Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A05O0125

POWER LOSS AND COLLISION WITH TERRAIN

PROGRESSIVE AERODYNE SEAREY C-GCWR
OSHAWA AIRPORT, ONTARIO
25 JUNE 2005

Canada

Aviation Investigation Report

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Oshawa Airport, Ontario
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Report Number A05O0125

Summary

The Progressive Aerodyne, Inc. SeaRey amphibious aircraft (serial number DK173, registration C-GCWR) was taking part in the Canadian Aviation Expo at the Oshawa Airport. The flight was planned as part of a two-plane demonstration with another SeaRey aircraft, registration C-GJIB. The plan was to take off in formation with C-GCWR leading, climb to 1000 feet above ground level, turn left, and join a left downwind for Runway 30. When south of the airport, the aircraft were to split and perform a coordinated series of non-aerobatic manoeuvres that had been briefed and practised.

Before take-off, C-GCWR had radio problems, so C-GJIB led the take-off and C-GCWR was in a right-echelon wingman position. The aircraft were cleared to take off in formation on Runway 30 from the intersection of Runway 04/22. After take-off, the lead aircraft climbed out the extended centreline of the runway. C-GCWR made a left turn as if leaving the formation toward the southwest, then turned to the right to again follow the lead aircraft. C-GCWR then pitched nose up and appeared to stall and spin to the left. The propeller was turning as the aircraft descended. The aircraft continued in a descending turn to the left until it struck the ground in a residential construction area. The aircraft was destroyed, and the pilot was fatally injured. There was no post-impact fire. The accident took place at 1339 eastern daylight time at 43°55'25" N, 78°54'55" W.

Ce rapport est également disponible en français.

Other Factual Information

The most recent weather report from the Oshawa Airport at 1300 eastern daylight time[1] was scattered cloud at 5000 feet above ground level (agl), visibility 3 statute miles in haze, wind 240° True (T) at 10 knots. Weather was not a factor in the accident.

The pilot held a valid airline transport pilot licence, issued by Transport Canada, endorsed for single- and multi-engine land and sea aeroplanes, and a Group 1 instrument rating. He had owned and operated C-GCWR since 2003 and had accumulated about 280 hours in it, with about 300 landings on land and 400 on water. The pilot was an experienced career airline pilot. He was known to be disciplined, and he had adeptly handled a previous critical emergency in this aircraft. Based on the autopsy and medical records, there was no indication that incapacitation or physiological factors affected his performance.

Communications between the aircraft and air traffic control were reviewed. Transmissions from C-GCWR were garbled and unreadable when C-GCWR requested taxi clearance before the take-off. As a result, the lead changed to C-GJIB. C-GJIB obtained a take-off clearance for both aircraft and communicated with C-GCWR by hand signals, a normal practice in formation flying. Moments before impact, there was a three-second garbled transmission that was similar to earlier ones from C-GCWR. Nothing intelligible was discernable from the tape when it was analysed by the TSB Engineering Laboratory.

The aircraft struck a mound of earth behind foundations of residential housing under construction. It was on an easterly heading with about 20 degrees of left bank (all measurements are approximate). The left side of the fibreglass hull struck a concrete sewer casement that was protruding from the mound of earth. The aircraft stopped abruptly, nosing over into the depressed area between two mounds of earth. The cockpit came to rest nearly vertically and nose down. The aft fuselage buckled and continued beyond the vertical. Distance from the beginning of the ground scar to the nose was about 15 feet. Beyond the second pile of earth was a 400-foot length of unobstructed roadway beyond which were 2000 feet of driving range and a golf course.

The cockpit area was essentially intact. The three-point harness tore out of the tubular aluminium frame at the common attachment point of the seat and shoulder belts. There was no indication of pre-impact structural damage. Flight controls were examined on site and found to be continuous and free. The elevator trim was full aircraft nose up. The flaps were up. One blade of the three-bladed Kiev Prop propeller was embedded approximately 18 inches in the earth. The propeller blade was cracked laterally but not broken, and displayed only radial scores, indicating that it was not rotating when it dug in.

