Final Report

Concerning

EgyptAir Boeing 777-200 aircraft cockpit fire

AT Cairo Airport

On 29th July 2011

Registration SU-GBP

Flight No MS 667 Cairo/ Jeddah

Issued by

Aircraft Accident Investigation Central Directorate

Egyptian Ministry of Civil Aviation

Cairo

September, 2012

Foreword

In accordance with Annex 13 to the Convention on International Civil Aviation and with European Regulation n°996/2010, the investigation has not been not conducted so as to apportion blame, nor to assess individual or collective responsibility. The sole objective is to draw lessons from this occurrence which may help to prevent future accidents.

Consequently, the use of this report for any purpose other than for the prevention of future accidents could lead to erroneous interpretations.

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Glossary

A/C	Aircraft
ATC	Air Traffic Control
APU	Auxiliary Power Unit
Capt	Captain
CMRDI	Central Metallurgical Research and Development Institute
CSN	Cycles since New
ECAA	Egyptian Civil Aviation Authority
EgyptAir M & E	EgyptAir Maintenance and Engineering
F/O	First Officer
FAA	Federal Aviation Administration
MCA	Ministry of Civil Aviation
(MCA- AAI)	Ministry of Civil Aviation, Aircrafts Accidents Investigation
NTSB	National Transport Safety Board
O2	Oxygen
TSN	Time since New
UTC	Universal Time Coordinate

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Synopsis

***Date of accident*:** 29th July 2011.

Time of accident: 07 h 11 min UTC.

Site of accident: Gate F7, Terminal 3, Cairo International Airport, Egypt.

Flight Number: 667, regularly scheduled international passenger flight, Cairo/ Jeddah

Aircraft type, registration: Boeing 777-200 registered SU- GBP.

Operator: EgyptAir.

Persons onboard: Cockpit Crew 2, Cabin Crew 8, Passengers 307

FDR information: SN 2057, P.N 980-4700-003, manufactured by AlliedSignal

CVR information: SN 3667, P.N 980-6022-001, manufactured by Honeywell

INFORMATION ABOUT THE INVESTIGATION PROCEDURE

- Just after the accidents, the aircraft was examined by specialized team including Egyptian (MCA-AAI)[1], ECAA, EgyptAir M & E[2], United States, the country of the aircraft manufacturer (Boeing representatives as technical advisors to the US accredited representative NTSB). Boeing representatives attended and represented NTSB, FAA and Boeing

  The status of the aircraft damage was recorded. Several photos were taken to thoroughly show the aircraft damage.
  (Refer to exhibit #1)

- Official meetings were held at the (MCA-AAI) with the event flight cockpit crew (Captain and F/O). Cockpit crew responded to all investigation team inquiries.

  (Refer to exhibit #2 Captain Statement and exhibit #3 F/O Statement).

- Aircraft FDR and CVR were removed from the aircraft for the readout analysis. They were received at the "AAI (FDR and CVR center) on 29th July 2011. (Same day of the accident).
  At the time of the accident, only the APU was running, the engines were not started yet; consequently the FDR did not include any information about the accident.
  CVR recording showed some information within the time of the accident.

- Information on the QAR was read by EgyptAir M & E. It included mainly information about the APU.
  (Refer to exhibit #4)

- Several meeting and telephone conferences were held at (MCA- AAI) and EgyptAir M & E, between Egyptian representatives (MCA-AAI, ECAA, and EgyptAir), USA representatives (NTSB, FAA) and Boeing.
  Meetings and conferences were held to discuss and study the factual information and the possible scenarios for the accident, and to perform necessary short terms and long term actions to maintain highest degree of safety.

- A video tape was extracted from surveillance tapes developed by Cairo Airport Authority. This is a standard procedure used by Cairo Airport Authority. This video tape was received by (MCA- AAI) to support the investigation.

- Time correlation between the events included in the video tape and the CVR was made by (MCA-AAI).

- Samples from the burnt parts in the cockpit were collected and sent by the (MCA- AAI) to a

[1] Ministry of Civil Aviation, Aircrafts Accidents Investigation
[2] EgyptAir Maintenance and Engineering

specialized institute (CMRDI) for examination and analysis.

The samples included the following:

- Sample No.1: Yellow Powder (Flight Deck R.H.S.)
- Sample No.2: Blue Powder (Flight Deck R.H.S.)
- Sample No.3: Charred Material and Powder (R.H.S.)
- Sample No.4: Bright Blue Material (Flight Deck R.H.S. AFT of Main hole Adjacent to Wiring
- Sample No.5: Anti Kink Spring Supply Hoses Floor to Tee F/O O2 (Stainless steel Spring)

(Refer to exhibit #5 and exhibit #6)

- Examination and Analysis of the "Extinguishing Foam Agent" used by Cairo Airport Authority, was made by Ministry of Trade & Industry, Chemistry Administration, upon the request of (MCA- AAI).

  (Refer to exhibit #5 and exhibit #7)

- Oxygen cylinder purity test was made by the Egyptian Air Force, Aviation Engineering Department, Gas Plant No 1, upon the request of (MCA- AAI).
  (Refer to exhibit #8)

- The Boeing Company has conducted an extensive test program to determine if the oxygen system hoses were electrically conductive, and if they could have ignited if an electrical fault was present that involved these components.

- The Boeing Company, in coordination with the AAI, ECAA, and NTSB, FAA, developed mitigation strategies designed to eliminate this potential source of fire in the cockpit.

1 - FACTUAL INFORMATION

1.1 History of Flight

- On July 29, 2011, the said Boeing 777-200, Egyptian registration SU-GBP, operated by EgyptAir, arrived from Madina, Saudi Arabia (Flight No 678) and stopped at Gate F7, terminal 3, Cairo international airport almost at 0500 UTC time.

- Necessary maintenance actions (After Landing Check ALC, Transit Check) have been performed by EgyptAir engineers and technicians, to prepare the aircraft for the following scheduled flight (Cairo/ Jeddah, scheduled at 0730 UTC, same day 29 July 2011, flight number 667).

- The cockpit crew (Captain and F/O) for the event flight (Cairo/ Jeddah), started the cockpit preparation including checking the cockpit crew oxygen system as per normal procedures. The F/O reported that the oxygen pressure was within normal range (730 psi).

- At almost 0711 UTC, and while waiting for the last passengers to board the aircraft, the F/O officer reported that a pop, hissing sound originating from the right side of his seat was heard, associated with fire and smoke coming from the right side console area below F/O window #3 (right hand lower portion of the cockpit area) [The aircraft was still preparing for departure at Gate F7, Terminal 3 at Cairo Airport at the time the crew detected the fire].

- The Captain requested the F/O to leave the cockpit immediately and notify for cockpit fire. The captain used the cockpit fire extinguisher bottle located behind his seat in attempt to fight and extinguish the fire. The attempt was unsuccessful, the fire continued in the cockpit.

- The F/O left the cockpit, he asked the cabin crew to deplane all the passengers and crew from the aircraft, based on captain's order. He moved to the stairs and then underneath the aircraft in attempt to find anyone with a radio unit but he could not. He returned to the service road in front of the aircraft and stopped one car and asked the person in the car to notify the fire department that the aircraft is burning on the stand F7 using his radio unit.

- The cabin crew deplaned the passengers using the two doors 1L and 2L. The passenger bridge was still connected to the entry doors that were used for deplaning.

- The first fire brigade arrived to the aircraft after three minutes.

- The fire was extinguished. Extinguishing actions and cooling of the aircraft were terminated at 0845 UTC (1045 Cairo local time).

- The aircraft experienced major damage resulting from the fire and smoke.
- Passengers deplaned safely, some (passengers, employees) suffered mild asphyxia caused by smoke inhalation.
- Passengers and crew were as follows:

  Passengers 307, Cockpit Crew 2, Cabin Crew 8
- The investigation into this accident was led by the Egyptian (MCA-AAI) with the participation of ECAA, EgyptAir as advisors and also with the participation of an Accredited Representative of the United States NTSB. The manufacturer of the aircraft (The Boeing Company), and the United States FAA are acting as technical advisors to the United States Accredited Representative. .

1.2 Injuries to persons:

7 persons (Egypt Air employees, passengers and fire fighting personnel) suffered from mild asphyxia caused by smoke inhalation during the attempt to extinguish the fire. They were transferred to appropriate medical centers.

1.3 Damage to aircraft:

A. Examination of the aircraft

Examination of the aircraft determined that the cockpit was extensively damaged, and two holes were burned through the aircraft external skin just below the First Officer's window.

In addition, smoke damage occurred throughout the aircraft, and heat damage was found on overhead structures well aft of the cockpit.

Isolated areas of heat damage were found in the forward electronics bay located below the flight deck in locations where molten metal had dripped down from the main deck.

B. Accident aircraft photos:

Several shots were taken of the aircraft to show the damage details.

(Refer to exhibit #1).

1.4 Other Damages

- The passenger bridge at gate F7, where the aircraft was parked, experienced some damages as follows:
    - Window glass on the right side of the bridge was damaged.
    - Two jacks controlling the canopy at the front end of the bridge were bent, as a result of the extremely high temperature.
    - Longitudinal separation (cut) in the forward canopy at the right side. Length of the cut is almost 70 cm.
    - Damage of the machine controlling the bridge door, as a result of rushed entry of the fire personnel to the aircraft.
    - Some cracks in the glass reinforcing the operation cabin (about 10 small pieces).
- All necessary maintenance and repair actions were performed on the bridge. The bridge has been restored to service again on August the 2nd 2011.

1.5 Personnel Information

1.5.1 Captain:

A. Captain information:

- The captain is 49 years old, Egyptian Nationality.
- The captain holds an ATP license # 635, renewed and valid for the period between 26/5/2011 and 20/11/2011, issued by Egyptian Civil Aviation Authority on the aircraft type B777/200-300 as Group 1.
- His last medical examination is valid up to 20/11/2011.
- "Privilege of an Instrument Rating" is endorsed on his license, valid for the period between 22/11/2010 to 21/11/2011.
- "Instructor rating" is endorsed on his license, valid up to 13/05/2011 on the B777 type.
- He completed his last proficiency check satisfactorily on 21/05/2011.
- Following table includes information concerning his past experience and number of flying hours up to 29/07/2011.

Item	Hours	Minutes
Total number of flying hours	16982	37
Total number of flying hours on the B777 type	5314	22
Total number of flying hours through the previous month before the accident.	20	38
Total number of flying hours through the previous week before the accident.	5	25
Total number of flying hours through the previous day before the accident.	--	--

B. Captain Statement:

- An interview was made with the Captain at the (MCA-AAI). The captain responded to all inquiries raised by the investigation team based on his observations and associated actions.

- Questions and answers are documented in Arabic and English languages.

  (Refer to exhibit #2)

1.5.2 First Officer:

A. F/O information:

- The F/O is 25 years old, Egyptian Nationality.
- The F/O holds an ATP license # 4619, renewed and valid for the period between 29/12/2010 and 31/07/2011, issued by Egyptian Civil Aviation Authority on the aircraft type B777/200-300 as Group 2.
- His last medical examination is valid up to 21/12/2011.
- "Privilege of Instrument Rating"is endorsed on his license, valid for the period between 21/12/2010 to 20/12/2011.
- He completed his last proficiency check satisfactorily on 20/07/2011.
- Following table includes information concerning his past experience and number of flying hours up to 29/07/2011.

Item	Hours	Minutes
Total number of flying hours	2247	01
Total number of flying hours on the B777 type	198	10
Total number of flying hours through the previous month before the accident.	15	10
Total number of flying hours through the previous week before the accident.	4	30
Total number of flying hours through the previous day before the accident.	--	--

B. F/O Statement:

- An interview was made with the F/O at the (MCA-AAI). The F/O responded to all inquiries raised by the investigation team based on his observations and associated actions.

- Questions and answers are documented in Arabic and English languages.

  (Refer to exhibit #3)

1.6 Aircraft Information

1.6.1 Aircraft General Information

- Aircraft: B777-200 registered SU- GBP.
- Owner and Operator: EgyptAir, Serial number 028423.
- The aircraft holds a registration certification number 999 in the Egyptian records, issued from Egyptian Civil Aviation Authority on 09/02/2006.
- The aircraft holds a certificate of airworthiness number 845 issued from Egyptian Civil Aviation Authority, valid from 23/05/2011 to 22/5/2012.
- The aircraft holds a flying certificate number 259 years 2011 issued from Egyptian Civil Aviation Authority, valid from 24/05/2011 to 31/10/2011.
- Total number of flying hours 48281 hrs, 27 min (TSN), 11448 cycles (CSN) up to 15/07/2011.
- The following was recorded in its technical record, the period between 1/7/2011 up to the accident date:

  - Flight MS 684 Dammam / Cairo dated 29/7/2011:

    SAME SNAG PAGE NO 54709,54250,54702,54707
  - Flight MS 678 Medina/ Cairo dated 29/7/2011:

    DURING T/O ROLL AT HIGH SPEED NOISE HEARING FROM WHELLS (Wheels).
  - Flight MS 660 Jeddah/ Cairo dated 28/7/2011:

    FUEL ISLN VALVE APU STAT MSG SAME (SNAG) AS PAGE
    NO. 0054702.
  - Flight Jeddah/ Cairo dated 28/7/2011:

    FUEL ISOLATION VALVE APU.
  - Flight MS 678 EL medina/ Cairo dated 27/7/2011:

    NO FINAL APR (NO AUTO LAND) Comes at NPFD.
  - Flight MS 660 Jeddah/ Cairo dated 27/7/2011:

    SAME SNAG PAGE NO 0054250 ITEM NO.1 FUEL ISLN VALVE APU.
  - Flight MS 678 El Medina/ Cairo dated 26/7/2011:

    FUEL ISLN VALVE APU, STS MSG SNAG REPEPETITIVE ON PAGE 0054248.
    WXR SYS WXR FAIL MSG DURING FLIGHT.
  - Flight MS 662 Jeddah/ Cairo dated 26/7/2011:

    FUEL FSLAN VALVE APU STS MSG.
    NO AUTO LAND.
  - Flight MS 915 Dubai/ Cairo dated 23/7/2011:

    FUEL ISLN VALVE APU.
    BOTH EFB ARE U/S.
  - Flight MS 672 Jeddah/ Cairo dated 21/7/2011:

CURSOR CONTROL DEVICE F/O SIDE NOT WORKING PROPERLY.

PLS CHECK STS FUEL ISLN VALVE FUEL.

- Flight MS 915 Dubai/ Cairo dated 18/7/2011:

  CHECH STATUS (BANK ANGLE PROTECT).

- Flight MS 678 El Medina/ Cairo dated 13/7/2011:

  FLT DECK DOOR SWITCH SPRING IS U/S.

  LEFT CDU IS NOT WORKING ON GROUND.

  LAND 3 IS INOP.

- Flight MS 611 Kuwait/ Cairo dated 10/7/2011:

  NO LAND 3 " AUTO PILOT BACK DRVR “.

- Flight MS 615 Kuwait/ Cairo dated 08/7/2011:

  F/O EFB U/S.

- Flight MS 2055 Dammam/ Cairo dated 04/7/2011:

  APU GIVING FAILURE LIGHT ON OVER HEAD PANEL & STATUS PAGE, A/O IGV DOES NOT FLLOWS COMMANDS.

  F/O EFB HAS NO PRFORMANCE TERMINAL CHARTS. EON COOL VELVE ON STSTUS PAGE.

- Flight MS 678 El Medina/ Cairo dated 3/7/2011:

  NO AUTO LAND.

  DURING DESEND HYDRAULICS SMELL.

1.6.2 Flight Crew Oxygen System Description

Oxygen Systems

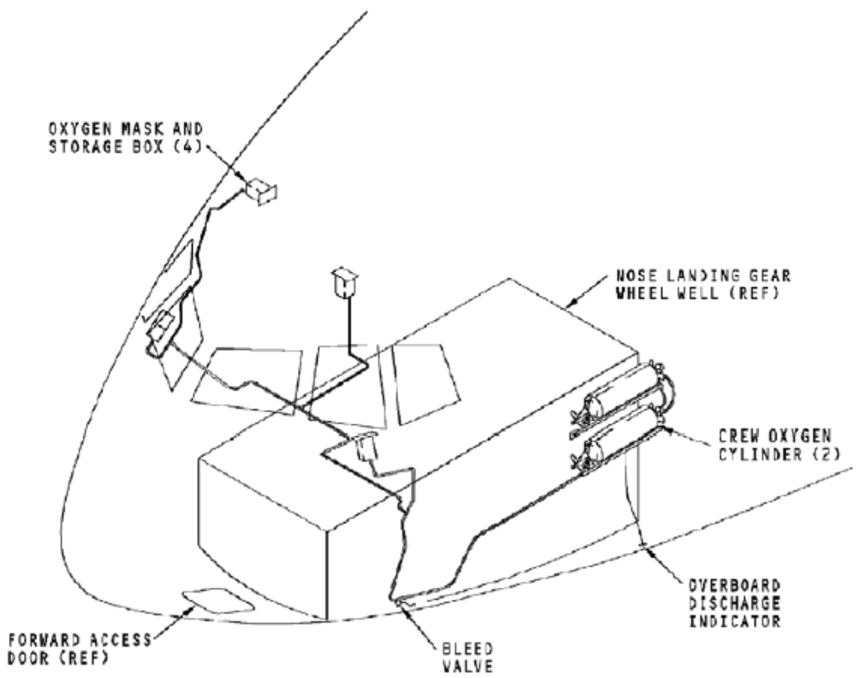
Two independent oxygen systems are provided, one for the flight crew and one for the passengers. Portable oxygen cylinders are located throughout the airplane for emergency use.

Flight Crew Oxygen System

The flight crew oxygen system gives oxygen to the flight crew for emergencies and procedures that make its use necessary. Oxygen is stored as a compressed gas in cylinders located in the main equipment center. A line connects the cylinders to oxygen masks in the flight deck. A regulator at the cylinders and diluter/demand valves at the masks decrease oxygen pressure to the correct pressure for crew use.

Quick–donning masks and regulators are located at each crew station. Oxygen pressure is displayed on the MFD STATUS display. The EICAS advisory message CREW OXYGEN

LOW alerts the flight crew of a low oxygen pressure condition. Flight crew and observer masks and regulators are installed in oxygen mask panels near each seat.



1.7 Meteorological Information

Based on the report, issued by the "Meteorological General Organization", the weather report on Cairo airport the time of the accident, time between 0600 and 0800 UTC was as follows:

Time UTC	Surface Wind		Visibility range	Metrological event	Clouds	Barro Press	Temp.	
	Direction	Speed knots	Horizontal Meters			hp	Dry Bulb	Dew Point
0600	300	04	6000	---	-	1004	26	22
0630	300	04	6000	---	-	1004	26	22
0700	310	02	More than 10 km	---	-	1005	27	22
0730	310	02	More than 10 km	---	-	1005	28	22
0800	310	02	More than 10 km	---	-	1004	29	22

1.8 Aids to Navigation

- Not relevant.

1.9 Communication

- Aircraft crew did not establish any radio communication with any traffic unit.
- First information regarding the accident event was reported by the captain of the aircraft that was parked at gate F8, scheduled for departure (MS 912 flight).

1.10 Aerodrome Information

- The aircraft was parked at Gate F7, terminal 3, Cairo international airport. There are two passenger bridges within this site at 1L and 2L.

1.11 Flight Recorders [3]

1.11.1 Cockpit Voice Recorder CVR

- CVR information: SN 3667, P.N 980-6022-001, manufactured by Honeywell.
- The CVR included the following audio information.
  - At 9:11:38 local time, a pop, hissing sound was heard.
  - At 9:11:41 local time, the captain requested the F/O to move out of the cockpit.
  - At 9:12:02 local time, the captain announced “fire”. He asked to call the fire fighting.
  - At 9:12:04 local time, The F/O voice was heard, he was asking for fire fighting.
  - At 09:12.06, sound of fire extinguisher

- CVR transcript:

A pop is heard, followed by a hissing sound similar to the escape of pressurized gas	09:11.38
• Captain: You get up get out now. fire fire call for fire	 09:11.41 09:12.02
• First officer: call for fire	 09:12.04
• sound of fire extinguisher	09:12.06
• captain: slowly	 09:12.15

1.11.2 Flight Data Recorder FDR

- FDR information: SN 2057, P.N 980-4700-003, manufactured by AlliedSignal.
- FDR did not include any information about the accidents (Engines were not started yet).

1.11.3 QAR (Quick Access Recorder)

- Information on the QAR was read by EgyptAir M & E. It included mainly information about the APU.

  (Refer to exhibit #4 QAR information)

[3] Information has been made available by the FDR, CVR center, Central Accident Investigation Department

1.11.4 Time correlation between CVR audio and the Cairo Airport Authority surveillance video tape for the accident.

- Time correlation has been made by the FDR, CVR lab team at the (MCA-AAI).
- Accident video is available at the (MCA-AAI).

1.12 Wreckage and impact information

- At the moment of the accident, the aircraft was parked at Cairo International Airport Gate F7, terminal #3.
- For aircraft damage details, refer to section 1.3.

1.13 Medical Pathological Information

- Not relevant.

1.14 Fire

- The civil protection service center received notification from the operation center of Cairo international airport who was in turn notified by EgyptAir IOCC based on a report from an adjacent aircraft to the event aircraft, requesting Fire fighting because of fire at EgyptAir B777 aircraft. The fire fighting units arrived to the aircraft site and started immediately dealing with the fire.
- Ten fire brigade and rescue units of different types dealt with fire & cooling down of the aircraft.

1.15 Survival Aspects

- Some passengers and some security personnel suffered mild asphyxia caused by smoke inhalation.

- The aircraft was in flight preparation phase, bridges were still at the entry doors. Passengers were deplaned using the entry doors and passenger bridges at doors 1L & 2L.

- The slide rafts were not used.

1.16 Tests and Researches

Several tests and researches were conducted locally in Cairo and USA. Following is a summary of the main tests and researches carried out up to the issuing of this report.

A. Tests and researches carried out locally in Cairo:

I. **Examination, Analysis of burnt parts samples (collected from the cockpit) done by Central Metallurgical Research and Development Institute (CMRDI).**

Samples from the burnt parts in the cockpit were collected and sent by the (MCA-AAI) to a specialized institute (CMRDI, Egypt) for examination and analysis.

The samples included the following:

- Sample No.1: Yellow Powder (Flight Deck R.H.S.).
- Sample No.2: Blue Powder (Flight Deck R.H.S.).
- Sample No.3: Charred Material and Powder (R.H.S.).
- Sample No.4: Bright Blue Material (Flight Deck R.H.S. AFT of Main hole Adjacent to Wiring.
- Sample No.5: Anti Kink Spring Oxygen Supply Hoses, Floor to Tee, F/O station (Stainless steel Spring).

Following is a summary of the results:

i. XRD samples analysis results:

(Refer to exhibit #5, Analysis report on Residual of Ground Fire of Boeing 777, developed by CMRDI).

Sample No.1: Yellow Powder (Flight Deck R.H.S. SU-GBP)

The test results showed that the yellow powder is mainly consists from Sulfaguanidine C7H10N4O2S and Mascagnite (NH4)2SO4.

*Sample No.2: Blue Powder (Flight Deck R.H.S.)

The test results showed that the blue powder mainly consists of Mascagnite (NH4)2SO4 and Barite BaSO4.

Sample No.3: Charred Material and Powder (R.H.S.)

The test results showed that the charred material mainly consists of Iron ammonium Nicotinate N-Oxide Sulfate Decahydrate C21H31FeN7O17S2.10H2O, Aluminum Boron Molybdenum Oxide B3.26Al4MoO14.96 and Hydrogen Deuterium Aluminum Silicate. (H0.13D0.87)(AlSi2O6).

Sample No.4: Bright Blue Material (Flight Deck R.H.S. AFT of Main hole Adjacent to Wiring).

The test results showed that the bright blue material mainly consists of Mascagnite (NH4)2SO4.

Sample No.5: Anti Kink Spring Oxygen Supply Hoses, Floor to Tee, F/O station (Stainless steel Spring).(Refer to item iii within this section)

ii. Examination of Stainless Steel Oxygen Supply Tube:

(Refer to exhibit #6 Examination of Stainless Steel Oxygen Supply Tube and Kink Spring).

The Stainless Steel Supply Tube was subjected to several inspections including the following:

1- Visual inspection.

2- Dye penetrant test.

3- Leakage test.

Following is a summary for the examination results:

1. Visual Inspection.

The tube surface was covered by fire products, and some areas have rough surface. The molten metal is basically aluminum alloy, resulted from the fire.

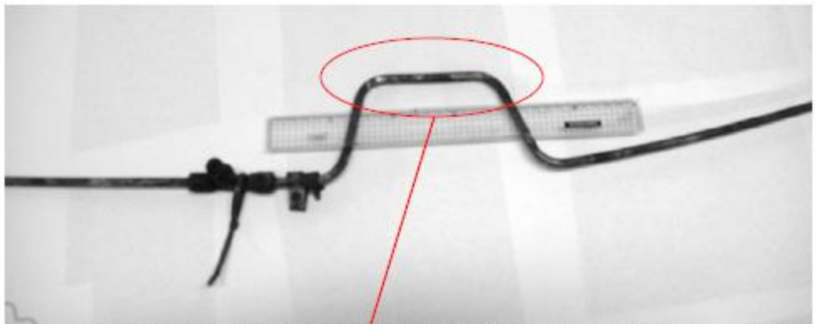


Fig. 1 General View of the received stainless steel supply tube

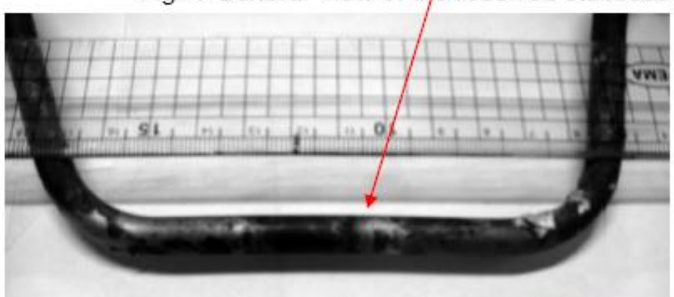


Fig. 2 Area of deposited molten metal

Fig.3 Another area covered with deposited molten metal

2. Dye penetrant test

No indications were detected.

3. Leakage test

No leakage areas were detected throughout the length of the tube.

iii. Examination of Anti Kink Spring Oxygen Supply Hoses, Floor to Tee, F/O station (Stainless steel Spring).

(Refer to exhibit #5, Analysis report on Residual of Ground Fire of Boeing 777, developed by CMRDI, exhibit #6 Examination of Stainless Steel Supply Tube and Kink Spring)

The stainless steel spring surface was covered by fire products with some spot rusted area (red color). No direct evidence of a short circuit was fund found, but most of the wiring near the supply tubing and portions of the tubing were missing, with evidence of melting on the remaining portions.

According to CMRDI view, most plausible cause for the observed melting of the stainless steel spring assembly is an oxygen fuel flame caused by high attained temperatures

The microstructure is normal for this type of stainless steel with normal grain size and without any precipitates.

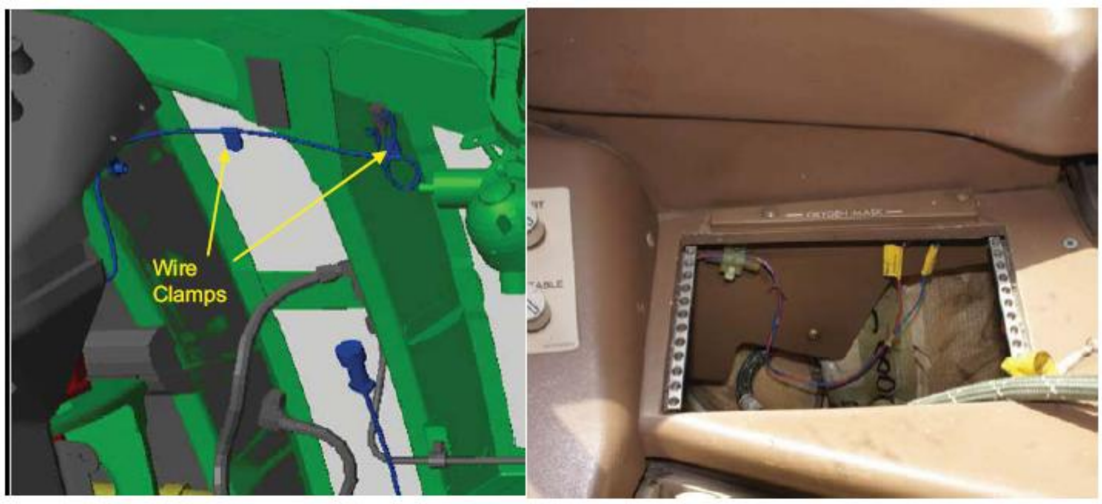
Microstructure of the investigated stainless steel spring, 200X

iv. Examination of other 777 Aircraft in EgyptAir Fleet

In the days following the fire, the area of intense fire damage was inspected on other EgyptAir 777-200 and 777-300 aircraft.

