



# Aviation Investigation Final Report

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<b>Location:</b>	Jamaica, New York	<b>Incident Number:</b>	ENG12IA010
<b>Date &amp; Time:</b>	February 8, 2012, 11:09 Local	<b>Registration:</b>	N360AA
<b>Aircraft:</b>	Boeing 767	<b>Aircraft Damage:</b>	None
<b>Defining Event:</b>	Fire/smoke (non-impact)	<b>Injuries:</b>	210 None
<b>Flight Conducted Under:</b>	Part 121: Air carrier - Scheduled		

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## Analysis

On February 8, 2012, American Airlines flight 837, a Boeing 767-323ER, had a fire in the right engine, a General Electric (GE) CF6-80C2B6, shortly after takeoff from John F. Kennedy International Airport (JFK), Jamaica, New York. The pilots reported that as the airplane was climbing through 9,000 feet, they heard a bang that was immediately followed by a right engine fire warning in the cockpit. The pilots further stated that they shutdown the right engine and discharged both fire bottles into the right engine's nacelle before the fire warning was extinguished. The pilots also stated that they declared an emergency and returned to JFK for a single-engine, overweight landing without further incident. When the right engine was wet motored, fuel leaked from the front of the integrated drive generator (IDG) fuel-oil heat exchanger. The examination of the front of the IDG fuel-oil heat exchanger revealed there was a pre-service bulletin 73-0242 two-piece bracket and spray shield that had been misinstalled with the bracket over the spray shield rather than the spray shield being over the bracket. American Airlines aviation maintenance technicians replaced the right engine's fuel flow transmitter and an adjacent fuel tube during the previous night requiring the removal and reinstallation of the bracket and spray shield on the front of the IDG fuel-oil heat exchanger. A seal under the fuel tube flange that is held in place by the bracket had the O-ring partially missing, which was the source of the fuel leak.

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this incident to be: The failure of the American Airlines aviation maintenance technicians to properly reassemble the two-piece bracket and spray shield on the integrated drive generator fuel-oil heat exchanger that caused a fuel leak that sprayed out and ignited on hot engine cases. Contributing to the cause of the fire was the 767 Aircraft Maintenance Manual's lack of any

graphical or pictorial displays of the correct assembly of the two-piece bracket and spray shield.

## Findings

<b>Aircraft</b>	Fuel oil cooler - Incorrect service/maintenance
<b>Organizational issues</b>	Adequacy of documents/info - Manufacturer

## Factual Information

### History of Flight

Initial climb	Fire/smoke (non-impact) (Defining event)
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#### History of Flight

On February 8, 2012, about 1109 eastern standard time, a Boeing 767-323ER, N360AA, operated by American Airlines as flight 837, experienced an undercowl engine fire in the right engine shortly after takeoff from John F. Kennedy International Airport (JFK) in Jamaica, New York. As the airplane was climbing through 9,000 feet, the pilots heard a bang that was immediately followed by a right engine fire warning in the cockpit. The pilots shutdown the right engine and discharged one fire bottle into the right engine's nacelle. The pilots declared an emergency with air traffic control (ATC) advising them that they had an engine fire and leveled the airplane off at 10,000 feet. The fire warning did not go out after 30 seconds and the pilots discharged the second fire bottle in the right engine's nacelle. Several seconds after the second fire bottle had been discharged, the fire warning went out. The captain directed the first officer (FO), who was the pilot flying, to continue to fly the airplane as well as communicate with ATC while the captain and the second first officer (FB) went through the checklists and communicated with the lead flight attendant (FA1). The FO contacted ATC and advised that they needed to return to JFK immediately. ATC offered an immediate clearance to JFK's runway 4R that the FO accepted. The FO maneuvered the airplane for an approach to runway 4R as the captain and FB completed the checklists. The captain contacted the FA1 to advise her to have the flight attendants prepare the cabin for an emergency landing. The captain also contacted the FA1 to ask her to check the right engine to see if it was still on fire. The FA1 reported back that she could not see any fire from the right engine. The airplane made an overweight, single-engine landing on runway 4R with what the pilots reported to be a minimal sink rate. The airplane rolled out to the end of runway 4R and turned off at taxiway 'FB' where it stopped to allow the airport fire department personnel to check the right engine. After the fire department personnel confirmed the fire in the right engine was out, the airplane taxied back to the gate under its own power where the passengers and crew deplaned normally. The airplane was operating as a scheduled international passenger flight on an instrument flight rules flight plan from under the provisions of 14 Code of Federal Regulations Part 121 from JFK to Toussaint Louverture International Airport, Port au Prince, Haiti.

