

### NATIONAL TRANSPORTATION SAFETY BOARD OFFICE OF AVIATION SAFETY WASHINGTON, D.C. 20594

November 22, 2011

# **GROUP CHAIRMAN'S FACTUAL REPORT**

#### MAINTENANCE

- A. <u>INCIDENT:</u> DCA11IA040
  - LOCATION: New Orleans, Louisiana

DATE/TIME: April 4, 2011, at about 7:25 a.m. CDT

AIRCRAFT: Airbus A320-232, N409UA, S/N 462

#### B. <u>GROUP MEMBERS:</u>

Group Chairman:	Pocholo Cruz National Transportation Safety Board Washington, DC
Member:	Randal Rutkowski Federal Aviation Administration San Francisco, California
Member:	Jon Garliepp United Airlines San Francisco, California
Member:	Pramod Thomas International Brotherhood of Teamsters Chicago, Illinois.

im Littlejohn
Air Line Pilots Association
San Francisco, California

# C: <u>SUMMARY</u>

On April 4, 2011, at about 0725 central daylight time, an Airbus 320-232 (N409UA), serial number 462, operating as United Airlines flight 497, exited the left side of runway 19 at the Louis Armstrong New Orleans International Airport (MSY) after returning due to automated warnings of smoke in an equipment bay. The airplane's nose wheel exited the side of runway 19 upon completing the landing roll and an emergency evacuation was conducted. The airplane, with 109 passengers and crew aboard, had departed MSY about 20 minutes prior. The passengers and crew exited the airplane via slides. There were no reported injuries. Initial information is that the airplane had minor damage.

# D: DETAILS OF THE INVESTIGATION

# **1.0** Air Carrier Certificates

United Air Lines, Inc., San Francisco International Airport, San Francisco, California 94128, Certificate Number UALA011A, was originally issued by the Federal Aviation Administration (FAA) Flight Standards District Office (FSDO), Western-Pacific Region on April 1, 1954.

United Air Lines Inc. also received a Part 145 Repair Station Certificate (Certificate Number UALR011A) on July 1, 1953, from the FAA's Western-Pacific Region FSDO. The repair station, which is located at the San Francisco International Airport, San Francisco, California 94128 was approved with the following ratings: Airframe (3/26/1984), Powerplant (9/1/1971), Accessory (3/7/1957), Instrument, Radio, and Limited Nondestructive Inspection/Testing Processing (11/12/1998).

See Attachment 1 for more information.

# 2.0 **Operations Specifications (OpSpecs)**<sup>1</sup>

United Air Lines, Inc. has a Part 121 Certificate, which included the standards, terms, conditions, and limitations contained in the FAA approved Operations Specifications (Parts D and E) were reviewed.

(a) Air carrier was authorized as a 14CFR Part 121 operation.

<sup>&</sup>lt;sup>1</sup> Operations Specifications contains the authorizations, limitations, and certain procedures under which each kind of operation, if applicable, is to be conducted by the certificate holder.

- (b) Per section D072 of the OpSpecs, the Continuous Airworthiness Maintenance Program (CAMP) authorized United Air Lines, Inc. to use the manufacturer/United Air Lines, Inc. maintenance and engine maintenance programs to maintain the airplanes.
- (c) Per section D074 of the OpSpecs, United Air Lines, Inc. was authorized to use the provisions of a maintenance reliability program on their fleet.
- (d) Per section D076 of the OpSpecs, United Air Lines, Inc. was authorized to use short-term escalations of maintenance intervals on their fleet.
- (e) Per section D085 of the OpSpecs, United Air Lines, Inc. had the following airplanes in its fleet 55-A319, 97-A320, 44-737, 29-747, 96-757, 35-767 and 52-777.
- (f) Per section D090 of the OpSpecs, United Air Lines, Inc. was authorized to utilize CASE<sup>2</sup> as a means of qualifying a vendor for services, parts, and materials to satisfy the requirements of 14 CFR Section 121.373.
- (e) Per section D091 of the OpSpecs, United Air Lines, Inc. was authorized to make arrangements with other organizations to perform substantial maintenance.
- (f) Per section D095 of the OpSpecs, United Air Lines, Inc. was authorized to use an approved Minimum Equipment List (MEL).
- (g) Per section D485 of the OpSpecs, United Air Lines, Inc. had an Aging Aircraft Inspection and Records Review. N409UA's Aging Aircraft Inspection and Records review was completed on September 2010.
- (h) Per section E096 of the OpSpecs, United Air Lines, Inc. was authorized for a Weight and Balance Program.