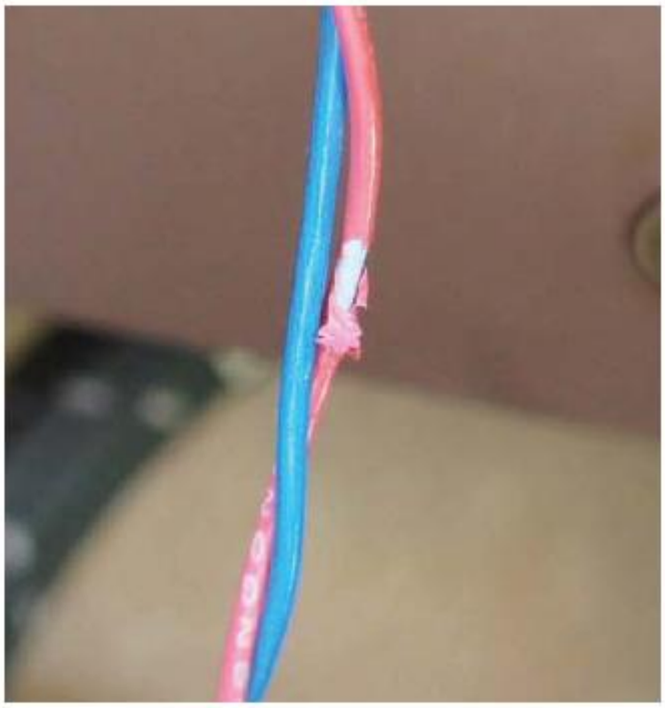
Oxygen Light Plate Wiring

The 777-200 aircraft were found to differ from Boeing's current design. In particular, the wiring to the first officer's oxygen mask light plate differed in the follow aspects: a wire clamp was missing, the wiring was not sleeved, and a large loop of unsupported wire was found. All of EgyptAir's 777-200 had a similar wiring configuration at the first officer's oxygen mask location. The captain's side wiring was similar, except that sleeving was present on all airplanes inspected.



Current Design As found on a different 777-200

On one of the 777-200 aircraft, the outer layer of wiring insulation was found damaged, although the inner layer was intact and the conductor was not exposed.



Damaged first officer oxygen light plate 5 volt AC wiring on a different 777-200 airplane

It was later determined that approximately 380 early 777 aircraft (including the accident) had been produced without sleeving on this wire run. Although the missing clamp was found on a number of 777-200 aircraft, the reason for the missing clamps could not be determined as the clamps have been part of the original design of the 777 aircraft. Boeing determined that it was appropriate to install sleeving on these wires and released a Service Bulletin (777-33-0042, dated 9 January 2012) recommending that 777 operators inspect and if necessary repair the captain's and first officer's oxygen light plate wiring.

Oxygen Hose Inspection

Flexible oxygen hoses in the flight deck of one in-service 777-200 aircraft were inspected for conductivity using a hand-held multi-meter. Although test conditions did not permit conclusive results, neither of the two hoses tested were found to be conductive

II. Examination and Analysis of the "Extinguishing Foam Agent" used by Cairo Airport Authority, done by CMRDI and Ministry of Trade & Industry, Chemistry Administration.

(Refer to exhibit #5, Analysis report on Residual of Ground Fire of Boeing 777, developed by CMRDI and exhibit #7 Extinguishing Foam Agent" examination done by Ministry of Trade & Industry, Chemistry Administration).

Examination and Analysis of the "Extinguishing Foam Agent" used by Cairo Airport Authority, has been made by CMRDI and Ministry of Trade & Industry, Chemistry Administration, upon the request of (MCA-AAI)

i - Results obtained from CMRDI examination, analysis:

Regarding the chemical composition of the used foam, it can be concluded that:

1) The collected residual mainly consists of ammonium sulfate compounds which are related to the foam type.

2) The charred material mainly resulted from the melting of aircraft body.

ii- Results obtained from the Ministry of Trade & Industry ,Chemistry Administration.

Examination and analysis:

The following table shows that the sample was in conformity with the specifications.

Test	Result	Specification	Conformity
Appearance	Yellow Transparent Liquid	Yellow xxx liquid	Conforming
Specific Gravity	1.004 gm/ ml	1.010 ± 0.010 gm/ ml	Conforming
PH	7.7	7.7 ± 0.5	Conforming

Refraction Coefficient	1.3532	Not less than 1.230	Conforming
Viscosity	1 cm (Poise)	Less than 3 cm (Poise)	Conforming
Expansion	6 times	Not less than 5 times	Conforming
Separation Time 25%	160 seconds	Not less than 150 second	Conforming

الحمايه المدنيه :—

الاختبار	النتيجة	المواصفة مرفقه	مدى المطابقة
١–المظهر	سائل اصفر شفاف	سائل أصفر [illegible]	مطابقة
٢ – الكثافة النوعية	١,٠٠٤ مل/جم	١,٠١٠ ± ٠,٠[illegible] مل/جم	مطابقة
٣– الأس الهيدروجيني (PH)	٧,٧	[illegible],٧ ± ٠,٥	مطابقة
٤– معامل الانكسار	١,٣٥٣٢	لا تقل عن ١,[illegible]	مطابقة
٥–اللزوجة	١ سنتى بواز	أقل من ٣ سنتى بواز	مطابقة
٦ – التمدد	٦ امثال	لا تقل عن ٥ أمثال	مطابقة
٧–زمن الانفصال ٢٥%	١٦٠ ث	لاتقل عن ١٥٠ ث	مطابقة

III. Examination of Oxygen cylinder for purity, done by the Egyptian Air Force, Aviation Engineering Department, Gas Plant No 1.

(Refer to exhibit #8 Examination of Oxygen cylinders for purity, done by the Egyptian Air Force.

Oxygen cylinder purity test was made by the Egyptian Air Force, Aviation Engineering Department, Gas Plant No 1, upon the request of (MCA,AAI).

The report certified that Cylinder Purity was 99.4 %, according to the standards

- MIL-PRF-27210.
- TO - 42B5 - 1 – 2.
- MIL-STD-1411.

IV. CVR and FDR readouts

CVR and FDR were transferred to the FDR, CVR Center; (MCA-AAI)

For the CVR readout, refer to section 1.11.1.

The FDR did not include any information about the accident.

V. CVR/ video tape correlation:

Time correlation has been made between the CVR and the video tape obtained from Cairo Airport Authority

(Refer to section 1.11.4)

VI. QAR readout:

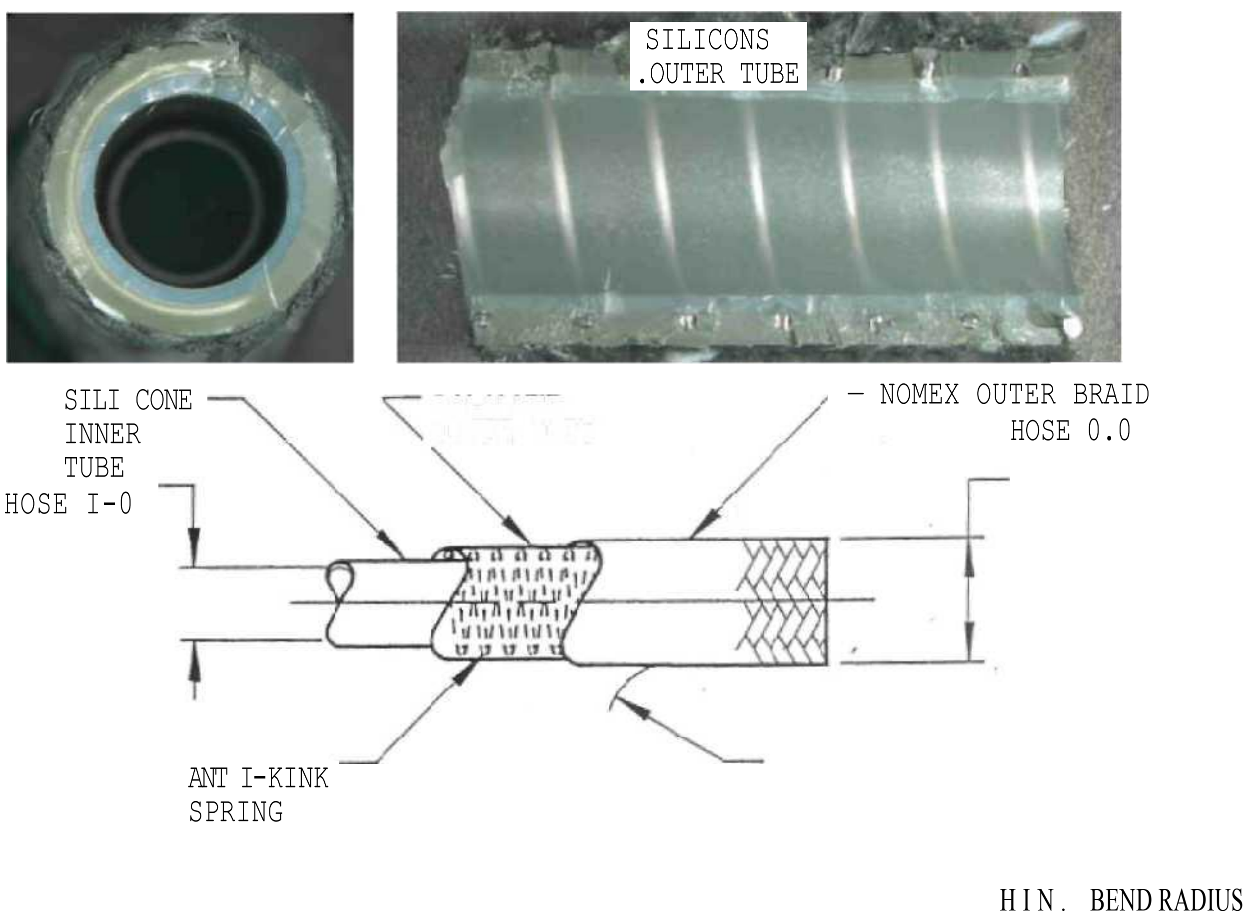
QAR readout has been made by EgyptAir M & E (refer to 1.11.3).

<u>B. Tests and researches carried out by Boeing Company (USA)</u>

Previous Events and Research

On 28 June 2008, an oxygen-fed fire destroyed the flight deck of a 767 airplane awaiting departure at San Francisco. Following that event, the US NTSB performed testing on flexible oxygen hoses with internal anti-kink springs. The NTSB found that these hoses could ignite if exposed to an electrical current conducted along their length by the anti-kink spring (Reference NTSB Fire Testing Factual Report No. 08-136, dated 13 January 2009).

The hoses tested by the NTSB in 2008/2009 were of comprised of clear polyvinyl chloride (PVC) with an internal stainless steel anti-kink spring. The hoses used on accident airplane (SU-GBP) were different in that they were comprised of two layers of silicon tubing with the anti-kink springs embedded in the outer layer.

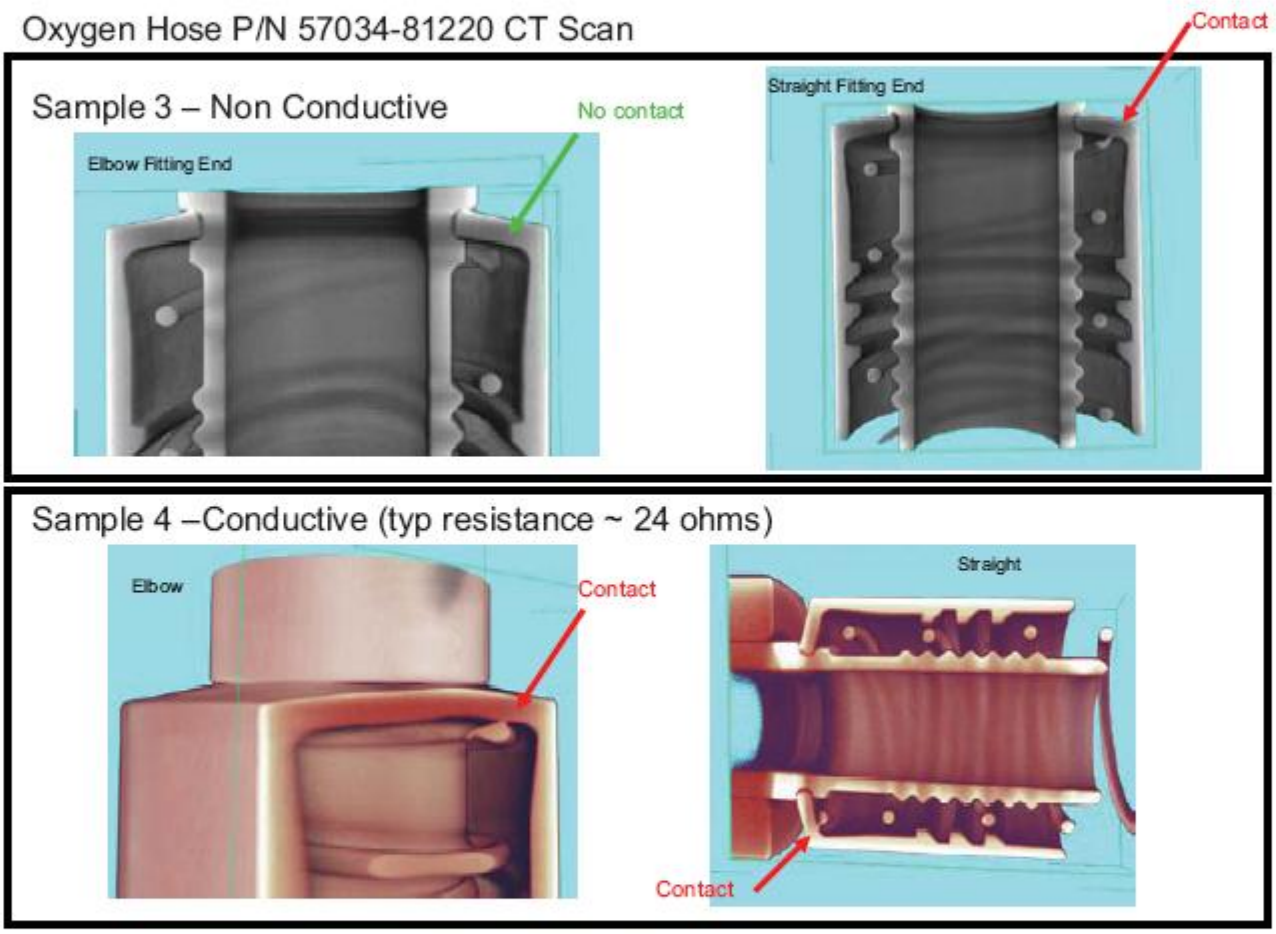


Flexible Oxygen Hose Construction

At the request of the EMCA, Boeing performed a number of tests on the silicon hoses:

Conductivity

The hoses used in the manufacture of the 777 do not have any design requirements related to conductivity. Seven exemplar flexible oxygen hoses were tested for conductivity. Of the seven hoses tested, two were found to be conductive and the remainder were non-conductive. The hose end fittings were imaged via computed tomography (CAT scan) to determine the reason for the variability. Variations were found in the details of the cut end of the hose. Specifically, in some samples, the cut end of the embedded spring was in contact with the end fitting and in other cases it was not. The two hoses that were found to be conductive had both ends of the spring in contact with their respective end fittings. Some of the non-conductive samples were found to have one end of the spring in contact with the end fitting, but were not conductive because the other end was not in contact.

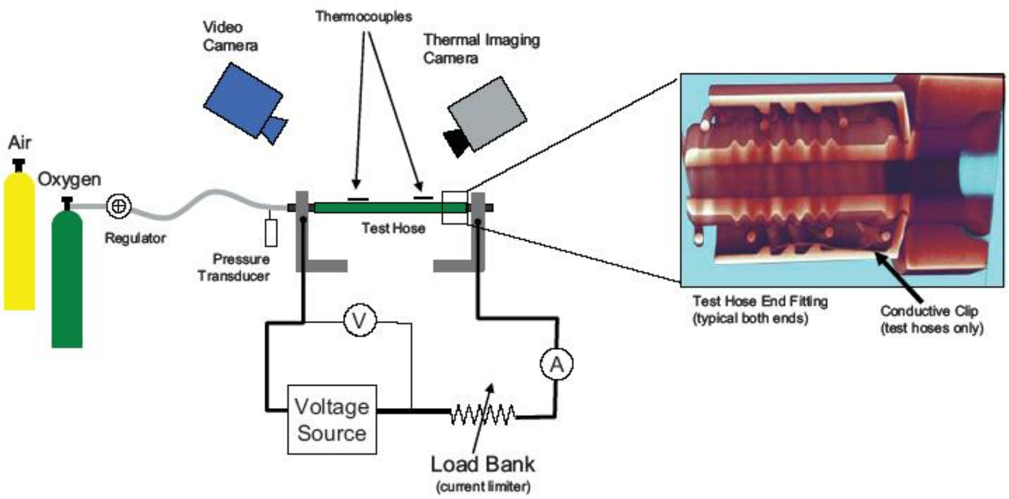


Hose End CT Scan Images

Flexible Hose Testing - Exposure to Electrical Current

At the request of the EMCA, Boeing performed testing on silicon flexible oxygen hoses similar to the testing that had previously been conducted on PVC hoses by the NTSB. Because of the variability in silicon hose conductivity, special hoses were fabricated for the test which included a metallic clip to ensure electrical conductivity between the end fitting and anti-kink spring. The hose length chosen for the test is the shortest of the hoses used on the 777 flight crew oxygen system and thus the lowest resistance and most susceptible to electrical heating.

The test setup includes means to pressurize the hose under test with either air or oxygen and apply an electrical current along the hose from one end fitting to the other. A load bank was connected in series with the test hose in order to limit current to values typical of actual aircraft circuits.



Flexible Oxygen Hose Test Setup

As shown in the diagram, the voltage was measured across the test hose and load bank connected in series and thus represents the combined voltage across both. The actual voltage across the hose by itself was lower than the measured value.

Test Results

Results from the tests conducted by Boeing are shown below.

Gas	Voltage	Current (amps)	Max Temp	Results	Notes
Air	5 VAC	1.2	~125°F	No rupture Slight internal discoloration	
Air	5 VAC	1.16	~302°F	No rupture Some internal discoloration	Wrapped with insulation
Air	28 VAC	2.5	~280°F	No rupture Some internal discoloration	
Air	28 VAC	5.0	~640°F	Smoke by ~370°F Burst near middle at ~635°F Significant degradation of hose material	
Air	28 VAC	6.0	~630°F	Smoke by ~370°F Leak near middle at ~630°F with some incandescence Significant degradation of hose material	
Air	115 VAC	2.5	~312°F	No rupture Some internal discoloration	
Air	115 VAC	5.0	~620°F	Smoke by ~330°F Leak near middle at ~620°F with visible incandescence Significant degradation of hose material	
Oxygen	5 VAC	1.2	~128°F	No rupture Slight internal discoloration	
Oxygen	28 VAC	2.5	~310°F	No rupture Some internal discoloration	
Oxygen	28 VAC	5.0	~604°F	Leak near middle at ~604°F followed by ignition and complete rupture of hose	

Selected test photos are shown in Exhibit #X

The testing demonstrated that a) the limiting factor is available voltage which is required to push current through the conductive oxygen hose, and b) 5 volts AC is not sufficient to cause hose failure during testing, even when the hose was wrapped in insulation to maximize heating.

Potential Electrical Short Circuits

The flight crew oxygen system design was examined to determine what potential sources of electrical energy were in proximity to the oxygen hoses and rigid tubing. Boeing performed an audit of the design. With the exception of the oxygen mask microphone wire (which was found to carry only milliamp level signal currents), all of the wiring in the area of the captain's and first officer's oxygen system followed the design requirements for separation. However, it was determined that contact between aircraft wiring and oxygen system components may be possible if multiple wire clamps are missing or fractured or if wires are incorrectly installed.

Other Potential Fire Scenarios

At the request of the EMCA, Boeing examined two other potential ignition scenarios.

Adiabatic Heating

Previous oxygen system fires have resulted from the sudden release of pressurized oxygen into a previously unpressurized system. If the quantity and pressure differential are sufficient, the resulting compression of oxygen gas at the end of the tubing run can result in heating sufficient to lead to ignition. In particular, failure of an oxygen system regulator could theoretically allow high pressure oxygen into the low-pressure tubing portion of the system. This hypothetical scenario was evaluated to determine if the resulting temperature rise posed a risk, given the conditions that existed at the time of the event and taking into account the design of the 777 flight crew oxygen system. It was found that the resulting temperature rise from such an event was not an ignition risk.

Window Crank Grease

Adjacent to the captain and first officer's oxygen mask storage boxes are mechanisms to open and close the #2 flight deck window. These mechanisms are periodically lubricated and grease was evident during inspections of other 777 aircraft in Cairo. Boeing was asked to study if the presence of this grease combined with the potential for an oxygen enriched atmosphere (from a hypothetical slow leak) and high ambient temperatures could lead to an ignition event. It was found that the flash points of the approved greases were at least 200°F above the highest theoretical temperature for this compartment. Further, the flash point was not affected by oxygen concentration, and an enriched oxygen environment was unlikely in the area due to high ventilation rates and daily monitoring of the crew oxygen system pressure.

C. Boeing Actions

Since the accident, Boeing has taken the following actions:

1. Released Service Bulletin 777-33-0042, dated 9 January 2012, recommending that 777 operators inspect and if necessary repair the captain's and first officer's oxygen light plate wiring.

2. Revised 777 new production to replace low pressure oxygen hoses with non-conductive low pressure oxygen hoses located in the flight deck. The first new airplane with non-conductive hoses was delivered in November 2011.

3. Released Alert Service Bulletin 777-35A0027, dated 15 December 2011, recommending that operators of previously delivered 777 airplanes replace low pressure oxygen hoses with non-conductive low pressure oxygen hoses located in the flight deck.

4. Provided information to 777 operators regarding the progress of the investigation and the changes described above (in coordination and with the approval of the EMCA).

1.17 Organizational and Management

- None.

1.18 Additional Information

*A. **Investigation Progress Statement***

Investigation Progress Statement for the Boeing 777 Cockpit fire accident has been issued by Egyptian (MCA- AAI).

Following is a copy of the investigation progress statement released on 18 October 2011:

On July 29, 2011, a Boeing 777-200, Egyptian registration SU-GBP, operated by EgyptAir, experienced a fire in the cockpit, the fire started at the right hand lower portion of the cockpit area, below the number 3 window.

The aircraft was preparing for departure at Gate F7, Terminal 3 at Cairo Airport at the time the crew detected the fire, and the crew and passengers expeditiously deplaned with no injuries. The flight was a regularly scheduled international passenger flight.

The investigation into this accident is being led by the Central Directorate for Aircraft Accidents Investigation, Ministry of Civil Aviation with assistance being provided by an Accredited Representative of the United States' National Transportation Safety Board. The manufacturer of the aircraft, The Boeing Company, and the United States' Federal Aviation Administration are acting as technical advisors to the United States Accredited Representative. The investigation is still in the early phases, and no final conclusions have yet been drawn. However, there has been substantial work conducted to determine the possible causes of the fire and to determine what mitigating actions should be taken.

Examination of the aircraft determined that the cockpit was extensively damaged, and two holes were burned through the aircraft external skin just below the First Officer's window. In addition, smoke damage occurred throughout the aircraft, and heat damage was found on overhead structures well aft of the cockpit. The investigation has been working to determine potential ignition sources in most heavily damaged portion of the cockpit. The crew oxygen system has a number of oxygen lines and hoses running through this area, so the investigation has conducted testing to determine if a failure involving these hoses could have been the primary cause of the fire

The Boeing Company has conducted an extensive test program to determine if the oxygen system hoses were electrically conductive, and if they could have ignited if an electrical fault was present that involved these components. The preliminary results of this testing indicate that some hoses used in the crew oxygen system are electrically conductive, while some hoses are not. When the hoses were manufactured, there was no specification in place to require that the hoses be non-conductive as received from Boeing. In addition, the test results indicate that, if the hoses are conductive, and if a sufficient electrical current is flowing through them, the hoses may heat to the point of failure and self-ignition.

Currently, the Boeing Company, in coordination with the investigation and the Federal Aviation Administration of the United States, is working to develop mitigation strategies that are designed to eliminate this potential source of fire in the cockpit. Boeing is working to finalize a Service Bulletin that is designed to inspect for and eliminate potential electrical faults around the crew oxygen system lines and hoses. In addition, Boeing is developing plans to replace the current crew oxygen system hoses with new, non-conductive hoses and is evaluating the benefits to providing additional electrical grounding points for crew oxygen system components. The design work for these efforts is expected to be complete by the end of November, and any newly required parts are expected to be available in the first quarter of 2012.
As the investigation a progress, additional updates will be issued.

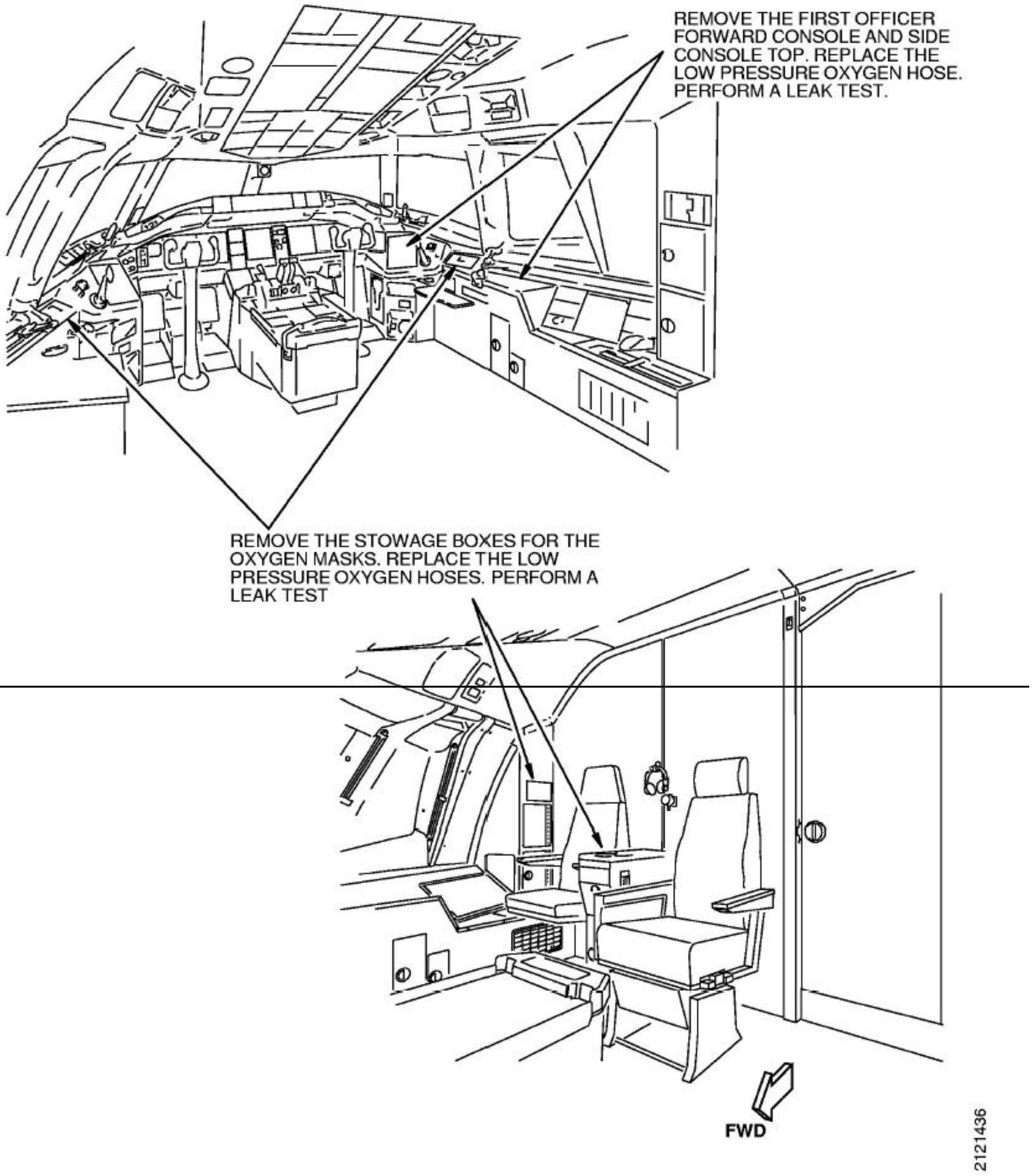
B. Boeing Service Bulletin 777-33-0042:

Boeing has issued an S/B Regarding LIGHTS - Passenger Compartment Illumination - First Officer's Oxygen Module Wiring and Inspection

S/B Number: 777-33-0042
Airplanes 777
Original Issue: October 25, 2011
ATA System: 3300
SUBJECT: LIGHTS - Passenger Compartment Illumination - First Officer's Oxygen Module Wiring and Inspection

C. Boeing Service Bulletin 777-35A0027:

Boeing has issued an S/B Regarding OXYGEN - Crew Oxygen System - Low Pressure Oxygen Hose Replacement
S/B Number: 777-35A0027
Airplanes 777
Original Issue: December 15, 2011
ATA System: 3511
Subject: Oxygen - Crew Oxygen System - Low Pressure Oxygen Hose Replacement


REMOVE THE FIRST OFFICER FORWARD CONSOLE AND SIDE CONSOLE TOP. REPLACE THE LOW PRESSURE OXYGEN HOSE. PERFORM A LEAK TEST.
REMOVE THE STOWAGE BOXES FOR THE OXYGEN MASKS. REPLACE THE LOW PRESSURE OXYGEN HOSES. PERFORM A LEAK TEST
FWD
2121436

2. Analysis

2.1 Analysis Overview

Methodology used:

During the investigation, the accident investigative team, which consisted of Egyptian, and U.S. investigators, mutually agreed upon and adopted a methodology to determine the accident sequence of events.

As part of this methodology, the investigative team identified possible accident scenarios, and sufficient evidence existed for the team to rule out the inapplicable scenarios.

The team then examined the remaining scenarios and the evidence collected during the investigation to determine which scenario most likely explained the accident sequence of events.

