

Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

AVIATION INVESTIGATION REPORT

A08C0171



ENGINE POWER LOSS AND FORCED LANDING

NORTHWAY AVIATION LTD.

CESSNA 207A C-FBHP

ST. ANDREWS, MANITOBA, 2 nm N

08 AUGUST 2008

Canada

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Summary

The Northway Aviation Ltd. Cessna 207A (registration C-FBHP, serial number 20700647), operating as Northway Flight 841, was departing from Winnipeg/St. Andrews Airport, Manitoba, en route to Bloodvein River, Manitoba, with one pilot and three passengers on board. Shortly after take-off, the aircraft's engine performance deteriorated and several engine backfires were noted. The pilot attempted to return to Winnipeg/St. Andrews Airport but the aircraft could not maintain altitude. The pilot carried out a forced landing on Provincial Highway 8, approximately 2 nautical miles north of the airport at 1356 central daylight time. The aircraft was not damaged and none of the aircraft occupants was injured.

Ce rapport est également disponible en français.

Other Factual Information

The passengers consisted of two adults and one infant, all seated in the second row of cabin seats. The adult passengers were restrained by lap belts; the infant was held in the arms of one of the passengers. In addition to the passengers, the aircraft carried some hand luggage and a stroller restrained in the rear of the cabin. The aircraft weight and centre of gravity were within the prescribed limits.

The 1400 central daylight time ¹ meteorological report for Winnipeg/James Armstrong Richardson International Airport, located 12 nm southwest of Winnipeg/St. Andrews Airport, was as follows: wind 160° true (T) at six knots, visibility 15 statute miles, a few cumulus clouds at 5500 feet above ground level (agl), scattered cloud at 25 000 feet agl, temperature 27°C and dew point 14°C.

The pilot completed a pre-flight inspection and engine run-up before departure. All aircraft and engine parameters were normal. During the take-off run on Runway 36, the aircraft did not accelerate as expected. Though engine rpm and manifold pressure were normal, the poor aircraft performance was attributed to the high ambient temperature.

After lift-off, climb performance degraded; the cylinder head temperature rose rapidly to its maximum allowable value and beyond. The engine began to vibrate and the pilot turned left to join a downwind leg to return to Runway 36. Despite full throttle, a fine propeller pitch and rich mixture, the aircraft could not maintain altitude. The pilot noticed that a two-lane section of Provincial Highway 8 was momentarily clear of traffic and landed the aircraft in a southerly direction on the highway. Two oncoming vehicles left the paved roadway to make way for the aircraft. One of the drivers sustained minor injuries when his vehicle entered a ditch adjacent to the highway. After the aircraft came to a stop, it was pushed onto a private driveway by the pilot with the help of several bystanders.

After the occurrence, the aircraft was towed back to the company's hangar at the Winnipeg/St. Andrews Airport for examination. The engine magneto timing was checked and both magnetos were found to be incorrectly timed. The required timing is 22° BTDC (before top dead center) on the compression stroke on the number one cylinder piston. The magnetos were found to be timed to approximately 50 to 60° BTDC. Such an advanced timing of the magnetos leads to pre-ignition or detonation of the combustion gases in the engine and results in high cylinder head temperatures and engine power loss.

A 50-hour inspection of the aircraft was started on 28 July 2008 and completed on the day of the occurrence. In conjunction with this inspection, a 500-hour inspection of the Slick 6310 magnetos was carried out in accordance with Slick Service Bulletins SB2-08 and SB3-08. These service bulletins require the magnetos to be removed from the engine and sent to an engine

¹ All times are central daylight time (Coordinated Universal Time minus five hours).

overhaul facility for inspection. The facility completed the inspection of the magnetos and returned them to Northway Aviation Ltd. The magnetos were reinstalled on the aircraft eight days after they were removed.

The maintenance engineer who removed and installed the magnetos began employment with Northway Aviation Ltd. approximately two months before the occurrence. The engineer had approximately 15 years' aviation maintenance experience, the last seven of which as a licenced aircraft maintenance engineer (AME). Though there is no colour vision requirement to hold an AME licence, the engineer has a red/green colour vision deficiency and is incapable of discerning reds or greens.

The engineer was familiar with the various timing procedures on this engine, but this was the first time he timed the magnetos on this particular aircraft. Before starting the work, the engineer referenced the Cessna 207 series service manual, Chapter 12-78, Magnetos - Installation and Timing to Engine, to re-familiarize himself with the job task. Chapter 12-78 indicates that the advanced firing position of the number one cylinder may be determined by the use of a timing disc and pointer, Time-Rite piston position indicator, protractor and piston locating gauge, or external engine timing mark reference. The external engine timing marks are located on a bracket attached to the starter adapter, with a timing mark on the alternator drive pulley as the reference point. These marks consist of indented lines on the parts in question.