#### Injuries to Persons

There were no injuries to the 3 pilots, 9 flight attendants, and 201 passengers on board.

#### Damage to Airplane

The airplane and the left engine's nacelle were not damaged.

### Airplane Information

N360AA was a Boeing 767-323ER, Boeing serial number (SN) 24041, with a maximum takeoff gross weight of 408,000 pounds. The airplane's takeoff weight was for the incident flight was 343,100 pounds. At the time of the incident, the airplane had accumulated 97,101 hours time since new.

The airplane was equipped with General Electric CF6-80C2B6 turbofan engines. The CF6-80C2B6 engine has a takeoff thrust rating of 60,070 pounds that is flat-rated to 86°F (30°C).

The right engine was engine serial number (ESN) 690-295. According to American Airlines' maintenance records, ESN 690-295 had accumulated 81,234 hours and 13,042 cycles since new. The engine had completed a heavy maintenance shop visit at American's Maintenance & Engineering Center, Tulsa, Oklahoma on November 5, 2009, and 6,651 hours and 1,087 cycles since that shop visit. The engine was installed on the airplane on November 18, 2009, at San Francisco, California following the last shop visit.

### Communications

There were no reported communications issues.

### Flight Recorders

The airplane was equipped with a cockpit voice recorder (CVR) and flight data recorder (FDR) that were removed from the airplane and returned to the NTSB's Recorder Laboratory for playback.

The CVR was an L3 Fairchild recorder model number 2100-1020-00 SN 000132742. The playback of the CVR provided a recording that was of excellent quality that captured the entire flight from taxiing out to the runway, the takeoff, flight including the incident, return to JFK, landing, and taxi back to the gate. The playback of the CVR revealed the pilots responded correctly and appropriately to the in-flight fire and there were no issues noted with the pilot's performance or actions. A CVR group was not formed.

The FDR was an L3 Fairchild recorder model number 2100-4043-00 SN 000107232. The FDR contained 59 hours of data spanning 11 flights including the engine fire event. The playback revealed that the engine parameters had stopped recording 54 hours before the end of the recording. American was notified of the lack of engine data on the FDR and initiated an investigation. American, in troubleshooting the problem, replaced the digital flight data acquisition data unit, however, a subsequent check of the FDR data showed the engine data was still not being recorded. Upon further investigation, American identified the cause of the engine data not being recorded on the FDR to a malfunctioning engine indicating and crew

alerting system (EICAS) lower display switch module. After the EICAS lower display switch module was replaced, a check of the FDR showed that it was properly recording all data, including the engine data.

## Fire

The right engine had evidence of a fire.

The exterior of the right engine's left and right side thrust reverser cowls did not have any damage, although there was soot visible at the split line between the two cowls at the bottom. On the interior surface of the left-hand thrust reverser cowl, the thermal barrier was charred and blistered. On the interior surface of the right-hand thrust reverser cowl, there were localized areas that were discolored

The left side of the engine was completely covered with soot. The right side of the engine was generally free of soot except around the fuel flow transmitter and the integrated drive generator (IDG) fuel-oil heat exchanger. The insulation and chaff guards on the both sides of the engine below the horizontal centerline as well as the center drain mast were charred and partially melted. Above the horizontal centerline, the wires, particularly on the left side, were just sooted.

## Tests and Research

The engine was examined by investigators while it was still installed on the airplane and the airplane was in an American Airlines hangar at JFK. The right engine was wet-motored twice. Each time the engine was wet-motored, fuel leaked out from the under the spray shield on the forward (fuel inlet) end of the IDG fuel-oil heat exchanger. The examination of the forward end on the IDG fuel-oil heat exchanger revealed it was the original two-piece bracket and spray shield and the bracket was over the spray shield rather than the spray shield being over the bracket. When the IDG fuel-oil cooler was removed, all of the retaining bolts had the required torque. When the seal was removed from the front of the IDG fuel-oil, the O-ring on the front side of the seal was missing a 0.9-inch long arc. The remainder of the O-ring on the front side of the seal and the entire O-ring on the aft side of the seal were in good condition.

