Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A05F0001

ENGINE FAILURE–FUEL STARVATION

AIR CANADA
BOEING 767-375, C-FCAG
SANTIAGO, CHILE, 180 nm NORTH
02 JANUARY 2005

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.

Aviation Investigation Report

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Summary

On 02 January 2005, a Boeing 767-375 aircraft (registration C-FCAG, serial number 24085) operating as Air Canada Flight 092, was on a scheduled flight from Toronto/Lester B. Pearson International Airport, Ontario, to Santiago/Aeropuerto Comodoro Arturo Merino Benitez, Chile, with 144 passengers and a crew of 10. At 1102 Chile daylight time (CLDT), nine hours and 42 minutes after take-off, the aircraft was in cruise flight at flight level (FL) 370 approximately 180 nautical miles (nm) north of Santiago, 60 nm prior to the planned start of descent. At that time, the crew received an engine indicating and crew alerting system (EICAS) warning of low fuel pressure output from both boost pumps in the left main fuel tank, and 45 seconds later the left engine (General Electric CF6-80C2B6 turbofan, serial number 690255) flamed out.

The crew immediately opened the fuel cross-feed valve, declared a Mayday with Santiago radar and began a drift-down descent. As the aircraft descended through FL330, the auxiliary power unit (APU) was started. At approximately FL230, 18 minutes after the engine flamed out, the crew restarted the left engine. The aircraft continued to Santiago with both engines operating and landed without further incident at 1135 CLDT. After landing, the fuel quantity indicating system indicated 4500 kg in the right tank and 800 kg in the left tank. After the engines were shut down, the fuel quantity in the tanks was "drip checked" using measuring sticks and found to be 4700 kg in the right tank and no fuel in the left tank. The left hand fuel quantity indication later blanked out while the aircraft was on the ground in Santiago.

Ce rapport est également disponible en français.

Other Factual Information

On 01 January 2005 at approximately 2100 eastern standard time, the aircraft arrived at the gate in Toronto from its previous flight.[1] The crew entered 7600 kg fuel remaining in the aircraft journey log; however, according to the aircraft communications addressing and reporting system (ACARS) arrival report, the aircraft arrived with 10 100 kg fuel on board. Flight dispatch planned the fuel load for the next flight based on all the applicable operational factors (including the arrival fuel) and prepared a Flight Release, which is a fuel message that is forwarded to the fueller.

The aircraft fuel system comprises left and right main wing tanks with a nominal capacity of 18 450 kg (22 975 litres) each and a centre tank with a capacity of 36 500 kg (45 450 litres) for a total of 73 400 kg. Fuel is normally loaded equally in the main wing tanks. If more fuel is required for a flight, it is loaded into the centre tank. The fuel quantity indicating system (FQIS) comprises sensors and a densitometer in each fuel tank, a fuel quantity processor unit (FQPU) that calculates the fuel in each tank, an overhead panel in the cockpit that displays individual tank and total fuel quantity,[2] and a quantity display at the fuelling control panel in the leading edge of the left wing. The FQIS also controls the fuelling valves to terminate fuelling automatically at the level selected by the fueller.

The fueller found the fuel system indicating 3700 kg in the left main tank, 5900 kg in the right main tank, and zero in the centre tank for a total of 9600 kg of fuel on board. The main wing tanks were filled until they shut off automatically, then the centre tank was filled to achieve the desired total quantity. The fueller's handwritten entries on the Flight Release slip showed that 61 354 litres/49 721 kg[3] of Jet A1 fuel were added, which would have brought the total fuel to 59 321 kg, provided there was 9600 kg of fuel on board at the start of fuelling. On completion of fuelling, the Flight Release slip indicated 18 800 kg in the left main tank, 23 670 kg in the centre tank, and 18 800 kg in the right main tank for a total of 61 270 kg.