Methodology includes the following:

1. Define Accident Top Event
    a. Gather Performance, Data Recorders, and Operational Factors Investigators to brainstorm
    b. Layout all known evidence and facts related to
    c. Develop Sequence of Events if timing of events is known
    d. Decide on a description of what went wrong with the aircraft
2. Determine Most Direct Causes
3. Continue Breaking Down Causes
4. Use Facts to Draw Conclusions
5. Define Probable Cause(s)

2.2 Main events in Chronological sequence

- Necessary maintenance actions (After Landing Check ALC, Transit Check) have been performed by EgyptAir engineers and technicians, to prepare the aircraft for the following scheduled flight (Cairo/ Jeddah scheduled at 0730 UTC).

- The cockpit crew reached the aircraft almost 55 minutes before the departure time.

- Aircraft logbook was reviewed; the logbook did not include any snag.

- A conversation between the F/O and the purser took place, the purser was complaining that the aircraft was hot and asked for air conditioning unit.

- External air conditioning unit was requested and connected, however the cooling efficiency of the unit was low, hence the APU was started and used for cabin airconditioning (after the completion of the aircraft fueling). The temperature went down.

- The cockpit crew (Captain and F/O) for the event flight (Cairo/ Jeddah), started the cockpit preparation including checking the cockpit crew oxygen system as per normal procedures. The F/O reported that the oxygen pressure was within normal range (730 psi).

- At that moment, the passengers were about to start aircraft boarding, cockpit preparation was completed.

- The captain switched off the ground electrical power and allowed the ground services to disconnect the external power upon their request.

- At 9:11:38 local time (07:11:38 UTC), and while waiting for the last passengers to board the aircraft, the F/O officer reported that a pop, hissing sound originating from the right side of his seat was heard, associated with fire and smoke coming from the right side console area immediately below F/O window #3 (right hand lower portion of the cockpit area) [The aircraft was still preparing for departure at Gate F7, Terminal 3 at Cairo Airport at the time the crew detected the fire].

- At 9:11:41 local time, the Captain requested the F/O to leave the cockpit immediately

(You get up, get out now.) and notify for cockpit fire.

- At 9:11:55 local time, the captain used the cockpit fire extinguisher bottle located behind his seat in attempt to fight and extinguish the fire. The sound of the operation of fire bottle was heard in the CVR. The attempt was unsuccessful, the fire continued in the cockpit.

- At 9:12:01 local time, the captain announced “fire”. He asked to call the fire fighting. (Fire, fire, call for fire), the F/O left the cockpit and notified about the fire in the cockpit. He requested to deplane all the passengers and crew from the aircraft, based on captain’s order.

- At 9:12:02 local time, the captain announced “fire”. He asked to call the fire fighting.

- At 9:12:04 local time, The F/O voice was heard, he was asking for fire fighting.

- At 19:12:06 a sound of fire extinguisher activation was heard

- At 09:12:15 The captain announced “slowly”

- The cabin crew deplaned the passengers using the two doors 1L and 2L. The passenger bridge was still connected to the entry doors that were used for deplaning.

- The first fire brigade arrived to the aircraft after three minutes.

- Fire was extinguished; extinguishing actions and cooling of the aircraft were terminated at 0845 UTC (1045 Cairo local time).

- Passengers deplaned safely, some (passengers, employees) suffered mild asphyxia caused by smoke inhalation.

- In parallel to the actions done in the cockpit and the cabin, the external video installed at the apron stand showed the events that took place on ground beneath the aircraft. These events included the following:

    - The fire was coming out through two opening (made by the fire) beneath the F/O windows. The fire was easily seen from outside. Smoke was also seen coming out from the forward L.H. door

- The time the fire started in the cockpit, loading of the aft cargo holding was still in progress.

- A portable fire extinguisher bottle was used by one of the ground crew members beneath the aircraft and was directed to the openings that were induced by the fire.

- Few seconds later, another ground crew member used a second portable fire bottle and directed it towards the same fire source.

- Few seconds later, the towing truck started moving forward, leaving the aircraft.

- A fire brigade (truck) approached the aircraft from the right forward side also and started directing the pressurized extinguishing foam towards the fire source.

2.3 Human performance analysis

Cockpit crew:

- The two cockpit crew members were eligible for the flight. All documents and certificates were consistent with relevant regulations and standards.
- The cockpit crew adhered to the Standard Operating procedures and relevant Check lists. No evidences of errors or violations
- The cockpit crew was highly assertive. They handled the emergency situation in a highly professional manner based on good knowledge of crm (crew resource management).
- All cockpit crew actions were prompt and timely. Decision making process was made efficiently and timely.

Cabin Crew:

- The cabin crew adhered to the instructions of the captain and deplaned all the passengers efficiently and timely.
- The efficient behaviour of the cockpit and cabin crews highly contributed to the safety of the passengers and a/c crews.

Ground Crew:

- The time the fire was recognized and visible from the left side under the F/O windows, the ground crew started dealing efficiently with this emergency situation.
- The fire department was promptly notified
- Two portable fire extinguisher bottles were used by the ground crew members beneath the aircraft and were directed to the openings that were induced by the fire.
- In less than four minutes after the fire recognition, the fire brigades were available beneath the aircraft and started immediately the fire extinguishing process.
- The ground crew members moved the towing truck away of the aircraft.

2.4 Aircraft status:

Reviewing the records and certificates of the aircraft, the following can be concluded:

- The aircraft was Airworthy. All the documents and certificates are consistent with relevant standards and regulations.

- There were no deferred snags
- All snags that are recorded in the aircraft technical log the date from 1/7/2011 up to the accident date are not related to the accident.

2.5 Flight Recorders

2.5.1 Flight Data Recorder FDR

At the time of the accident, only the APU was running, the engines were not started yet; consequently the FDR did not include any information about the accident.

2.5.2 Cockpit Voice Recorder CVR

CVR recording showed some information within the time of the accident. Information extracted from the CVR was added to other information from other source to build the Main events in Chronological sequence

2.5.3 Quick Access Recorder QAR

The QAR included information about several parameters (Analog/ Discrete). Parameters are sampled every one second for total time duration of almost 80 seconds.

A list and summary of recorded parameters information are shown in the following text (Refer to Exhibit #9 Quick Access Recorder QAR for full Detailed Analysis):

- Weight on Wheel WOW:
  The QAR confirmed that the aircraft was on ground for the whole recording duration time.
- Magnetic Heading:
  The QAR showed a fixed heading of 252.25 degree throughout the whole recording duration time.
- Start valves:
  The QAR showed that the start valves for both engines were closed and remained closed for the whole recording duration time.
- Fuel flow:
  Fuel Flow values for both engines were shown to be zero for the whole recording duration time.
- AC Utility Bus-Left:
  Current load was shown to be zero for the whole recording duration time.
- AC Transfer Bus-Left:
  Current load was shown to be zero for the whole recording duration time.
- Main Battery Voltage:
  Main Battery Voltage was shown to be 27 volt for the whole recording duration time.
- TRU Current:
  TRU Current-L, TRU Current-R, TRU CurrentC1, TRU CurrentC2 showed variations in the values throughout the recording duration
  Max TRU Current-L was 51 amp
  Max TRU Current-R was 57 amp
  Max TRU Current-C1 was 54 amp
  Max TRU Current-C2 was 20 amp

- TRU Voltages:
  TRU Voltages were as follows:

- TRU Voltage- L = 28 volt
- TRU Voltage- R = 28 volt
- TRU Voltage C1 = 27 volt
- TRU Voltage C2 = 28 volt

(For the whole recording duration time).

- Galley Doors:

  Galley doors #2, #4 were shown to be closed For the whole recording duration time.

- Auxiliary Power Unit APU:

  The APU was shown to be started before the (APU speed started showing above zero value at 7 second on the reference time). Shut down time was not shown within APU data,

  Examination of the APU plots does not reveal any abnormality with the APU operation

  (Refer to Exhibit #8 for full APU data analysis)

2.6 Technical analysis to identify the probable cause(s) for the accident:

2.6.1 General

Taking into considerations that the cockpit area where the fire started has no:

- Fuel lines
- Hydraulic lines
- Oil lines

Most of the technical studies and tests were focused on the Crew Oxygen System as a root cause or contribution factor to the accident.

2.6.2 Analysis and tests

Several tests and analysis have been done either locally or at Boeing to identify the probable cause of the accident as shown in the factual information section.

Following are summary of the analysis and tests conclusions:

A. Examination & tests done locally in Cairo:

1. **Examination, Analysis of burnt parts samples (collected from the cockpit) done by Central Metallurgical Research and Development Institute (CMRDI).**

   Analysis of different samples of the burnt parts revealed that the sample powders consisted of several materials as follows:

   - Sulfaguanidine $C_7H_{10}N_4O_2S$
   - Mascagnite $(NH_4)_2SO_4$
   - Barite $BaSO_4$
   - Iron ammonium Nicotinate N-Oxide Sulfate Decahydrate $C_{21}H_{31}FeN_7O_{17}S_2.10H_2O$
   - Aluminum Boron Molybdenum Oxide $B_{3.26}Al_4MoO_{14.96}$
   - Hydrogen Deuterium Aluminum Silicate. $(H_{0.13}D_{0.87})(AlSi_2O_6)$.

   The Stainless Steel Supply Tube was subjected to several inspections

   Following is a summary for the examination results:

   - The tube surface was covered by fire products, and some areas have rough surface. The molten metal is basically aluminum alloy, resulted from the fire.
   - No leakage areas were detected throughout the length of the tube.

   Examination of Anti Kink Spring Oxygen Supply Hoses, Floor to Tee, F/O station (Stainless steel Spring) revealed the following:

   - The stainless steel spring surface was covered by fire products with some spot rusted area (red color). No direct evidence of a short circuit was fund found, but most of the wiring near the supply tubing and portions of the tubing were missing, with evidence of melting on the remaining portions.

- According to CMRDI view, most plausible cause for the observed melting of the stainless steel spring assembly is an oxygen fuel flame caused by high attained temperatures
- The microstructure is normal for this type of stainless steel with normal grain size and without any precipitates.

In the days following the fire, the area of intense fire damage was inspected on other EgyptAir 777-200 and 777-300 aircraft. Examination Revealed the following:

- Oxygen Light Plate Wiring

  The 777-200 aircraft were found to differ from Boeing's current design. In particular, the wiring to the first officer's oxygen mask light plate differed in the follow aspects:

  > a wire clamp was missing, the wiring was not sleeved, and a large loop of unsupported wire was found. All of EgyptAir's 777-200 had a similar wiring configuration at the first officer's oxygen mask location. The captain's side wiring was similar, except that sleeving was present on all airplanes inspected.

- Current Design As found on a different 777-200

  On one of the 777-200 aircraft, the outer layer of wiring insulation was found damaged, although the inner layer was intact and the conductor was not exposed.

- Regarding Damaged first officer oxygen light plate 5 volt AC wiring on a different 777-200 airplane

  Although the missing clamp was found on a number of 777-200 aircraft, the reason for the missing clamps could not be determined as the clamps have been part of the original design of the 777 aircraft.

Boeing determined that it was appropriate to install sleeving on these wires and released a Service Bulletin (777-33-0042, dated 25 October 2011, revised 9 January 2012 and again on 4 April 2012) recommending that 777 operators inspect and if necessary repair the captain's and first officer's oxygen light plate wiring.

- Oxygen Hose Inspection

Flexible oxygen hoses in the flight deck of one in-service 777-200 aircraft were inspected for conductivity using a hand-held multi-meter. Although test conditions did not permit conclusive results, neither of the two hoses tested were found to be conductive

2. **Examination and Analysis of the "Extinguishing Foam Agent" used by Cairo Airport Authority, done by CMRDI and Ministry of Trade & Industry, Chemistry Administration.**

   Examination and Analysis of the "Extinguishing Foam Agent" used by Cairo Airport Authority revealed the following:
   - The collected residual mainly consists of ammonium sulfate compounds which are related to the foam type.
   - The charred material mainly resulted from the melting of aircraft body.
   - The sample was in conformity with the specifications.
3. **Examination of Oxygen cylinder for purity, done by the Egyptian Air Force, Aviation Engineering Department, Gas Plant No 1.**

   The examination output report certified that Cylinder Purity was 99.4 %, according to the standards
   - MIL-PRF-27210.
   - TO - 42B5 - 1 – 2.
   - MIL-STD-1411.
4. **CVR and FDR downloads Analysis:**
   - The CVR download was used with another source of information to develop the Chronological Sequence as shown in item 2.2.
   - The FDR did not include any information about the accident.

5. **Examining video tape made by the external video camera situated on the apron stand**

   Video tape examination was used to develop time correlation between the CVR and the video tape

   Video tape examination showed the several actions made by the ground crew members on the ramp beneath the airplane including the following:
   - Use of portable fire extinguishers
   - Moving the towing truck away of the aircraft
   - Fire Brigade intervention

6. **QAR downloads Analysis (80 seconds): (refer to 2.5.2)**
   - The QAR confirmed that the aircraft was on ground for the whole recording duration time.

- The QAR showed a fixed heading of 252.25 degree throughout the whole recording duration time.
- The QAR showed that the start valves for both engines were closed and remained closed for the whole recording duration time.
- Fuel Flow values for both engines were shown to be zero for the whole recording duration time.
- Current load at AC Utility Bus-Left was shown to be zero for the whole recording duration time.
- Current load at AC Transfer Bus-Left was shown to be zero for the whole recording duration time.
- Main Battery Voltage was shown to be 27 volt for the whole recording duration time.
- TRU Current-L, TRU Current-R, TRU CurrentC1, TRU CurrentC2 showed values of 27V and 28 V)
- Galley doors #2, #4 were shown to be closed For the whole recording duration time.
- APU was shown to have been started. QAR showed plenty of APU parameters. All parameters showed normal operation.

B. Examinations & tests done at Boeing:

1. **Previous Events and Research** (Refer to 1.16 Tests and Researches item B)
   - An oxygen-fed fire destroyed the flight deck of a 767 airplane awaiting departure at San Francisco. Following that event, the US NTSB performed testing on flexible oxygen hoses with internal anti-kink springs. The NTSB

found that these hoses could ignite if exposed to an electrical current conducted along their length by the anti-kink spring .

- The hoses used on accident airplane were different in that they were comprised of two layers of silicon tubing with the anti-kink springs embedded in the outer layer.

2. Conductivity tests on the silicon hoses (refer to 1.16 B):

- The hoses used in the manufacture of the 777 do not have any design requirements related to conductivity.
- Seven exemplar flexible oxygen hoses were tested for conductivity.
- Of the seven hoses tested, two were found to be conductive and the remainder were non-conductive.
- Variations were found in the details of the cut end of the hose.
- Specifically, in some samples, the cut end of the embedded spring was in contact with the end fitting and in other cases it was not.
- The two hoses that were found to be conductive had both ends of the spring in contact with their respective end fittings.
- Some of the non-conductive samples were found to have one end of the spring in contact with the end fitting, but were not conductive because the other end was not in contact.

3. F**lexible Hose Testing - Exposure to Electrical Current (refer to 1.16 B):**

- Special hoses were fabricated for the test which included a metallic clip to ensure electrical conductivity between the end fitting and anti-kink spring. The hose length chosen for the test is the shortest of the hoses used on the 777 flight crew oxygen system and thus the lowest resistance and most susceptible to electrical heating.
- A load bank was connected in series with the test hose (pressurized with air and oxygen) in order to limit current to values typical of actual aircraft circuits.
- The testing demonstrated that

  a) The limiting factor is available voltage which is required to push current through the conductive oxygen hose, and

  b) 5 volts AC is not sufficient to cause hose failure during testing, even when the hose was wrapped in insulation to maximize heating.

Note:

All tests were made using new hoses; Boeing plans to examine aged hoses returned from in-service airplanes to determine if any age-related changes are evident which might affect the test results.

4. Potential Electrical Short Circuits (refer to 1.16 B):

- The flight crew oxygen system design was examined to determine what potential sources of electrical energy were in proximity to the oxygen hoses and rigid tubing.
- It was determined that contact between aircraft wiring and oxygen system components may be possible if multiple wire clamps are missing or fractured or if wires are incorrectly installed.

5. **Other Potential Fire Scenarios (potential ignition scenarios. Adiabatic Heating) (refer to 1.16 B):**

- Previous oxygen system fires have resulted from the sudden release of pressurized oxygen into a previously unpressurized system.
- In particular, failure of an oxygen system regulator could theoretically allow high pressure oxygen into the low-pressure tubing portion of the system.
- This hypothetical scenario was evaluated to determine if the resulting temperature rise posed a risk, given the conditions that existed at the time of the event and taking into account the design of the 777 flight crew oxygen system.
- It was found that the resulting temperature rise from such an event was not an ignition risk.

6. Window Crank Grease (refer to 1.16 B):

- Boeing was asked to study if the presence of window #2 lubricating grease combined with the potential for an oxygen enriched atmosphere (from a hypothetical slow leak) and high ambient temperatures could lead to an ignition event.
- It was found that the flash points of the approved greases were at least 200°F above the highest theoretical temperature for this compartment.
- Further, the flash point was not affected by oxygen concentration, and an enriched oxygen environment was unlikely in the area due to high ventilation rates and daily monitoring of the crew oxygen system pressure.

3 Conclusions:

Probable causes for the accident can be reached through:

- Accurate and thorough reviewing of the factual information and the analysis sections
- Excluding the irrelevant probable causes included in the analysis section

Examination of the aircraft revealed that the fire originated near the first officer's oxygen mask supply tubing, which is located underneath the side console below the no. 3 right hand flight deck window. Oxygen from the flight crew oxygen system is suspected to have contributed to the fire's intensity and speed.

The cause of the fire could not be conclusively determined. It is not yet known whether the oxygen system breach occurred first, providing a flammable environment or whether the oxygen system breach occurred as a result of the fire.

Accident could be related to the following probable causes:

1. Electrical fault or short circuit resulted in electrical heating of flexible hoses in the flight crew oxygen system. (Electrical Short Circuits; contact between aircraft wiring and oxygen system components may be possible if multiple wire clamps are missing or fractured or if wires are incorrectly installed).

2. Exposure to Electrical Current

4. Safety Recommendations:

It is recommended that all Boeing 777 operators:

1. Inspect and if necessary repairing the captain's and first officer's oxygen light plate wiring. (as per “Service Bulletin 777-33-0042")

2. Replace low pressure oxygen hoses with non-conductive low pressure oxygen hoses located in the flight deck (as per Alert Service Bulletin 777-35A0027)

5- Technical Investigation Committee

1- Capt/ Shaker Kelada	**Chief**
2-Eng./Gebaly H. Eldesoky	**Member**
3- Capt / Ayman F. El mokadem	**Member**
4- Capt / Basem Gohar	**Member**
5-Eng./ Mohamed A. Hamdy	**Member**
6- Eng./Wageh S. Hanna	**Member**
7-Eng./Hany Salah Eldin	**Member**
8- Eng./Shiref Afify	**Member**
9- Eng./ Aisha A. Salah Eldin	**Member**
10- Eng./ Mona A. Arafa	**Member**
11. Spl. Hazem A. Gamaa	**Member**
12. Mr./ Ehab. Hosny Mohamed	**Technician**
13. Mr./ Mohamed Eesa Ahmed	**Technician**

Raised to H E the Minister of Civil Aviation for Kind Approval,

Eng. Hazem Mohamed Elsaid

D. G. for Aircraft Accident Investigation

Capt / Shaker Kelada

Head of Central Directorate of Accidents

Approved,

Samir Embaby

Minister of Civil Aviation

Exhibits

Exhibit #1

Photos for the accident aircraft


S 24 R
30 inch tall approx.
16 inch wide approx.
10 inch tall approx.
4 inch wide approx.
BS 204 approx.
BS 189 approx.
BS 179 approx.
BS 175 approx.
NEFERTITI
BANK EGYPT


BEST BANK
by Euromoney and

EGYPTAIR
Item
Check Label
P/N
SN or Batch No
Due Date
Action subject
to Due Date:
CS2800-4171
Form


EGYPTAIR


NO STEP


افتح
OPEN


ITEM 26
STA

Frame STA 676
Looking Aft
ITEM 27
STA


ITEM 37
ITEM 38
افتح
OPEN


Item 43
08.06.2011


ITEM 47


ITEM 48

EGYPTAIR


Item 5

Exhibit #2

Captain Statement

جمهورية مصر العربية
وزارة الطيران المدنى
الادارة المركزية للحوادث

محضـــــر تحقيـــــق فنـــى

- حادث/واقعة/مخالفة الطائرة المسجلة SU-GBP من طراز B777-200
التابعة لشركة.. مصر للطيران للخطوط الجوية...... يوم ٢٠١١/٨/٩
وبحضور اعضاء اللجنة [illegible]...
و [illegible]...... برئاسة.. [illegible]

- انه فى الساعة ١٢١٠ يوم ٢٠١١/٨/١٥ حضر السيد/ [illegible]
السن ٤٩ عاماً الوظيفة... طيار قائد [illegible] مصر للطيران للخطوط الجوية
العنوان [illegible]
وذلك لسماع اقواله فى هذا الشان وقد توجهت اليه بالاسئلة الاتية فاجاب:-

س: ما هى معلوماتك عن الواقعة موضوع التحقيق؟

ج: انا كنت معين على رحلة مصر [illegible]
[illegible] الساعة ١٧٦٠ [illegible]
[illegible] IOCC [illegible]
[illegible] ٢٢ [illegible]
[illegible]
[illegible]
[illegible]
[illegible] lower central display [illegible]
[illegible]

٢٠١١/٨/١٥

التوقيعات

(C)

الطائرة الساعة ٦ صباحاً وأبلغني رئيس الطاقم بعطل جهاز تكييف وبالفعل
تم طلب سيارة تكييف لأن تكييف خارجي الـ ... لم يتم ذلك
باعلامنا بأنها ... تم الاتصال بمكتب الطائرة بالعقود ... تم
لإدارة الـ APU واستخدام تكييف الطائرة وبالفعل كانت
درجة الحرارة داخل الكابينة ... عند الصعود ...
ذلك كان قد تم من التجهيزات الخاصة للكابينة cockpit prepration
وقت عمل الفحوصات ... الطائرة كانت عادية
حيث كان ضغط الأكسجين 700 psi داخل المدى الأكسجين
700 - 1300 psi لم يلاحظ أي ... ماعدا ... [illegible]
وسواء فحوصات ... الطاقم ... كانت ...
الفحوصات اللازمة ... بحالة ... الأكسجين
... عمل ... جهاز الـ
FMC ... بعد ذلك ... قام ...
ذلك ... الـ ground
ground ... switch الـ ... Power
Power ... بالكهرباء الأرضية
أثناء ذلك ... دخول الركاب ... حوالي ... دقائق ...
الـ load sheet ... الركاب ... ثم ...
... أحد الركاب

[illegible]
٢٠١١/١٩/١٠

[illegible]

التوقيعات

جمهورية مصر العربية
وزارة الطيران المدنى
الادارة المركزية للحوادث

علماً بأن ذلك حدث أثناء بعد صعود جميع الركاب بالطائرة بساعة حوالي
الساعة ٨ وعشر دقائق أثناء مرحلة التجهيز النهائي للرحلة وأثناء
متابعة إجراءات الإقلاع سمعنا صوت أشبه بصفير
آت من ناحية الطيار المساعد يشبه صوت صفارة تلقائي ثم صوت
المساعد يستغيث بكلمة حريق بالتفاتي حيث أدركت أنه صادر من
جهة ... مع تصاعد دخان كثيف جداً وطلبت من الطيار
المساعد الخروج سريعاً حتى ينجو من الدخان وقمت بالاتصال (cockpit)
من القطاع ... لم يمكن ... استعمال ... طفاية
أنه صادر من ... الكابينة ... الـ Nozzle ... الطفاية
في اتجاه الحريق اعتقاداً مني أنني أستطيع الوصول لمصدر الحريق
الذي ... بعد تفريغ الطفاية بالكامل لم يحدث أي
تأثير ... شدة الحريق الذي بدأ يتزايد مع صعوده
إلى ... وأسود ... طفاية الحريق ... الكابينة
القيادة ... ... ساعة الإطفاء ... ومحاولة
للتأكد ... هذا الحريق ... الطائرة لم ...
... داخل الكابينة ...
الذي ... بالفعل ... مغادرة الطائرة ... Tube
... الموجودة بالإسراع في ...
خروج جميع الركاب وبالفعل تمت عملية الخروج بسرعة

التوقيعات

١٥/١٢/٢٠١١

(٤)

وجميع المسافرين في هذه الحالة يتوجهون للباب مع المضيفات وللتأكد
من عدم وجود حالة Bank ومضاءة علامة الباب L2 ونظرت
من النافذة الصغيرة بالباب [illegible] للتأكد من الباب للتأكد من
عدم وجود عائق خارج الباب في حالة الإخلاء [illegible] وفتحت
فتحات الطائرة وفتح الباب [illegible] الركاب [illegible]
نستطيع ان تخرج [illegible] انه ليس [illegible]
ملتصق من الجهة L الـ Tube وبالفعل خرج الجميع وتأكدت من عدم
وجود ركاب أو أي عضو من أفراد الطاقم في الطائرة وخرجت
خلف أفراد طاقم الركاب من الباب L2 وتأكدت
من تحرك الركاب في الـ Tube داخل الصالة وكان هناك
تكدس [illegible] الا انه بعد ذلك الـ Flow
أصبح حركته طبيعية [illegible] صوت عالي مع المضيفات
للتأكد مرة أخرى أنهم لم يروا أو يسمعوا أي ركاب أو
أعضاء متعلقة داخل الطائرة ثم بعد خروج الطاقم من الـ
Tube [illegible] من دخول الركاب الى الصالات
[illegible] الـ Tube [illegible] بالفعل
[illegible] مع الحريق الذي كانت
[illegible] داخل [illegible] الطائرة

التوقيعات

٢٠١١/٨/١٠

جمهورية مصر العربية
وزارة الطيران المدنى
الادارة المركزية للحوادث

س: ما هى المدة التى استغرقتها عملية اخلاء الركاب؟
ج: حوالى ٤ - ٥ دقائق
س: هل سمعت أى صوت شرشرة وشرارة مثل الحريق؟
ج: لم أسمع أى صوت أو أى فرقعة أو أى دخانات كانت الكابينة فى وضع طبيعى كامل.
س: ما هى المدة بين انطلاق الـ oxygen mask وبين الحريق؟
ج: حوالى نصف ساعة
س: هل كانت هناك أى مصدر للنيران أو الاشتعال فى الكابينة قبل نشوب الحريق؟
ج: لا هى الكابينة لم يكن بها مصدر وأنا متأكد من ذلك مصدر.
س: من معرفتك ما هو سبب اشتعال الحريق داخل غرفة قيادة الطائرة؟
ج: من خبرتى فى الطيران ومعرفتى بالحوادث خلال سنوات عملى تعلمت أنه يصعب جداً الآن إبداء التصور بسبب أى حادثة حيث أنه يتطلب التحقيق الكامل من جميع النواحى أما من حيث الأكسجين فهو مادة الاشتعال مما يساعد على سرعة الحريق ويبقى تحديد مصدر الشرارة المسببة لهذا الحريق.

التوقيعات

س: ما عدد الطائرات التي قمت بقيادتها؟

م: لا — قمت بقيادة طائرة واحدة المصعدة في الكابينة -

س: هل صدرت [illegible] ملاحظات أو إنذارات أو [illegible] من قبل؟

م: لا لم يحدث

س: ما هي الطائرات المؤهل عليها؟

م: A300-600، A300B4، 737-500، 737-200، Foker 27

س: هل لديك أقوال أخرى؟

م: لا

تمت أقواله وطلع عليها [illegible] -

التوقيعات

Arab Republic of Egypt
Ministry of Civil Aviation
Accident Investigation Central Administration

Technical Inquiry

EgyptAir Boeing 777-200 aircraft cockpit fire Accident
AT Cairo Airport
On 29th July 2011, Registration SU-GBP
Flight No MS 667 Cairo/ Jeddah

Investigation Team:
Engineer/ Gebaly Hosny Eldesouky
Captain/ Ayman El Mokaddem
Engineer/ Mona Ahmed Bakr
Headed by:
Captain/ Shaker Kelada

The Event flight captain was received at 12:15, 15 August, 2011, at Accident Investigation Central Administration Ministry of Civil Aviation to answer the investigation team inquiries related to the accidents.

Captain Information:
Name: Shaheer Magdy Abdel Sayyed,
Occupation: EgyptAir Airline Captain
Age: 49 years
Address: 11 Ismail Basha st. Cairo
Tel: 0122144702

Questions and Answers are shown in the following text

Question: What is yr information regarding the said accident?
Answer:

- I was assigned to Jeddah flight scheduled on 9:15 as the aircraft captain.
- I arrived to the aircraft on 7:45 local using MS ground transportation.
- Briefing for the flight was made at IOCC operation room.
- Fuel requested for the flight was 33 ton
- We moved directly to the aircraft, we reached the aircraft almost 55 minutes before the departure time, and then I moved to the cockpit at the F/O seat.
- Aircraft logbook was reviewed, the logbook did not include any snag, however, we were told through the briefing that there is a malfunction in the lower central display.
- I was caught by a conversation between the F/O and the purser, the purser was complaining that the aircraft was hot and asked for air conditioning unit.
- External air conditioning unit was requested and connected, however the cooling efficiency of the unit was low, hence we waited for the completion of the aircraft fueling, and then started the APU and used it for aircraft Airconditioning. The temperature went down.
- At that moment, the passengers were about to start aircraft boarding, cockpit preparation was completed.
- I have done all relevant checks in conjunction with the F/O, everything seemed to be normal.
- Oxygen pressure was 700 psi (normal range is 700-1300 psi). The cockpit did not have any additional crew members, just the F/O and captain.
- I moved to my seat and started checking emergency equipment including oxygen system. The system was normal.
- I was observing the work of the F/O to prepare the FMC. I rechecked his work when he completed FMC programming
- The Ground services requested to disconnect the external power, so I switched off the ground electrical power and allowed them to disconnect the external power.
- At that time, the passengers started the boarding.