The airplane's log book showed that the right engine's fuel flow transmitter had been replaced the previous night by American Airlines aviation maintenance technicians (AMT) at the Miami International Airport (MIA), Miami, Florida. In addition to replacing the fuel flow transmitter, the AMTs also replaced the fuel tube between the IDG fuel-oil heat exchanger and the fuel flow transmitter in accordance with Airworthiness Directive (AD) 2000-04-14. The AMTs in separate interviews stated that they could not ascertain the PN of the fuel tube, so they changed the tube. The AD required certain PN fuel tubes to be replaced to prevent high pressure fuel leaks that could result in fires. A subsequent examination of the fuel tube that was replaced confirmed that the PN was barely legible, but it was the correct PN tube installed.

American's records show that the AD had been complied with. In addition, American stated that before a CF6-80C2 engine is shipped from the MEC following maintenance, the PNs of the fuel numbers are verified to ensure the AD has been accomplished. After the fuel flow transmitter and the fuel tube between the IDG fuel-oil heat exchanger and fuel flow transmitter had been replaced, the airplane operated one flight from MIA to JFK without incident. The maintenance records showed that there was no work accomplished to the airplane, including the right engine, while the airplane was at JFK prior to departing on the incident flight

## Additional Information

### Aircraft Maintenance Manual instructions

The instructions to replace the fuel flow transmitter are contained in the 767 aircraft maintenance manual (AMM) Section 73-31-01-4, Transmitter – Fuel Flow – Removal/Installation. The instructions have multiple references about checking the PNs of the tubes between the IDG fuel-oil heat exchanger and fuel flow transmitter and between the fuel flow transmitter and the main engine control or hydromechanical unit. The instructions document removing the tubes including removal of the brackets and spray shields. For reassembly, the instructions state to install the bracket and spray shield. But the instructions do not differentiate between the one-piece or two-piece configuration nor do they show any diagrams or pictures on how the two-piece bracket and spray shield should be assembled.

### Previous Incident

On July 12, 2006, a Delta Air Lines Boeing 767-300ER, N153DL, experienced an engine fire shortly after takeoff from Rio de Janeiro, Brazil for Atlanta, Georgia. As the airplane was climbing through 3,000 feet, the pilots received a left engine fire warning in the cockpit. The pilots shutdown the left engine and discharged one fire bottle into the engine's nacelle before the fire warning was extinguished. The airplane returned to Rio de Janeiro for a single-engine, overweight landing that resulted in a hot brake warning and six main landing gear tires deflating.

The damage that was observed on the Delta engine was virtually identical to what occurred on the American engine. The engine was covered with soot. Many of the wires and cables on the lower half of the engine were partially burned away or had the insulation melted. The inside of the right-hand thrust reverser cowl had thermal damage. When the engine was wet motored, fuel leaked from the front of the IDG fuel-oil heat exchanger. The closer examination of the forward end of the IDG fuel-oil heat changer revealed the bracket and spray shield had been misassembled with the spray shield being installed under rather than over the bracket. The examination of the seal between the fuel tube and the front of the IDG fuel-oil heat exchanger also revealed a 0.375-inch long section of the seal was missing.

### Two-piece versus one-piece bracket and spray shield configuration

The original configuration of the CF6-80C2 series engine IDG fuel-oil heat exchanger bracket and spray shield was the two-piece configuration. On May 17, 1996, GE issued Service Bulletin (SB) 73-0242, "Fuel and Control - (73-00-00) – Spray Shields and Support Bracket – Improvement," that introduced a one-piece bracket and spray shield for the front of the IDG fuel-oil heat exchanger to replace the two-piece bracket and spray shield. According to the SB, the purpose of the one-piece bracket and spray shield was to improve the maintainability of the IDG fuel-oil heat exchanger and the inspection of the IDG fuel-oil heat exchanger and flowmeter [fuel flow transmitter] fuel tube swivel flanges. The SB further stated that the one-piece bracket and spray shield eliminated the potential for misassembly. The SB was initially issued as a Category 7 bulletin meaning that GE recommended operators could incorporate the SB at their option. But on March 9, 2007, following the Delta Air Lines engine fire at Rio de Janeiro, GE elevated the bulletin to Category 3, which means GE recommended operators should accomplish the SB at the next shop visit of the engine.