The crew for the flight to Santiago noted a discrepancy between the indication on the fuel totalizer (9600 kg) and the amount entered by the previous crew in the journey log (7600 kg). When the crew entered the fuel upload into ACARS with 7600 kg from the previous flight, the ACARS unit indicated insufficient fuel for the flight. Air Canada procedures require the captain of the aircraft to resolve such a discrepancy before departure, but do not indicate a specific procedure for doing so. The crew manually changed the amount of the arrival fuel to 9600 kg, which coincided with the amount that the fueller had noted as the start fuel, and ACARS then accepted the upload. Neither the operational flight plan nor the Flight Release slip indicated the

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1 All times are eastern standard time (Coordinated Universal Time minus five hours), unless otherwise noted.

2 The FQIS rounds fuel quantities off to the nearest 100 kg; fuel quantities from other sources are not rounded. The numbers in the following paragraph are as printed or written on the flight release.

3 Weight of fuel is based on a fuel weight conversion factor (FWCF) of 0.81039 kg/litre. This was the actual density based on two samples taken near the time of refuelling.

arrival fuel from the previous flight. It was not clear how flight dispatch used arrival fuel in planning for the next flight, but had the information been available to the fueller or the flight crew, it would have indicated another discrepancy in the fuel load. A further indication of fuel discrepancy was that the crew found the rudder trim set at three units left at the end of the previous flight (it is usually less than one unit from neutral), indicating that the aircraft was trimmed left-wing down,[4] consistent with less fuel in the left main wing tank. After refuelling, the FQIS cockpit indications were recorded as 18 500 kg in the left main tank, 24 500 kg in the centre tank, and 18 500 kg in the right main tank for a total of 61 500 kg, and the flight management computer (FMC) indicated a total of 61 500 kg. The operational flight plan showed the required fuel to be 61 300 kg.

The aircraft departed Toronto on 01 January 2005 at 2320. Fuel remaining at a waypoint 56 minutes after take-off was recorded as 53 700 kg, 2700 kg more than the minimum fuel shown in the operational flight plan. The flight proceeded with no significant deviations from the flight planned route and conditions. Two minutes before the engine flamed out, the flight log indicated 11 300 kg fuel remaining, 4 200 kg more than the minimum required, indicating that fuel consumption had been less than expected during cruise flight.

The crew noted that the left main tank fuel quantity blanked out intermittently during the flight. The flight data recorder (FDR), which records total fuel quantity from the FQIS, showed zero for most of the flight, indicating a failure in the FQIS. When a quantity was recorded, unexplained fluctuations of over 1000 kg suggest that the indication was not reliable. The crew, therefore, relied on the fuel quantity indicated by the FMC, which calculates the fuel remaining by subtracting the fuel consumed by the engines[5] from the initial total amount at engine start. When the engine flamed out, the FQIS cockpit display showed 5700 kg fuel in the right main tank, and the left main tank indicator was blanked out. The FMC calculated total fuel remaining was 10 900 kg; by deduction the left main tank should have contained 5200 kg. After landing, the actual fuel remaining (4700 kg) was 5000 kg less than the FMC calculated fuel remaining. That amount is consistent with calculations based on engine fuel flow from the FDR. Fuel consumption during the flight was less than indicated in the operational flight plan, but was consistent with the aircraft being lighter than planned throughout the flight. In the absence of any indication of a fuel leak, it was deduced that the fuel state of the aircraft must have been 5000 kg less than was indicated after fuelling.

The aircraft's history of fuel indication problems during the five weeks prior to the occurrence is presented in Appendix A. There were five defect reports stating that the left fuel quantity indication went blank or was inoperative. In each case the snag was deferred and the aircraft released for operation under provisions of the minimum equipment list[6] (MEL) 28-41-01-A, which, among other things, requires the fuel quantity to be verified by measuring sticks before

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4 The manufacturer recommends the use of rudder trim in cruise flight to level the control wheel in order to minimize trim drag. The aircraft operations manual limitation on rudder trim is 3.0 units after the airplane is stabilized in cruise for at least 30 minutes.