The wreckage was taken to the TSB regional examination facility. The instruments and global positioning system (GPS) were removed and examined by the TSB Engineering Laboratory. The vertical speed indicator had a very heavy pointer mark at 830 feet per minute (fpm) down that was attributed to impact, and the airspeed indicator had a faint counter-weight mark in the

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1 All times are eastern daylight time (Coordinated Universal Time minus four hours).

range of 20 to 40 mph. The GPS yielded time, position, and altitude information indicating that the aircraft climbed at 60 to 65 mph indicated airspeed and reached a maximum height of 322 feet agl before beginning the final dive. The flight path is shown in Appendix A and the flight data derived from the GPS and other known data are presented at Appendix B.

The Rotax 912UL-2 engine, serial number 4401361, was sent to Rotech Research Canada Limited, the Canadian factory representative for Rotax engines, and was examined by TSB and company personnel. Rotational scrape marks on the inside of the plastic ignition cover, as a result of contact with the flywheel, indicate that the engine was operating at the time of impact. It was not possible to determine the power being produced. The impact forces damaged one ignition system,[2] rendering it inoperable, and detached one carburettor, resulting in engine stoppage at impact. With a low-inertia propeller, the engine stopped rotating before the aircraft came to rest, and the propeller did not have rotation damage.

Discrepancies were noted in the fuel system including primer ports that were not capped, an in-line fuel filter that was installed backwards with two hose clamps on the outlet side of the filter and one clamp on the inlet side, and a loose fitting on the gascolator. These conditions could allow air to be introduced to the suction side of the fuel pump's primary feed line causing inadequate fuel flow and loss of engine power. The air filters were dirty and were distorted as a result of the impact. When the ignition trigger was reinstalled, the carburettors were reattached, and a serviceable fuel/air system was attached, the engine ran smoothly and produced full power.


Photo 1. SeaRey C-GCWR

The SeaRey is a two-seat, tube, fabric, and composite amphibious aircraft that is built from a kit manufactured by Progressive Aerodyne, Inc. The type can be registered in either the ultralight or the amateur-built category. There are 22 SeaRey aircraft registered in Canada, 9 amateur-built, 11 advanced ultralights, and 2 basic ultralights. The aircraft kits do not include cockpit furnishings, control panel, and other controls. The individual builder provides the material and designs the installation to suit the owner's needs. In C-GCWR, the electrical trim and electrical flaps were controlled by four push-button switches in a diamond arrangement on the top of the control stick. The fore and aft switches activated aircraft nose-down and aircraft nose-up pitch trim, respectively, while the switches to the left and right activated the flaps down and up, respectively. The switches were exposed and the pilot was known to have inadvertently activated the flaps or trim during previous flights.

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2 The position of the ignition trigger most likely shifted due to impact forces resulting in it being struck and damaged by the flywheel.

Take-off configuration for the SeaRey is flaps 20°, trimmed fully aircraft nose up. Best angle climb is obtained at 60 mph, flaps 20°. Best rate climb is at 65 mph, flaps 10°. Flaps are not normally retracted to 10° until a speed of 60 to 65 mph is reached. On the day of the occurrence, the lead aircraft climbed at 60 mph with flaps 20°. Airport patterns are normally flown at 70 mph, flaps 10°, and final approach at 70 mph, flaps 20°. Best glide speed for the SeaRey is 70 mph with flaps 10°, which will give an engine-off rate of descent of 650 fpm. With flaps up, the rate of descent is about 700 fpm at 72 mph and as much as 1000 fpm at lower speeds. The aircraft is known to be susceptible to increased rates of descent if airspeed is allowed to drop below 1.3 V_s on final approach.[3]

The aircraft is normally trimmed fully aircraft nose up for take-off because of the nose-down pitching moment of high power on the high-mounted engine. Control forces are relatively light and manageable in mis-trim situations. Wings level, the aircraft typically stalls with a classical g-break at all flap settings. Full aft elevator control input is required to reach the stall. There is no pre-stall buffet.