According to American's maintenance records, the engine underwent a heavy maintenance shop visit on November 5, 2009. Investigators asked American why after the engine had undergone a heavy maintenance shop visit over two years after SB 73-0242 had been elevated from a Category 7 to a Category 3 bulletin, the engine had the two-piece bracket and spray shield (pre-SB 73-0242) configuration installed. American stated that over the past 20 years, the CF6-80C2 engines on its fleet of 767s had been operating with a mix of the two and one-piece bracket and spray shields. American further stated that until the engine fire that occurred on February 8, 2012, they had replaced fuel flow transmitters on the 767's CF6-80C2 engines countless times without a problem. American stated that based on the reliability data up until the engine fire, there was no economic reason to replace the two-piece bracket and spray shield with the one-piece bracket and spray shield. American also stated that since the SB was a recommendation by the GE and was not required by any regulatory action, they elected not to modify their fleet.

### Safety Recommendation

On July 12, 2012, as a result of its investigation of the engine fire that occurred on American Airlines flight 837 on February 8, 2012, the Safety Board issued Safety Recommendation A-12-47. Safety Recommendation A-12-47 recommended the FAA issue an AD to require the incorporation of GE SB 73-0242, "Fuel and Control – (73-00-00) – Spray Shields and Support Bracket – Improvement," to prevent fires on CF6-80C2 engines due to misassembly of the two-piece support bracket and spray shield on the front of the IDG fuel-oil heat exchanger.

On August 13, 2012, the FAA issued a notice of proposed rulemaking, No. FAA-2012-0817, that proposed mandating the incorporation of GE SB 73-0242 that would require the installation of the one-piece bracket and spray shield.

## Pilot Information

<b>Certificate:</b>	Airline transport	<b>Age:</b>	51, Male
<b>Airplane Rating(s):</b>	Multi-engine land	<b>Seat Occupied:</b>	Left
<b>Other Aircraft Rating(s):</b>		<b>Restraint Used:</b>	
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	
<b>Instructor Rating(s):</b>		<b>Toxicology Performed:</b>	No
<b>Medical Certification:</b>	Class 1 Without waivers/limitations	<b>Last FAA Medical Exam:</b>	December 9, 2011
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	November 22, 2011
<b>Flight Time:</b>			

## Co-pilot Information

<b>Certificate:</b>	Airline transport	<b>Age:</b>	44, Male
<b>Airplane Rating(s):</b>	Multi-engine land	<b>Seat Occupied:</b>	Right
<b>Other Aircraft Rating(s):</b>		<b>Restraint Used:</b>	
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	
<b>Instructor Rating(s):</b>		<b>Toxicology Performed:</b>	No
<b>Medical Certification:</b>	Class 1 Without waivers/limitations	<b>Last FAA Medical Exam:</b>	September 13, 2011
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	July 7, 2011
<b>Flight Time:</b>			

## Information

<b>Certificate:</b>	Airline transport	<b>Age:</b>	Male
<b>Airplane Rating(s):</b>	Multi-engine land	<b>Seat Occupied:</b>	Center
<b>Other Aircraft Rating(s):</b>		<b>Restraint Used:</b>	
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	
<b>Instructor Rating(s):</b>		<b>Toxicology Performed:</b>	No
<b>Medical Certification:</b>		<b>Last FAA Medical Exam:</b>	
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	
<b>Flight Time:</b>			