#### **3.0** Aircraft Information

N409UA was purchased new by United Air Lines, Inc. from Airbus Industries on March 21, 1994. The airplane had accumulated 58,253:02 flight hours and 21,414 cycles at the time of the incident.

The airplane was equipped with two IAE V2500 turbofan engines and an Auxiliary Power International Corporation (Hamilton Sundstrand Company)

<sup>&</sup>lt;sup>2</sup> The Air Carriers section of the Nonprofit Coordinating Agency for Supplier Evaluations (C.A.S.E.) was organized as a means of sharing non-prejudicial supplier quality approval data among the membership airlines. This increases surveillance coverage of suppliers and thereby upgrades their quality programs. It also has an economic impact on each C.A.S.E. member by decreasing the cost of supplier surveillance and making their surveillance programs more effective.

Auxiliary Power Unit. The engines and APU had accumulated the following operating times at the time of the accident:

	No.1 Engine	No.2 Engine	APU
Manufacturer	IAE	IAE	APIC
Part Number	4W5198S01	4W5198S01	4500001B
Manufacture Date	11/1/1999	12/27/2001	1/3/2002
Date Installed	1/8/2007	12/16/2008	5/7/2009
Serial Number	V10666	V11185	1877
Location of	SFO	SFO	SFO
Engine/APU			
Installation			
Total Time	18,777	22,119	13,780
(Engine /APU hours)			
at installation			
Total Cycles	7,041	8,034	17,425
(Engine/APU cycles)			
at installation			
Total Time of	28,675	30,260	52,197:59
Airframe during			
engine/APU			
installation (hours)			
Total Cycles of	10,911	11,612	18,783
Airframe during			
engine/APU			
installation			
Time Since Overhaul	13,967:22	7,588	2,582:51
(hours)			
Hours since last	13,967:22	7,288:34	2,582:51
installation (cycles)	(5,563)	(3,120)	(3,383)
Total Time in hours	32,745:11	29,408:01	16,362.51
and (Cycles) as of	(12,604)	(11,154)	(20,808)
4/4/2011			

#### **Table 1 – Engine and APU Information**

### 4.0 Continuous Airworthiness Maintenance Program (CAMP)

Summary of United Air Lines, Inc. Maintenance Program

Airworthiness Directives, Manufacturer Service Bulletin compliance, Zonal and Structural tasks were written into the United Air Lines, Inc. maintenance program.

#1 Service (#1 SVC) – accomplished daily

#3 Service (#3 SVC) – accomplished within 70 Fight Hours of last accomplishment.

"A" Check - The "A" check was sequenced (1 to 12) and performed within 600 hours of aircraft time-in-service since the preceding "A" check.

"C" Check - The "C" check was sequenced (1 to 4) and performed within 608 days of aircraft time-in-service since the preceding C check. The "C" check also accomplishes a (reset) of the #1 and #3 Services.

"HMV" Check - The "HMV" check was performed at intervals not to exceed 2,432 days of aircraft time-in-service since the previous HMV check. The "HMV" check also accomplishes resets of the #1 and #3 Services and the next "C" check due tasks.

The following is a listing of the previous inspections accomplished on airplane N409UA.