Stall recovery is accomplished by lowering the nose and applying power. The aircraft normally recovers with an altitude loss of less than 100 feet. In accelerated stalls, recovery is immediate on relaxation of aft elevator control with minimal altitude loss. Aileron control is effective at the stall. The aircraft displays no propensity to spin. The aircraft's characteristics were verified during the investigation by flying another SeaRey. The flying qualities of C-GCWR were not known to deviate from those characteristic of the type.

According to the "Special Certificate of Airworthiness (Amateur-Built)," C-GCWR had a maximum gross weight of 1500 pounds. The climb report submitted to Transport Canada to satisfy the requirements of Section 549.111 of the *Canadian Aviation Regulations* (CARs) indicated a rate of climb of 400 fpm. The gross weight at the time of the accident was estimated to be between 1250 and 1300 pounds with a mid-range centre of gravity. With this loading, the wings-level stall speed was estimated to be approximately 50 mph with flaps up, 42 mph with flaps 20°.

Tests by the kit manufacturer indicate that, in the event of an engine failure during climb out, a minimum of 450 feet of altitude is required to carry out a 180-degree turn and land. This is based on an initial condition of 65 to 70 mph and flaps 20°, a representative speed and configuration for a normal climb after take-off. To accomplish this, the nose was pushed over immediately upon loss of power to an attitude of about 20° nose down while simultaneously rolling into a 45° bank turn. As soon as the aircraft had turned through 180 degrees, it was rolled out and flared. These tests were carried out by an experienced company demonstration pilot. It was noted that the aircraft is a low-inertia high-drag machine, making loss of airspeed easy, but the regaining of it difficult. To regain 10 mph of speed requires a lot of nose-down attitude and a few hundred feet of altitude loss.

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3 V_S = stall speed

Analysis

The investigation focused on the beginning of the turning descent that culminated in the collision with terrain. Although some reports suggested that the aircraft stalled and spun, airspeeds derived from the GPS data indicate an 18 mph margin over flaps 20° stall speed or 10 mph margin over flaps-up stall speed. Airspeed remained above the estimated stall speed, adjusted for the calculated bank angle, throughout the descending left turn. In view of the predictable stall characteristics of this aircraft type and its lack of propensity to spin, it was concluded that the aircraft did not stall or spin before entering the descent.

There was no indication of pilot incapacitation or aircraft control system malfunction that would suggest loss of control of the aircraft. At impact, the aircraft was nearly rolled out of the bank and the descent rate was almost arrested, indicating that the pilot was actively controlling the aircraft, most likely attempting to align it and land on the clearway beyond the point of impact. This implies that the aircraft must have suffered a loss of engine power; otherwise, the pilot could easily have recovered at any point during the descent. Also, the aircraft was observed to pitch nose up at the top of its trajectory, which is consistent with a reduction of engine power in an aircraft with a high thrust line.

The engine was operating at impact. During the descent, the aircraft lost significantly less altitude than had been experienced by the manufacturer during controlled tests that simulated total engine failure. It was therefore unlikely that the loss of engine power was total. The pilot was experienced, disciplined, adept, and he was aware of the low-inertia, high-drag characteristic of the SeaRey. These factors suggest that he would not have attempted a turn back to the airfield from a height of 322 feet in the event of a total engine failure.

Also, shortly after take-off, the aircraft made a turn, inconsistent with normal formation procedures or with the planned routine. Before the turn, the climb rate was more than 400 fpm, consistent with the climb rate contained in the climb report. During the turn, the rate of climb dropped to 150 fpm, indicating a partial loss of engine power. The left turn is consistent with the pilot recognizing a problem and initiating return to the airport.