5 Engine fuel consumption is derived from the engine fuel flow sensors.

6 The MEL lists the circumstances and conditions under which an aircraft is permitted to be dispatched with specified equipment inoperative.

each departure. Maintenance action on the first three entries involved increased troubleshooting of system wiring and components, and on two occasions the densitometer in the left tank was replaced. On completion of rectification of the third indication snag on 21 December, the densitometer was unserviceable and the aircraft was released under MEL 28-41-01-C1. On the fourth occasion, the left fuel quantity defect was signed off as fixed without any maintenance work being done after the system performed normally on two subsequent flights. On the fifth occasion, six days before this occurrence, the snag appeared and was deferred in Sao Paulo, but the aircraft defect log was not filled in correctly. When the aircraft returned to Toronto, a technician, apparently unaware that a MEL limitation was attached to it, incorrectly signed it out and entered it in the aircraft maintenance tracking and control (AMTAC) system as fixed, resulting in the MEL being removed from the deviation list. As a result, not only was the snag not repaired, but the aircraft was not subject to the MEL 28-41-01-A with respect to verifying fuel quantity with measuring sticks prior to each flight and with respect to operational procedures for monitoring fuel and detecting fuel leaks.

During this period, while operating in accordance with the MEL, there were two "information" defect entries that noted erratic or erroneous left fuel quantity indications (over-reading by as much as 2500 kg) and one entry that noted a normal left fuel quantity indication for one flight. There was also a verbal report of the left fuel indication under-reading.

CARs Standards for Air Operator Maintenance (AOM) require a defect recording and control system that identifies recurring defects and specifies how the defects should be handled.

> CARs Standard 726.05, Defect Recording and Control
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> (1) The defect recording system shall include a method to highlight defects that recur, so that they are readily identifiable by flight crews and the maintenance organization at all bases where the aircraft is operated. The air operator is responsible for identifying defects as recurring defects to maintenance personnel in order to avoid the duplication of unsuccessful attempts at rectification.
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> (2) The defect control system shall ensure that the rectification of a defect identified as a recurring defect will take into account the methodology used in previous repair attempts.
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> (3) For the purposes of these standards, defects are recurring defects where a failure mode is repeated three times, on a particular aircraft, within 15 flight segments of a previous repair made in respect of that failure mode.

In addition to describing the handling of recurring defects, there is a technical dispatch procedure in the standards, as follows:

> CARs Standard 726.06, Technical Dispatch Procedures (only the applicable paragraph is quoted).
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> (1) The purpose of the technical dispatch procedures is to ensure that only those aircraft that conform to applicable airworthiness, operational, and corporate requirements are dispatched into service. This system also forms the basis upon which the pilot-in-command will determine aircraft serviceability in respect of airworthiness directives, maintenance, weight and balance control, operational, or corporate requirements.

After the indication problem was rectified on 21 December, and the aircraft placed under the provisions of MEL 28-41-01-C1 for the densitometer, the maintenance control and dispatch of this aircraft did not effectively identify and control subsequent fuel indication problems as a continuation of the earlier problem, resulting in the dispatch of this aircraft when it was not airworthy in accordance with CARs.

Other discrepancies were noted in the maintenance and dispatch of the aircraft during that period. On 02 and 03 December 2004, the aircraft was dispatched on two flights under both MEL 28-41-01-A and MEL 28-44-01, contrary to the qualifying condition in MEL 28-44-01 that the measuring sticks not be required for operation under MEL 28-41-01. On 11 December, the aircraft was dispatched under MEL 28-41-01-A, one day outside the repair interval stipulated in that MEL. On 15 December, the aircraft was dispatched with a disconnected densitometer without being placed under the provisions of MEL 28-41-01-C1. On 30 December, MEL 28-41-01-C1 was extended despite aircraft downtime being scheduled and parts being available. On 02 January 2005, a densitometer defect was signed off as fixed when it was not, resulting in the provisions of MEL28-41-01-C1 being lifted when they still should have applied. Each of these contravenes the requirements of CAR 605.09 and indicates deficiencies in Air Canada's maintenance control and technical dispatch system. An Air Canada Maintenance review of the process identified several problems including complacency, circumvention of procedures, manpower shortage, unclear roles and responsibilities, and acceptance of the situation as being the norm. Action was initiated to redress these problems.

