

Aerovodochody L29 Delfin, G-MAYA

AAIB Bulletin No: 3/2001

Ref: EW/C2000/08/01 - Category: 1.2

Aircraft Type and Registration: Aerovodochody L29 Delfin, G-MAYA

No & Type of Engines: 1 Walter M701C-500 turbojet engine

Year of Manufacture: 1973

Date & Time (UTC): 18 August 2000 at 1321 hrs

Location: Eastbourne, East Sussex

Type of Flight: Air Display

Persons on Board: Crew - 1 - Passengers - None

Injuries: Crew - Fatal - Passengers - N/A

Nature of Damage: Aircraft destroyed

Commander's Licence: Airline Transport Pilot's Licence

Commander's Age: 63 years

Commander's Flying Experience: 18,222 hours (of which 235 were on type)
Last 90 days - 146 hours
Last 28 days - 46 hours

Information Source: AAIB Field Investigation

History of the flight

The pilot was flying the aircraft in a display as part of the 'Eastbourne Airbourne' airshow at Eastbourne, Sussex. He had flown a similar display successfully at the same show on the previous day. On the morning of the accident the pilot prepared the aircraft at Manston Airport, Kent, and departed from there at 1253 hours. A full fuel load was carried, including full underwing tanks, giving an endurance of approximately 1 hour 30 minutes. The aircraft was seen performing some aerobatics en-route to the display venue by another display pilot. On arrival in the Eastbourne area the pilot made radio contact with the airshow radio information service and commenced his display at 1316 hours.

During the display the aircraft was due to perform a version of a 'Cuban Eight' along the display line. Each half of the 'Eight' comprised a half roll descending from the top of a loop, followed by a full aileron roll on a descending 45° angle. (See Figure 1.) Subsequent analysis of video footage

indicated that the first half, with one and a half aileron rolls at a 45° angle of descent, was carried out normally.

The second half was attempted but during the entry to the full descending aileron roll the nose of the aircraft pitched up slightly, causing the aircraft to turn off the intended roll axis. Then, when the aircraft rolled through the inverted, the nose dropped to a near vertical position and a high rate of descent developed. From this very steep nose down position the pilot rolled the wings level and then attempted to pull up. Condensation trails could be seen from the wing tips but there was insufficient height in which to recover. The aircraft then began a banked turn to the left just before entering the water.

The impact with the water was in a 15° nose down attitude with 40° of left bank. The aircraft immediately broke up, lighter pieces being thrown into the air and heavier parts sinking into the water. Nearby rescue boats were over the site of the impact within 30 seconds and located the pilot but he had suffered fatal injuries. There had been no attempt at ejection from the aircraft.

Display venue

The 'display line' was established 230 metres offshore parallel to the shoreline at Eastbourne and was marked by a number of orange buoys. The display datum point was the 'Wish Tower', an old Martello tower centrally located on the seafront. An air traffic information service was operated from the 'Wish Tower' for the 4 days of the airshow. There were a number of safety boats available on the water, one of which was in radio contact with the shore. The written flying display arrangements sent to pilots included the following note: "Pilots are reminded of the need for extra attention to height judgement when low flying over calm water and with an ill-defined horizon." A copy of a section of the map issued to display pilots is reproduced at Figure 2.

Pilot experience

The pilot had originally been trained to fly while serving in the Royal Air Force (RAF). His final tour of duty was as a member of the Red Arrows display team flying Hawker Siddeley Gnat aircraft. After leaving the RAF he continued to fly professionally, both as a flight instructor and as an examiner. He was closely concerned with the introduction of the L29 type to the UK and had recorded 235 hours on L29/L39 types since 1997. His previous recorded jet aircraft flight prior to 1997 was during his service with the RAF in 1975. A large proportion of his recent flight time on the L29 aircraft was spent in training other pilots in preparing and practising aerobatic displays. The Display Authorisation (DA) he held allowed him to conduct aerobatic manoeuvres down to 300 feet agl and flypasts down to 100 feet agl. The DA was renewed with an approved examiner 3 days prior to the accident at which time the complete display sequence was demonstrated. Excepting the display on the 17 August, his previous display flight was on 12 June 1999.

The pilot had carried out a number of training and practice flights over the sea in conditions similar to those at Eastbourne. It was noted that he tried to ensure when practising over the sea that sandbanks would be exposed to give a surface reference. It was his usual practice, in conditions with poor visual reference, to use the attitude indicator to assist with checking pitch and roll attitudes during manoeuvres.

The manoeuvre being carried out immediately prior to the accident would not have imposed a high 'g' level on the pilot and there was no evidence of any pre-existing medical condition having had any influence.

Meteorology

The weather conditions at Eastbourne at the time of the accident were overcast cloud at 7,000 to 9,000 feet, visibility of 15 km, surface wind from 190° at 5 to 8 kt. Sea conditions were calm and the sea sky horizon was distinct at sea level. When airborne in the area the sea sky horizon was reported by other pilots to have been poor. The conditions on the previous day while the pilot was flying the display differed in that the cloud cover was scattered giving areas of sunshine and the horizon was distinct at all levels.

The aircraft

The L29 Delfin is a tandem two seat basic and advanced jet trainer designed to Russian military requirements. Production was carried out in Czechoslovakia from 1963 to approximately 1974. The aircraft has straight wings and is of straightforward construction. The primary flying controls are manually operated, with the flaps and airbrakes being operated by a hydraulic system.