The climb rate began to increase, returning to over 400 fpm, indicating a recovery of engine power. C-GCWR then turned back to the right toward the lead aircraft, which would be consistent with the pilot returning to the air show plan, indicating that he believed the problem to be transitory and now resolved. Taking into account the discrepancies in the fuel system, this sequence is consistent with air being introduced into the fuel system causing a transitory degradation of engine performance.

When power degraded for a second time, the pilot most likely decided again to return to the airfield. Such a decision is consistent with the expectation that the power loss was partial, with sufficient power available to return to the field, or that the situation was transient and power would recover. Either expectation is consistent with the earlier degradation, followed by recovery, of engine power.

The aircraft flaps were in the up position at impact, which is inconsistent with either the climb or approach phases of flight. The design of the flap and trim control switches on the top of the control stick rendered them susceptible to inadvertent operation. The pilot is known to have operated them unintentionally in the past. It is likely that the flaps were inadvertently raised by the pilot when he was manoeuvring after the partial loss of engine power. The resulting increase in aircraft stall speed would have made the airspeed less than 1.3 V_s, exacerbating the performance deficit of the aircraft. The severity of the net power loss was probably not evident to the pilot until he was already established in the descending turn and had no realistic option but to aim for the clearway behind the houses under construction.

At impact, the propeller did not strike the engine pylon or the boom tube, indicating low vertical impact forces on initial contact with the mound of soft earth. However, the hull was penetrated when it struck the concrete sewer casement, creating a very high longitudinal deceleration. The resulting force overloaded the seat and shoulder belt attachment, resulting in the pilot striking the instrument panel.

The following Engineering Laboratory report was completed:

LP 119/2005 – Fuel Filter Examination, Progressive Aerodyne Inc. SeaRey, C-GCWR, 25 June 2005.

This report is available from the Transportation Safety Board of Canada upon request.

Findings as to Causes and Contributing Factors

1. Discrepancies in the fuel system most likely allowed air into the fuel line, causing a partial loss of engine power.

2. While the pilot was turning back toward the airport, the flaps were raised, probably inadvertently, causing an increased rate of descent so that the pilot had insufficient altitude to manoeuvre to an open area for landing.

3. The aircraft struck a concrete sewer casement, causing high deceleration and overloading the common attachment point of the seat and shoulder belts, with the result that the pilot struck the instrument panel and received fatal injuries.

Safety Action Taken

The Canadian distributor of SeaRey aircraft has taken the following safety actions:

- Information describing the dangers of using the Ray Allen Company G205 stick grip to actuate trim and flaps has been posted to the SeaRey technical website (a private website at which SeaRey owners and operators in North America, Europe and Australia access technical assistance in building, operating and maintaining their aircraft).

- The Recreational Aircraft Association has been asked to warn its members about the use of Ray Allen Company stick grips and to contact the Ray Allen Company for a solution to the problem of inadvertent activation by incorporating switch guards on stick grips.

- A recommendation has been posted to the SeaRey technical website that fuel manifolds with return-to-tank fuel lines be incorporated into all Rotax installations.

- The Canadian distributor for Rotax engines has been asked to request Bombardier-Rotax GmbH to configure new engines with a fuel manifold with return-to-tank fuel lines.

- A recommendation has been posted to the SeaRey technical website that auxiliary fuel pumps be incorporated in all high engine/low tank Rotax 912 installations for the following reasons:

  a. It provides a backup pump to supply the carburettor float bowls if the engine-driven pump should fail.

