Cessna 182S, G-BYEG

AAIB Bulletin No: 3/2002	**Ref: EW/C2001/5/4**	**Category: 1.3**
Aircraft Type and Registration:	Cessna 182S, G-BYEG	
No & Type of Engines:	1 Lycoming IO-540-AB1A5 piston engine	
Year of Manufacture:	1998	
Date & Time (UTC):	12 May 2001 at 0835 hrs	
Location:	Leicester Airport	
Type of Flight:	Private	
Persons on Board:	Crew - 2	Passengers - None
Injuries:	Crew 2 Fatal	Passengers N/A
Nature of Damage:	Aircraft destroyed	
Commander's Licence:	Private Pilots Licence	
Commander's Age:	58 years	
Commander's Flying Experience:	464 hours (of which 398 were on type)	
	Last 90 days 4 hours	
	Last 28 days 0 hours	
Information Source:	AAIB Field Investigation	

Background

The aircraft occupants were a married couple who had owned a share in a Cessna 182 for 11 years that was kept in a hangar at Leicester Airport. In 1998 their shared 1966 model Cessna 182J was damaged during a storm at La Rochelle Airport and, together with the owner of another share, they purchased G-BYEG as a replacement. This aircraft was one year old when they purchased it and was equipped with a factory fitted avionics suite that included an autopilot.

Unless they were flying with an instructor, the two pilots invariably flew together and they alternated the role of handling pilot in the left seat. Together they had flown 72 hours in G-BYEG. The aircraft had last flown on 2 May when the co-owner had returned from Guernsey. The co-owner stated that there were no aircraft defects apparent during his flight to Leicester. He refuelled the aircraft to full tanks on 5 May and parked it in its hangar where it remained until the day of the accident.

History of Flight

On the morning of 12 May, an anticyclone dominated weather conditions over central England. At Leicester Airport the sky was clear, the QNH was 1022 mb and the surface wind was from the north-east. The runway in use was tarmac surfaced Runway 04 which is 490 metres long.

Shortly after 0800 hrs the two pilots arrived at their aircraft and loaded their baggage in preparation for the first leg of their 'flying holiday' which was to Copenhagen. They extracted the aircraft from the hangar and were seen inspecting its exterior in preparation for flight. A minor issue of fuel dripping from the engine bay was soon resolved and they had a brief conversation with friends, who were to take-off before them in their own aircraft, regarding the in-flight rendezvous and radio procedures. The pilot of G-BYEG for this flight occupied the left-hand seat and his wife acted as co-pilot in the right hand seat. She made all the radio calls before take-off. Engine start-up and taxi were apparently normal and at the holding point, the co-pilot transmitted that power checks had been completed and stated that the aircraft was ready for departure. The radio operator responded with the measured wind conditions which were 040° at 5 to 10 kt. The aircraft then lined-up and began its take-off roll. None of the witnesses noticed the position of the wing flaps but the pilots habitually used 10° flap for take-off. The aircraft was seen to accelerate normally with a healthy sound from the engine and it became airborne after about 200 metres of ground roll. Initially, until about 100 feet agl the take-off appeared normal but then the aircraft adopted an ever increasing nose-high attitude which culminated in a gentle left roll at about 300 feet agl before the aircraft's nose dropped sharply. It seemed to the aero club witnesses that the aircraft had stalled in a markedly nose-up attitude. After what appeared to be an attempted stall recovery at about 100 feet agl, it dived into the ground whilst rolling left with the engine still running. Both occupants received fatal injuries on impact; neither made any radio transmission after the start of the take-off roll.

Wreckage and impact information

The aircraft crashed into a standing crop of oilseed rape within the airfield boundary approximately 250 metres north-west of the end of runway 04. The impact track was 108° and it is likely that the aircraft had rotated to the left following the observed stall in order to arrive at this location on the observed track. The impact attitude was steeply nose down, with a section of the left wing tip having become lodged in the earth at an angle of 43°. The nose and cabin of the aircraft were extensively disrupted; however, the rear fuselage and empennage were comparatively intact.