Check	Last Check Date	Location	Total Time	Total Cycles
1SV	4/3/2011	IAD	58,250:35	21,412
3SV	4/1/2011	LGA	58,229:33	21,404
A03	3/13/2011	MEX	58,019:46	21,325
A02	1/13/2011	DEN	57,438:48	21,089
A01	11/10/2010	DEN	56,861:08	20,824
H03	9/26/2010	BFM	56,460:01	20,630
A12	8/19/2010	DEN	56,349:01	20,585
A11	6/23/2010	DEN	55,762:14	20,348
A10	4/27/2010	DEN	55,177:26	20,105
C04	3/02/2010	BFM	54,755:27	19,916
A09	1/21/2010	DEN	54,587:00	19,840
A08	11/18/2009	DEN	54,026:48	19,595
A07	9/18/2009	DEN	53,513:21	19333
A06	8/3/2009	MEX	53,027:27	19,135
A05	6/12/2009	DEN	52,539:58	18,919
A04	4/12/2009	DEN	51,983:36	18,687
C03	6/13/2008	SMB	49,262:18	17,663
C02	1/11/2007	SMB	44,285:40	15,851
C01	7/22/2005	SMB	38,681:56	13,898
H02	1/29/2004	BFM	33,300:03	12,085
H01	1/24/1999	IMC	16,856:41	6,224

**Table 2 - Maintenance Checks** 

SMB - San Francisco Maintenance Base

BFM - Mobile, Alabama

IMC – Indianapolis Maintenance Center

### 5.0 Continuing Analysis and Surveillance System (CASS)<sup>3</sup>

United Air Lines, Inc. conducts daily meetings to review the previous day's maintenance discrepancies on the fleet. The CASS is an approved program by the FAA. The program was in place to ensure the adequacy of the maintenance programs and to confirm the programs were properly followed and controlled.

In addition, United Air Lines, Inc. conducted quarterly CASS and Reliability Review Board meetings. The reports for these meetings covered the preceding quarter's activity. The report was a statistical analysis of maintenance data collected from the following sources: (1) Departure delays; (2) Flight cancellations; (3) Pilot reports; (4) Component removals and (5) Engine data. The FAA representative's attended the quarterly meetings.

Both 2011 quarterly CASS and Reliability Review Board Reports were tracking Smoke in the Cabin/Cargo Smoke Detector events respectively. Action plans were developed from the Reliability Review Board Reports.

The last two quarterly CASS and Reliability Review Board Reports were reviewed. The fourth quarter 2010 CASS report contained a summary of 2010 smoke in the cabin events for the entire United Air Lines, Inc. fleet. Also contained in this report was a summary of the source of smoke in the cabin for these events. It was noted that the Airbus fleet had the second highest amount of events compared to other fleets. There was mention of avionic smoke detection related to a finding of high humidity in the avionics bay as well as three "no cause identified." Specifically, it was stated that two events on incident aircraft 4709 occurred in 2010, but the sources were not similar.

The Airbus Reliability Review Board report dated February 17, 2011 contained a section of key metrics for Service Difficulty Reports and other events of interest. For the time period of November 2010 – January 2011 it was reported that there were seven smoke in the cabin events. From these events, the decision was made to focus and implement an action plan for the Cargo Smoke Detector system to decrease these types of smoke events. This plan consisted of cleaning the cargo smoke detectors at C-checks and HMVs, and changing the ionization detectors with optical detectors on an attrition basis.

<sup>&</sup>lt;sup>3</sup> As established by 14 CFR Part 121.373, each certificate holder shall establish and maintain a system for the continuing analysis and surveillance of the performance and effectiveness of its inspection program and the program covering other maintenance, preventative maintenance and alterations and for the correction of any deficiency in those programs, regardless of whether those programs are carried out by the certificate holder or by another person.

# 6.0 Minimum Equipment List (MEL)<sup>4</sup>

United Air Lines, Inc. was authorized to use an approved MEL on its A320 airplane per its OpSpecs. At the time of the accident, there were 3 open MEL or deferred items in the airplane logbook.

See Attachment 2 for more information.

# 7.0 Supplemental Type Certificates (STC)<sup>5</sup>

Supplemental Type Certificates (STC), supplied by air carrier, were reviewed. A total of 11 STCs were documented and installed on the airplane by the operator.

See Attachment 3 for more information.

