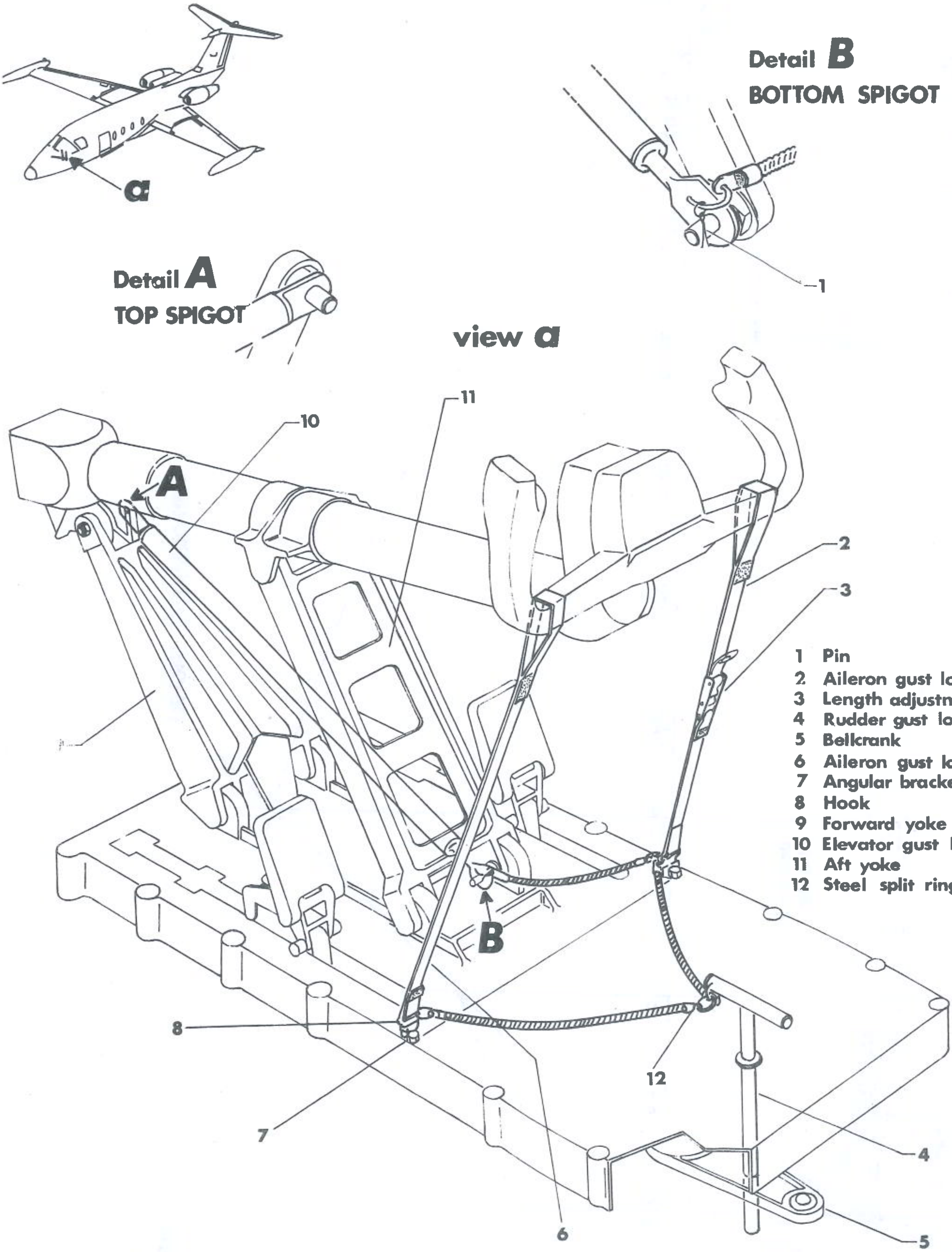
APPENDIX 1

PERFORMANCE GRAPH



GUST LOCK DIAGRAM

APPENDIX 2



1 Pin
2 Aileron gust lock strap
3 Length adjustment device
4 Rudder gust lock pin
5 Bellcrank
6 Aileron gust lock strap
7 Angular bracket
8 Hook
9 Forward yoke
10 Elevator gust lock strut
11 Aft yoke
12 Steel split ring

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