It was found that the elevator trim tab, located on the right hand elevator, was at, or very close to, the maximum nose up position. The tab actuator on this type of aircraft is a screwjack, which is located in the right hand horizontal stabiliser and connected via a cable run to the trim wheel on the cockpit centre console. The longitudinally compressive forces acting on the fuselage structure during the impact would have acted to remove tension in the trim tab operating cables and thus preserve the pre-impact setting of the screwjack. The tab position was corroborated by the position of the trim indicator needle in its slot adjacent to the trim wheel, and additionally by the positions of the cable blocks that are clamped to the cables connecting the tab to the trim wheel. It is these blocks that define the limits of travel. Trim tab movement as a result of post-impact operation of the electric trim was considered improbable because the cable had become trapped in the trim wheel operating mechanism on the console following the accident.

The flap actuator, which is a screwjack operated by an electric motor, had extended to a position corresponding to approximately 15° of flap whereas the pilot normally took off with 10° of flap set.

Whilst it is possible that the flap selector lever had not been accurately positioned in its gate by the pilot, it is also possible that an electrical short could have caused some limited post impact running of the flap motor.

Both front seats had remained attached close to the forward limit of travel on their respective rails by means of the spring-loaded plungers that engage in holes in the rails. Seat adjustment was achieved by pulling the handle that extracted the plungers, which allowed the seat to move along the rails to the desired position. There have been instances of seats moving to the rear stop of the rails during take-off due to improperly engaged plungers; however, such an event does not appear to have occurred in this case.

Loss of Control

The flight path described by witnesses was consistent with a loss of pitch control. An extreme aft centre of gravity position was one explanation considered so most of the items on board the aircraft were weighed accurately. Some small fluid containers had burst and shed their contents so their intact weights had to be estimated before the aircraft's weight and centre of gravity position could be calculated. Those calculations revealed that the aircraft's weight was at least 100 lb below the maximum take-off weight and the centre of gravity position was mid-range. Consequently, an aft centre of gravity contribution to the accident was discounted. Within the wreckage, the only physical evidence of any pre-impact abnormality was the elevator trim.

The two occupants were, reportedly, careful and methodical pilots who were well acquainted with the Cessna 182 type. A plastic covered and enlarged (A4 sized) copy of the aircraft checklist *(jpg 158kb)* contained within the Pilot's Operating Handbook was found in the wreckage. (The Handbook was also found in the wreckage. It was endorsed with a statement that it represented the Flight Manual that formed part of the Certificate of Airworthiness for G-BYEG).

The checklist was open at the BEFORE TAKEOFF and TAKEOFF sections, suggesting that it had been used just before the accident. A copy of this checklist is attached to this report at Appendix A. Item 10 of the BEFORE TAKEOFF checklist requires that the elevator and rudder trim be set for take-off. The correct elevator trim position, which is the same for both a flaps-up and a flaps 10° departure, is indicated by a TAKEOFF mark on the trim gauge beside the manual trim wheel. The location of the trim wheel is shown as item 34 on the diagram at Appendix B *(jpg 310kb)*. The TAKEOFF mark is to the left of the wheel, near the centre of the range of pointer movement. The mark corresponds to a trim tab position close to neutral relative to the elevator.

Anecdotal accounts of unexplained instances of finding the elevator trim at the full nose-up setting during avionic maintenance prompted an investigation of the trim system and its relationship with the autopilot.

Aircraft history

This aircraft was one of the current production series and had achieved approximately 350 flying hours. The most recent maintenance was an annual inspection carried out in April 2001. The avionics and autopilot were a factory fitted option. In March 2000 the autopilot servos were changed as a result of an Airworthiness Directive.