Another factor concerning operations with inoperative FQIS indications and under the auspices of MEL 28-41-01-A is that the centre tank fuel pump configuration on the Boeing 767, when changed in compliance with airworthiness directive 2001-15-08 (which applied to this aircraft) and Boeing Service Bulletin 767-28-0062 (revised 05 February 2004), is prone to initiating a fuel imbalance. Until final resolution of the issue, Boeing issued revised Operations Manual Bulletin ACN-53 R2 dated 12 July 2004 to Air Canada recommending, among other things, not dispatching an aircraft under MMEL 28-41-1 with an FQIS quantity indicator inoperative if the centre fuel tank is loaded. It further recommends that if a main fuel tank FQIS quantity indicator fails after dispatch, the flight be terminated by taxiing back to parking or landing at the nearest suitable airport. At the time of this occurrence, an earlier version of the Boeing Operations Manual Bulletin, which did not contain these procedures, was incorporated in the AOM, and the Air Canada MEL 28-41-1A did not preclude operation with fuel in the centre tank. As a result, during the month prior to this incident, the aircraft was operated under the provision of MEL 28-41-1A with fuel in the centre tank. In addition, when the left main fuel tank indicator failed on the incident flight, it did not land at the nearest suitable airport as recommended by the Boeing Operations Manual Bulletin.

After the flame-out, a defect report was again entered for the left fuel quantity indication being blank, and the aircraft was dispatched under MEL 28-41-01-A until it could be repaired in Toronto. After considerable troubleshooting, the final rectification was replacement of a wiring harness in the left wing. The defect accounts for both the faulty FQIS readings and the premature automatic shut-off of the refuelling of the left main tank. The fuel shortage would have been detected had the quantity been verified using measuring sticks in accordance with MEL 28-41-01A. Since this was not done, the aircraft took off with a fuel imbalance of 5000 kg and landed at Santiago with an imbalance of 4700 kg, exceeding the limitations contained in the AOM.[7] CAR 602.07 requires that aircraft be operated in accordance with the operating limitations set out in the aircraft flight manual. The total fuel load at take-off was approximately 56 500 kg, 4800 kg less than required by the operational flight plan and company policy; however, the flight arrived at destination with adequate fuel to proceed to the flight-planned alternate.

MEL 28-41-01A contains operational procedures for monitoring fuel quantity and for detecting fuel leaks in the event that a portion of the FQIS system is inoperative. It notes that a fuel imbalance condition may not be signalled by FUEL CONFIG advisory messages when the left or right FQIS is inoperative. It also notes that flame-out of an engine is an indication of a possible fuel leak. The Boeing 767 *Quick Reference Handbook* (QRH) does not include engine flame-out as a symptom of a fuel leak. The crew did not consider the possibility of a fuel leak because they had not seen any EICAS messages or other indicators of a fuel leak as presented in the QRH. They were unaware that the EICAS messages were inhibited due to the failure of the left FQIS. In the event of a FQIS failure, the Boeing 767 has no independent physical means of detecting low fuel quantity before fuel exhaustion occurs. The crew must depend on the FMC to calculate the fuel remaining based on the assumption that the initial value was correct. In the event of a fuel indicating system malfunction, the QRH contains no additional guidance or cautionary procedure, similar to that in MEL 28-41-01-A, for detecting a possible fuel leak. One of the first steps in the QRH procedure for a suspected fuel leak is to turn the cross-feed off. In this incident, the fuel leak procedure was not carried out, the cross-feed was turned on immediately after the engine failed, and the engine was restarted, incurring the risk of feeding a leak and depleting the fuel on the good side.