- 10 minutes before the departure, we received the load sheet; we made the necessary computations for the take off. The dispatcher asked me to allow him to supervise the arrival of some more passengers, and he will be back after the complete boarding of the passengers. The time was about 9:10 local.
- During the final preparation for the flight, and during discussing the last computations, we heard a bang (fissing) sound at the right lower side of the F/O followed by air sound xxx . The F/O jumped out of his seat. I realized that there was a fire at the right side of the F/O. The fire color was yellow with very light blue color.
- I ordered the F/O to leave the cockpit immediately so as I can make the necessary actions. I shouted on him "Go Out"
- I picked the portable fire extinguisher bottle in the cockpit and started using it, at the same time I asked the F/O to notify that there is a fire in the cockpit. I directed the nozzle of the fire bottle to the fire believing that I can reach the fire source. The fire bottle was completely depleted without any influence on the fire intensity. The fire was more growing with white and black smoke.
- I threw the fire bottle and left the cockpit quickly to check if the fire brigade has arrived or not, and trying to find an assistance to control that fire.
- While being at the aircraft door, I did not find any assistance. I moved directly inside the cabin towards the passengers. At this time the passengers already started deplaning the aircraft through the tube. I shouted to the cabin crew with a loud voice to immediately ensure that all the passengers have left the airplane.
- Passengers deplaning was performed very quickly, I helped in directing the passengers with the cabin crew, ensuring that there were no Rank case. At that time I was at the door 2L, I looked through the small window on the door and passenger window close to the door to ensure that there are no obstacles outside the door in case we might need to open it and use the slide rafts. I felt that the remaining number of passengers is able to leave the airplane before being badly influenced by the smoke. I kept following up the passengers while leaving the airplane through the tube.
- All the passengers have left the aircraft safely. I ensured there were no passengers or cabin crew members in the aircraft, then I left the aircraft after the last passenger and cabin crew member using door 2L.

- I made a follow up for the movement of the passengers inside the tube to the hall. There was some simple crowd for a moment, however the flow of passengers returned back to normal condition.
- I shouted again to the cabin crew with a loud voice for the second time to ensure that they have not seen or heard any passenger that was still remaining in the cabin.

Question: What was the time taken to deplane the passengers?
Answer: about 4 to 5 minutes

Question: Did you hear any leaking sound or spark before the fire?
Answer: I did not hear any sound or feel any smell or see any smoke in the cockpit. Every thing was quite normal.

Question: What is the time between testing the oxygen mask and the start of the fire?
Answer: About half an hour.

Question: Was there any source for fire or ignition in the cockpit before the fire?
Answer: I like to assure you that the F/O and I are not smokers.

Question: From yr personal view, what is the cause of the fire in the cockpit?
Answer:
Based on my experience in aviation for several years, and my long readings about accidents, I learned that it is so difficult to predict the cause of an accident as it needs lot of investigations. However, the existence of oxygen at this area, might have contributed to the fire intensity. The ignition source for the fire should be determined.

Question: How many fire bottles did you use in the cockpit?
Answer: I used only one fire bottle that is available in the cockpit.

Question: Have you been informed about any injury among passengers or cabin crew?
Answer: No. Did not happen

Question: What is your experience?. What are the types that you are qualified on?
Answer: A300-600, A300B4, B737-500, B737-200, Fokker 27.

Question: Do you want to add any more information?
Answer: No

The captain reviewed all the above information, he accepted it and signed

Exhibit #3

F/O Statement

جمهورية مصر العربية
وزارة الطيران المدنى
الادارة المركزية للحوادث

محضـــــــر تحقيـــــق فنـــى

- حادث/واقعة/مخالفة الطائرة المسجلة SU-GBP طراز B.777-200
التابعة لشركة مصر للطيران للخطوط الجوية .... يوم ٢٠١١/٨/٢٩
وبحضور اعضاء اللجنة [illegible]
و. [illegible] ..... برئاسة [illegible]
- انه فى الساعة ١١:٢٠ يوم ٢٠١١/٨/١٥ حضر السيد/ [illegible]
السن [illegible] الوظيفة ... [illegible] مصر للطيران للخطوط الجوية
العنوان ٩٠ شارع [illegible] ت/ ٠١٢٥٨٤٦٦٧٤٤٦
وذلك لسماع اقواله فى هذا الشان وقد توجهت اليه بالاسئلة الاتية فاجاب:-

س: ما معلوماتك عن الواقعة موضوع التحقيق
ج: أثناء [illegible] dispatch office [illegible] on time [illegible]
[illegible]
[illegible] ok [illegible]
[illegible] lower center display unit [illegible] B snag
[illegible] mop [illegible]
[illegible]
[illegible] normal procedures ال [illegible]
[illegible] 730 psi [illegible] oxygen pressure [illegible]
[illegible] log book ال [illegible] weekly

التوقيعات

[illegible]
[illegible] ٢٠١١/٨/١٥

(٢)

مستوى الصيانة يوم ٢٠١١/٧/٢٣ آخر ٢٠١١/٧/٢٤ [illegible] الـ Daily Check

مستوى الصيانة يوم ٢٠١١/٧/٢٨ [illegible] الـ Transit كان موقع

يوم ٢٠١١/٧/٢٩ [illegible] Bsnag [illegible] الطائرة

وجد الـ Bsnag Dispatch حالة Removed وتم [illegible]

الـ lower center display وجد أنها [illegible]

تم تعديلها وكان [illegible] paint

وصول الطائرة تم [illegible] الطائرة وتم إجراء

Walk around [illegible] Normal [illegible]

الـ Tail Nav. light [illegible]

[illegible] بالطائرة [illegible]

[illegible] رئيس الطاقم [illegible] الكابينة [illegible]

[illegible] Aircondition [illegible]

[illegible] الـ APU [illegible]

APU [illegible] walkaround

[illegible] over head panel [illegible]

APU Bleed [illegible] off [illegible]

الـ APU [illegible] الـ Air condition [illegible]

[illegible] Tow Bleed [illegible] 2 Sources [illegible]

[illegible] رئيس الطاقم [illegible]

التوقيعات

[illegible]
٢٠١١/٨/١٥

[illegible]

وأبلغنا ان الطائرة لديها السالة ونظام الكابينة دائرة
الـ APU يعمل وطلبنا من ان أبلغ الـ ground ان يقوم
بتشغيل الـ Air condition ثم علمنا ان الطائرة موضع الـ
APU Bleed on وذلك لعدم وجود هواء كافي
ساعة ٣ ما أن بدأ السلالة باقى الطائرة وبشر
اضاءة oxygen masks بالـ normal وذلك تم
بالضغط على مفتاح الـ Reset test وقول يعمل Hold
Emergency selector Push Botten وبعد ذلك سمعت صوت متواصل
وصدا الطبيعي وصوت يدفع بيدى ما تقطع الصوت (صوت طبيعي
التسريب من الـ mask) والاضاءة الثانى أقوم بالضغط
على الـ (Blanker) test switch وصوت الـ
الـ Blanker (turn zero) ثم أغلقنا وصدا
بالتأكد ال 100% Continuous Flow ثم
أعطونا البيانات الـ load sheet فى معاده وتم التحرك
وبعد انتهاء ... شاهدت شرار طبيعي
الـ manual (RTOW) فوق الـ glar shield
التأكد بحركات ... الطائرة
... صوت ... تقطيع ... صوت ...
طوالها ... الـ Side wall

التوقيعات

ملاحم
٢٠١١/٨/١٥

شريف شحاتة

جمهورية مصر العربية
وزارة الطيران المدنى
الادارة المركزية للحوادث

عن يمين الكابينة فاستلمت مقعدي لعدم تمكني الزحام أمامه
Seat belt وجلست بدون ربط حيث أمسكت مقعدي بيدي
قام مضيف الطائرة بسرعة وسأل عن سبب هذه الدخان كثيف
بسبب انتشار الـ Smoke والـ Fire بسرعة جداً
وبعدها طلب مني قائد الطائرة وقال لي (أطلع بره) وقام بالفور
بفتح كابينة الحريق وبالإطفاء أطفأ الحريق بطفاية موجودة
داخل الكابينة وتابعت أنه يطلق Fire وقال لي يطلق Fire
وحصل من الـ Gate بأبواب الطائرة وأبلغنا اننا طلبنا من الركاب
الراكبين أن يبلغوا بالخروج للركاب الموجودين على ذلك
ذلك ... ... بعد ذلك ...
الكابينة ... ... قادم للأمام ...
فابلغت أن يتم Controled evacuation بسرعة وبعد ذلك
... ... الطائرة ... ...
شخص مع ... بلاغ ... ...
... أمام الطائرة ... ...
... ...
... الطائرة ... f7 ... ...
... ...
... ... الطائرة ...

التوقيعات

[signature]

[signature]

ال First officer [illegible] طفاية [illegible]
[illegible] ال First officer [illegible]
[illegible] الطفاية [illegible] الحريق [illegible] كانت الطفاية
[illegible]
[illegible]
[illegible]
[illegible]

س: قبل نشوب الحريق هل سمعت أي صوت غير عادي في الكابينة أو صوت شرر أو شيء مختلف؟

ج: لا كان كل شيء طبيعي مثل كل يوم.

س: هل سمعت صوت الفرقعة الذي صاحب بداية الحريق أثناء ارتداء الـ oxygen mask؟

ج: كانت تقريبا بعدها حوالي ٢٠ دقيقة.

س: هل كان هناك أي مصدر اشتعال في الكابينة؟

ج: لا لم يكن هناك مصدر اشتعال في الكابينة.

س: متى رأيت مكان الحريق بالضبط؟

ج: كان بين الفتحة بين الـ Right window الجزء [illegible]
[illegible] في الكونسولتين.

س: متى كانت آخر رحلة لك على هذه الطائرة قبل يوم الحادث؟

التوقيعات

٢٠١١/١٢/١٠

جمهورية مصر العربية
وزارة الطيران المدنى
الادارة المركزية للحوادث

ج: كانت قبلها بيوم أو بيومين وعلى ما أعتقد كانت للدواسة

س: ما هو الـ Power الذي كان به مشكلة قبل حدوث الحريق؟

ج: كان الـ APU مطفي وكنا شغالين على الـ Grand Power

س: [illegible] ما إذا كان لونه [illegible]؟

ج: كان لونها orange مائل للأحمرار وكانت كثيفة

س: هل لديك أقوال أخرى؟

ج: لا

تمت أقواله وأقفل عليها وأمضي [illegible]

[illegible] (توقيع)

٢٠١١/١٢/١٠

التوقيعات

Arab Republic of Egypt

Ministry of Civil Aviation

Accident Investigation Central Administration

Technical Inquiry

EgyptAir Boeing 777-200 aircraft cockpit fire Accident

AT Cairo Airport

On 29th July 2011, Registration SU-GBP

Flight No MS 667 Cairo/ Jeddah

Investigation Team:

Engineer/ Gebaly Hosny Eldesouky

Captain/ Ayman El Mokaddem

Engineer/ Mona Ahmed Bakr

Headed by:

Captain/ Shaker Kelada

The Event flight F/O was received at 11:30, 15 August, 2011, at Accident Investigation Central Administration Ministry of Civil Aviation to answer the investigation team inquiries related to the accidents.

F/O Information:

Name: Sherif Mohamed Abdel Moneim Shehata

Occupation: EgyptAir Airline F/O.

Age: 25 years

Address: 9 General/ Abdel Aziz Aly Street, Military College.

Tel: 0128266226

Questions and Answers are shown in the following text

Question: What is yr information regarding the said accident?

Answer:

- I arrived the airport on time, and then I entered the dispatch office and asked for the flight envelop
- I reviewed all the contents of the envelop
- Weather was O.K. xxx . Everything was quite normal.
- The "Lower Center Display Unit" was reported as inoperative and recorded as a B snag.
- I moved to the aircraft with the captain almost one hour before the flight. I entered the cockpit and started the F/O normal procedures including checking the oxygen pressure. The oxygen pressure was 730 psi.
- I reviewed the technical logbook. The weekly check was performed and signed on 26 July or 27 July. The Daily check was signed on 28 July, 2011. The transit check was signed on 29 July, 2011
- Upon reviewing the B snags in the technical logbook, I found out that the dispatch B snag was removed. I checked the lower central display, it was replaced with a new one.
- There was only one snag concerning the aircraft paint.
- I moved under the aircraft and performed the walk around check. Everything was normal. I noticed that the Tail Navigation Light was inoperative. This was the only malfunction in the aircraft.
- I moved once again to the cockpit, I was informed by the purser that the cabin is very hot. I asked him to ask the coordinators to bring and connect the ground Airconditioning unit to save the APU life.
- When we reached the cockpit, the APU was not running, that was before performing the Walk Around.
- When I started the Overhead Panel preparation, I switched off the APU bleed so as not to get bleed from two bleed sources when the APU is started.
- After about 10 minutes or more, the purser entered the cockpit again and informed me that the cabin is still hot; accordingly the captain started the APU. The captain asked me to ask the ground to disconnect the ground

Airconditioning unit, and then the captain turned on the APU bleed. This was almost half an hour before the fire as I can remember.

- I completed the remaining aircraft preparation. I tested the oxygen mask and it was normal. I made the test by pressing the reset test button and then I hold on the Emergency Selector Push Button. A continuous sound was heard, this is normal, then I released my hand, the sound stopped (the sound of oxygen flowing out of the mask). The second test is performed by pressing on the test switch (Blanker). I made sure that Blanker (turn zero) and then close it. I made sure that it was on Continuous Flow, 100 %.
- The load sheet was brought to us on time. We made the take off speed computations.
- We were waiting for a late passenger, everything was normal.
- The RTOW manual was above the glare shield to confirm take off speeds.
- Suddenly, a bang (fissing) sound was heard coming from the right side of my seat. I have seen a crack of about 10 cm long at the side wall to the right of the oxygen mask.
- I unfastened the seat belt immediately, and stood up very quickly. At the same time, the captain left his seat quickly. The smoke and fire were spreading very quickly. After that, the captain ordered me to get out the cockpit. He started immediately pulling the fire bottle in the cockpit in an attempt to extinguish the fire.
- The captain asked me to notify about the fire
- I went out through the gate at the aircraft door. I asked the people at outside to notify for deplaning the passengers outside the aircraft because of fire.
- A cabin crew member named Sherif came to me; I moved to the cabin after that, I found a cabin crew member named Sherif moving forward and facing me. I asked him to make controlled evacuation quickly.
- I moved to the stairs after that and then underneath the aircraft. I tried to find any one with a radio unit to notify the fire brigade, but I did not find any one. I returned to the service road in front of the aircraft and stopped one car and asked person in the car if he has a radio unit. He said yes. I asked him to notify that the aircraft is burning on the stand F7 quickly. He gave me his fire extinguishing bottle, I took it. At that time I have seen smoke and fire coming outside the aircraft at the F/O side. I took the fire bottle and moved towards the

lower side of the F/O. I tried to direct the bottle towards the fire from outside, however the airplane was high and the wind was so strong so it did not help

- Many people tried to extinguish the fire from the same side, and then the fire brigades were seen, so we cleared the area for them. They started doing there job. We felt that our role has been ended at this stage.

Question: Before the fire, did you hear any leaking sound in the cockpit or ignition sound or strong leak?

Answer: No everything was normal as everyday.

Question: when was the bang (hissing) sound heard with regard to the oxygen mask test?

Answer: It was almost 35 minutes after the test.

Question: Was there any source for ignition in the cockpit?

Answer: No, there was no ignition source in the cockpit.

Question: Where did the fire start exactly?

Answer: It was at the level of the hinge between the twp parts of the right window, the fixed and moveable parts, in the plastic at the console itself.

Question: When was your last flight on this type before the event?

Answer: One or two days before the event. I believe it was to Riad

Question: What was the used power source at the time of the event?

Answer: The APU was the only source. We disconnected the ground power before that

Question: What was the color of the fire?

Answer: The fire color was orange with some red color. The fire was very intensive.

Question: Do you want to add any more information?

Answer: No

The F/O reviewed all the above information, he accepted it and signed

Exhibit #4

QAR information

Sample	DATE-DAY	DATE-MON	GMT	TAT	WoW-Air	HeadingMag	StartAirVlvL	StartAirVlvR
1			6:47:04	30.1	0	252.25	0	0
2	29	7	6:47:05	30.1	0	252.25	0	0
3			6:47:06	30.1	0	252.25	0	0
4			6:47:07	30.1	0	252.25	0	0
5			6:47:08	30.1	0	252.25	0	0
6	29	7	6:47:09	30.1	0	252.25	0	0
7			6:47:10	30.1	0	252.25	0	0
8			6:47:11	30.1	0	252.25	0	0
9			6:47:12	30.1	0	252.25	0	0
10	29	7	6:47:13	30.1	0	252.25	0	0
11			6:47:14	30.1	0	252.25	0	0
12			6:47:15	30.1	0	252.25	0	0
13			6:47:16	30.1	0	252.25	0	0
14	29	7	6:47:17	30.1	0	252.25	0	0
15			6:47:18	30.1	0	252.25	0	0
16			6:47:19	30.1	0	252.25	0	0
17			6:47:20	30.1	0	252.25	0	0
18	29	7	6:47:21	30.1	0	252.25	0	0
19			6:47:22	30.1	0	252.25	0	0
20			6:47:23	30	0	252.25	0	0
21			6:47:24	30	0	252.25	0	0
22	29	7	6:47:25	30.1	0	252.25	0	0
23			6:47:26	30	0	252.25	0	0
24			6:47:27	29.9	0	252.25	0	0
25			6:47:28	29.9	0	252.25	0	0
26	29	7	6:47:29	29.9	0	252.25	0	0
27			6:47:30	29.9	0	252.25	0	0
28			6:47:31	29.9	0	252.25	0	0
29			6:47:32	29.9	0	252.25	0	0
30	29	7	6:47:33	29.9	0	252.25	0	0
31			6:47:34	29.9	0	252.25	0	0
32			6:47:35	29.9	0	252.25	0	0
33			6:47:36	29.9	0	252.25	0	0
34	29	7	6:47:37	29.9	0	252.25	0	0
35			6:47:38	29.9	0	252.25	0	0
36			6:47:39	29.9	0	252.25	0	0
37			6:47:40	29.9	0	252.25	0	0
38	29	7	6:47:41	29.9	0	252.25	0	0
39			6:47:42	29.9	0	252.25	0	0
40			6:47:43	29.9	0	252.25	0	0
41			6:47:44	29.9	0	252.25	0	0
42	29	7	6:47:45	29.9	0	252.25	0	0
43			6:47:46	29.9	0	252.25	0	0
44			6:47:47	29.9	0	252.25	0	0
45			6:47:48	30	0	252.25	0	0
46	29	7	6:47:49	30	0	252.25	0	0
47			6:47:50	29.9	0	252.25	0	0
48			6:47:51	30	0	252.25	0	0
49			6:47:52	30	0	252.25	0	0
50	29	7	6:47:53	29.9	0	252.25	0	0
51			6:47:54	29.9	0	252.25	0	0
52			6:47:55	29.9	0	252.25	0	0
53			6:47:56	29.9	0	252.25	0	0

54	29	7	6:47:57	30	0	252.25	0	0
55			6:47:58	30	0	252.25	0	0
56			6:47:59	29.9	0	252.25	0	0
57			6:48:00	29.9	0	252.25	0	0
58	29	7	6:48:01	29.9	0	252.25	0	0
59			6:48:02	30	0	252.25	0	0
60			6:48:03	29.9	0	252.25	0	0
61			6:48:04	29.9	0	252.25	0	0
62	29	7	6:48:05	30.1	0	252.25	0	0
63			6:48:06	29.9	0	252.25	0	0
64			6:48:07	29.9	0	252.25	0	0
65			6:48:08	29.9	0	252.25	0	0
66	29	7	6:48:09	29.9	0	252.25	0	0
67			6:48:10	29.9	0	252.25	0	0
68			6:48:11	29.9	0	252.25	0	0
69			6:48:12	30	0	252.25	0	0
70	29	7	6:48:13	29.9	0	252.25	0	0
71			6:48:14	29.9	0	252.25	0	0
72			6:48:15	29.9	0	252.25	0	0
73			6:48:16	30	0	252.25	0	0
74	29	7	6:48:17	29.9	0	252.25	0	0
75			6:48:18	29.9	0	252.25	0	0
76			6:48:19	29.9	0	252.25	0	0
77			6:48:20	29.9	0	252.25	0	0
78	29	7	6:48:21	29.9	0	252.25	0	0
79			6:48:22	29.9	0	252.25	0	0
80			6:48:23	29.9	0	252.25	0	0

Sample	FuelFlow-L	FuelFlow-R	ACUtilBus-L	ACXfrBus-L	MainACBus-L	MainBatVolt	TruCurrent-L
1	0	0	0	0	0	27	49
2	0	0	0	0	0	27	50
3	0	0	0	0	0	27	49
4	0	0	0	0	0	27	49
5	0	0	0	0	0	27	49
6	0	0	0	0	0	27	50
7	0	0	0	0	0	27	49
8	0	0	0	0	0	27	49
9	0	0	0	0	0	27	50
10	0	0	0	0	0	27	50
11	0	0	0	0	0	27	49
12	0	0	0	0	0	27	49
13	0	0	0	0	0	27	50
14	0	0	0	0	0	27	50
15	0	0	0	0	0	27	49
16	0	0	0	0	0	27	49
17	0	0	0	0	0	27	50
18	0	0	0	0	0	27	50
19	0	0	0	0	0	27	49
20	0	0	0	0	0	27	50
21	0	0	0	0	0	27	50
22	0	0	0	0	0	27	50
23	0	0	0	0	0	27	49
24	0	0	0	0	0	27	49
25	0	0	0	0	0	27	50
26	0	0	0	0	0	27	49
27	0	0	0	0	0	27	49
28	0	0	0	0	0	27	49
29	0	0	0	0	0	27	50
30	0	0	0	0	0	27	50
31	0	0	0	0	0	27	49
32	0	0	0	0	0	27	50
33	0	0	0	0	0	27	50
34	0	0	0	0	0	27	50
35	0	0	0	0	0	27	49
36	0	0	0	0	0	27	50
37	0	0	0	0	0	27	49
38	0	0	0	0	0	27	49
39	0	0	0	0	0	27	49
40	0	0	0	0	0	27	49
41	0	0	0	0	0	27	49
42	0	0	0	0	0	27	49
43	0	0	0	0	0	27	49
44	0	0	0	0	0	27	49
45	0	0	0	0	0	27	49
46	0	0	0	0	0	27	48
47	0	0	0	0	0	27	49
48	0	0	0	0	0	27	49
49	0	0	0	0	0	27	49
50	0	0	0	0	0	27	49
51	0	0	0	0	0	27	49
52	0	0	0	0	0	27	49
53	0	0	0	0	0	27	49

54	0	0	0	0	0	27	49
55	0	0	0	0	0	27	49
56	0	0	0	0	0	27	49
57	0	0	0	0	0	27	48
58	0	0	0	0	0	27	49
59	0	0	0	0	0	27	49
60	0	0	0	0	0	27	50
61	0	0	0	0	0	27	51
62	0	0	0	0	0	27	51
63	0	0	0	0	0	27	51
64	0	0	0	0	0	27	50
65	0	0	0	0	0	27	51
66	0	0	0	0	0	27	51
67	0	0	0	0	0	27	50
68	0	0	0	0	0	27	50
69	0	0	0	0	0	27	51
70	0	0	0	0	0	27	51
71	0	0	0	0	0	27	50
72	0	0	0	0	0	27	50
73	0	0	0	0	0	27	51
74	0	0	0	0	0	27	51
75	0	0	0	0	0	27	50
76	0	0	0	0	0	27	51
77	0	0	0	0	0	27	51
78	0	0	0	0	0	27	51
79	0	0	0	0	0	27	50
80	0	0	0	0	0	27	51

Sample	TruCurrent-R	TruCurrent C1	TruCurrent C2	TruVoltage-L	TruVoltage-R	TruVoltage C1	TruVoltageC2
1	57	54	20	28	28	27	28
2	57	54	20	28	28	27	28
3	57	54	20	28	28	27	28
4	57	54	20	28	28	27	28
5	57	54	20	28	28	27	28
6	57	54	20	28	28	27	28
7	57	54	20	28	28	27	28
8	57	54	20	28	28	27	28
9	57	54	20	28	28	27	28
10	57	54	20	28	28	27	28
11	57	54	20	28	28	27	28
12	57	54	20	28	28	27	28
13	57	54	20	28	28	27	28
14	57	54	20	28	28	27	28
15	57	54	20	28	28	27	28
16	57	54	20	28	28	27	28
17	57	54	20	28	28	27	28
18	57	54	20	28	28	27	28
19	57	54	20	28	28	27	28
20	57	54	20	28	28	27	28
21	57	54	20	28	28	27	28
22	57	54	20	28	28	27	28
23	57	54	20	28	28	27	28
24	57	54	20	28	28	27	28
25	57	54	20	28	28	27	28
26	57	54	20	28	28	27	28
27	57	54	20	28	28	27	28
28	57	54	20	28	28	27	28
29	57	54	20	28	28	27	28
30	57	54	20	28	28	27	28
31	57	54	20	28	28	27	28
32	57	54	20	28	28	27	28
33	57	54	20	28	28	27	28
34	57	54	20	28	28	27	28
35	57	54	20	28	28	27	28
36	57	54	20	28	28	27	28
37	57	54	20	28	28	27	28
38	57	54	20	28	28	27	28
39	57	54	20	28	28	27	28
40	57	54	20	28	28	27	28
41	57	54	20	28	28	27	28
42	57	54	20	28	28	27	28
43	57	54	20	28	28	27	28
44	57	54	20	28	28	27	28
45	57	54	20	28	28	27	28
46	57	54	20	28	28	27	28
47	57	54	20	28	28	27	28
48	57	54	20	28	28	27	28
49	57	54	20	28	28	27	28
50	57	54	20	28	28	27	28
51	57	54	20	28	28	27	28
52	57	54	20	28	28	27	28
53	57	54	20	28	28	27	28

54	57	54	20	28	28	27	28
55	57	54	20	28	28	27	28
56	57	53	20	28	28	27	28
57	57	53	20	28	28	27	28
58	57	54	20	28	28	27	28
59	57	54	20	28	28	27	28
60	57	54	20	28	28	28	28
61	56	54	20	28	28	28	28
62	56	54	19	28	28	28	28
63	56	54	19	28	28	28	28
64	56	54	19	28	28	28	28
65	56	54	19	28	28	28	28
66	56	54	19	28	28	28	28
67	56	54	19	28	28	28	28
68	56	54	19	28	28	28	28
69	56	54	19	28	28	28	28
70	56	54	19	28	28	28	28
71	56	54	19	28	28	28	28
72	56	54	19	28	28	28	28
73	56	54	19	28	28	28	28
74	56	54	19	28	28	28	28
75	56	54	19	28	28	28	28
76	56	54	19	28	28	28	28
77	56	54	19	28	28	28	28
78	56	54	19	28	28	28	28
79	56	54	19	28	28	28	28
80	56	54	19	28	28	28	28

Sample	Door2Galy	Door4Galy	APU-Enable	APUC-On	APURun	APUDoor	APUDr-Clsd
1	0	0	0	1	0	0	0
2	0	0	0	1	0	0	0
3	0	0	0	1	0	0	0
4	0	0	0	1	0	0	0
5	0	0	0	1	0	0	0
6	0	0	0	1	0	0	0
7	0	0	0	1	0	1	0
8	0	0	0	1	0	1	0
9	0	0	0	1	0	1	0
10	0	0	0	1	0	1	0
11	0	0	0	1	0	1	0
12	0	0	0	1	0	1	0
13	0	0	0	1	0	1	0
14	0	0	0	1	0	1	0
15	0	0	0	1	0	1	0
16	0	0	0	1	0	1	0
17	0	0	0	1	0	1	0
18	0	0	0	1	0	1	0
19	0	0	0	1	0	1	0
20	0	0	0	1	0	1	0
21	0	0	0	1	0	1	0
22	0	0	0	1	0	1	0
23	0	0	0	1	0	1	0
24	0	0	0	1	0	1	0
25	0	0	0	1	0	1	0
26	0	0	0	1	0	1	0
27	0	0	0	1	0	1	0
28	0	0	0	1	0	1	0
29	0	0	0	1	0	1	0
30	0	0	0	1	0	1	0
31	0	0	0	1	0	1	0
32	0	0	0	1	0	1	0
33	0	0	0	1	0	1	0
34	0	0	0	1	0	1	0
35	0	0	0	1	0	1	0
36	0	0	0	1	0	1	0
37	0	0	0	1	0	1	0
38	0	0	0	1	0	1	0
39	0	0	0	1	0	1	0
40	0	0	0	1	0	1	0
41	0	0	0	1	0	1	0
42	0	0	0	1	0	1	0
43	0	0	0	1	0	1	0
44	0	0	0	1	0	1	0
45	0	0	0	1	0	1	0
46	0	0	0	1	0	1	0
47	0	0	0	1	0	1	0
48	0	0	0	1	0	1	0
49	0	0	0	1	0	1	0
50	0	0	0	1	0	1	0
51	0	0	0	1	0	1	0
52	0	0	0	1	0	1	0
53	0	0	0	1	0	1	0