The co-owner of G-BYEG indicated that on at least two occasions during year 2000 the aircraft had pitched up following autopilot engagement but a Journey and Technical Log kept by the aircraft owners recorded only one such problem. It occurred on 27 August 2000, 35 flights before the accident flight. In January 2001 the aircraft was returned to the aircraft manufacturer's UK dealers for a package of warranty work to be carried out on the avionics. The problem of the autopilot pitch excursion was investigated at this time, but the fault was not confirmed. Nevertheless the pitch trim servo was replaced as a precaution, since when the problem had not recurred. However, since the accident it has been established that no fault was found with the unit that was removed from the aircraft.

Autopilot description

The autopilot was a two-axis Bendix/King KAP 140 rate based digital system. This type of autopilot does not use control surface position feedback information. In the basic pitch and roll modes, the computer receives data from an accelerometer plus a built-in pressure transducer (for maintaining altitude or a selected vertical speed) and from the turn co-ordinator gyroscope. The mode buttons were labelled AP, HDG, NAV, APR, REV and ALT. The purpose of the AP button was to engage the autopilot in the basic roll and pitch modes. The basic roll mode functions as a wing leveller and the basic pitch mode captures the existing vertical speed. A further press of the AP button disengages the autopilot and extinguishes all the LED (Light Emitting Diode) indications. The HDG button engages the autopilot in heading hold mode and the NAV mode can engage the autopilot in a VOR, ILS localiser or GPS tracking mode. The APR button can engage the autopilot into an ILS approach mode and the REV button arms the ILS Back Course approach mode in which the autopilot response to localiser deviation signals is reversed. The ALT button engages the autopilot in altitude hold mode and captures the altitude at the moment the button is pressed. There are also two buttons for varying the vertical speed or altitude captured. These UP and DN buttons do not engage the autopilot.

Electrical power to the autopilot system was wired through the 'AVIONICS MASTER SWITCH' on the lower instrument panel above the pilot's knees (Appendix B item 35) and then through a circuit breaker on the 'AVIONICS CIRCUIT BREAKER PANEL' in front of the co-pilot (Appendix B item 39). Normal procedure is to leave all the circuit breakers in the 'in' position. The Avionics Master Switch should remain at 'OFF' until the engine has started. Once the engine is running, selecting the Avionics Master Switch to 'ON' supplies power to all the avionic control panels including the autopilot.

In a factory standard Cessna 182 the autopilot computer, incorporating the control/display unit is located at the bottom of the integrated avionics stack in the centre of the instrument panel; this is the 'factory fit' location. The system's other principal components are: the configuration module (located behind the instrument panel, and contains the aircraft - specific control loop gains); the roll servo, which is located in the right wing and operates on the aileron control circuit; and the elevator and pitch trim servos, located in the rear fuselage. The elevator servo cable capstan is connected to the same operating linkage as the manual controls so that the control yokes move when the aircraft is under autopilot control. In a similar manner, the pitch trim servo is connected to the trim tab operating screwjack so that trim servo operation causes the screwjack to back-drive the manual trim circuit, including the trim wheel and its associated indicator on the console. The trim servo provides a manual electric trim (MET) facility when the autopilot is electrically energised but disengaged, ie inactive. Note that MET is not enabled until after the autopilot has been switched on via the Avionics Master Switch and the unit has completed its automated pre-flight test sequence. The MET rate is such that motoring from full nose-up to full nose-down trim takes about 40 seconds; motoring from the TAKEOFF position to full nose up takes about 18 seconds.

The principals of automatic trim are the same as for manual flight. Engaging an autopilot pitch mode (eg vertical speed or altitude hold) clutches the elevator servo to the elevator control circuit which then deflects the elevator by the required amount. This produces 'out of trim' forces in the form of unequal tensions in the cables on the servo cable capstan. Force balance transducers within the unit detect this imbalance and signal the pitch trim servo to move the trim tab in the appropriate direction. As a consequence the control loads are trimmed out, thus equalising the tension in the elevator servo capstan cables and cancelling the signal to the trim servo.