The following Engineering Branch report was prepared:

LP004/2005 – FDR Analysis

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

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[7] The Aircraft Operating Manual states that the maximum allowable fuel imbalance between the left and right main tanks is 1100 kg when total main fuel is less than 22 000 kg, decreasing to 600 kg when total main tank fuel is greater than 38 000 kg.

Findings as to Causes and Contributing Factors

1. The fuel quantity indicating system was defective. As a result, during refuelling the left main wing tank shut off prematurely when the tank was approximately 5000 kg less than full; fuel quantity indications were incorrect; and, during the flight, fuel quantity and balance warnings were inoperative.

2. A maintenance control error removed the fuel quantity indicating system defect from the aircraft deviation list. As a result the aircraft was dispatched without the fuel load being validated using measuring sticks in accordance with the MEL.

3. The operator's procedures do not specify how to resolve fuel quantity discrepancies, nor does flight dispatch advise the crew of the reported arrival fuel. As a result, when the crew adjusted the fuel quantity to get the ACARS to accept the fuel upload, it defeated the intent of the fuel check and did not resolve the discrepancy. The result was acceptance of an inadequate fuel load.

4. The operator did not incorporate Boeing Operations Manual Bulletin ACN-53 R2 into the aircraft operating manual. The bulletin recommended that the aircraft be landed at the nearest suitable airport in the event of a main fuel tank quantity indicator failure in flight with fuel loaded in the centre tank. As a result, when a main fuel tank quantity indicator failed after take-off from Toronto, the crew continued the flight.

5. The fuel in the left main wing tank was exhausted without any prior fuel low-level warning, resulting in the left engine flaming out.

Findings as to Risk

1. The operator's maintenance control and technical dispatch procedures allowed the aircraft to be dispatched several times when it was not airworthy or in compliance with the minimum equipment list.

2. The aircraft operated throughout this flight with a fuel imbalance that exceeded the limitations published in the aircraft operating manual.

3. The operator did not incorporate a Boeing Operations Manual Bulletin recommendation into its MEL Manual, resulting in the aircraft being dispatched during the month prior to this occurrence with fuel in the centre tank under the provisions of MEL 28-41-1-A, contrary to the Boeing recommendation.

4. In the event of a FQIS failure in flight, the Boeing 767 has no independent means of detecting low fuel quantity, nor does the QRH contain a precautionary procedure, similar to that contained in MEL 28-41-01-A, against a possible fuel leak. As a result, there is a risk of flight crew taking inappropriate action, feeding the leak, and depleting the fuel on the good side.

Safety Action Taken

Air Canada reported undertaking the following safety actions:

Several changes were commenced shortly after an internal investigation began. Because maintenance activities are presently contracted out to other airlines in some of the South American stations, it was recommended that maintenance investigate acquiring a digital tape recording system to record all conversations with Maintenance Operation Control (MOC). This will allow a confirmation of information that is was passed verbally and should prove valuable when dealing with personnel whose primary language is neither English nor French.

Flight Operations and Maintenance Fleet Managers began regularly scheduled phone conversations regarding overall fleet serviceability and problems associated with particular aircraft by registration, presently on or under consideration for MEL relief. Flight Operations has also changed MEL 28-41-01-C1, to require a fuel drip check in the event of fuel reading discrepancies. Flight Operations in coordination with Maintenance Engineering are also exploring methods for pilots to more accurately determine minimum fuel figures that will not affect the safety of the flight in all flights over three hours.

The Vice President Maintenance agreed to commence an experience pollination program by bringing senior technical staff into positions within MOC, and exporting some of the MOC experience back to the hangar floor.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 23 November 2005.