# 8.0 Airworthiness Directive (AD)<sup>6</sup> and Service Bulletin (SB) Summary

The air carrier provided an AD and Service Bulletin summary list for review. A review of both the AD and SB listing for the aircraft were conducted. No discrepancies were found during the review of the listing.

See Attachment 4 for more information.

# 9.0 Aircraft Flight Logs

Electronic Aircraft Flight Logs were reviewed from April 1, 2010 thru April 4, 2011.

A review of Air Conditioning System write-ups from April 2010 to April 4, 2011 revealed (8) Blower Faults messages, (3) Aft Cargo Heat INOP messages, (2) Avionic Smoke with land ASAP messages, (10) Avionic Smoke Fault messages and (4) Hot Air Fault Light Illuminated messages.

Date	Logpage	Discrepancy	Corrective Action	Location
04/02/11	2362001	Cargo Smoke Det Fault.	Crew Cycled CB's per SAMC No MX Action	CUN

Table 3 – Logbook Pages (Avionic Smoke)

<sup>&</sup>lt;sup>4</sup> The FAA approved Minimum Equipment List contains a list of equipment and instruments that may be inoperative on a specific aircraft for continuing flight beyond a terminal point.

<sup>&</sup>lt;sup>5</sup> The FAA issues Supplement Type Certificates, which authorize a major change or alteration to an aircraft, engine or component that has been built under an approved Type Certificate.

<sup>&</sup>lt;sup>6</sup> Airworthiness Directive (AD) is a regulatory notice sent out by the FAA informing the operator of an action that must be taken for the aircraft to maintain its airworthiness status.

03/29/11	1852001	AEVC Fault on ECAM: Avionics Smoke ECAM Displayed. Cycled CBs	Cycled CBs Fault Cleared	CUN
03/28/11	1772002	Avionics Smoke ECAM	Cycled CBs Fault Cleared	CUN
02/01/11	6012001	CB F1 and Q7 cycled in CUN for False Avionics Smoke ECAM	Entered into History	CUN
12/26/10	2652002	Avionics Smoke Fault, suspect high humidity	Vented Avionics compartment	AUA
12/26/10	2652003	CB's cycled , reset Capt's Emer Authority, land ASAP	Part of the above item 2652002	AUA
10/27/10	7446001 7446002 7446003	Avionics Smoke Light ON after TO RETURN TO FIELD	No evidence of smoke, just wet wood boxes in fwd cargo	MSY
06/24/10	7812002	Avionics Smoke ECAM	Cycled CB's F1 and Q7, No other Faults	CUN
06/12/10	6662004	Replaced AEVC Smoke Det due to several reports of Avionic Smoke Msg after aircraft in humid conditions	Replace Smoke Detector 1WA	ORD
06/12/10	6612001	Avionic Smoke ECAM	Cycled CB	SJU
06/1/10	5362003	Crew Report: Avionic Smoke	Cycled CB	CUN
05/16/10	3712002	Land ASAP Avionic Smoke Message	Cycled CB	CUN
05/3/10	2302001	Avionic Smoke displayed on upper ECAM	Cycled CB	CUN
04/29/10	1932002	Avionic Smoke displayed on upper ECAM	Reset AEVC VENT CTRL	CUN

A review of the United Air Lines, Inc. Chronic Aircraft Management System did not show that the incident aircraft had an issue with Avionic Smoke messages from April 2010 to April 4, 2011.

See Attachment 5 for more information.

#### 10.0 Weight and Balance Summary

Per United Air Lines, Inc., all airplanes will be reweighed according to the Fleet Weighing Program as outlined in AC120-27E and UAL Engineering Report F-932A, Rev. 48, Sect. 2, paragraph 2.2.3. Only a portion (30%) of the A320 fleet must be weighed in a 36 calendar month period. Regardless of the number of aircraft in the fleet, no aircraft may exceed 10 years from the date of its last weighing before being reweighed.

The last actual weight and balance for N409UA was performed on August 18, 2004 and was accomplished by SFO.