The engineer chose the external engine timing mark reference as the method of timing because the external magneto timing indicator plate was present on the engine. The external magneto timing indicator plate is located on the rear of the engine, in a dimly lit area of the engine bay. The mark on the alternator drive pulley had been painted red for conspicuity during the last engine overhaul.

The engineer brought the engine around to the compression stroke on the number one cylinder piston and aligned the mark on the alternator drive pulley with the 22° BTDC position on the external engine timing plate. The engineer removed the magnetos and sent them to the engine overhaul facility for the 500-hour inspection compliance.

During the eight-day period in which the magnetos were away for inspection, the engineer completed other maintenance tasks on the aircraft as required by the 50-hour inspection chart. The engine bay was dirty and the engine and belly of the aircraft was washed with solvent. Upon return of the magnetos, the engineer reset the engine timing to the 22° position because the propeller had been turned during the servicing of the aircraft.

As the engineer rotated the propeller to align the timing marks, the first mark that came into view on the alternator drive pulley was a scratch (see Photo 1) that had snagged debris from the engine washing. The scratch, with the embedded debris, looked similar in appearance to the correct timing mark (see Photo 2). The engineer was not able to discern the red paint colouring to cross-reference the mark and chose the scratch as the timing mark of reference. The correct timing mark was out of view on the opposite side of the pulley. The engineer installed the magnetos using the scratch with the embedded debris as the reference point.



Photo 1. Mistaken timing mark with debris removed

After the magneto installation was completed, the engineer carried out an engine run to ensure correct operation. During the five-minute ground run, the engine achieved full static rpm with normal engine operating temperatures. The full static rpm run was limited in time because of the difficulty encountered in holding the aircraft stationary using only the aircraft brakes.



Photo 2. Correct timing mark

A magneto drop test was conducted at 1700 rpm. The magneto drop was observed to be 25 rpm per side, well within the 150 rpm allowable drop per side but considerably lower than the normal 50 to 75 rpm drop per side. The aircraft was brought back into the hangar and the engine cowlings were removed as a final check for engine leaks and security. The engine seemed unusually hot for the brief time that it was run, but because the engine operating temperature and pressures were normal, the hot engine was attributed to the high ambient temperature. The inspection was signed out as being completed and the aircraft was returned to service. The engine power loss occurred on the first flight after the completion of this inspection.

The Cessna 207 series service manual, Chapter 12-80, Magneto Check, states: "advanced timing settings in some cases is the result of the erroneous practice of bumping magnetos up in timing in order to reduce rpm drop on single ignition." The manual further states: "an absence of an rpm drop should be a cause for suspicion that the magneto timing has been set in advance of the setting specified." The service manual cites: "never advance timing beyond specifications in order to reduce rpm drop."

On 19 June 1984, the engine manufacturer, Teledyne Continental Motors (TCM), issued service bulletin (SB) M84-8 to remove the external engine magneto timing indicator plate (bracket). TCM found that magneto timing errors were occurring due to improper alignment of the timing marks after removal or replacement of the starter adapter. TCM eliminated the use of the external magneto timing indicator plate on all new and rebuilt engines, and recommended that the external magneto timing indicator plate be removed at the next starter adapter rework or engine overhaul.

On 30 November 2004, the work described in SB M84-8 was accomplished on the occurrence aircraft at engine overhaul. The external magneto timing indicator plate was removed and returned to Northway Aviation Ltd. along with the overhauled engine. Before the removal of the external magneto timing indicator plate, the engine overhaul facility made sure that the alignment of the plate to pulley mark was correct and that the mark on the pulley was painted red. This was done to ensure that, if the plate was to be re-installed, the timing marks would be properly aligned. The red paint was used to highlight the correct timing mark in case of confusion with other markings on the pulley. The overhaul facility was aware that some operators preferred the use of the external magneto timing indicator plate because it is an easier and more precise way of timing the magnetos as compared to the other methods.

Upon receipt of the engine, Northway Aviation Ltd. re-installed the external magneto timing indicator plate because it was part of original equipment on the engine. SB M84-8 was not supported by an airworthiness directive and, as such, was not considered mandatory. In addition, the Cessna 207 series service manual still referenced the external engine timing mark as an approved timing procedure and the timing mark alignment was verified as being correct by the engine overhaul facility. *Canadian Aviation Regulations* Standard 571, Maintenance – Information Note, states, in part: “Where the recommendations of the aircraft manufacturer are incompatible with those of the engine, propeller, or appliance manufacturer, the recommendations of the aircraft manufacturer shall be used.”