54	0	0	0	1	0	1	0
55	0	0	0	1	0	1	0
56	0	0	0	1	0	1	0
57	0	0	1	1	1	1	0
58	0	0	1	1	1	1	0
59	0	0	0	1	1	1	0
60	0	0	0	1	1	1	0
61	0	0	0	1	1	1	0
62	0	0	0	1	1	1	0
63	0	0	0	1	1	1	0
64	0	0	0	1	1	1	0
65	0	0	0	1	1	1	0
66	0	0	0	1	1	1	0
67	0	0	0	1	1	1	0
68	0	0	0	1	1	1	0
69	0	0	0	1	1	1	0
70	0	0	0	1	1	1	0
71	0	0	0	1	1	1	0
72	0	0	0	1	1	1	0
73	0	0	0	1	1	1	0
74	0	0	0	1	1	1	0
75	0	0	0	1	1	1	0
76	0	0	0	1	1	1	0
77	0	0	0	1	1	1	0
78	0	0	0	1	1	1	0
79	0	0	0	1	1	1	0
80	0	0	0	1	1	1	0

Sample	APUDr-Open	APUDrSOV	APUBatCurr	APUBatVolt	APULoadDisch	APUFuelVlv	APU-IGVane
1	0	0	2	27	0	4.9	77.3
2	0	0	2	27	0	4.9	77.1
3	0	0	2	27	0	4.9	77.1
4	0	0	2	27	0	4.9	77.3
5	0	0	2	27	0	4.9	77.1
6	0	0	2	27	0	4.9	77.1
7	0	0	2	27	0	4.9	77.1
8	1	0	-153	16	0	4.8	77.1
9	1	0	-173	16	0	32.5	77.1
10	1	0	-173	17	0	20.6	77.3
11	1	0	-173	18	0	18	77.1
12	1	0	-173	18	0	16.4	77.1
13	1	0	-173	19	0	16.5	77.3
14	1	0	-173	19	0	16.4	77.1
15	1	0	-173	19	0	16.6	77.3
16	1	0	-173	20	0	16.5	77.1
17	1	0	-173	20	0	17.3	77.3
18	1	0	-173	20	0	18.8	77.1
19	1	0	-173	20	0	20.1	77.1
20	1	0	-173	20	0	21.1	77.1
21	1	0	-173	20	0	22	77.3
22	1	0	-173	20	0	22.9	77.3
23	1	0	-174	20	0	23.8	77.3
24	1	0	-173	20	0	24.8	77.1
25	1	0	-173	21	0	25.9	77.3
26	1	0	-173	21	0	27	77.1
27	1	0	-174	21	0	28	77.1
28	1	0	-173	21	0	28.8	77.3
29	1	0	-173	21	0	29.9	77.1
30	1	0	-173	21	0	30.9	77.1
31	1	0	-173	21	0	32	77.3
32	1	0	-173	21	0	32.5	77.1
33	1	0	-173	21	0	33.1	77.1
34	1	0	-173	21	0	34	77.1
35	1	0	-173	21	0	35.3	77.1
36	1	0	-173	21	0	37	77.1
37	1	0	-173	21	0	38	77.1
38	1	0	-173	22	0	35.9	77.1
39	1	0	-173	22	0	36.4	77.1
40	1	0	-173	22	0	37.6	77.3
41	1	0	-173	22	0	39.3	77.3
42	1	0	-127	24	0	41.3	77.3
43	1	0	57	25	0	42.3	77.3
44	1	0	62	25	0	43.5	77.1
45	1	0	61	25	0	44	77.1
46	1	0	61	25	0	45.6	77.3
47	1	0	62	25	0	46.8	77.3
48	1	0	62	25	0	48.9	77.1
49	1	0	61	25	0	51.4	77.1
50	1	0	62	25	0	53.6	77.3
51	1	0	62	25	0	56.9	77.1
52	1	0	61	25	0	60.1	77.3
53	1	0	61	25	0	66	77.3

54	1	0	62	25	0	71.6	76.9
55	1	0	62	25	2.633	70	76.4
56	1	0	61	25	2.578	68.1	76.4
57	1	0	61	25	2.531	68	76.3
58	1	0	62	25	2.344	67.3	76.4
59	1	0	61	25	2.531	67.9	76.4
60	1	0	61	25	2.617	67.9	76.3
61	1	0	61	25	2.359	67.4	76.4
62	1	0	61	25	2.484	67.3	76.4
63	1	0	61	25	2.469	67.5	76.4
64	1	0	61	25	2.555	66.8	76.4
65	1	0	61	25	2.422	66.9	76.4
66	1	0	61	25	2.547	66.9	76.4
67	1	0	61	25	2.516	66.5	76.4
68	1	0	61	25	2.359	66.8	76.4
69	1	0	61	25	2.531	66.4	76.3
70	1	0	61	25	2.523	66.5	76.3
71	1	0	61	25	2.516	66.6	76.4
72	1	0	61	25	2.484	66.3	76.3
73	1	0	61	25	2.453	66.1	76.3
74	1	0	61	25	2.555	65.9	76.4
75	1	0	61	25	2.547	66.1	76.4
76	1	0	61	25	2.555	65.9	76.4
77	1	0	61	25	2.5	65.9	76.4
78	1	0	61	26	2.477	66.3	76.4
79	1	0	61	26	2.508	66.1	76.4
80	1	0	61	26	2.477	65.8	76.4

Sample	APUSpd-1	APUSpd-2	APUStatIn	APUSurgeVlv	APUBldPres	APUCompln	APUVlv-Clsd
1	0	0	14.44	9.9	14.8	49	1
2	0	0	14.44	9.9	14.8	49	1
3	0	0	14.44	9.9	14.8	49	1
4	0	0	14.44	9.9	14.8	49	1
5	0	0	14.44	9.9	14.8	49	1
6	0	0	14.44	9.9	14.8	49	1
7	0	0	14.44	9.9	14.8	49	1
8	4	4	14.44	9.9	14.8	49	1
9	7.5	7.5	14.44	9.9	14.8	49	1
10	10.3	10.3	14.44	9.9	14.8	49	1
11	12.8	12.8	14.44	9.9	14.9	48	1
12	14.9	14.9	14.44	9.9	14.9	48	1
13	16.8	16.8	14.44	9.9	14.9	47	1
14	18.3	18.3	14.44	9.9	14.9	47	1
15	19.6	19.6	14.44	9.9	14.9	46	1
16	20.9	20.9	14.44	9.9	14.9	46	1
17	21.9	21.9	14.44	9.9	14.9	46	1
18	22.9	22.9	14.44	9.9	15	45	1
19	23.9	23.9	14.44	9.9	15	45	1
20	25	25	14.44	9.9	15	44	1
21	26	26	14.44	9.9	15	44	1
22	27	27	14.44	9.9	15	43	1
23	28	28	14.44	9.9	15	43	1
24	29	29	14.44	9.9	15	42	1
25	30	30	14.44	9.9	15.1	42	1
26	31	31	14.44	9.9	15.1	41	1
27	32	32	14.44	9.9	15.1	41	1
28	33	33	14.44	9.8	15.3	41	1
29	34	34	14.44	9.9	15.1	40	1
30	35	35	14.44	9.9	15.3	40	1
31	36	36	14.44	9.9	15.3	39	1
32	37.1	37.1	14.44	9.9	15.4	39	1
33	38.1	38.1	14.44	9.9	15.4	39	1
34	39.3	39.3	14.44	9.9	15.4	38	1
35	40.3	40.4	14.44	9.9	15.4	38	1
36	41.5	41.5	14.44	9.9	15.5	38	1
37	42.8	42.8	14.44	9.9	15.5	37	1
38	44.5	44.5	14.44	9.9	15.6	37	1
39	46	46	14.44	9.9	15.6	37	1
40	47.6	47.6	14.38	9.9	15.8	36	1
41	49.4	49.4	14.44	9.9	15.8	36	1
42	51.1	51.1	14.38	9.9	15.9	36	1
43	53.1	53.1	14.38	9.9	15.9	35	1
44	55.3	55.3	14.38	9.9	15.9	35	1
45	57.5	57.5	14.38	9.9	16	35	1
46	60	60	14.38	9.8	16.1	34	1
47	62.6	62.5	14.38	9.9	16.3	34	1
48	65.4	65.4	14.38	9.8	16.3	34	1
49	68.5	68.5	14.38	9.8	16.5	33	1
50	72.3	72.3	14.31	9.9	16.5	33	1
51	76.6	76.6	14.38	9.9	16.8	33	1
52	81.8	81.8	14.31	9.8	17	33	1
53	88	88	14.25	9.8	17	32	1

54	95.8	95.8	14.19	9.9	17.8	32	1
55	98.9	98.9	14.19	10.1	17.8	32	1
56	100.3	100.3	14.13	10	17.9	31	1
57	100	100	14.19	10	18	31	1
58	99.9	99.9	14.19	10	18.4	31	1
59	100	100	14.19	10	18.3	31	1
60	100	100	14.19	10	18.3	30	1
61	100.1	100	14.19	10	18.6	30	1
62	100	100.1	14.19	10	18.6	30	1
63	100	100	14.13	10	18.1	30	1
64	100	100	14.19	10	18	30	1
65	100	100	14.13	10	18	30	1
66	100	100	14.13	10	18.3	29	1
67	100	100	14.13	10.1	18	29	1
68	100	100	14.13	10	17.9	29	1
69	100	100	14.06	10	18.1	29	1
70	100	100	14.13	10	18.1	29	1
71	100	100	14.13	10	18	29	1
72	100	100	14.13	10	18	29	1
73	100	100	14.13	10	18.1	28	1
74	100	100	14.19	10	18.1	28	1
75	100	100	14.19	10	18.1	28	1
76	100	100	14.19	10	18.1	28	1
77	100	100	14.19	10	18.1	28	1
78	100	100	14.19	10	18.1	28	1
79	100	100	14.19	10	18.1	28	1
80	100	100	14.19	10	18.1	28	1

Sample	APUVlv-Open	APU#Starts	APUFltHours	APUFltStarts	APUGndHours	APUGndStarts	APUHours	APUPwrUpCyc
1	0				2395			3737
2	0					2502		
3	0	2554	102	52				
4	0						2497	
5	0				2395			3737
6	0					2502		
7	0	2554	102	52				
8	0						2497	
9	0				2395			3737
10	0					2502		
11	0	2554	102	52				
12	0						2497	
13	0				2395			3737
14	0					2502		
15	0	2554	102	52				
16	0						2497	
17	0				2395			3737
18	0					2502		
19	0	2554	102	52				
20	0						2497	
21	0				2395			3737
22	0					2502		
23	0	2554	102	52				
24	0						2497	
25	0				2395			3737
26	0					2502		
27	0	2554	102	52				
28	0						2497	
29	0				2395			3737
30	0					2502		
31	0	2554	102	52				
32	0						2497	
33	0				2395			3737
34	0					2502		
35	0	2554	102	52				
36	0						2497	
37	0				2395			3737
38	0					2502		
39	0	2554	102	52				
40	0						2497	
41	0				2395			3737
42	0					2502		
43	0	2554	102	52				
44	0						2497	
45	0				2395			3737
46	0					2502		
47	0	2554	102	52				
48	0						2497	
49	0				2395			3737
50	0					2502		
51	0	2554	102	52				
52	0						2497	
53	0				2395			3737

54	0					2503		
55	0	2555	102	52				
56	0						2497	
57	0				2395			3737
58	0					2503		
59	0	2555	102	52				
60	0						2497	
61	0				2395			3737
62	0					2503		
63	0	2555	102	52				
64	0						2497	
65	0				2395			3737
66	0					2503		
67	0	2555	102	52				
68	0						2497	
69	0				2395			3737
70	0					2503		
71	0	2555	102	52				
72	0						2497	
73	0				2395			3737
74	0					2503		
75	0	2555	102	52				
76	0						2497	
77	0				2395			3737
78	0					2503		
79	0	2555	102	52				
80	0						2497	

Sample	APUStAttempt	APUNGFStarts	APUNGGStarts	APUSerial#	APUContrl	APUOilQty	APUBldAir	APUFire	APU-FireAlrm
1		8		1451	0	0	0	0	0
2	2783				0	0	0	0	0
3					0	0	0	0	0
4			221		0	0	0	0	0
5		8		1451	0	0	0	0	0
6	2783				0	0	0	0	0
7					0	0	0	0	0
8			221		0	0	0	0	0
9		8		1451	0	0	0	0	0
10	2783				0	0	0	0	0
11					0	0	0	0	0
12			221		0	0	0	0	0
13		8		1451	0	0	0	0	0
14	2783				0	0	0	0	0
15					0	0	0	0	0
16			221		0	0	0	0	0
17		8		1451	0	0	0	0	0
18	2783				0	0	0	0	0
19					0	0	0	0	0
20			221		0	0	0	0	0
21		8		1451	0	0	0	0	0
22	2783				0	0	0	0	0
23					0	0	0	0	0
24			221		0	0	0	0	0
25		8		1451	0	0	0	0	0
26	2783				0	0	0	0	0
27					0	0	0	0	0
28			221		0	0	0	0	0
29		8		1451	0	0	0	0	0
30	2783				0	0	0	0	0
31					0	0	0	0	0
32			221		0	0	0	0	0
33		8		1451	0	0	0	0	0
34	2783				0	0	0	0	0
35					0	0	0	0	0
36			221		0	0	0	0	0
37		8		1451	0	0	0	0	0
38	2783				0	0	0	0	0
39					0	0	0	0	0
40			221		0	0	0	0	0
41		8		1451	0	0	0	0	0
42	2783				0	0	0	0	0
43					0	0	0	0	0
44			221		0	0	0	0	0
45		8		1451	0	0	0	0	0
46	2783				0	0	0	0	0
47					0	0	0	0	0
48			221		0	0	0	0	0
49		8		1451	0	0	0	0	0
50	2783				0	0	0	0	0
51					0	0	0	0	0
52			221		0	0	0	0	0

53		8		1451	0	0	0	0	0
54	2784				0	0	0	0	0
55					0	0	0	0	0
56			221		0	0	0	0	0
57		8		1451	0	0	0	0	0
58	2784				0	0	0	0	0
59					0	0	0	0	0
60			221		0	0	0	0	0
61		8		1451	0	0	0	0	0
62	2784				0	0	0	0	0
63					0	0	0	0	0
64			221		0	0	0	0	0
65		8		1451	0	0	0	0	0
66	2784				0	0	0	0	0
67					0	0	0	0	0
68			221		0	0	0	0	0
69		8		1451	0	0	0	0	0
70	2784				0	0	0	0	0
71					0	0	0	0	0
72			221		0	0	0	0	0
73		8		1451	0	0	0	0	0
74	2784				0	0	0	0	0
75					0	0	0	0	0
76			221		0	0	0	0	0
77		8		1451	0	0	0	0	0
78	2784				0	0	0	0	0
79					0	0	0	0	0
80			221		0	0	0	0	0

Sample	APULimit-Cau	APUShutDn	APUCOper	APU-CTC-L	APU-CTC-R	HtTCV-Open	IDG/AP%Ld-A	IDGCur-PhA-	IDGCur-PhB-	IDGCur-PhC-	IDGGenFreq-A	IDGVolt3Ph-A
1	0	0	8	0		0	0	0	0	0	0	0
2	0	0			0	0	0	0	0.5	0.5	0	0
3	0	0		0		0	0	0	0	0	0	0
4	0	0			0	0	0	0	0	0	0	0
5	0	0	8	0		0	0	0	0	0	0	0
6	0	0			0	0	0	0	0.5	0.5	0	0
7	0	0		0		0	0	0	0	0	0	0
8	0	0			0	0	0	0	0.5	0.5	0	0
9	0	0	8	0		0	0	0	0	0	0	0
10	0	0			0	0	0	0	0	0.5	0	0
11	0	0		0		0	0	0	0	0	0	0
12	0	0			0	0	0	0	0.5	0.5	0	0
13	0	0	8	0		0	0	0	0.5	0.5	0	0
14	0	0			0	0	0	0	0	0	0	0
15	0	0		0		0	0	0.5	0.5	0.5	0	0
16	0	0			0	0	0	0	0	0.5	0	0
17	0	0	8	0		0	0	0	0	0.5	0	0
18	0	0			0	0	0	0.5	0	0	0	0
19	0	0		0		0	0	0	0	0	0	0
20	0	0			0	0	0	0	0	0	0	0
21	0	0	8	0		0	0	0	0	0	0	0
22	0	0			0	0	0	0	0	0	0	0
23	0	0		0		0	0	0	0	0	0	0
24	0	0			0	0	0	0	0	0	0	0
25	0	0	8	0		0	0	0	0	0	0	0
26	0	0			0	0	0	0	0	0	0	0
27	0	0		0		0	0	0.5	0.5	0.5	0	0
28	0	0			0	0	0	0	0	0	0	0
29	0	0	8	0		0	0	0.5	0.5	0.5	0	0
30	0	0			0	0	0	0	0	0	0	0
31	0	0		0		0	0	0.5	0.5	0.5	0	0
32	0	0			0	0	0	0	0	0.5	0	0
33	0	0	8	0		0	0	0.5	0	0.5	0	0
34	0	0			0	0	0	0.5	0.5	0.5	0	0
35	0	0		0		0	0	0	0	0	0	0
36	0	0			0	0	0	0.5	0.5	0.5	0	0
37	0	0	8	0		0	0	0	0	0	0	0
38	0	0			0	0	0	0	0.5	0.5	0	0
39	0	0		0		0	0	0.5	0.5	0.5	0	0
40	0	0			0	0	0	0	0	0.5	0	0
41	0	0	8	0		0	0	0	0	0	0	0
42	0	0			0	0	0	0	0	0	0	0
43	0	0		0		0	0	0.5	1	1	0	0
44	0	0			0	0	0	0	0	0	0	0
45	0	0	8	0		0	0	0	0	0.5	0	0
46	0	0			0	0	0	0	0	0	0	0
47	0	0		0		0	0	0	0	0.5	0	0
48	0	0			0	0	0	0.5	0.5	0.5	0	0
49	0	0	8	0		0	0	0	0	0.5	0	0
50	0	0			0	0	0	0	0.5	1	0	0
51	0	0		0		0	0	0	0	0.5	0	0
52	0	0			0	0	0	0	0.5	0.5	0	0

53	0	0	8	0		0	0	0	0	0.5	0	0
54	0	0			0	0	0	1	1	1	0	110.18
55	0	0		0		0	0	1	1	1	394.8	115.03
56	0	0			0	0	0	0.5	0.5	1	400.3	115.03
57	0	0	3	0		0	0	1	0.5	1	399.3	114.93
58	0	0			0	0	0	0	0	0.5	399.3	115.03
59	0	0		0		0	21	65	76.9	80.6	399.5	113.38
60	0	0			0	0	21	65.5	77.4	81.6	399.3	113.67
61	0	0	3	0		0	21	65	77.4	81.1	399.5	113.48
62	0	0			0	0	21	65.5	77.4	80.6	399.3	113.48
63	0	0		0		0	21	66	78	81.6	399.5	113.67
64	0	0			0	0	21	65.5	82.1	81.1	399.3	113.38
65	0	0	3	0		0	21	65.5	81.1	80.6	399.5	113.67
66	0	0			0	0	21	66	82.1	81.6	399.5	113.48
67	0	0		0		0	21	64.4	80.6	80.6	399.3	113.48
68	0	0			0	0	22	65.5	81.6	80.6	399.3	113.67
69	0	0	3	0		0	21	69.1	82.1	81.1	399.3	113.77
70	0	0			0	0	22	65	81.1	80.6	399.3	113.38
71	0	0		0		0	22	65.5	81.6	81.1	399	113.67
72	0	0			0	0	21	65.5	81.1	80.6	399.3	113.48
73	0	0	3	0		0	21	65.5	81.6	80.6	399.3	113.38
74	0	0			0	0	21	65.5	81.6	81.1	399.3	113.48
75	0	0		0		0	21	65.5	82.1	80.6	399.3	113.38
76	0	0			0	0	21	65	81.6	81.1	399.3	113.58
77	0	0	3	0		0	21	66	82.6	81.1	399	113.48
78	0	0			0	0	22	65	81.1	80.6	399.3	113.58
79	0	0		0		0	21	64.4	81.6	80.6	399.3	113.48
80	0	0			0	0	22	66	82.1	81.6	399	113.58

Exhibit #5

Analysis report on Residual of Ground Fire of Boeing 777, developed by CMRDI

ANALYSIS REPORT
On
Residual of Ground Fire of Boeing 777
Egypt Air

August 2011

1-Background

Responding to the request from Egyptian Civil Aviation (EMCA), research team from the Central Metallurgical Research and Development Institute (CMRDI) investigated the residual collected powders from the ground fire of Boeing 777. It was reported that the fire took place during regular operation before engine startup, and the airplane was substantially damaged. The residual powders were collected from different places and submitted to CMRDI to determine the nature and their chemical composition. In addition to stainless steel wire taken from the flexible oxygen hose installed at the forward cabin of the airplane.

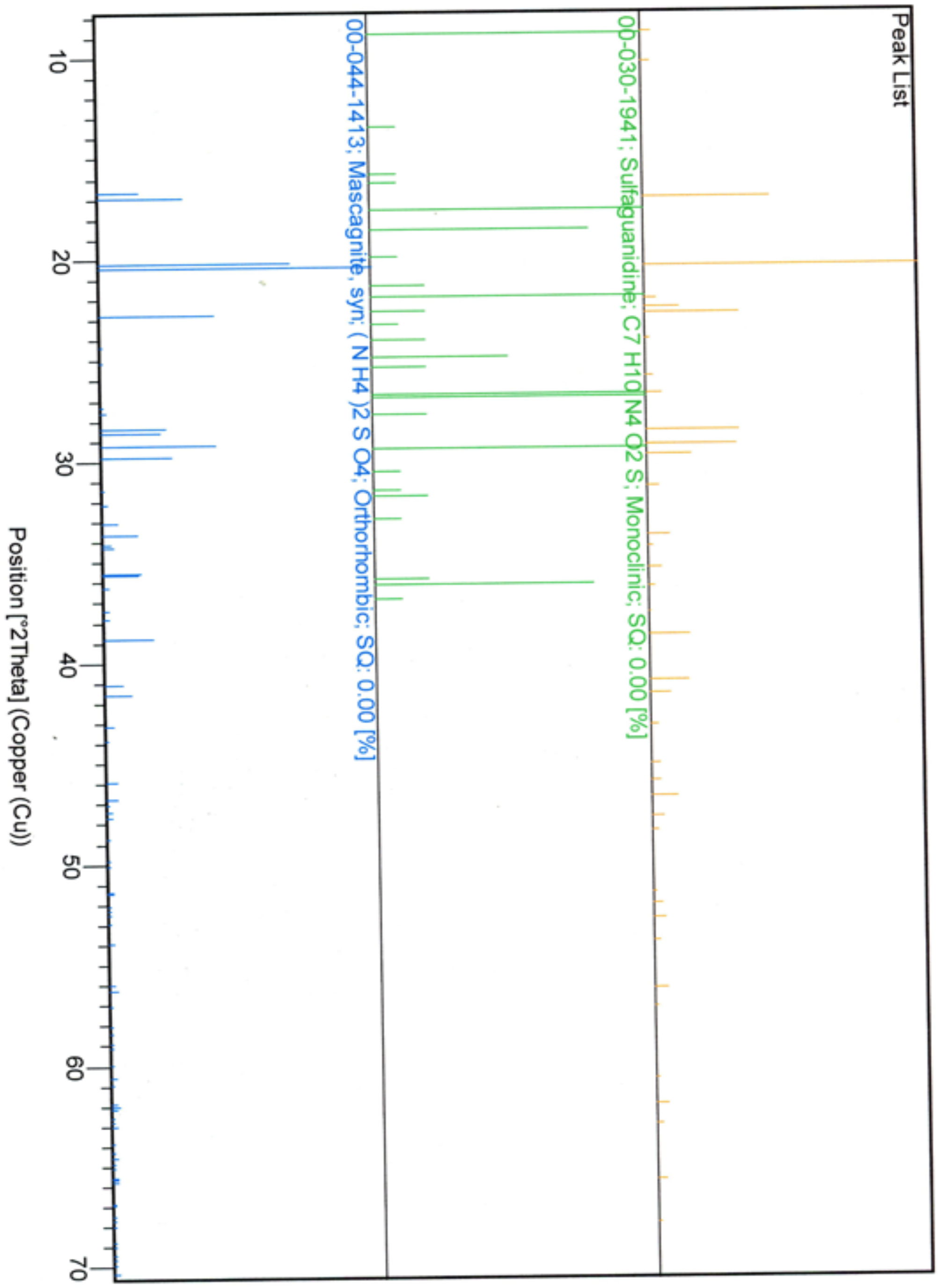
It was reported that the each of the oxygen mask stowage boxes (in the enclosure above the supernumerary occupant seats) included an oxygen mask assembly, a flexible hose that was primarily made of polyvinyl chloride (PVC), and rigid stainless steel supply tubing. The manufacturer of the PVC flexible oxygen hoses installed a stainless steel spring in the hoses, to prevent bends from collapsing the hose and disrupting the oxygen supply. The stainless steel spring was loosely attached to the aluminum fittings at each hose end, making the hoses electrically conductive. The received portion had been separated by melting of the tube. The investigation work was carried out in contact with Egyptian Civil Aviation. These analyses included complete chemical analysis by XRD, and cross-section microstructure.

2- Results and Discussions

2-1 XRD Analysis

Sample No.1: Yellow Powder (Flight Deck R.H.S. SU-GBP)

The test results showed that the yellow powder is mainly consists from Sulfaguanidine $C_7H_{10}N_4O_2S$ and Mascagnite $(NH_4)_2SO_4$.