Basic Operating Weight:	94,252.01 pounds
Arm:	743.99 inches
Moment:	70123354 lb-inches

At the time of the incident, N409UA had the follow Weight and Balance:

Basic Operating Weight:	94,210.5 pounds
Arm:	744.20 inches
Moment:	70111356.1 lb-inches

See Attachment 6 for more information.

# 11.0 Service Difficulty Reports (SDR)<sup>7</sup> and Mechanical Interruption Summary Report (MISR)<sup>8</sup>

From June 2006 through April 4, 2011, United Air Lines, Inc. reported approximately 46 Service Difficulty Reports to the FAA for aircraft N409UA. Three SDRs (6/12/2010, 10/28/2010 and 4/4/2011) were recorded for AVIONIC SMOKE for the incident airplane. There were no chronic systemic issues with any of the systems reported. All discrepancies to the airplane were rectified.

A review of the Mechanical Interruption Summary Report from April 2010 to April 2011 was conducted. The report revealed three instances (March 2011, October 2010 and June 2010) where a defect for Avionic Smoke was displayed on the ECAM. In all three cases, maintenance troubleshot the system and found no faults.

See Attachment 7 for more information.

<sup>&</sup>lt;sup>7</sup> A Service Difficulty Report (SDR) is a report of the occurrence or detection of each failure, malfunction, or defect as required by 14 CFR 121.703.

<sup>&</sup>lt;sup>8</sup> Each scheduled operator is required under 14 CFR Part 121.705 to submit a summary of any (a) interruption to flight, (b) unscheduled change of aircraft en route, or unscheduled stop or diversion from a route caused by known or suspected mechanical difficulties or malfunctions that are not required to be reported as service difficulty reports.

# **12.0** Major Repairs and Alterations

The airplane major repair records supplied by the operator were reviewed. Prior to the incident, there were seven major repairs accomplished on the airplane. The most recent major repairs were accomplished at the airplanes last Heavy Maintenance Visit at Mobile, Alabama in September 2010. All were structural in nature.

The major alteration records were also reviewed. The records show the operator accomplished 11 STCs (See attachment 3) on the incident aircraft. The most recent alteration was the removal of the A320 SKY Radio installation from the airplane on September 24, 2010 in Mobile, Alabama.

See Attachment 8 for more information.

# **13.0** Time Limit Control Components

Time limited component status for the airplane and two installed V2500 powerplant engines and Auxiliary Power Unit were reviewed. The compliance status was satisfactory and no discrepancies were noted.

### 14.0 Vendors

On the average, United Air Lines, Inc. accomplished audits of the approved vendors at intervals of one to three years (i.e. Airframe Maintenance Repair Organizations: twice a year, Repair Stations: yearly, Others: one to three years depending on risk factors). All substantial maintenance vendors are listed in the operator's Approved Supplier Listing. As previously stated, United Air Lines, Inc. was authorized to use CASE which is audited every 2 years.

# **15.0** Method of Record Keeping

All routine and non-routine work forms, log books, serviceable part tags from components installed, deferred items records, engine records, etc., were entered into the aircraft computer records [Aircraft Maintenance Information System (AMIS) and/or Maintenance Compliance System (TRAX)] on a daily basis. A computer file history was maintained so that all inspections and checks were monitored for time limitations. The computer files were backed up daily to prevent total loss of history files. United Air Lines, Inc also kept all hard copies of the paperwork.

#### 16.0 Manuals

United Air Lines, Inc. used the following manual to maintain the airworthiness of its fleet and management of the airline.

<u>Maintenance Operations Procedures (MOP)</u> – Provides instructions to Technicians when they are documenting work they perform

<u>Administrative and Operating Policy (AOP)</u> – Provides documented methods of compliance with the code of Federal Regulations, company regulations and United Services division business policies.

<u>Minimum Equipment List (MEL)</u> – A United Airlines, Inc. list of equipment and instruments that may be inoperative on a specific aircraft, based upon the manufacturer's produced Master Minimum Equipment List (MMEL)

<u>Weight and Balance Manual</u> – Weight and balance procedures to be followed by Load Planning personnel on all aircraft operated by United Air Lines, Inc.