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Appendix A–Fuel Snag History

30 Nov. 2004 Defect L1398037 – The left fuel indication went blank after refuelling. The snag was deferred under MEL 28-41-01-A, which requires a fuel "drip" check (i.e., fuel quantity must be checked using measuring sticks) prior to each flight. The aircraft was dispatched twice on 11 December (the 11th day after the day of discovery) with this deviation. Maintenance was carried out on 12 December. The left main tank bussing plug was found loose and contaminated. It was replaced and the aircraft was released to service. Before the next flight, the left fuel indication again went blank. (See 13 Dec. 2004, defect L1398045.)

02 Dec. 2004 Defect L1398039 – Left main fuel tank #8 drip stick unserviceable. The snag was deferred under MEL 28-44-01, which allows the aircraft to be dispatched with inoperative measuring sticks on the condition that "fuel quantity is determined by another approved means." The aircraft was dispatched and flown to Lima and back to Toronto with an unserviceable drip stick ***and*** under 28-41-01-A, which requires fuel quantity verification by drip stick. Maintenance removed excess sealant from the #8 drip stick and released the aircraft to service on 03 December.

06 Dec. 2004 Defect L1398040 – Left fuel quantity gauge erratic, reads 300-1300 kg more than the right gauge. The snag was signed off on the basis that the aircraft was still on MEL per defect L1398037.

12 Dec. 2004 Left fuel indication snag (defect L1398037) rectified as noted above.

13 Dec. 2004 Defect L1398045 – Left fuel tank indication blank (repeat of defect L1398037). The snag was again deferred under MEL 28-41-01-A. An MEL extension notice was sent to Transport Canada indicating that the snag would be rectified by 16 December.

Defect L1398046 – Information snag: left main fuel quantity came back on during flight. Indications were inconsistent with calculated quantity, suspected of over-reading by 1000-2500 kg. Drip check at destination resulted in total fuel quantity of 5,141 kg compared with 7,800 kg on cockpit indicator. Aircraft was still on MEL per defect L1398045 above. Snag signed off.

14 Dec. 2004 Rectification of defect L1398045 – The fuel quantity processing unit (FQPU) was replaced and the left densitometer was disconnected. Flight crew were requested to comment on the stability of the left fuel quantity indication. There was no record of the MEL 28-41-01-C1 (relief for unserviceable densitometer) being imposed or of results from flight crew. The defect was not signed out as fixed until 16 December. The aircraft flew Toronto to Munich return on 15 December.

16 Dec. 2004 Defect L1398045 was signed off as serviceable, and defect L1412452 was raised to change the left densitometer. The left densitometer was changed later the same day, and the aircraft was released to service.

17 Dec. 2004 M1203290 – This document cites a verbal report that the left tank was reading short of its actual load. Drip check confirmed the indication. The snag was initiated in Montréal by the Fleet Specialist due to multiple repeat snags on the aircraft. (See corrective action 20 Dec. 2004.)

19 Dec. 2004 Defect L1412455 – On fourth flight after previous rectification – left fuel quantity indicator blank – "repeat of snags L1398037-40-45-46 and L1412452." The snag was again deferred under MEL 28-41-01-A and a single flight was flown Toronto to Vancouver. (See corrective action 21 Dec. 2004.)

20 Dec. 2004 M1203290 corrective action – No faults found in troubleshooting wiring to various parts of the FQIS in the left tank. The densitometer DEU was replaced in accordance with instructions. The instructions called for replacement of the DEU connector, This was done on card M1203482. (See 21 Dec. 2004.)

21 Dec. 2004 M1203482 – Action to address repeat reports of left main fuel quantity blanking per L1412455: left densitometer connector replaced. Left tank unit #12 (capacitance probe) replaced. Capacitance and resistance values checked okay.

Defect L1412457 – The entry stated "left fuel tank densitometer unserviceable. Note: L1412455 corrected." The snag was deferred under MEL 28-41-01-C1. The aircraft was still operating under this MEL at the time of the incident. (See 30 Dec. 2004 for MEL extension.)