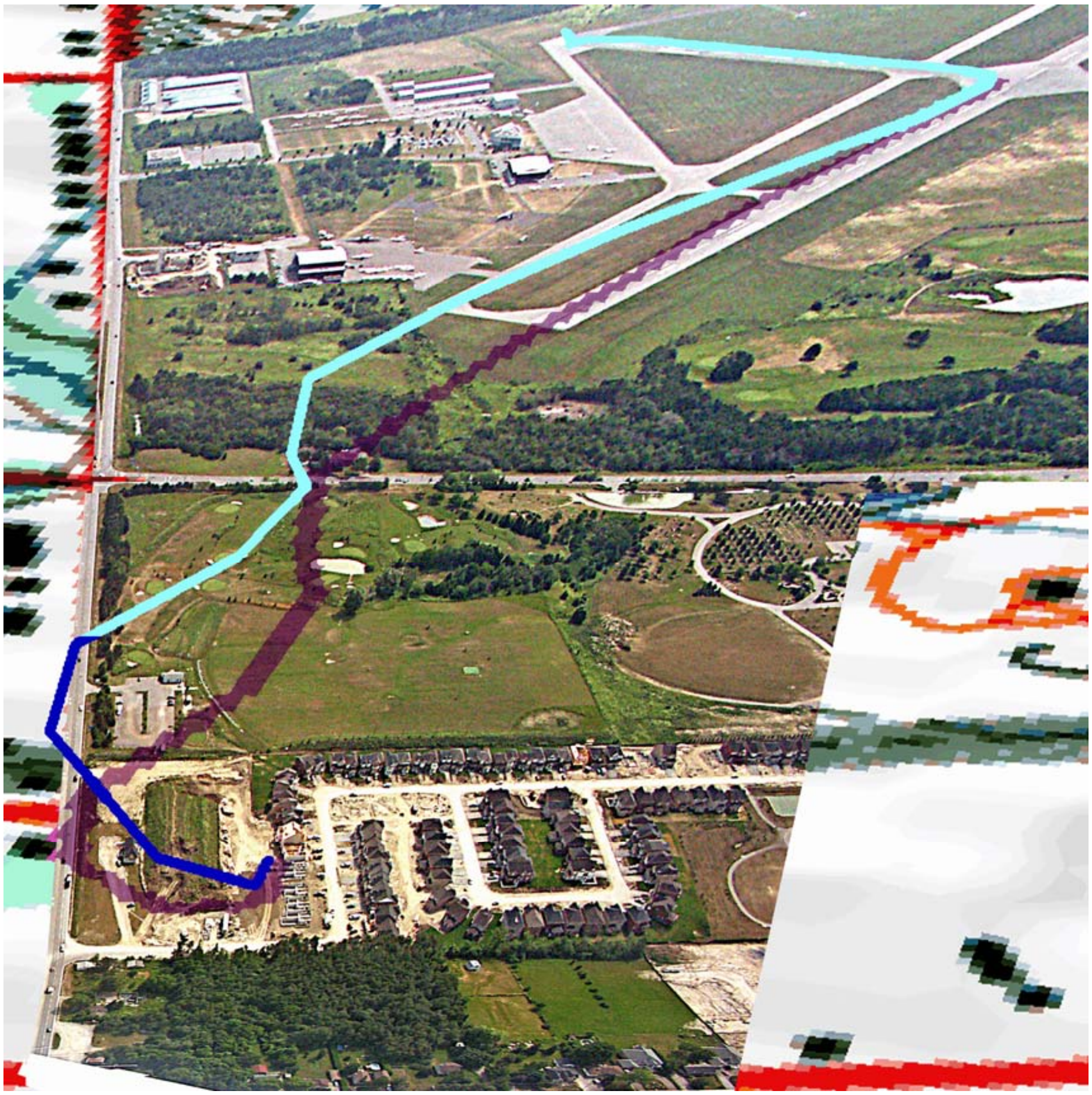
  b. It prevents low pressure (suction) upstream from the engine-driven pump perhaps helping to prevent air from entering the fuel line at a loose fitting and possibly the formation of a vapour lock.

  c. It provides a way to pressurize the fuel lines during pre-flight to check for fuel leaks.