Peak List
00-030-1941; Sulfaguanidine; C7 H10 N4 O2 S; Monoclinic; SQ: 0.00 [%]
00-044-1413; Mascagnite, syn; (N H4)2 S O4; Orthorhombic; SQ: 0.00 [%]
10
20
30
40
50
60
70
Position [°2Theta] (Copper (Cu))

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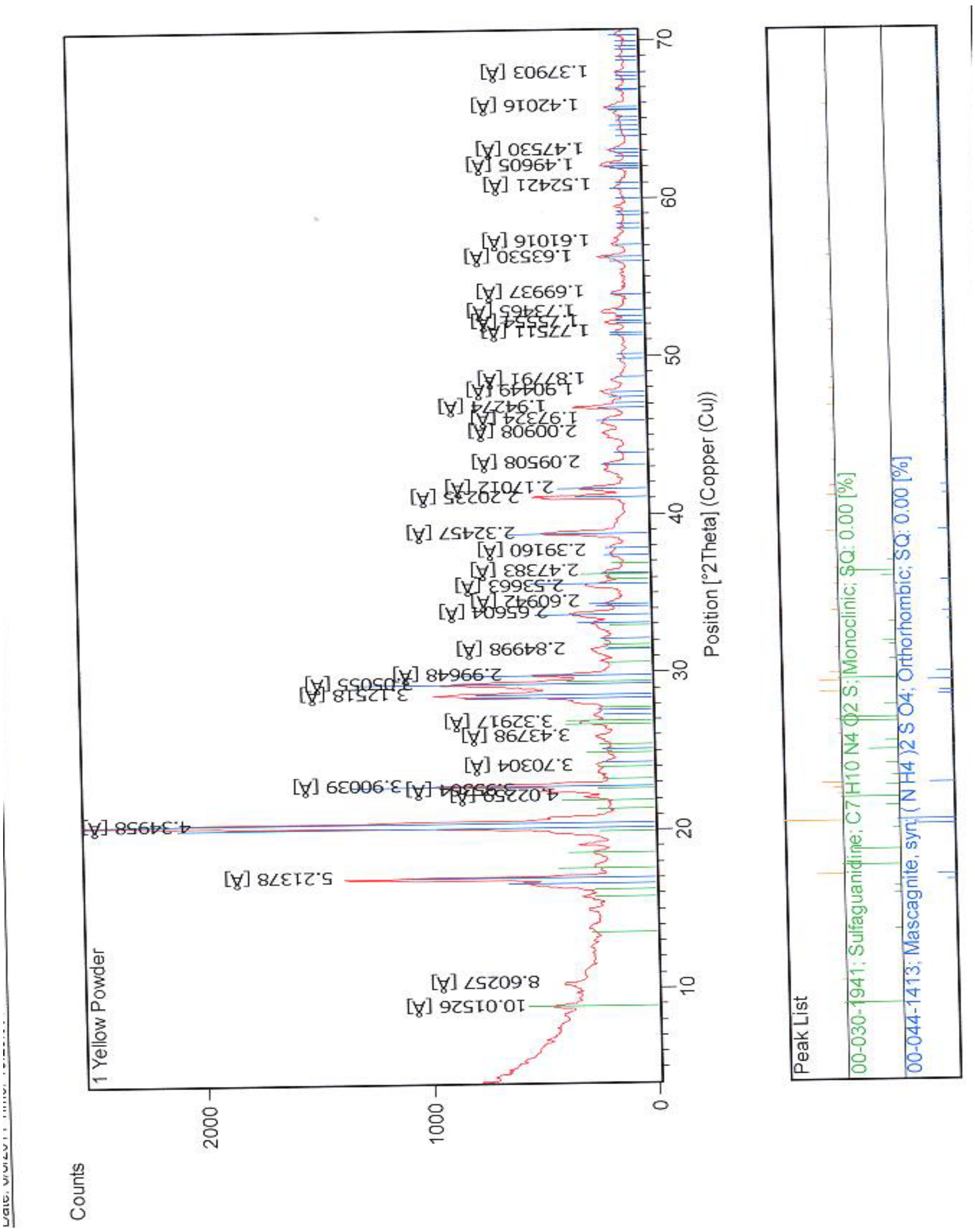
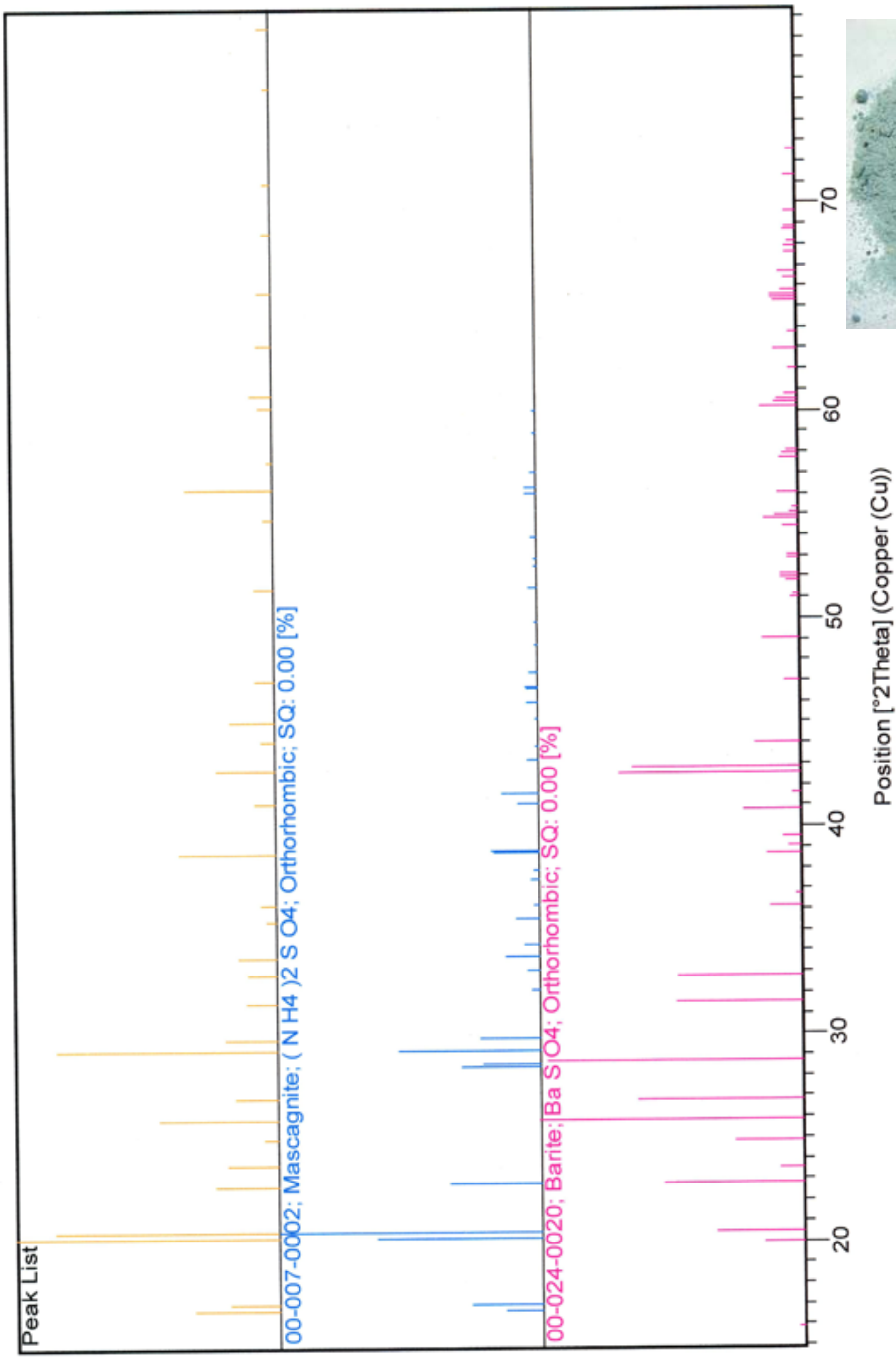
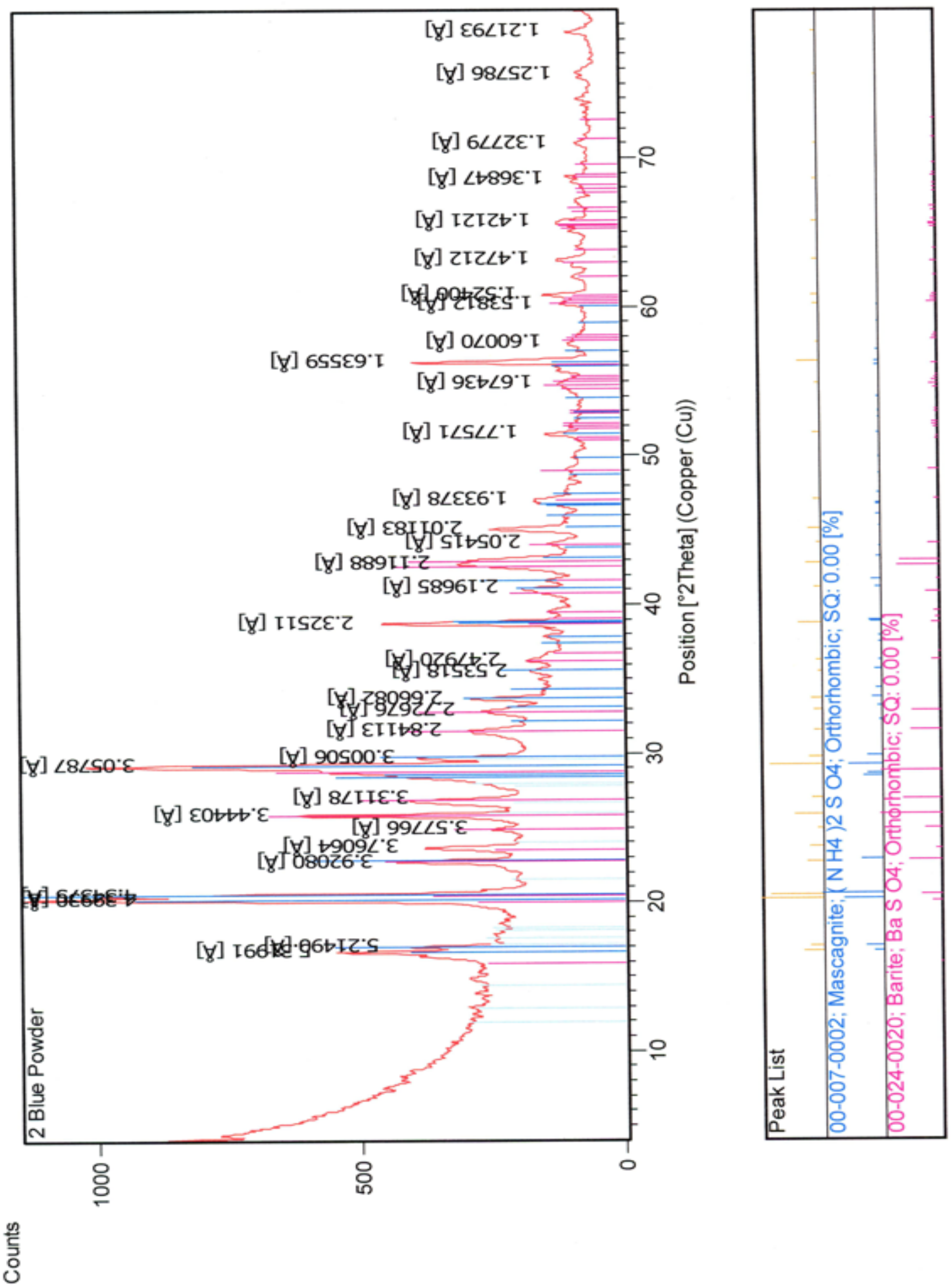


P.O. Box: 87 Helwan, Cairo Egypt
Fax: (+202) 25011185
Tel: (+202) 25010642 /2 5010643 Ext. 242
E-mail: albersadek@yahoo.com

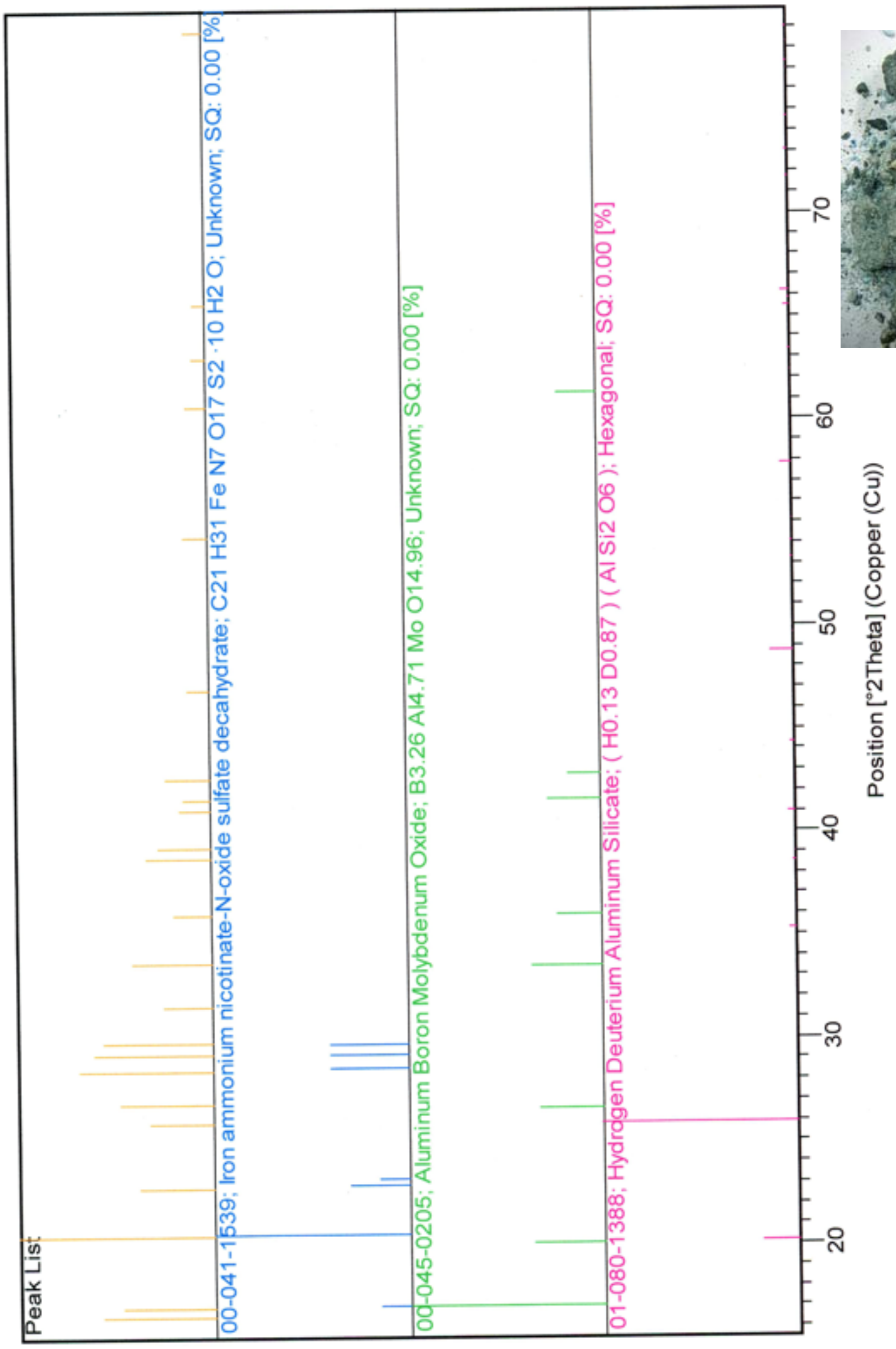
Sample No.2: Blue Powder (Flight Deck R.H.S. SU-GBP)

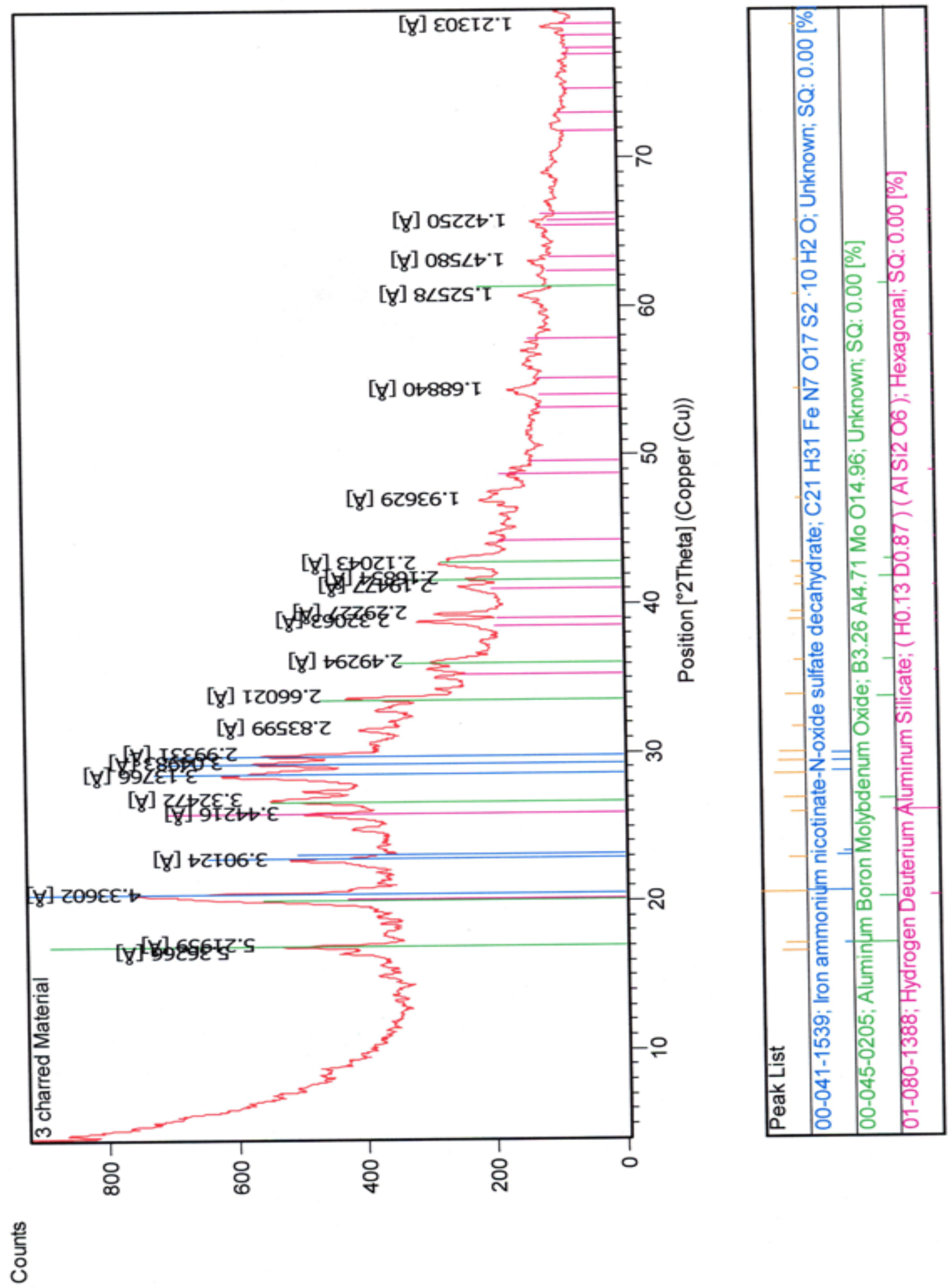




The test results showed that the blue powder is mainly consists of Mascagnite $(NH_4)_2SO_4$ and Barite $BaSO_4$.

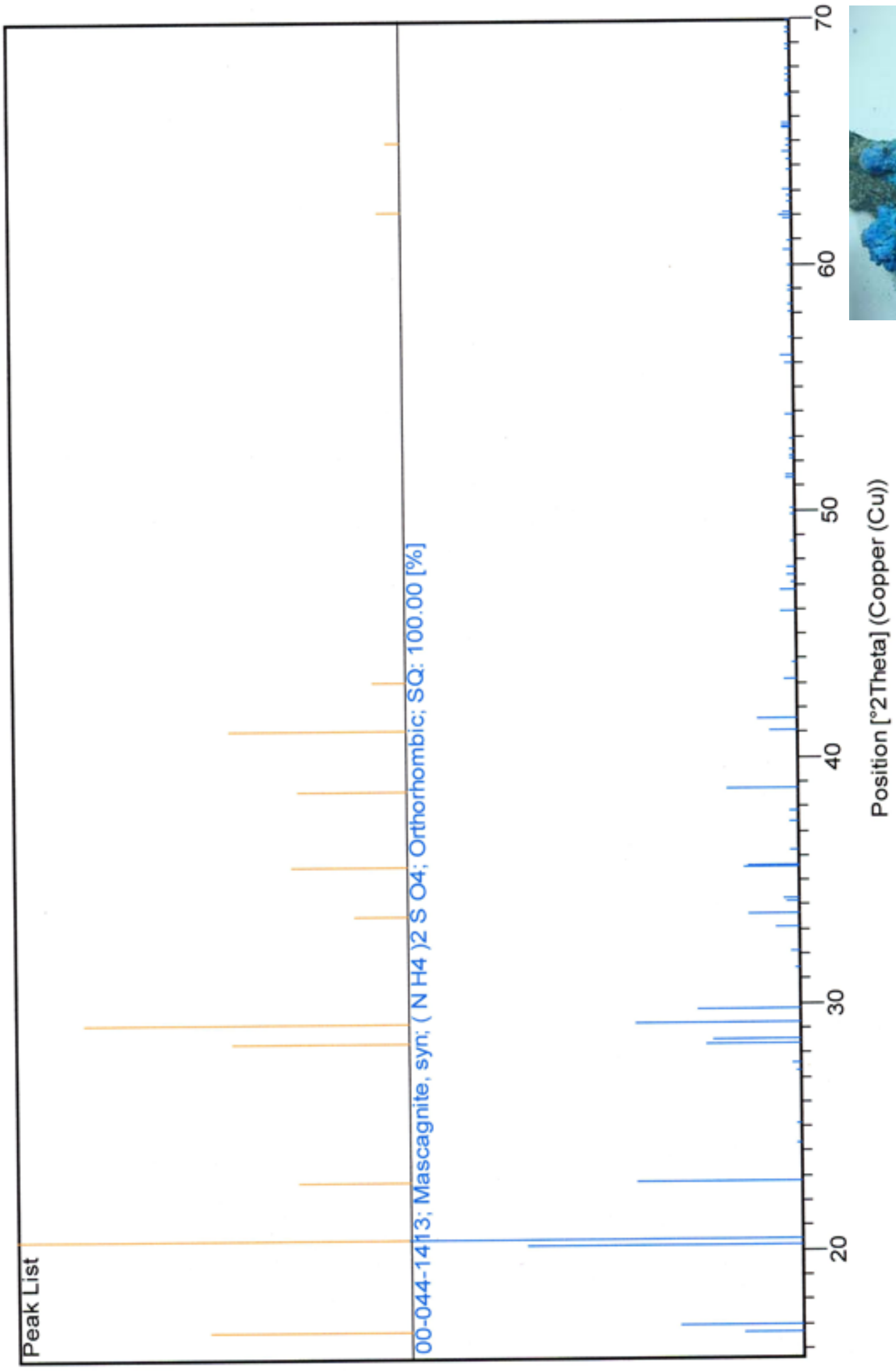
Sample No.3: Charred Material and Powder (R.H.S. SU-GBP)

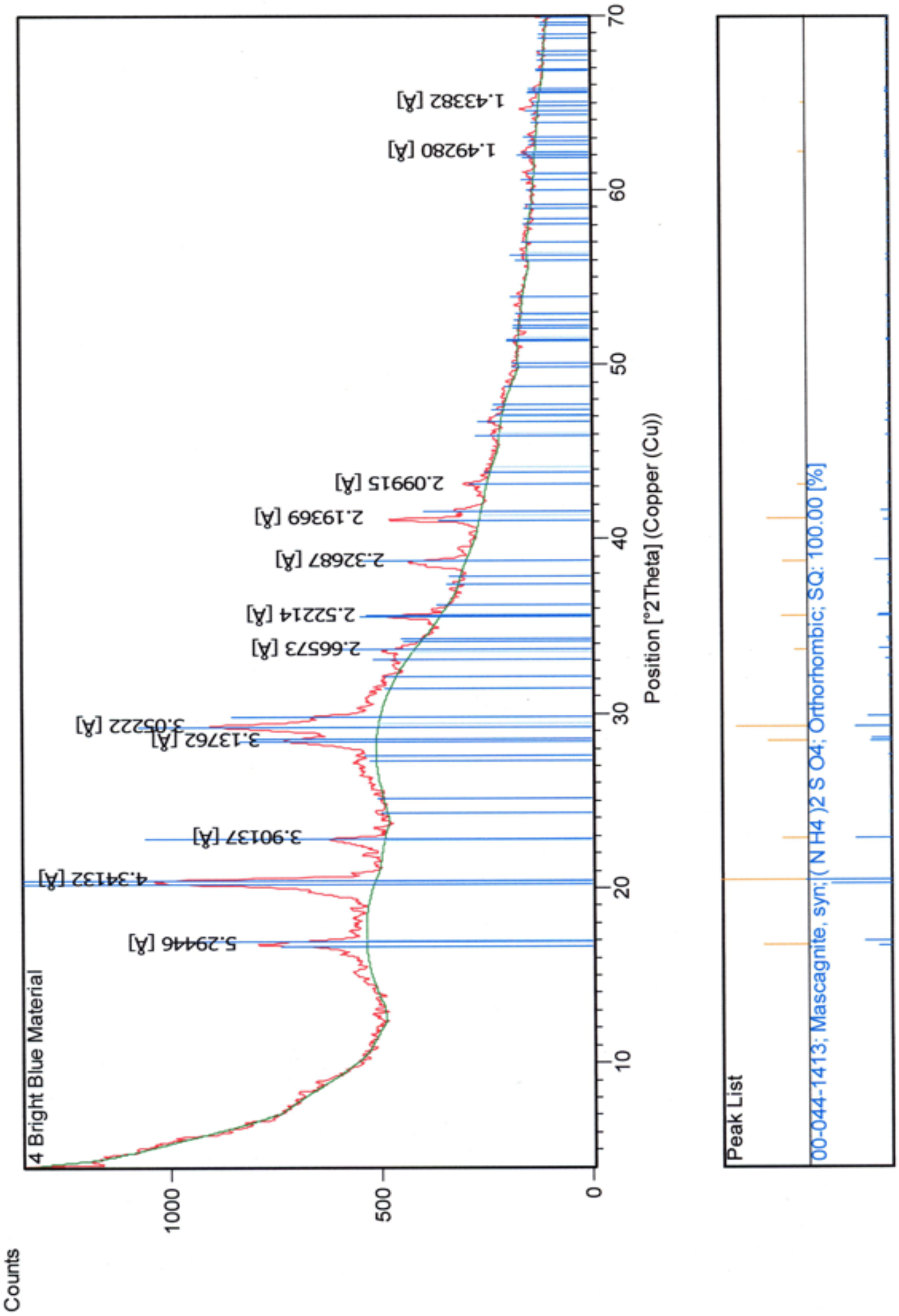




The test results showed that the charred material is mainly consists of Iron ammonium Nicotinate N-Oxide Sulfate Decahydrate $C_{21}H_{31}FeN_7O_{17}S_2.10H_2O$, Aluminum Boron Molybdenum Oxide $B_3.26Al_4MoO_{14.96}$ and Hydrogen Deuterium Aluminum Silicate $(H_{0.13}D_{0.87})(AlSi_2O_6)$.

Sample No.4: Bright Blue Material (Flight Deck R.H.S. AFT of Main hole Adjacent to Wiring SU-GBP)





The test results showed that the bright blue material is mainly consists of Mascagnite $(NH_4)_2SO_4$.

To have clear identifications of the obtained chemical analysis, CMRDI asked to know the type of the used fire fighting foam. It was reported that the fire fighting team used type 3%AFFF foam, as shown in ANNEX I. The chemical analysis of that type of foam is given in the followings:

Ingredient Name: Water
CAS No. 7732-18-5
TWA: Not established
STEL: Not established
PEL: Not established
Wt. by %: 85%-90%

Ingredient Name: propylene glycol t-butyl ether ($C_7H_{16}O_2$)
CAS No. 57018-52-7
TWA: Not established
STEL: Not established
PEL: Not established
Wt. by %: 2%-4%

Ingredient Name: magnesium sulfate ($MgSO_4$)
CAS No. 7487-88-9
TWA: N/A
STEL: N/A
PEL: N/A
Wt. by %: 1%-2%

Ingredient Name: proprietary hydrocarbon surfactant
CAS No. proprietary mixture
TWA: N/A
STEL: N/A
PEL: N/A
Wt. by %: proprietary

Ingredient Name: proprietary fluorosurfactant
CAS No. proprietary mixture
TWA: N/A
STEL: N/A
PEL: N/A
Wt. by %: proprietary

From the previous test results and the chemical composition of the used foam, it can be concluded that:

1) The collected residual are mainly consists of ammonium sulfate compounds which is related to the foam type.
2) The charred material is mainly resulted from the melting of airplane body.

Sample No.5: Anti Kink Spring Supply Hoses Floor to Tee F/O O_2 (Stainless Steel Spring)

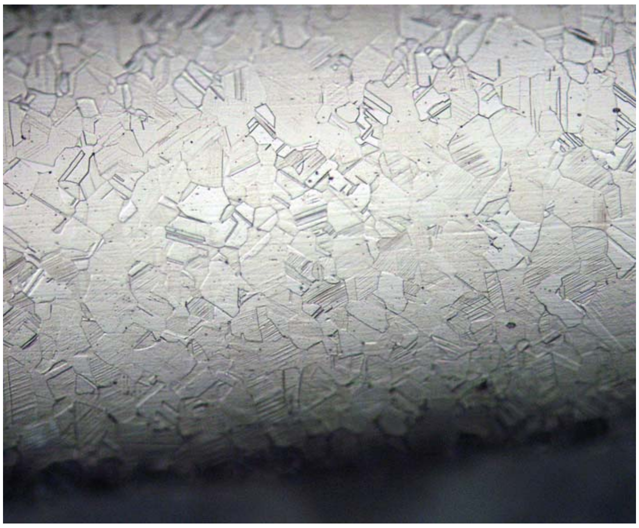
The stainless steel spring surface is covered by fire products with some spot rusted area (red color). No direct evidence of a short circuit was fund, but most of the wiring near the supply tubing and portions of the tubing were missing.

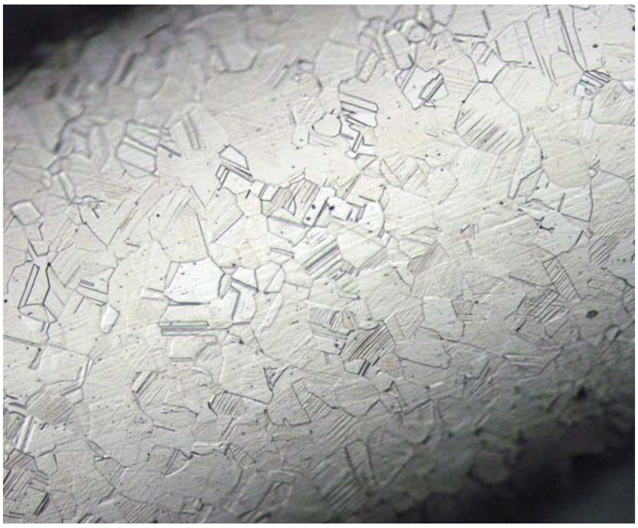
The only way to cause melting of the stainless steel spring assembly is an oxygen-fuel flame because temperatures that are attained in ordinary fires are not sufficient to melt stainless steel. The source of oxygen to allow for this melting would have had to be located closely to the melted stainless steel spring assembly; thus, the source of oxygen was the flexible oxygen hose connected to that particular spring assembly.

A short circuit from electrical wiring, which is supposed to be in contact with or routed near the stainless steel oxygen supply tubing, would be the most likely source to provide electrical energy to the spring.

It is supposed that the stainless steel spring had been subjected to high energy level, which heated the internal spring until it became an ignition energy source, causing the flexible oxygen hose to ignite and sustain a fire. The time to failure, may took few seconds depending on the amount of energy supplied to the internal spring.

This could be approved from the metallurgical microstructure of stainless steel wire, investigated at different places. The microstructure is normal for this type of stainless steel with normal grain size and without any precipitates, as shown in the following figure. If the heating of the stainless steel spring took long time the microstructure will be coarser and different type of precipitates will be observed on the grain boundaries, which is not our case.





Microstructure of the investigated stainless steel spring, 200X

ANNEX 1

سـري
٢٧٠١

الادارة المركزية لحوادث الطائرات
وارد
رقم / / التاريخ / / ٢٠١
المرفقات المرفقات

وزارة الداخلية

الإدارة العامة لشرطة ميناء القاهرة الجوى
مكتب المدير

السيد الطيار/ رئيس الإدارة المركزية للحوادث

بوزارة الطيران المدنى

تهدى الإدارة العامة لشرطة ميناء القاهرة الجوى أطيب تحياتها لسيادتكم ....