The subject aircraft was delivered to the Soviet airforce in 1973, where it remained in service until 1991. After a period in storage it was purchased by an Estonian aircraft dealer in 1995. Some modifications were carried out at this time; they included removal of some military equipment, such as the gun sight, and replacement of the metric altimeters with 'western' types, which had two pointers and a millibar subscale. The aircraft was imported into the UK in 1997 and was further modified by the addition of a VHF transceiver and the removal of more military equipment. The oxygen system was also disabled.

The aircraft was fitted with a modified MIG 15 ejection seat system, activated by pulling a lever attached to the right armrest. The force required to initiate ejection was considerable; a 30 to 40 kg action on the lever being required. Pilots flying the aircraft considered the system unsuitable for use below 1,000 feet agl and 90 kt.

Wreckage recovery

The aircraft impacted the sea close to one of the display line marker buoys where the depth of water varied between 3 and 7 metres, according to the tide. Some of the lighter items of wreckage were subsequently distributed along the coastline by tidal currents and were washed up on the beach. During the days following the accident, the Sussex Police Diving Unit mounted a recovery operation. However the divers' time on the seabed was limited to an hour or so either side of high and low tides, the currents at other times making conditions unworkable. In addition, the underwater visibility was poor and the rocky nature of the seabed made the location of pieces of wreckage difficult. As a consequence, less than half the aircraft was recovered. The wreckage that was recovered was taken to AAIB's facility at Farnborough; this included the empennage, the engine, a section of the fuselage spine, miscellaneous wing panels and some cockpit items, including both ejection seats.

Engineering investigation

General

The limited quantity and high degree of fragmentation of the wreckage meant that it contributed little to the overall investigation. In particular, only a small proportion of the flying controls were recovered, thus it was not possible to establish if there had been a jam or restriction.

Examination of the engine showed that considerable rotational damage had occurred to the compressor and turbine, indicating a high RPM at impact. This was in agreement with the video recording, the audio track of which indicated that the engine was functioning normally throughout the display.

The aircraft was fitted with an attitude indicator in each cockpit, each one slaved to a master gyro system. This instrument was considered to be reliable and useable throughout a display by the pilots who flew the aircraft. Among the limited cockpit instrumentation recovered was an attitude indicator, although it was not established whether it came from the front or rear cockpit. The indication was frozen at approximately 15° nose down and 40° left bank, ie the same as the impact angle observed on the video footage. This suggested that the attitude indication system had been functioning correctly.

Ejection seats

Both seats, which were operated by pyrotechnic cartridges, were examined and disarmed by a specialist organisation. Neither seat cartridge had detonated. The rear seat was found to be in the safe condition with the safety pin inserted through the firing unit. The top of the front seat gun had been damaged in the impact, although it is assumed that the safety pin had been removed prior to flight. Operation of the seat handle would cause the firing pin to strike the cartridge. There was no evidence of a dent made by the firing pin on the cartridge base, suggesting that ejection had not been initiated.

Video analysis

A large number of people witnessed the accident and a number of video recordings, audio recordings and still photographs were handed in. Video footage was also obtained of the display on the previous day for comparison. This evidence allowed a careful study of the flight manoeuvres that had been performed but did not give sufficient detail to be able to analyse control surface positions. Some estimates of aircraft speed were obtained and roll rates were measurable. It was not possible to estimate the height at the top of any manoeuvre but times taken for each pull up were measured. The aircraft did not carry a transponder and there was no recorded radar data available.

No significant difference was observed in the aircraft roll rates from one half of the final 'Cuban Eight' to the other. The measured roll rate for all of the aileron rolls performed during the display was 75 to 90 degrees per second, each full roll taking between 4 and 5 seconds to complete.

Discussion

The pilot was known to have been meticulous regarding achieving predetermined 'gate' heights before commencing any manoeuvre. Video recordings showed that the time to pull up into the final half of the Cuban from level flight was the same as on the other occasions so unless the speed was considerably less a similar height at the top should have been attained. Both of these factors suggest that the pilot had sufficient height to carry out the manoeuvre he was attempting.

Weather conditions for the display were not good in some areas but the pilot had practised under similar conditions. The lack of a clear horizon and surface reference over a calm sea would have made determination of pitch attitudes more difficult, in particular establishing the 45° descent for the aileron roll. The potential for pilot disorientation during a manoeuvre would also be greater under these conditions.

The DA issued to a pilot refers to a minimum height but that should not necessarily be considered a target height. A pilot would set his own higher minimum for any particular day based on the conditions. From observation of the video footage it appears that the pilot was operating down to his DA height during this display.

It was understood to be the pilot's usual practice to perform the half roll from the top of the loop, hold the wings level attitude briefly, pitch the nose up positively by 10 to 15 degrees, check that the 'gate' height of 1,500 feet was available and then to enter the full aileron roll. This was borne out by video footage from earlier in the display. On this occasion there was no hesitation before the full roll and no pitch up seen until the roll started. This deviation from his normal practice may indicate that there was a problem. It must be considered a possibility that the pilot suffered a temporary loss of reference, disorientation or disability, or that there was a problem with the aircraft or loose item within the cockpit. The aircraft subsequently attained a steep nose down attitude leading to an associated large height loss which was to prove crucial. Whatever had occurred the pilot was able to carry out a recovery from the steep nose down, banked attitude to a wings level attitude, but then had insufficient height remaining to pull out of the dive.