Ground testing of the autopilot

Exploratory ground tests were carried out on another 1998 model Cessna 182S with a similar 'factory fit' avionics package including the same autopilot as fitted to G-BYEG. A diagram showing the layout of the autopilot control panel and the functions of the buttons is attached at Appendix C *(jpg 310kb)*.

Autopilot Self Test

The autopilot computer began its sequence of automated pre-flight tests immediately electrical power was applied. The LED display elements showed the symbols PFT (pre-flight test) with an incrementing single digit as the test progressed. Successful completion of the self-test was confirmed by illumination of all the display elements accompanied by a transient red coloured 'PITCH TRIM' warning on the aircraft system annunciator display (Appendix B Item 13) and a short disconnect tone sounded by a loudspeaker in the cabin roof. Once the self-test had completed, all the display elements extinguished and the control panel appeared to be inactive (ie consistent with an OFF state).

Only the left control wheel had manual electric trim switches. These were fitted on the left handgrip adjacent to the A/P DISCONNECT/TRIM INTERRUPT button. The switches would command the pitch trim servo to move the tab if both were moved simultaneously in the same direction. The MET did not function if the autopilot circuit breaker was pulled. Once the circuit breaker was reset, the MET still did not function until the autopilot completed its sequence of automated pre-flight tests, which lasted for about 30 seconds. When the MET was available and used, the trim wheel (item 34) moved to 'follow up' the trim tab movement. MET operation was essentially silent and the only visual indication of electric trim operation was an amber coloured symbol on the face of the autopilot control panel.

Autopilot isolation

The purpose of the red 'PITCH TRIM' warning on the aircraft system annunciator display is to warn the pilot of an autopilot or auto-trim malfunction. Should this light illuminate in flight, the recommended action is to isolate the autopilot, either by pulling its circuit breaker or by temporarily placing the avionics master switch to OFF until the circuit breaker is located and pulled. These procedures confirm that there is no separate autopilot master or 'OFF' switch to isolate electrical power from the autopilot and electrical trim systems. Consequently, although the 'BEFORE TAKEOFF' checklist requires the pilot to confirm that the autopilot is 'OFF', there is no specific switch to achieve this state. The pilot can only check that the autopilot is disengaged, but in this condition it gives the appearance of being off because the display is blank.

Autopilot engagement on the ground

In common with all the other autopilot buttons, the AP button was compliant in that it moved inwards slightly when pressed but it did not latch into a detent; when pressed and released it always returned to its original position.

Deliberate autopilot engagement on the ground is included within the pre-flight procedures recommended in the Cessna 182 Pilot's Operating Handbook at Section 9 Supplement 11. The test procedures are required before every flight and commence after the autopilot has completed its automated pre-flight tests. The pilot is instructed to test the MET in both directions and to check that pressing the 'A/P DISC/TRIM INT' button adjacent to the MET switches interrupts the MET nose-up trim function but does not isolate it. The next test is to engage the autopilot with the AP button before moving the control wheel in pitch and roll to confirm that the autopilot can be overpowered; the forces required were very modest on the test aeroplane and did not disconnect the autopilot. The autopilot should then be disconnected with the 'A/P DISC/TRIM INT' button on the control wheel before the elevator trim is set to the take-off position manually.

Autopilot engagement in altitude hold mode

During the ground evaluation tests it was noticed that if the ALT button was pressed, the autopilot engaged and the legend ROL ALT appeared on the AP control panel. About three to four seconds later, the elevator trim commenced winding on nose-up trim until it reached maximum deflection; this took about 18 seconds. Whilst the trim was moving, a trim symbol flashed on the autopilot control panel; this was in the form of the letter P above the letter T with an arrow pointing upwards to indicate nose up trim application (see Appendix C Item 11). There were no aural warnings or other indications of trim movement apart from the trim wheel rotating and the flashing symbol. In addition, the autopilot remained engaged when maximum trim deflection was achieved. The positions of the autopilot control panel and trim wheel, at and below the base of the instrument panel respectively, made it unlikely that a pilot looking at the flight instruments or through the windshield would notice either the trim wheel rotating or the flashing trim symbol in his or her peripheral vision.