ونود الإشارة إلى الأتى :

- *إيماءاً لكتاب سيادتكم رقم ٤١٨٨ المؤرخ ٢٠١١/٨/١١ بشأن واقعة نشوب حريق فى غرفة قيادة الطائرة المسجلة SU – GBP من طراز البوينج ٢٠٠/٧٧٧ والتابعة لشركة مصر للطيران للخطوط الجوية أثناء إعدادها للقيام برحلتها رقم ٦٦٧ والتجهة إلى جدة بمبنى الركاب رقم ٣ بتاريخ ٢٠١١/٧/٢٩ .. وطلب الإفادة ببيان المواد المستخدمة فى أعمال مكافحة وإخماد الحريق ، وكذا تركيبها الكيميائى .. إستكمالاً للتحقيق الفنى فى الواقعة .*

أتشـرف بالإفـادة :-

- *أن المادة الرغوية المستخدمة فى عملية المكافحة من النوع AFFF تركيز ٣ ٪ ومرفق طيه صورة من التحليل الكيمائى الأخير للمادة الرغوية والذى أجرى بمعرفة مصلحة الكيمياء المصرية.*

للتفضل بالإحاطة ..

وتفضلوا سيادتكم بقبول وافر الإحترام ،،،

٢٠١١/٨/١٣
حسام

لواء / صلاح زيادة

مدير الإدارة العامة لشرطة ميناء القاهرة الجوى

CENTRAL METALLURGICAL RESEARCH AND DEVELOPMENT INSTITUTE

CMRDI

Ministry of Trade & Industry
Chemistry Administration

وزارة التجارة والصناعة
مصلحة الكيمياء
تأسست عام ١٨٩٨ م

٢٠١١/٤٩٨/٠٨

الإدارة العامة لمعامل / البحوث
المعمل المختص/التحليل الآلى

نوع العينة / سائل رغوى
تاريخ الصدور /٢٠١١/٧/١٨

جهة تقديم العينة / الادارة العامة لشرطة ميناء القاهرة الجوى–ادارة الحماية المدنية

****

تقرير اختبار

***

فيما يلى نتائج تحليل عينة السائل الرغوى المقدمة من الادارة العامة لشرطة ميناء القاهرة الجوى –ادارة الحماية المدنية :–

الاختبار	النتيجة	المواصفة مرفقه	مدى المطابقة
١–المظهر	سائل اصفر شفاف	سائل أصفر [illegible]	مطابقة
٢– الكثافة النوعية	١,٠٠٤ مل/جم	١,٠١٠ ± [illegible] مل/جم	مطابقة
٣– الأس الهيدروجينى (PH)	٧,٧	[illegible]	مطابقة
٤– معامل الانكسار	١,٣٥٣٢	لا تقل عن ١,[illegible]	مطابقة
٥–اللزوجة	١ سنتى بواز	أقل من ٣ سنتى بواز	مطابقة
٦– التمدد	٦ امثال	لا تقل عن ٥ امثال	مطابقة
٧–زمن الانفصال ٢٥%	١٦٠ ث	لاتقل عن ١٥٠ ث	مطابقة

وبذلك تكون العينة مطابقة للمواصفة الفنية المرفق ،،،

****

هذه النتيجة تخص العينة المقدمة و تمثيلها لآى كميات أخرى هى مسئولية جهة تقديم العينة

مدير الإدارة
كبير كيميائيين
المدير العام

إيمان/***

P.O. Box: 87 Helwan, Cairo Egypt
Tel: (+202) 25010642 /2 5010643 Ext. 242
Fax: (+202) 25011185
E-mail: albersadek@yahoo.com

Ministry of Trade & Industry
Chemistry Administration

وزارة التجارة والصناعة
مصلحـة الكيميــاء

تأسست عام ١٨٩٨ م

٢٠١١/٤٩٨/٠٨

الإدارة العامة لمعامل / البحوث — المعمل المختص/التحليل الآلى

نوع العينة / سائل رغوى — تاريخ الورود/ ٢٠١١/٧/١٨

جهة تقديم العينة / الادارة العامة لشرطة ميناء القاهرة الجوى–ادارة الحماية المدنية

****

تقرير اختبار

***

فيما يلى نتائج تحليل عينة السائل الرغوى المقدمة من الادارة العامة لشرطة ميناء القاهرة الجوى –ادارة الحماية المدنية :–

الاختبار	النتيجة	المواصفة مرفقة	مدى المطابقة
١–المظهر	سائل اصفر شفاف	سائل اصفر رائق	مطابقة
٢– الكثافة النوعية	١,٠٠٤ مل/جم	١,٠١٠ ± ٠,٠١ مل/جم	مطابقة
٣– الأس الهيدروجيني (PH)	٧,٧	٧,٧ ± ٠,٥	مطابقة
٤– معامل الانكسار	١,٣٥٣٢	لا تقل عن ١,٣٣٠	مطابقة
٥–اللزوجة	١ سنتى بواز	أقل من ٣ سنتى بواز	مطابقة
٦– التمدد	٦ امثال	لا تقل عن ٥ أمثال	مطابقة
٧–زمن الانفصال ٢٥%	١٦٠ ث	لاتقل عن ١٥٠ ث	مطابقة

وبذلك تكون العينة مطابقة للمواصفة الفنية المرفق ،،،

****

هذه النتيجة تخص العينة المقدمة و تمثيلها لآى كميات أخرى من مسئولية جهة تقديم العينة

مدير الإدارة — كبير كيميائيين — المدير العام

٧/٢٥
٢٠١١

إيمان/***

Exhibit #6

Examination of Stainless Steel Supply Tube and Kink Spring

Stainless Steel Supply Tube:

Figure 1 shows the received stainless steel supply tube, to carry out the necessary investigation on it.

1. Visual Inspection

The tube surface was covered by fire products, as shown in Fig.2, and some areas have rough surface. The deposited molten metal shown in Fig.2, was send to chemical analysis. The molten metal is basically aluminum alloy, resulted from the fire.

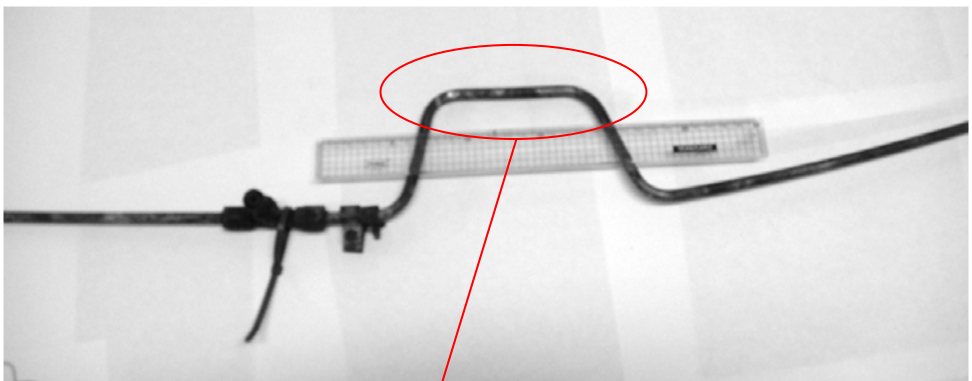


Fig. 1 General View of the received stainless steel supply tube

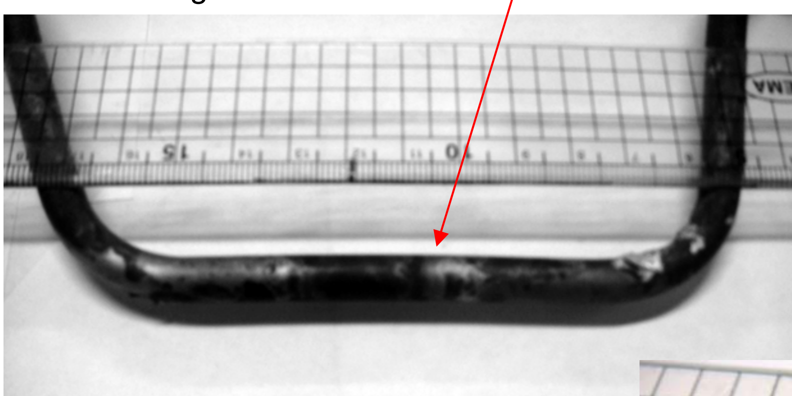


Fig. 2 Area of deposited molten metal

Another area was noted as shown in Fig.3, with suspected spot as an arc strike. Detail investigation showed that this is also covered only with deposited molten metal.

Fig.3 Another area covered with deposited molten metal

<u>2. Dye penetrant test</u>

To have precise investigation on the tube, dye pentrant test carried out on the tube. No indications were detected.

<u>3. Leakage test</u>

The investigated tube hydrostatically tested up to pressure of 2 bars, for the detection of any leakage from fine holes or hair cracks. No leakage areas were detected throughout the length of the tube.

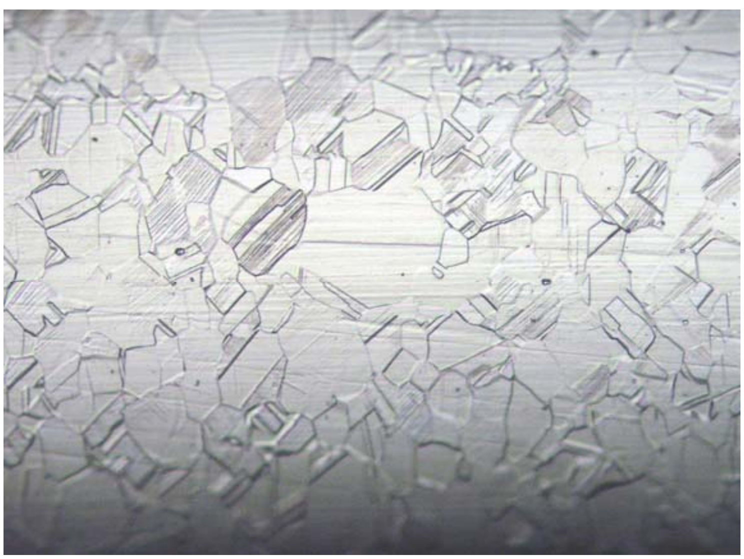
P.O. Box: 87 Helwan, Cairo Egypt
Tel: (+202) 25010642 /2 5010643 Ext. 242
Fax: (+202) 25011185
E-mail: albersadek@yahoo.com

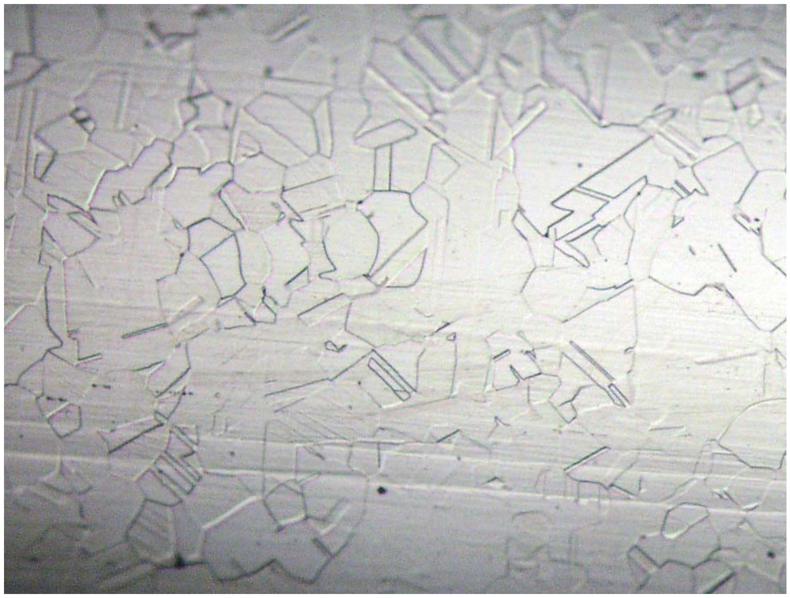
Anti Kink Spring Supply Hoses Floor to Tee F/O O_2 (Stainless Steel Spring)

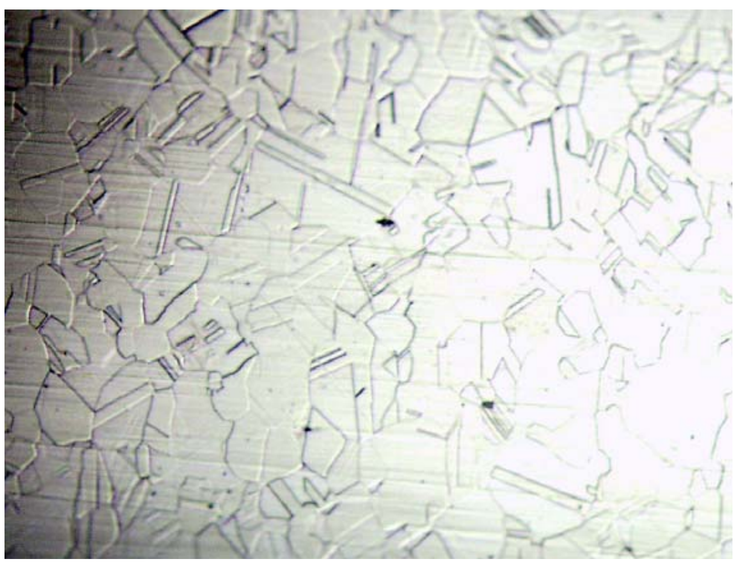
The anti kink spring attached to the received stainless steel supply tube was investigated. The stainless steel spring surface is covered by fire products with some inserted fired plastic parts. Also, no direct evidence of a short circuit was detected.

The only way to cause melting of the stainless steel spring assembly is an oxygen-fuel flame because temperatures that are attained in ordinary fires are not sufficient to melt stainless steel. The source of oxygen to allow for this melting would have had to be located closely to the melted stainless steel spring assembly; thus, the source of oxygen was the flexible oxygen hose connected to that particular spring assembly.

It is supposed that the stainless steel spring had been subjected to high energy level, which heated the internal spring until it became an ignition energy source, causing the flexible oxygen hose to ignite and sustain a fire. The time to failure, may took few seconds depending on the amount of energy supplied to the internal spring.
This could be approved from the metallurgical microstructure of stainless steel wire, investigated at different places. The microstructure is normal for this type of stainless steel with normal grain size and without any precipitates, as shown in the following figures. If the heating of the stainless steel spring took long time the microstructure will be coarser and different type of precipitates will be observed on the grain boundaries, which is not our case.







Microstructure of the investigated stainless steel spring, 200X

Exhibit #7

Extinguishing Foam Agent” examination done by Ministry of Trade & Industry Chemistry Administration

Ministry of Trade & Industry
Chemistry Administration

وزارة التجارة والصناعة
مصلحـــة الكيميـــاء
تأسست عام ١٨٩٨ م

٢٠١١/٤٩٨/٠٨

الإدارة العامة لمعامل / البحوث — المعمل المختص/التحليل الآلى
نوع العينة / سائل رغوى — تاريخ إصدار /٢٠١١/٧/١٨
جهة تقديم العينة / الادارة العامة لشرطة ميناء القاهرة الجوى-ادارة الحماية المدنية

****

تقرير اختبار

***

فيما يلى نتائج تحليل عينة السائل الرغوى المقدمة من الادارة العامة لشرطة ميناء القاهرة الجوى -ادارة الحماية المدنية :-

الاختبار	النتيجة	المواصفة مرفقه	مدى المطابقة
١-المظهر	سائل اصفر شفاف	سائل أصفر [illegible]	مطابقة
٢- الكثافة النوعية	١,٠٠٤ مل/جم	١,٠١٠ ± [illegible] مل/جم	مطابقة
٣- الأس الهيدروجينى (PH)	٧,٧	[illegible] ٧,٧	مطابقة
٤- معامل الانكسار	١,٣٥٣٢	لا تقل عن [illegible]	مطابقة
٥-اللزوجة	١ سنتى بواز	أقل من ٣ سنتى بواز	مطابقة
٦- التمدد	٦ امثال	لا تقل عن ٥ أمثال	مطابقة
٧-زمن الانفصال ٢٥%	١٦٠ ث	لاتقل عن ١٥٠ ث	مطابقة

وبذلك تكون العينة مطابقة للمواصفة الفنية المرفق ،،،

****

هذه النتيجة تخص العينة المقدمة و تمثيلها لآى كميات أخرى هى مسئولية جهة تقديم العينة

مدير الإدارة — كبير كيميائيين — المدير العام

٧/٢٥
٢٠١١

إيمان/***

وزارة الداخلية

الإدارة العامة لشرطة ميناء القاهرة الجوى
مكتب المدير

سرى
٢٧٠١

الادارة المركزية لحوادث الطائرات	
وارد	
رقم / /	التاريخ / / ٢٠٠
المرفقات	التراب

السيد الطيار/ رئيس الإدارة المركزية للحوادث

بوزارة الطيران المدنى

تهدى الإدارة العامة لشرطة ميناء القاهرة الجوى أطيب تحياتها لسيادتكم ....

ونود الإشارة إلى الآتى :

- إيماءاً لكتاب سيادتكم رقم ٤١٨٨ المؤرخ ٢٠١١/٨/١١ بشأن واقعة نشوب حريق فى غرفة قيادة الطائرة المسجلة SU – GBP من طراز البوينج ٢٠٠/٧٧٧ والتابعة لشركة مصر للطيران للخطوط الجوية أثناء إعدادها للقيام برحلتها رقم ٦٦٧ والتجهة إلى جدة بمبنى الركاب رقم ٣ بتاريخ ٢٠١١/٧/٢٩ .. وطلب الإفادة ببيان المواد المستخدمة فى أعمال مكافحة وإخماد الحريق ، وكذا تركيبها الكيميائى .. إستكمالاً للتحقيق الفنى فى الواقعة .

أتشرف بالإفادة :-

- أن المادة الرغوية المستخدمة فى عملية المكافحة من النوع AFFF تركيز ٣ ٪ ومرفق طيه صورة من التحليل الكيميائى الأخير للمادة الرغوية والذى أجرى بمعرفة مصلحة الكيمياء المصرية.

للتفضل بالإحاطة ..

وتفضلوا سيادتكم بقبول وافر الإحترام ،،،

٢٠١١/٨/١٣
حسام

لواء/

" صلاح زيادة "

مدير الإدارة العامة لشرطة ميناء القاهرة الجوى

Exhibit #8

Examination of Oxygen cylinders for purity, done by the Egyptian Air Force

Air Force
Aviation Engineering Department
Gas Planet No.1

Test certificate

Customer : EGYPT AIR Maintenance & Engineering

Description : cylinder
Gas Type : OXYGEN

PART No.	Serial No.
804044-15	ALT282-10220

We Certify that the above mentioned cylinder Purity IS
99.4 %
according to the standards
MIL-PRF-27210
TO – 42B5 – 1 – 2
MIL – STD – 1411

E.A.F GAS 1 Q.C

Date : 27/9/2011

Signature: Mr. Adel Abd Elaaty

Signature : Hatem Mohamed sabry

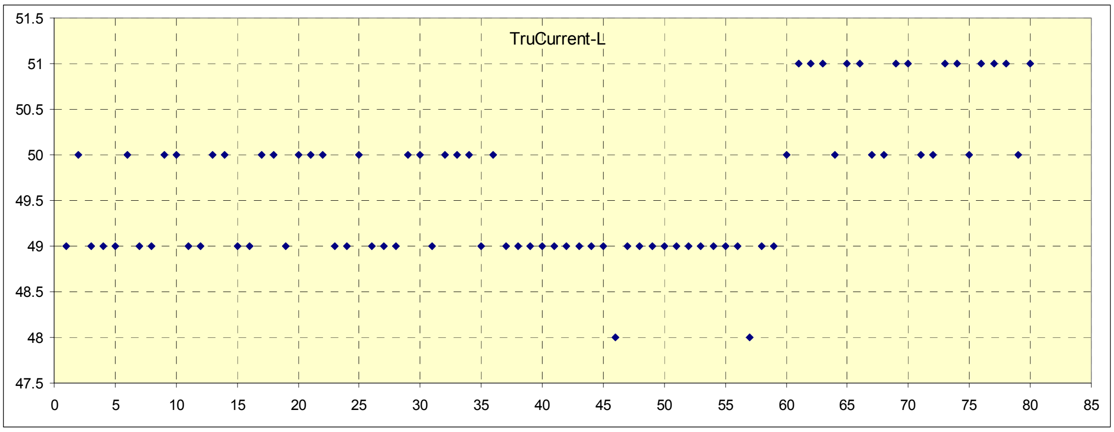
Exhibit #9

Quick Access Recorder QAR Detailed Analysis

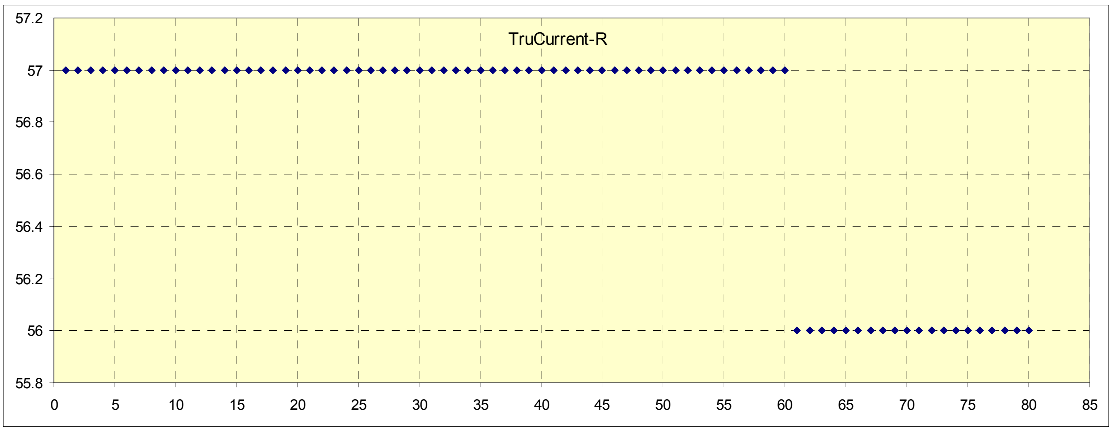
The QAR included information about several parameters (Analog/ Discrete). Parameters are sampled every one second for total time duration of almost 80 seconds.

A list and summary of recorded parameters information are shown in the following text:

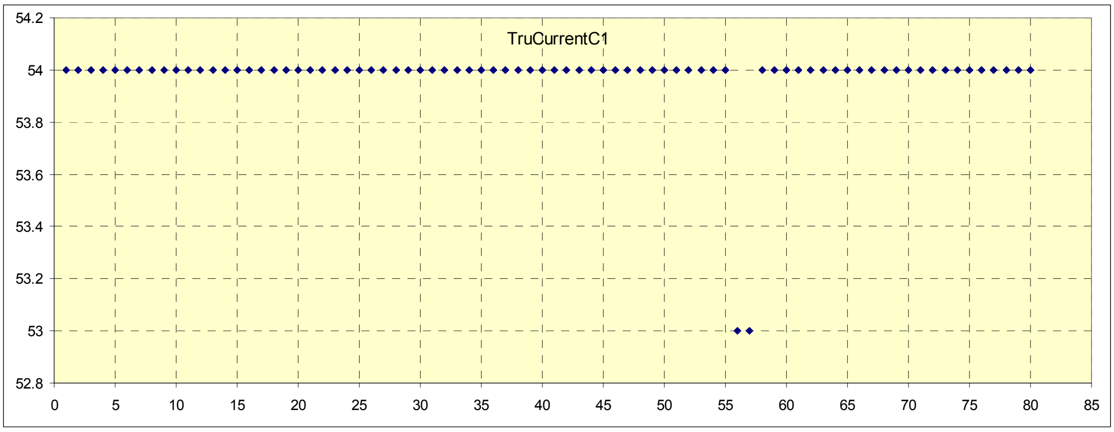
- Weight on Wheel WOW:
  The QAR confirmed that the aircraft was on ground for the whole recording duration time.
- Magnetic Heading:
  The QAR showed a fixed heading of 252.25 degree throughout the whole recording duration time.
- Start valves:
  The QAR showed that the start valves for both engines were closed and remained closed for the whole recording duration time.
- Fuel flow:
  Fuel Flow values for both engines were shown to be zero for the whole recording duration time.
- AC Utility Bus-Left:
  Current load was shown to be zero for the whole recording duration time.
- AC Transfer Bus-Left:
  Current load was shown to be zero for the whole recording duration time.
- Main Battery Voltage:
  Main Battery Voltage was shown to be 27 volt for the whole recording duration time.
- TRU Current:
  TRU Current-L, TRU Current-R, TRU CurrentC1, TRU CurrentC2 are shown in the following graphs



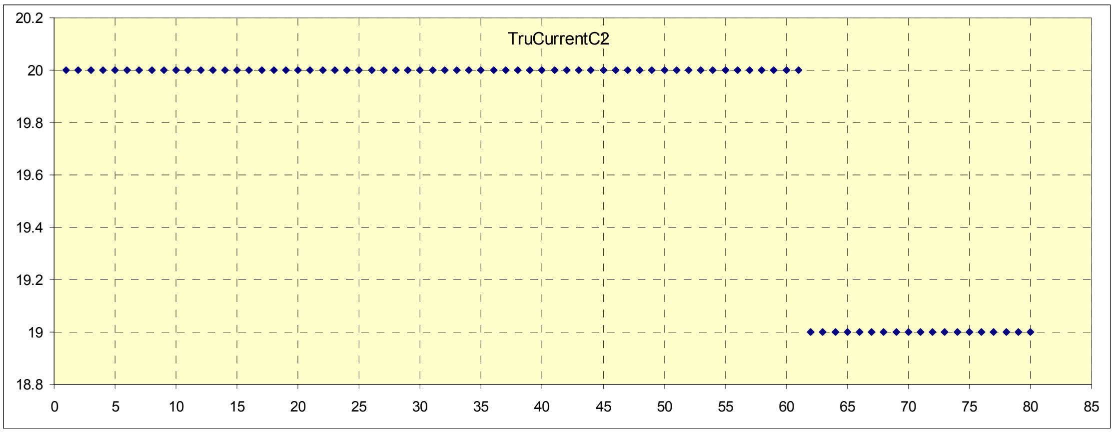
TRU Current L



TRU Current R



TRU Current C



TRU Current C2

- TRU Voltages:

  TRU Voltages were as follows:

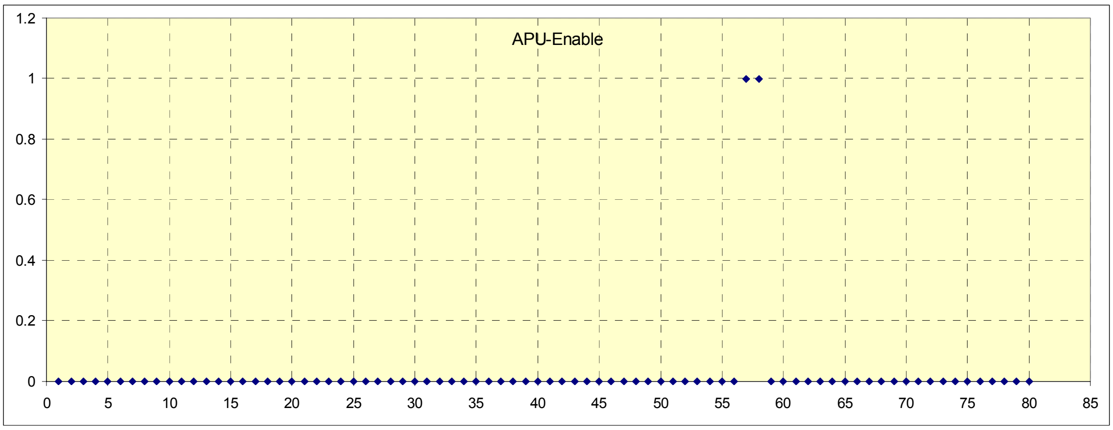
  - TRU Voltage- L = 28 volt
  - TRU Voltage- R = 28 volt
  - TRU Voltage C1 = 27 volt
  - TRU Voltage C2 = 28 volt

  (For the whole recording duration time).

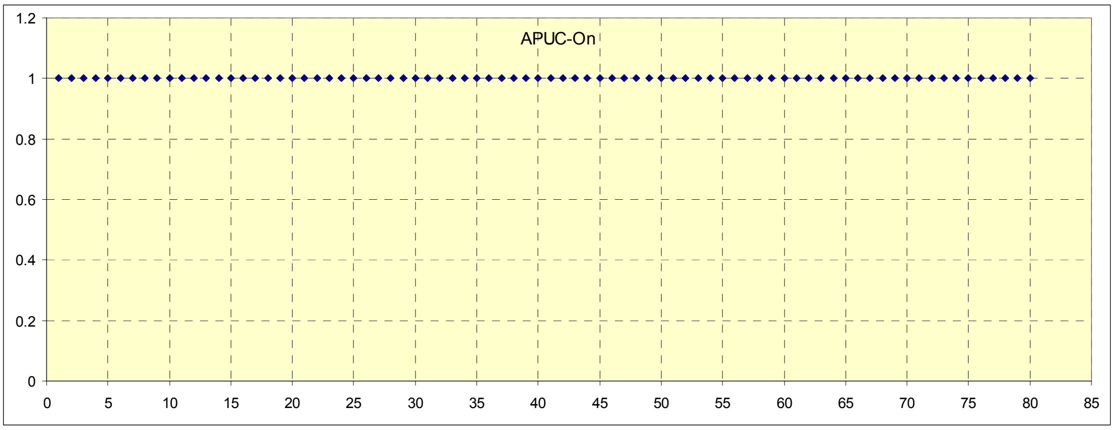
- Galley Doors:

  Galley doors #2, #4 were shown to be closed For the whole recording duration time.