Defect L1412455 was signed off on basis of M1203482 and M1203290.

22 Dec. 2004 Defect L1412458 – Left densitometer inoperative. Reference was made to defect L1412455 "info item" (fuel indication blanking). Left fuel tank quantity was stick checked and the snag was signed as fixed.

23 Dec. 2004 Defect L1412459 – On fourth flight after L1412455 rectification: left fuel quantity display blank, fuel quantity test normal, total quantity also blank, see long history. Due to extensive history, the snag was again deferred in accordance with MEL 28-41-01-A with the left tank indicator inoperative. The aircraft was dispatched to Beijing.

24 Dec. 2004 Defect L1412459 rectification – Indicators normal Vancouver-Beijing-Vancouver. After refuelling at Vancouver, uplift calculation confirmed indication. No other maintenance action was indicated. The defect was signed off as fixed and the aircraft dispatched to Montréal. Total time on the ground between landing and take-off to Montréal was1 hour and 34 minutes.

27 Dec. 2004 Defect L1412462 – Left fuel quantity and fuel quantity totalizer inoperative, found during preparation for flight in Sao Paulo and entered by the captain of the departing flight. MOC was advised, but it is unclear exactly what action MOC took, although United Airlines personnel at Sao Paolo carried out a reset that cleared the EICAS indications, and they performed a drip check to confirm the fuel on board. The captain of the flight wrote in the rectification remarks section,

"fuel drip carried out as per MEL 28-41-01. Mntc Rel #153546." The aircraft was safe for flight, but the defect had not been deferred correctly, the MEL block in the aircraft defect log was not filled in correctly, and there were no entries in either the "deferred" or "fixed" blocks of the defect log before the flight departed for Toronto.

28 Dec. 2004 Defect L1412462 (continued) – After the aircraft arrived in Toronto on 28 December at 1144 UTC after the flight from Sao Paulo, a Toronto-based mechanic signed the "fixed" box of the aircraft defect log and back-dated the entry to 27 December, 1000 UTC, and indicated the station as Sao Paolo. He also made an entry in AMTAC indicating that the defect was fixed. He apparently did not realize that he was signing off a fuel snag or that there was an MEL restriction attached to it.

The MEL was removed from the aircraft's deviation list when the shift manager in the MOC performed a scan of the deviation list. The scan is intended to identify MELs for which the related maintenance item has been fixed to facilitate their removal if appropriate. However, it had become an accepted practice in the MOC to short cut the procedure by placing a weight (stapler) on the enter key of the computer, thereby forcing AMTAC to remove any such MEL. In this case, this resulted in removal of MEL 28-41-01-A without further operator action.

30 Dec. 2004 Defect L1412466 – Left fuel quantity displays normal this flight: info only.

Defect L1412457 (See 21 Dec. 2004 for original entry.) – Although downtime had been planned and parts were available in the Air Canada system, rectification of this snag was further deferred under MEL 28-41-01-C1. An MEL extension notice was sent to Transport Canada citing lack of parts, specifically a harness not available. The aircraft was still operating under this MEL at the time of the incident.

02 Jan. 2005 Defect L1412470 – After the left engine flame-out: left fuel quantity indication blank. Status message fuel quantity channel. The flight crew did not enter a defect for the in-flight event. The entry was made by maintenance at Santiago. The snag was deferred under MEL 28-41-01-A.

Defect L1412457 was signed off and transferred to Defect L1412470 due to indicating system inoperative and drip check being required. Sign-off was done in Santiago with no indication of any actual maintenance being carried out.

10 Jan. 2005 MI L1412470 and MI L1412476 – Left wing fuel quantity probe harness replaced, densitometer and densitometer emitter replaced, left compensator replaced twice: none of these items corrected the problem. Left wing "Hi Z" harness from left bussing plug to left wheel well fixed the problem.