Potential hazard

The possibility of inadvertently engaging the autopilot before take-off was, to some extent, encouraged by the layout of the 'BEFORE TAKEOFF' checklist in the Pilot's Operating Handbook (see Appendix A). The elevator trim position is item 10 on the checklist whereas the check of the autopilot status is item 17 near the end of the checklist. In between, the engine power checks are accomplished at item 11 and the proximity of the autopilot ALT button to the propeller and mixture controls makes inadvertent pressing of the button a distinct possibility, depending on the pilot's grip of the push-pull type controls. There is another potential opportunity for inadvertent AP operation associated with item 16 of the checklist that calls for setting the avionics and radios to the desired settings. The risk is greatest when setting the transponder because it is immediately above the autopilot control panel. Since this accident the AAIB has been contacted by a Cessna 172SP pilot who believes he inadvertently engaged the KAP 140 autopilot with his knuckles shortly after take-off whilst holding the throttle in the fully open position.

Out of trim control forces

The out of trim control forces associated with full nose-up trim were evaluated in a Cessna 182S aircraft at FL 50. The aircraft was initially configured with almost full fuel, two pilots, 10° flap and full propeller RPM in level flight at 70 KIAS. With full nose-up trim applied, the forward push force on the control wheel was estimated to be between 10 and 15 lbf. However, the push force increased markedly as engine power was increased, reaching an estimated 50 to 60 lbf push at full throttle. An in-trim condition could be rapidly restored by retarding the throttle to give a manifold pressure of 13 inches. Given that the out-of trim force was a function of engine power, and that full power at sea level would be greater than full power at FL 50, the out of trim force on take-off would probably have been greater than 60 lbf.

Accident sequence of events

There is no proof that the autopilot was inadvertently engaged before take-off but the likelihood fits all the known facts and witness observations. If any one of the autopilot AP, HDG or ALT buttons had been pressed before the take-off roll commenced, the autopilot would have engaged and attempted to maintain the vertical speed existing at the time of engagement. In effect, since the vertical speed would have been zero, the autopilot signals would have been consistent with attempts to maintain level flight. In the absence of aerodynamic loads, the elevator would have drooped under its own weight, causing a difference in tension in the elevator servo capstan cables. This difference would have caused the pitch trim servo to be signalled in the normal manner, thus causing movement of the trim tab. With insufficient airflow to produce any aerodynamic force on the tab that would lift the elevator and eliminate the tension differential, the auto-trim function would have continued to apply nose-up trim until the trim actuator cables reached their stops.

If inadvertent autopilot engagement was noticed at item 17 on the checklist, the pilot would have been prompted to disengage the autopilot but he would not have been prompted to re-check the elevator trim position. Assuming more than 18 seconds had elapsed since the button was accidentally pressed, the elevator trim tab would have been at the full nose-up setting and the aircraft would have tended to pitch-up as soon as the tailplane and elevator became aerodynamically effective. A flight test showed that immediately after take-off, the force required to overcome the pitch trim setting and maintain a suitable pitch attitude could have exceeded 60 lbf. The exertion of a 60 pound or more push force to counteract the pitch-up with one hand could be too much for some pilots and the operation of the MET system would have been too slow to avoid an uncontrolled pitch-up.

Examination of autopilot components

The autopilot components were taken to the manufacturer's facility in the USA for test and examination under AAIB supervision. The servos all tested satisfactorily; there were minor shortcomings relative to the production test schedules in respect of the pitch and roll servos but these were attributed either to the effects of the impact or slight deterioration in service.

The KAP 140 configuration module, which 'tells' the autopilot computer that it is installed within (in this case) a Cessna 182, has an error register, contained in non-volatile memory (NVM), that logs up to 48 error messages. Successive messages overwrite the earliest ones. The system was designed to enable on-board troubleshooting of autopilot problems to be conducted by a service engineer equipped with a lap-top computer. Each message contains an error code, a brief description, a 'power cycle' number and a 'delta time' value. The last two are respectively a sequential number, from an arbitrary datum, of autopilot electrical power applications, together with the elapsed time to the detected fault.