On 25 April 2007, TCM issued Mandatory Service Bulletin MSB94-8C to provide magneto to engine timing procedures for all TCM engines. TCM’s preferred and most accurate method of timing was through the use of a positive top dead center locator, protractor and pointer device. Mandatory Service Bulletin MSB94-8C did not reference the external engine timing mark as an optional timing method because it was no longer supported by TCM.

Northway Aviation Ltd. holds an Air Operator Certificate and maintains its aircraft in accordance with its Air Operator Maintenance Control Manual (MCM) approved pursuant to Section 706.08 of the CARs. Subsections 25.4.f and 25.4.g of the MCM, entitled Approved Maintenance Schedule Evaluation, state: “changes in the manufacturer’s recommendations for maintenance, including service manuals, bulletins, letters or other instructions shall be considered mandatory until evaluated as per Section 25.2.c”; and “exceptions to the manufacturer’s recommendations shall be recorded on a Maintenance Evaluation Sheet and retained on the applicable aircraft file.” Subsection 25.2.c states: “All discrepancies and findings found during evaluation are recorded on the Audit Finding sheet and a report along with the findings are sent to the Maintenance Coordinator/Certificate Holder.”

Upon receipt of TCM's Mandatory Service Bulletin MSB94-8C, Northway Aviation Ltd.'s Director of Maintenance (DOM) evaluated the service bulletin against its fleet of aircraft. The bulletin was only applicable to the occurrence aircraft. The DOM chose not to incorporate the bulletin into its approved Cessna 207 maintenance schedule because the external engine timing mark was the reference being used on that aircraft in accordance with the Cessna 207 series service manual. After completion of the evaluation, the DOM did not prepare a maintenance evaluation sheet as required by the MCM.

Analysis

The engineer was experienced and qualified to work on the aircraft. He was new to the company and had not previously timed the magnetos on this particular aircraft. The engineer has a red/green colour vision deficiency that demanded greater effort on the task at hand when using coloured references in maintenance work.

Unable to discern the red paint on the timing mark, the engineer chose a mark, similar in appearance, as a reference for timing the magnetos without having rotated the pulley completely to confirm that selection. The subsequent engine ground run was not of sufficient duration to indicate any timing anomalies. The engineer attributed the lower-than-normal rpm drop on single magneto operation and the higher-than-normal after-run engine temperature as being consistent with the high ambient temperature of the day. The misalignment of the pulley mark with the indicator plate led to a timing discrepancy that resulted in pre-ignition or detonation of the combustion gases in the engine, which, in turn, caused high cylinder head temperatures and engine power loss after take-off.

Although the alignment of the timing marks was verified as correct in this occurrence, the use of an incorrect reference mark (scratch) had the same effect as if the alignment was incorrect to begin with.

The company chose to re-install the timing indicator plate due to its ease of use and precise way of magneto timing. Use of the external engine timing mark is an approved timing procedure referenced in the Cessna 207 series service manual and, therefore, the company has the option of using it. The decision to use the magneto timing indicator plate was supported by CARs Standard 571.

The engine manufacturer issued Mandatory Service Bulletin MSB94-8C in 2007 to address preferred magneto to engine timing methods. The external engine timing mark was not listed as an optional timing method because it was no longer supported by the engine manufacturer. The company evaluated the Mandatory Service Bulletin against the requirements of its company MCM and decided not to incorporate the bulletin into its approved Cessna 207 maintenance schedule. A maintenance evaluation sheet was not completed as required.

Finding as to Causes and Contributing Factors

1. During recent maintenance work, both engine magnetos were incorrectly timed. This condition was not detected during the subsequent engine ground run or before the flight. The incorrect magneto timing led to pre-ignition or detonation of the combustion gases in the engine, which resulted in high cylinder head temperatures and engine power loss after take-off.

Finding as to Risk

1. Service Bulletin (SB) M84-8 and Mandatory Service Bulletin MSB94-8C regarding preferred magneto timing methods were evaluated by the operator and not incorporated into its approved Cessna 207 maintenance schedule. The continued use of the external engine timing mark method increased the risk of a magneto timing error.

Other Finding

1. A maintenance evaluation sheet addressing the evaluation of Mandatory Service Bulletin MSB94-8C was not prepared by the company in accordance with its Maintenance Control Manual (MCM).

Safety Action Taken

Cessna indicated that it will be incorporating information in Mandatory Service Bulletin MSB94-8C into the next scheduled revision of the Cessna 207 maintenance manual.

The operator indicated that it will be making changes to its policy regarding the implementation of service bulletins.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 29 January 2009.

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