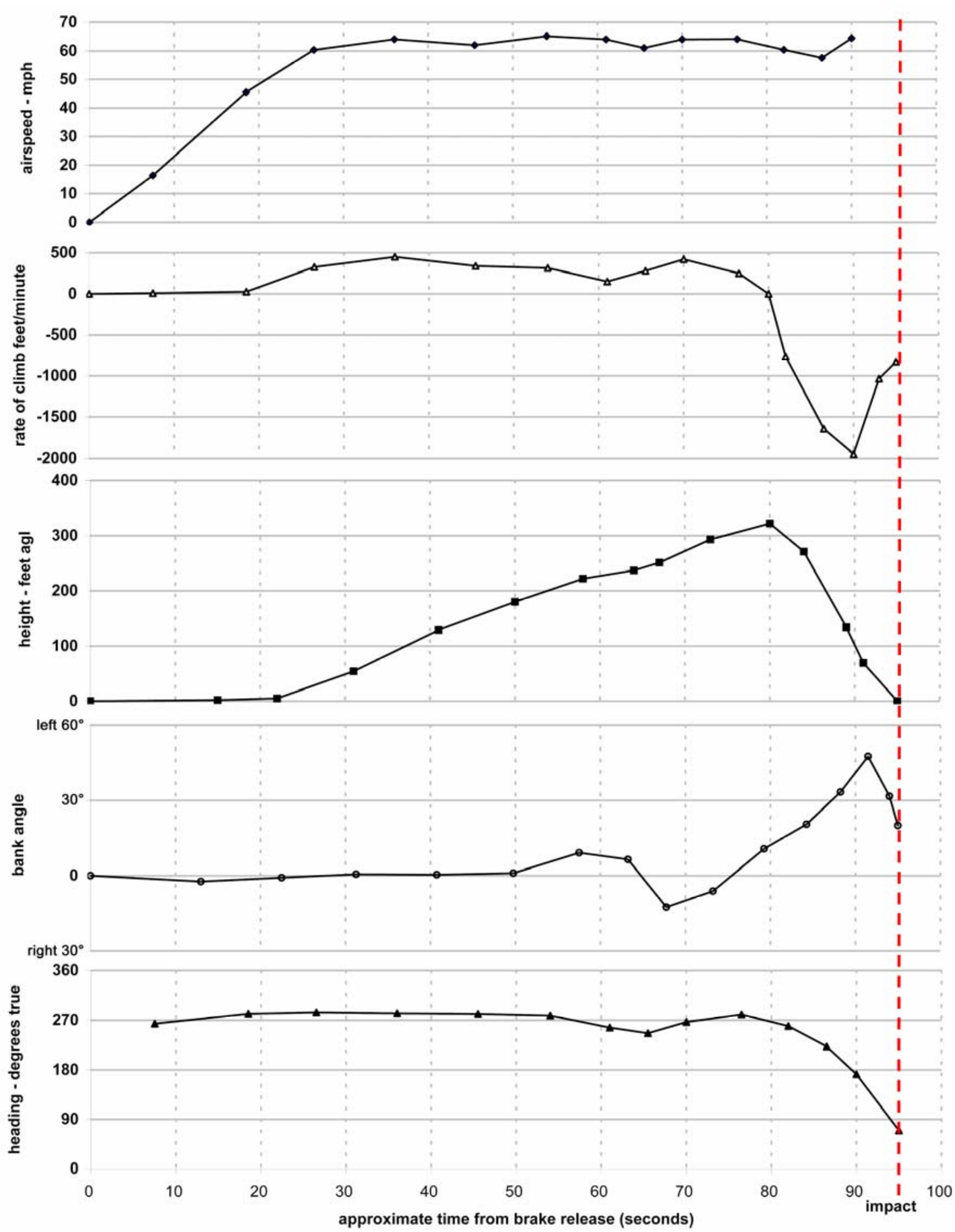
This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 19 June 2006.

*Visit the Transportation Safety Board's Web site (**www.tsb.gc.ca**) for information about the Transportation Safety Board and its products and services. There you will also find links to other safety organizations and related sites.*

Appendix A – C-GCWR Ground and Flight Path



Appendix B – Flight Data Derived from the Global Positioning System



C-GCWR - GPS-derived flight data