The configuration module from G-BYEG was connected to an intact autopilot computer on a test facility. The latter had been modified, by means of a software change, to prevent it writing to the NVM in the configuration module when electrical power was switched on, thereby losing potential evidence. Despite some physical damage to the module, it was found that the error log could be accessed and displayed on a computer monitor. The 'delta time' column indicated that most of the errors listed occurred within minutes or even seconds of switching the power on and were probably spurious. For example, the message 'NAV DENIED' may have been due to no navigation aids having yet been tuned by the pilot. However, an 'AUTOTRIM RUNAWAY' fault was recorded more than 19 minutes after switching on power cycle No 157 (the test bench power cycle No was 197). Although the fault messages were not date stamped, this particular message occurred 39 power cycles before the accident flight, which was power cycle No 196. The 39 cycle difference was reasonably consistent with the documented evidence of the pitch excursion on 27 August 2000, 35 flights prior to the accident. The 4 cycle difference was probably due to the avionics being switched on a number of times for maintenance purposes when the aircraft was not flown. Most importantly, no fault messages were logged for power cycle Nos 191 to 196 inclusive.

Autopilot computer tests

The autopilot computer from G-BYEG had been damaged in the accident but after a new control/display fascia had been fitted, it was found to function normally. The series of tests were completed by connecting together the computer, configuration module and the servos, when the latter were observed to engage normally. A single press of either the AP or the HDG buttons engaged the autopilot in the zero vertical speed pitch mode; the corresponding lateral modes were roll angle and heading hold respectively. Pressing the ALT button engaged the autopilot into altitude hold and roll angle hold modes. Pressing the NAV, APR and REV buttons had no effect because there were no valid navigation data for the autopilot to process and it would not engage.

Summary

The examination of the autopilot components indicated that there had been no pre-impact malfunction. Indeed, the error log in the configuration module provided some confidence in the system's ability to detect a genuine fault (the August 2000 pitch excursion). Thus a similar amount of confidence can be placed in the absence of recorded faults over recent flights up to and including the accident flight.

Moreover, tests on an intact aircraft indicated that an autopilot malfunction was not necessary in order to produce maximum trim. A simple process, which insidiously applied full trim with no associated audio or configuration warning, was demonstrated repeatedly. All that was required was one inadvertent press on one of the autopilot AP, HDG or ALT buttons after completing item 10 of the BEFORE TAKEOFF checklist. To some extent, the layout of the checklist and the relative positions of the engine and avionic controls contributed to the probability of inadvertent autopilot engagement. Whichever button was pressed, the autopilot would engage in a pitch mode that demanded level flight. If the pilot noticed that the autopilot was engaged before take-off and disengaged it, there was no checklist prompt to re-check the elevator trim position. If full nose-up trim had been set before take-off, the push force on the control wheel necessary to control the aircraft's tendency to pitch up at initial climb speed could have been too much for the pilot to exert and hold. There was no indication that the pilot had trimmed forward, but even if he had, the trim tab gearing was such that he would probably not have been able to re-trim in time to prevent the aircraft stalling, whether he used the MET or the trim wheel.

Wider Implications

Since 1996 the Bendix/King KAP 140 autopilot has been installed in several aircraft types including the Cessna 172, 182 and 206 series. Two versions of the autopilot can be fitted: a single axis (roll only) and a twin axis (pitch and roll modes). The single axis version is not susceptible to inadvertent elevator trim operation. The twin axis version is offered with the autotrim function as an option. However all systems currently in service are fitted with autotrim. At the time of the investigation more than 3,500 KAP 140 systems had been sold, of which about 2,000 were twin axis.

Safety Recommendations

The AAIB issued the following safety recommendations to recipients on 24 May 2001.