## Aircraft and Owner/Operator Information

<b>Aircraft Make:</b>	Boeing	<b>Registration:</b>	N360AA
<b>Model/Series:</b>	767 323	<b>Aircraft Category:</b>	Airplane
<b>Year of Manufacture:</b>		<b>Amateur Built:</b>	
<b>Airworthiness Certificate:</b>	Transport	<b>Serial Number:</b>	24041
<b>Landing Gear Type:</b>	Retractable - Tricycle	<b>Seats:</b>	225
<b>Date/Type of Last Inspection:</b>	February 2, 2012 Unknown	<b>Certified Max Gross Wt.:</b>	408000 lbs
<b>Time Since Last Inspection:</b>		<b>Engines:</b>	2 Turbo fan
<b>Airframe Total Time:</b>	97101 Hrs	<b>Engine Manufacturer:</b>	GENERAL ELECTRIC
<b>ELT:</b>	Installed, not activated	<b>Engine Model/Series:</b>	CF6 80C2
<b>Registered Owner:</b>	American Airlines	<b>Rated Power:</b>	60070 Lbs thrust
<b>Operator:</b>	American Airlines	<b>Operating Certificate(s) Held:</b>	Flag carrier (121)
<b>Operator Does Business As:</b>		<b>Operator Designator Code:</b>	AALA

## Meteorological Information and Flight Plan

<b>Conditions at Accident Site:</b>		<b>Condition of Light:</b>	
<b>Observation Facility, Elevation:</b>		<b>Distance from Accident Site:</b>	
<b>Observation Time:</b>		<b>Direction from Accident Site:</b>	
<b>Lowest Cloud Condition:</b>		<b>Visibility</b>	
<b>Lowest Ceiling:</b>		<b>Visibility (RVR):</b>	
<b>Wind Speed/Gusts:</b>	/	<b>Turbulence Type Forecast/Actual:</b>	/
<b>Wind Direction:</b>		<b>Turbulence Severity Forecast/Actual:</b>	/
<b>Altimeter Setting:</b>		<b>Temperature/Dew Point:</b>	
<b>Precipitation and Obscuration:</b>			
<b>Departure Point:</b>	Jamaica, NY (JFK)	<b>Type of Flight Plan Filed:</b>	Unknown
<b>Destination:</b>	(PAP)	<b>Type of Clearance:</b>	IFR
<b>Departure Time:</b>	11:00 Local	<b>Type of Airspace:</b>	

## Airport Information

<b>Airport:</b>	John F. Kennedy International JFK	<b>Runway Surface Type:</b>	
<b>Airport Elevation:</b>		<b>Runway Surface Condition:</b>	
<b>Runway Used:</b>		<b>IFR Approach:</b>	Unknown
<b>Runway Length/Width:</b>		<b>VFR Approach/Landing:</b>	Unknown

## Wreckage and Impact Information

<b>Crew Injuries:</b>	12 None	<b>Aircraft Damage:</b>	None
<b>Passenger Injuries:</b>	198 None	<b>Aircraft Fire:</b>	In-flight
<b>Ground Injuries:</b>		<b>Aircraft Explosion:</b>	None
<b>Total Injuries:</b>	210 None	<b>Latitude, Longitude:</b>	40.709255,-73.829734(est)

## Administrative Information

<b>Investigator In Charge (IIC):</b>	Hookey, Gordon
<b>Additional Participating Persons:</b>	Tsz Chan; Federal Aviation Administration; Garden City, NY John J Monaco; Federal Aviation Administration; Garden City, NY Chris Marple; American Airlines; Tulsa, OK Jorge Melendez; American Airlines; Jamaica, NY Ken Wolski; General Electric; Cincinnati, OH Harry Charalambous; Transport Workers Union; Jamaica, NY
<b>Original Publish Date:</b>	December 7, 2012
<b>Last Revision Date:</b>	July 8, 2024
<b>Investigation Class:</b>	<a href="#">Class</a>
<b>Note:</b>	
<b>Investigation Docket:</b>	<a href="https://data.nts.gov/Docket?ProjectID=82849">https://data.nts.gov/Docket?ProjectID=82849</a>

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable causes of the accidents and events we investigate, and issue safety recommendations aimed at preventing future occurrences. In addition, we conduct transportation safety research studies and offer information and other assistance to family members and survivors for each accident or event we investigate. We also serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties ... and are not conducted for the purpose of determining the rights or liabilities of any person” (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available [here](#).