<u>**Quality Assurance Manual**</u> - Provides procedures for auditing, certifying, and investigating the inspection and maintenance programs at United Airlines, including the procedures for correcting deficiencies in those programs. Additionally, the manual outlines the policy for continuing analysis and surveillance of the performance of inspection and maintenance programs at United Airlines (auditing), including the process for correcting deficiencies in those programs (Corrective Action Request process).

<u>Aircraft Reliability Program Manual (ARPM)</u> – provides procedures for the continual monitoring of mechanical and operational performance of the entire aircraft, including identification and correction of reliability issues. Additionally the manual outlines the policy for continuing analysis and surveillance of the effectiveness of inspection and maintenance programs at United Airlines (operational data collection and analysis), including the process for correcting deficiencies in those programs (Reliability Review Board process).

<u>Manufacture Supplied Manuals</u> - Aircraft/Engine Maintenance Manuals, Structural Repair Manuals, Wiring Diagrams, Overhaul Manuals, Illustrated Parts Catalog, Corrosion Program Manual, NDT Manual, Significant Structure Items Manual, Service Bulletins and Engine Manuals.

#### 17.0 ECAM Messages

### AVIONICS SMOKE DETECTION

The avionics compartment smoke detection is provided by a smoke detector installed on the air extraction duct of the avionics ventilation system. In case of smoke detection, the smoke detector sends signals to the Flight Warning Computer, the Avionics Equipment Ventilation Computer, and for the generation of local warnings. The smoke detector is of the ionization type. The Avionics Equipment Ventilation Computer controls the avionics ventilation system, monitors the smoke detector condition, and allows the detector to be tested by the Centralized Fault Display System. The Avionics Equipment Ventilation Computer (AEVC) checks the smoke detector when a test is initiated from the Centralized Fault Display Interface Unit (CFDIU). The smoke detector activates the generator 1 line smoke light on the emergency electrical power panel. The smoke detector activates the blower fault and extracts fault lights on the ventilation panel.

According to Airbus Technical Follow Up (TFU) 26.15.15.001 on Spurious Avionics Smoke Warnings dated December 2002, some operators have reported many cases of spurious avionics smoke warnings, leading to "Avionics Smoke" or "Land ASAP" ECAM messages. These warnings have mainly been reported on ground, however there have been a few cases generated in flight, shortly after take-off and gear retraction.

Investigations have shown that the ionization type smoke detectors sensitivity is subject to the ambient temperature, pressure and air contamination with moisture, dust or pollution. The highest sensitivity translated into a voltage shift being on the ground and during take-off.

In case of an 'AVIONICS SMOKE' warning triggered and latched on ground without evidence of smoke, Flight Warning Computer (FWC1 and FWC 2) should be reset one at a time by means of their C/B (3WW C/B 49VU for FWC1 and 2WW C/B 121VU for FWC2). This will clear the latched condition of the warning if the avionics smoke conditions have disappeared. Then an undue 'LAND ASAP' alarm will be avoided.

A new generation of smoke detector PN CGDU2000-00 using an optical technology has been developed in order to replace the 'OLD' generation of ionization type smoke detector. This new generation type of smoke detector has a different triggering principle and is therefore not affected by the temperature and pressure conditions.

At the time of the incident, according to the United Airlines, the airplane had the 'OLD' generation detectors installed during the incident. United Airlines plans to upgrade the 'Ionic or OLD' generation detectors with the 'Optical or NEW'

generation detectors in their Airbus Fleet (COA 40799 and Airbus Service Bulletin A320-26-1052). As of October 7, 2011, 124 airplanes or 82% of the affected airplanes have been modified with new optical detectors.

Flight Data Recorder readouts indicate the "AVIONIC SMOKE" WARN latched from power up through various heading changes and right until the end of data. There was no maintenance performed on the aircraft prior to the incident flight. Additionally the "AVIONIC SMOKE" WARN was not present prior to aircraft power up.

> Pocholo Cruz Aerospace Engineer