Beech Super King Air 200, G-BVMA

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Aircraft Type and Registration:	Beech Super King Air 200, G-BVMA
No & Type of Engines:	2 Pratt & Whitney PT6A-41 turboprop engines
Year of Manufacture:	1980
Date & Time (UTC):	25 January 1997 at 1440 hrs
Location:	In Cruise, Overhead Brussels
Type of Flight:	Public Transport
Persons on Board:	Crew - 2 - Passengers - 6
Injuries:	Crew - None - Passengers - None
Nature of Damage:	Top of door bent outwards
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	43 years
Commander's Flying Experience:	8,150 hours (of which 657 hours were on type) Last 90 days - 59 hours Last 28 days - 44 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and metallurgical examination of damaged components

The aircraft had departed Dusseldorf for London Gatwick at 1406hrs. During its climb out it was held for a few minutes at FL140and then continued to its cruising level of 220. All systems,including pressurisation, were working normally. At about 1425hrs the aircraft was levelled at FL220 and the crew began thecruise checks. The Captain was about to reduce the propellerspeed to 1,700 RPM when there was a loud bang and a rapid decompression. The crew carried out an emergency descent with all the occupantsbreathing oxygen from the emergency masks and they landed at Brusselsat 1440 hrs.

It was found that there had been failures in the hook mechanismswhich secure the top edge of the cabin door. This had allowedthe top of the door to deform outwards, lifting the pressurisationseal. The door is hinged at its bottom edge and retained closedby two shoot bolts on each side in addition to the top edge hooks. The shoot bolts were engaged and undamaged and the door remainedin place.

The failed hook mechanisms were examined by AAIB (Figure 1).In both cases the clevis pin which attached the hook arm to itsoperating lever had failed and, in the case of the front assembly,there was an opened crack on one side of the bifurcated sectionof the hook arm, between the hook and the clevis pin hole. Inthe front hook arm the headed end of the pin had remained trappedin the hole by plastic deformation of its shank. The headed endof another pin was found and this was taken to be from the rearhook arm. No other material was recovered from the failed pinsbut two other pins from the assembly were taken for metallurgicalcomparison. The fracture face on the separate clevis pin (rearhook arm) was typical of that occurring by simple bending fatigue. The fatigue had multiple origins but the surface was extensivelycorroded and had been mechanically damaged so it was not possibleto analyse it in detail or to estimate the number of load cyclesinvolved. The fractured end of the pin in the front hook armshowed much more mechanical damage over its fracture surface andany evidence of its original failure mode had been destroyed. From this damage, and from the lesser damage on the other pinit seemed that the broken pins had supported the operating leversfor some time after the initial failure. The matching pin holesin the lever also showed some plastic deformation at their edgeswhich showed that the deformed or broken pins had been causingexcess edge loads in the holes and that there had been considerablemovement at these pin locations. This movement would have loosenedthe hooks' engagement on the latch pins in the door frame. Asfound both hooks were almost fully retracted into their screwfittings in the ends of the hook arms *ie* almost fully adjustedin the direction which would absorb such play. The conditionto which the door and hooks had been rigged in the aircraft couldnot be reconstructed but from the above it appears that adjustmentshad been made to take up play created by the failure of the pins.

Vickers hardness tests on both the failed clevis pins and theintact ones showed that they had been manufactured from steelof approximately 63 tonf/in$_2$ tensile strengthwhich is correct for these pins. The Beech part (Part number131323-2C15) is made from a MS20392-2C15 pin and has a solid filmlubricant. The aircraft manufacturer reported that the FAA "Alert"reporting system contained two cases of worn or broken pins, theCAA's database contained none.

The crack in the front hook arm proved to be due to stress corrosion. The arm had been manufactured from steel of 102 tonf/in$_2$and the consultant metallurgist who examined these componentscommented that steels above about 90 tonf/in$_2$are susceptible to stress corrosion under high sustained surfacestresses in humid atmospheric conditions. The crack was evidentlysecondary to the failure of the clevis pin which probably resulted,in this case, in all of the hook load being taken by only oneside of the bifurcated hook arm.

The Overhaul and Replacement Schedule in the aircraft MaintenanceManual required the upper door hook mechanism (including the pins)to be replaced at every 12,000 flight hours. The aircraft hadcompleted 11,532 hours at the time of the accident. At 4,107hours (November 1987) the log book contained a record that thehooks had been replaced but this quoted the part number of thehook alone and not the hook arm and the rest of the assembly containingthe clevis pins. The manufacturer reports that an inspectionprocedure specifically for the pins is under consideration.