2001-55 The Civil Aviation Authority should take early measures to inform all owners and operators of aircraft on the UK register which may have a Bendix/King KAP 140 two axis autopilot of the dangers associated with inadvertent autopilot engagement in altitude hold mode before take-off.

2001-56 The Cessna Aircraft Company should review the layout and content of its BEFORE TAKEOFF checklists to minimise the dangers associated with inadvertent autopilot engagement in altitude hold mode before take-off.

2001-57 The Cessna Aircraft Company should review the integration of the Bendix/King KAP 140 autopilot into its aircraft products, preferably to provide a facility that prevents or suitably warns of undemanded or unexpected electrical activation of the elevator trim motor before take-off. Repositioning the autopilot control/display unit to a position less susceptible to inadvertent engagement could additionally be considered.

2001-58 The US Federal Aviation Authority, as the type certification authority, should ensure that effective action is taken to address the dangers associated with inadvertent engagement of the Bendix/King KAP 140 autopilot in altitude hold mode before take-off.

Safety Actions taken

2001-55 On 28 June 2001, the CAA issued Letters to Operators Nos 2235 and 2236. These letters informed owners of UK registered Cessna and Piper aircraft that might have a KAP 140 autopilot of the inherent dangers of autopilot authority over an electric trim system.

2001-56 Following a visit by AAIB Inspectors to the aircraft manufacturer's headquarters, the company wrote to the AAIB on 25 January stating: *"Cessna is currently working on a revision of the Before Takeoff checklist for all Cessna models equipped with the KAP-140 autopilot. The revision will relocate the check elevator trim procedure directly below the "Autopilot - Off" instruction"*.

2001-57 In their letter of 25 January, the aircraft manufacturer stated: *"Cessna is also testing new software for the KAP-140. The software is likely to require a pilot to depress the AP button for one-*

half second to turn the autopilot on, and then depress the HDG or ALT buttons to engage those autopilot modes. An audio feature is also being tested. The audio feature will advise the pilot aurally if the elevator trim runs for more than 5 seconds during normal operation. Before any firm decisions are made, the system must be evaluated for its effectiveness versus its potential to confuse the pilot or create a false sense of emergency. When the new autopilot software is found acceptable, Cessna will inform owners of where their aircraft can be taken to receive the update to the system".

2001-58 The Federal Aviation Authority (FAA) responded to this recommendation in a letter dated 9 July 2001. In the Authority's opinion, a full nose-up trim condition resulting from an inadvertent autopilot engagement should not have resulted in an uncontrollable condition. This letter was followed by another dated 9 August in which the FAA informed the AAIB that the Authority's Safety Recommendation Review Board had classified this recommendation as 'Closed-Not Adopted'.

Further Safety Action

The AAIB and the FAA agreed that it was **possible** to hold the out-of trim forces during take-off with full nose up trim applied but they disagreed on the **probability** of a pilot actually doing so. Also, the FAA seemed to have overlooked the risk that the push force might be too much for a slightly built pilot to hold. More importantly, recognising the situation would probably be beyond the average private pilot's experience. The extreme trim condition was likely to result in the aircraft becoming airborne prematurely and the push force required to regain control would probably exceed most pilots' expectations for an out-of-trim take-off.

The AAIB's opinion was reinforced by the American National Transportation Safety Board's publicly available accident records concerning light single-engined Cessna aircraft. Disregarding the reasons why the elevator trim was found at an abnormal setting, there were three comparable accidents where the trim was at full nose-up and control was lost. There were also three more accidents to Cessna single piston-engined aircraft caused by a nose-down out-of-trim condition.

On 16 August 2001 the Chief Inspector of Air Accidents wrote to the FAA expressing his surprise at the their decision. He reiterated the AAIB's position that the out-of-trim condition represents a serious hazard during the take-off and initial climb, and asked the FAA to reconsider its response. The FAA have yet to respond to the Chief Inspector's letter.