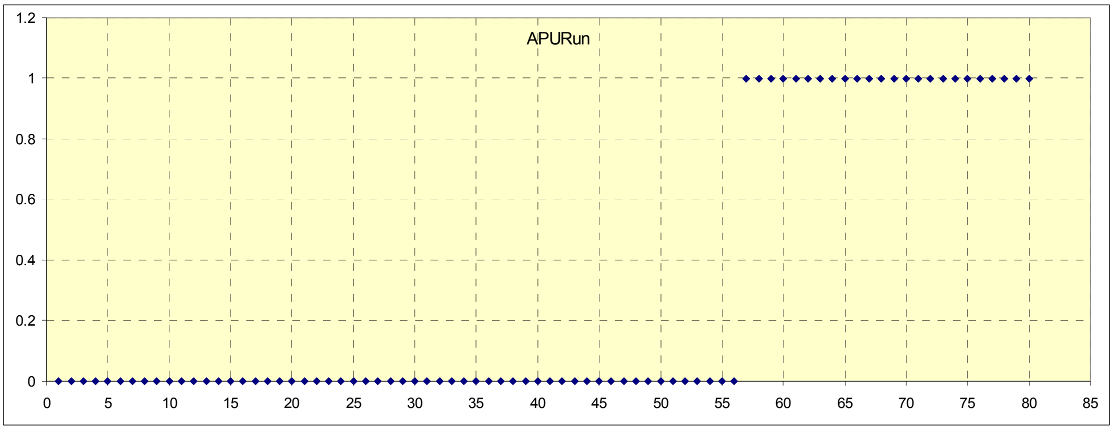
- Auxiliary Power Unit APU:
  The following plots show the variations of the APU parameters throughout the whole recording time duration.



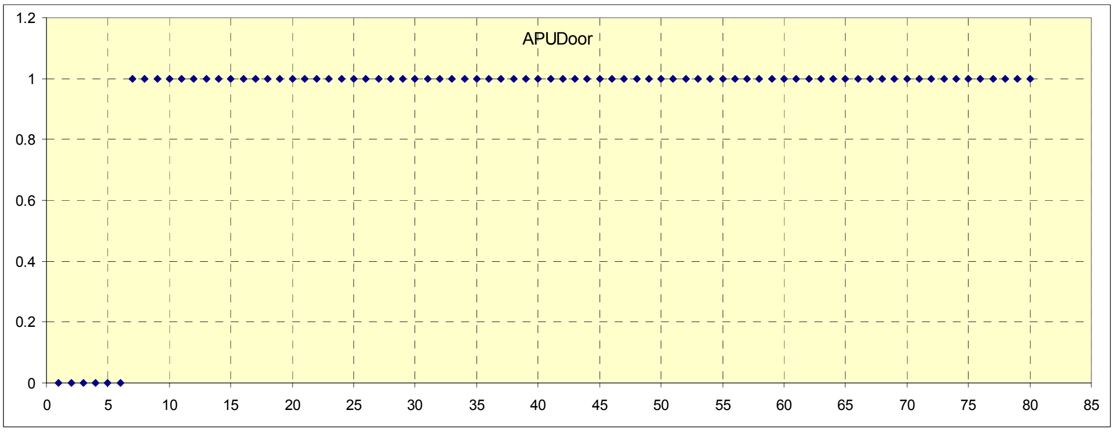
APU Enable



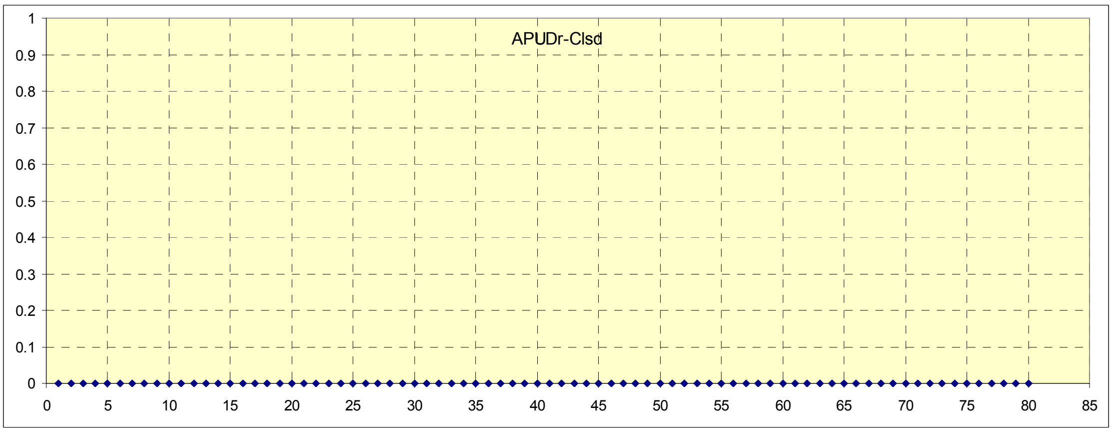
APUC-On



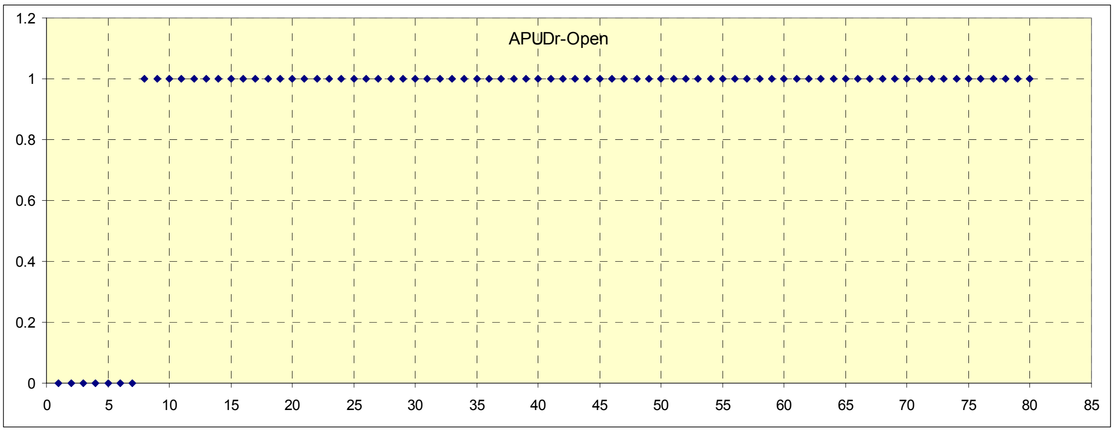
APU Run



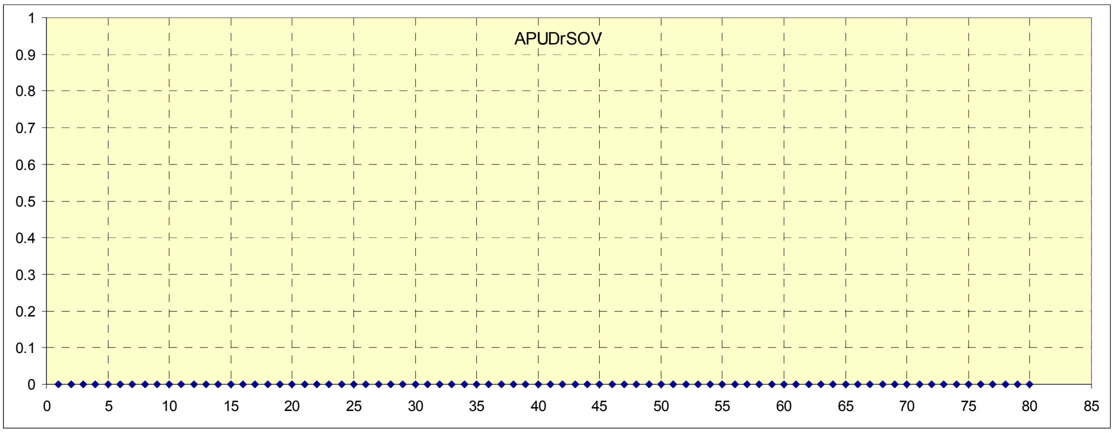
APU Door



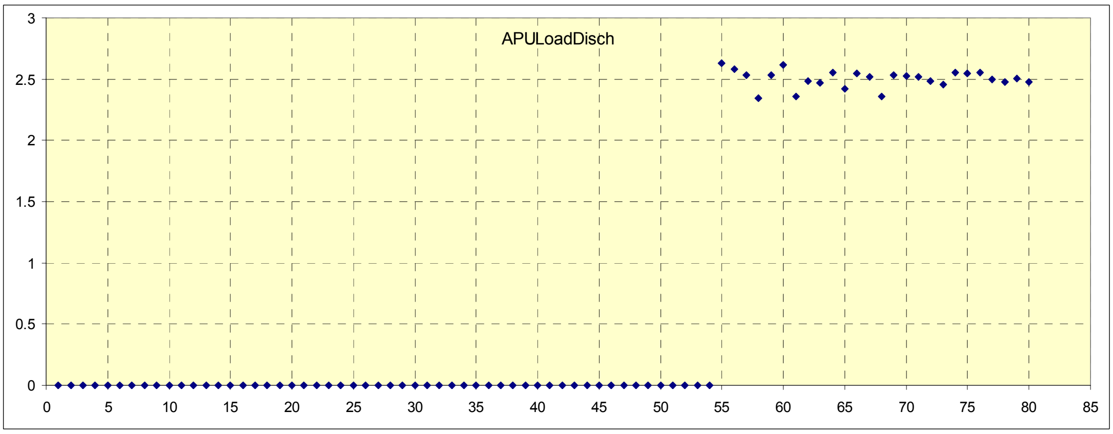
APU Door Closed



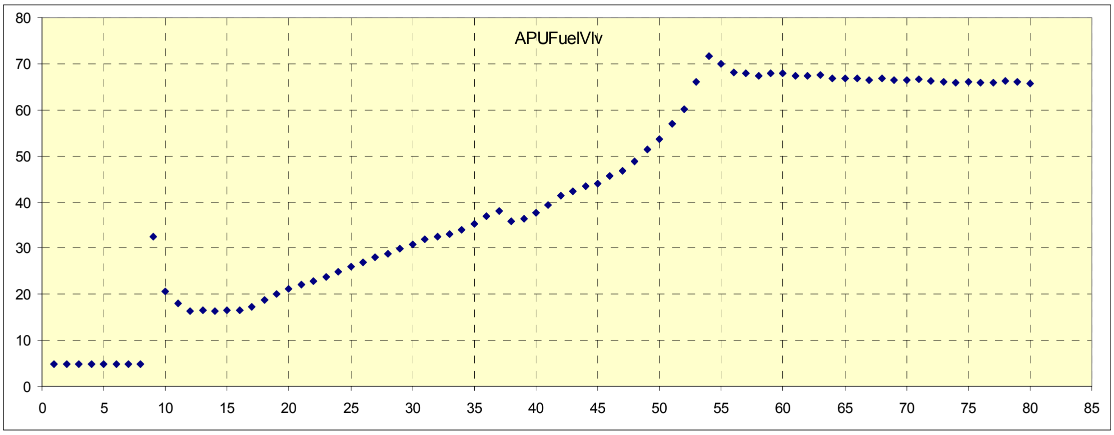
APU Door Open



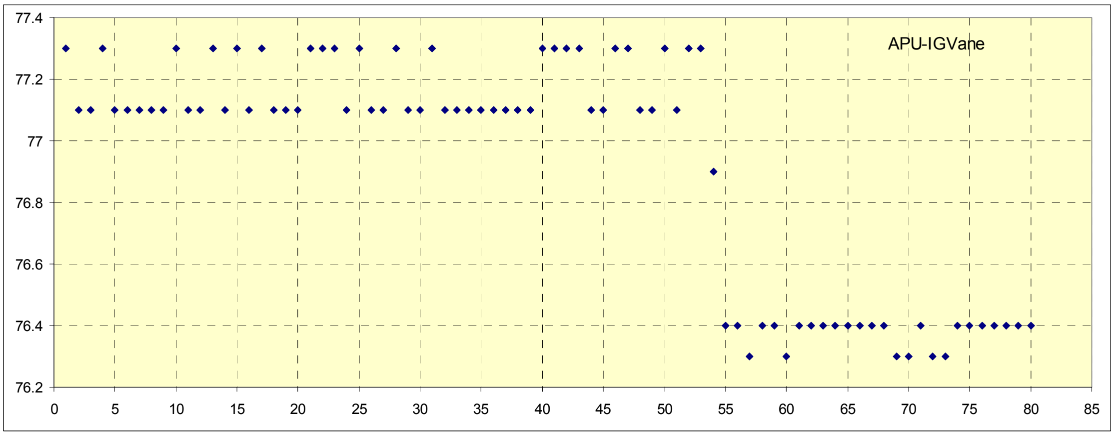
APU Door SOV



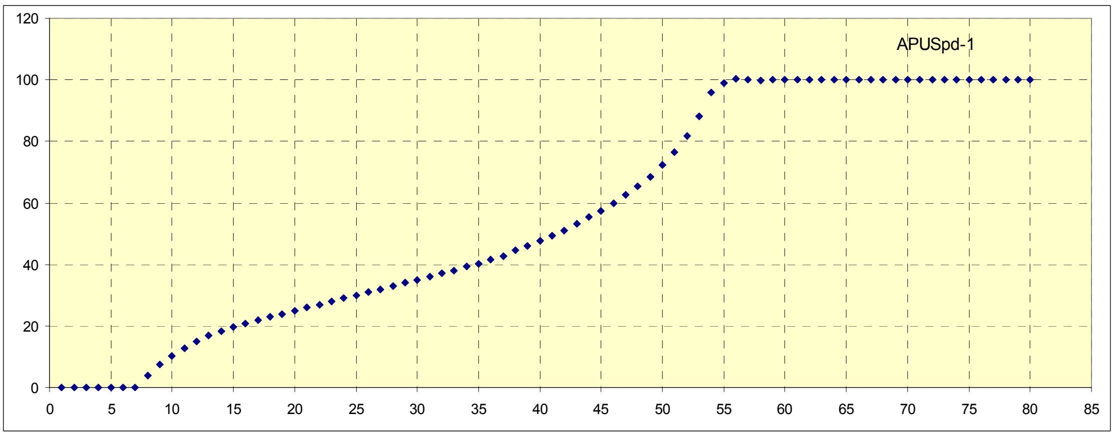
APU Load Discharge



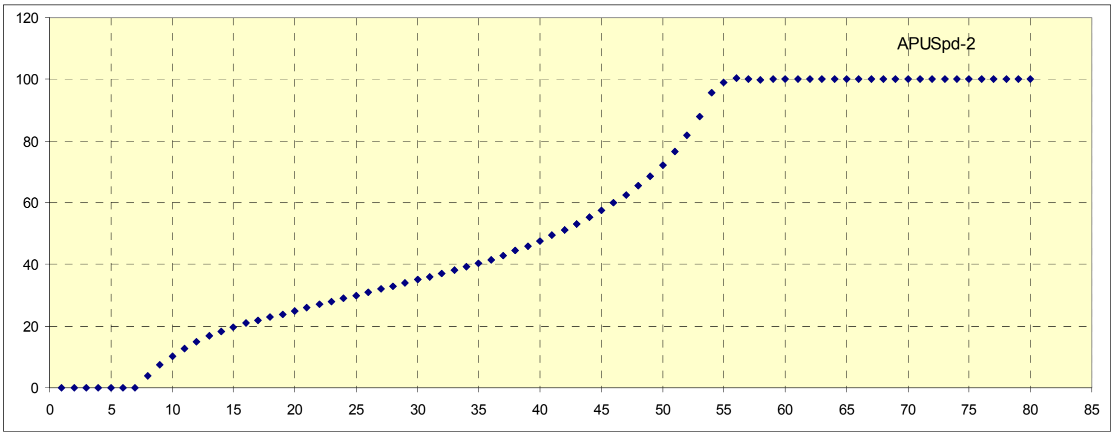
APU Fuel Valve



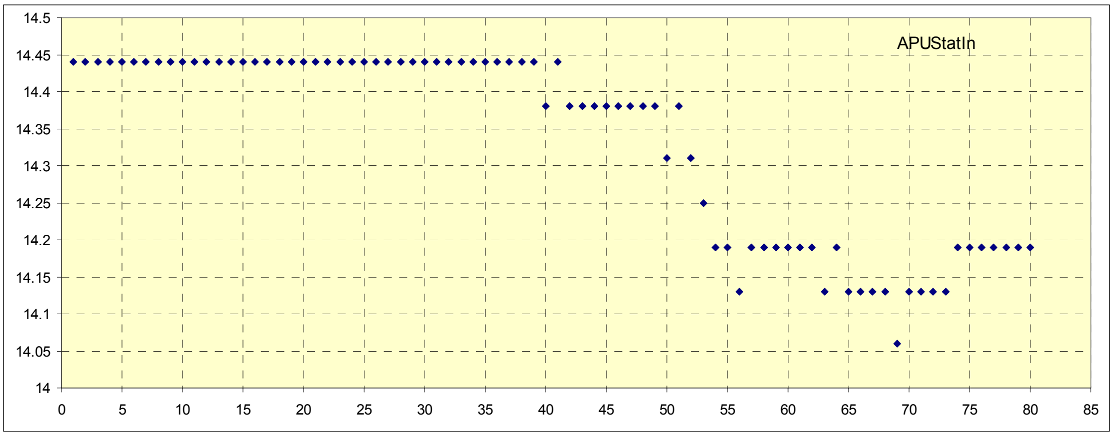
APU Intake Guide Vane



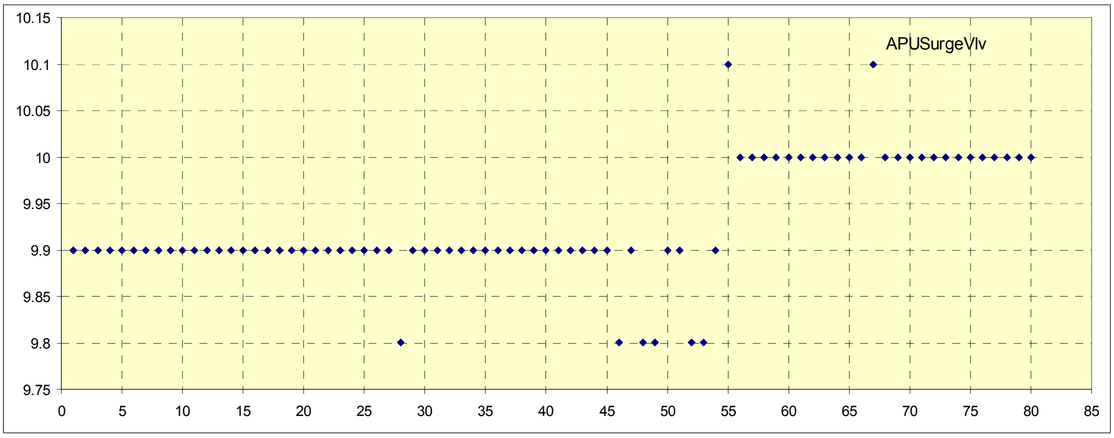
APU speed 1



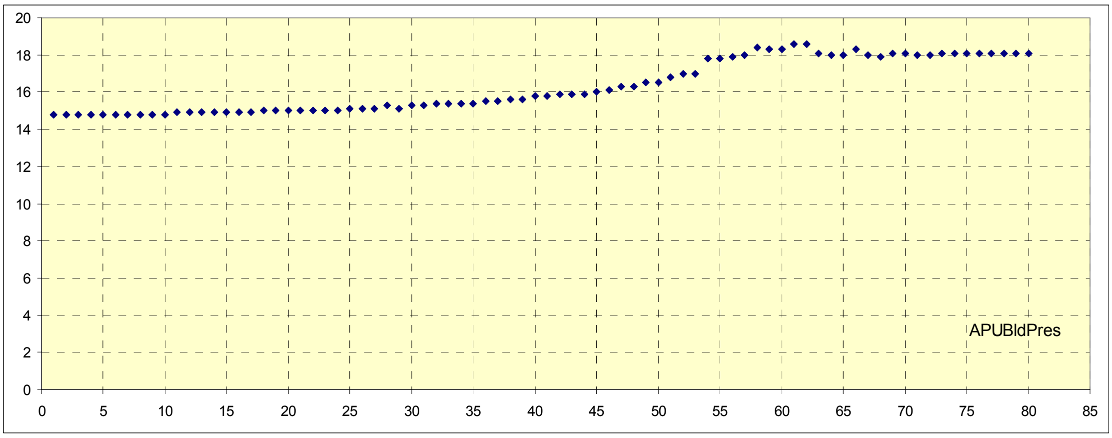
APU Speed 2



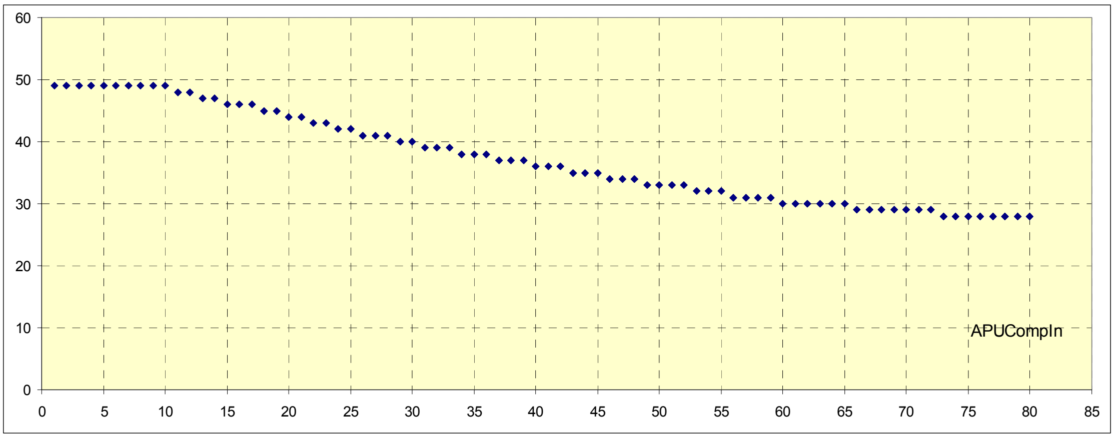
APU Statin



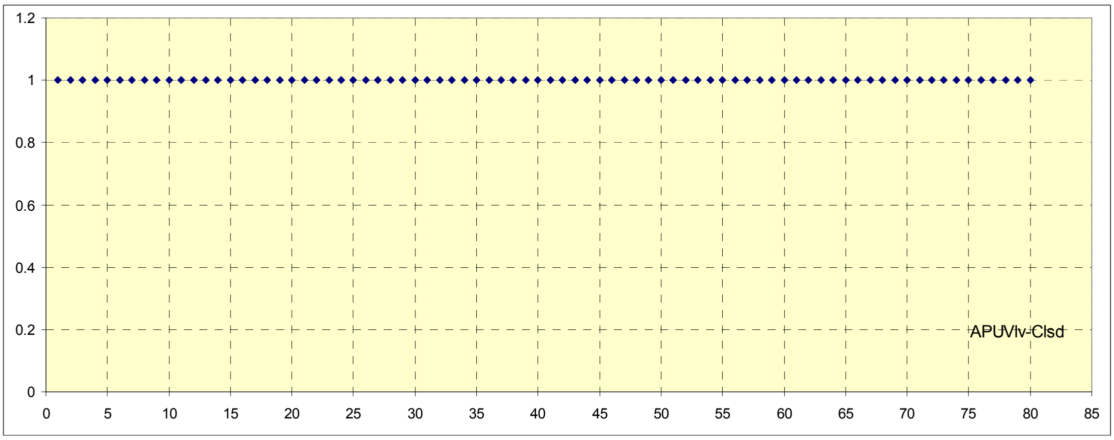
APU Surge valve



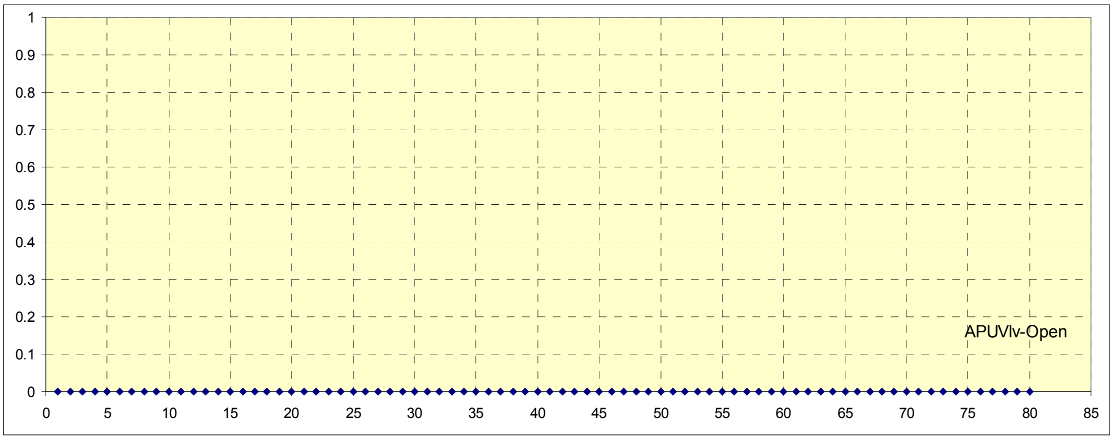
APU Bleed Pressure



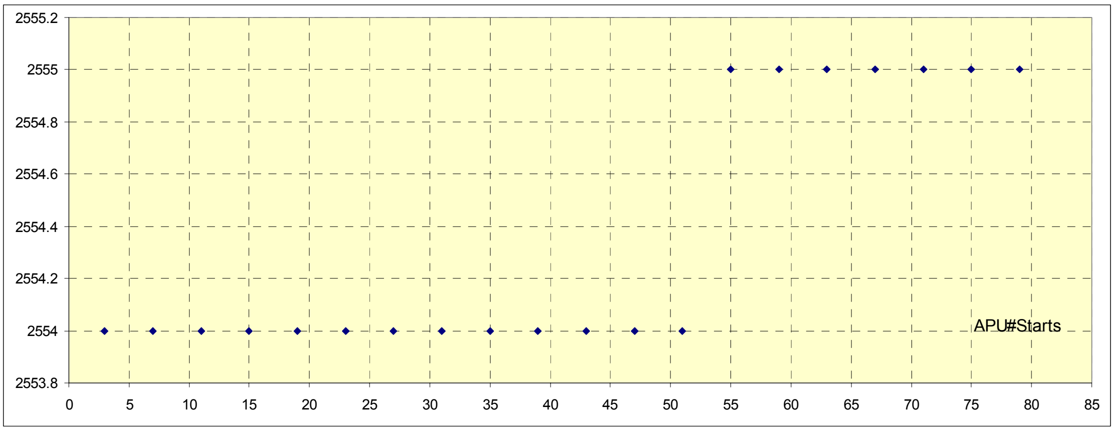
APUCompIn



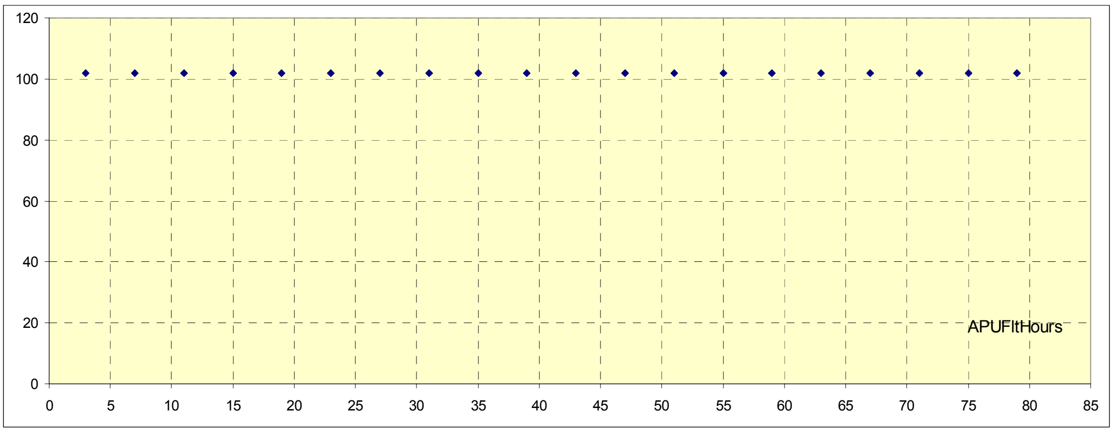
APU Valve Closed



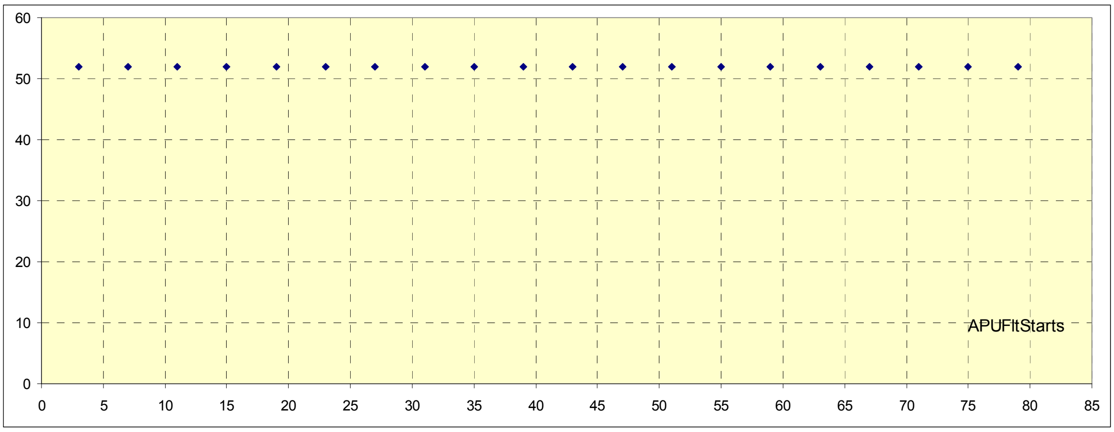
APU Valve Open



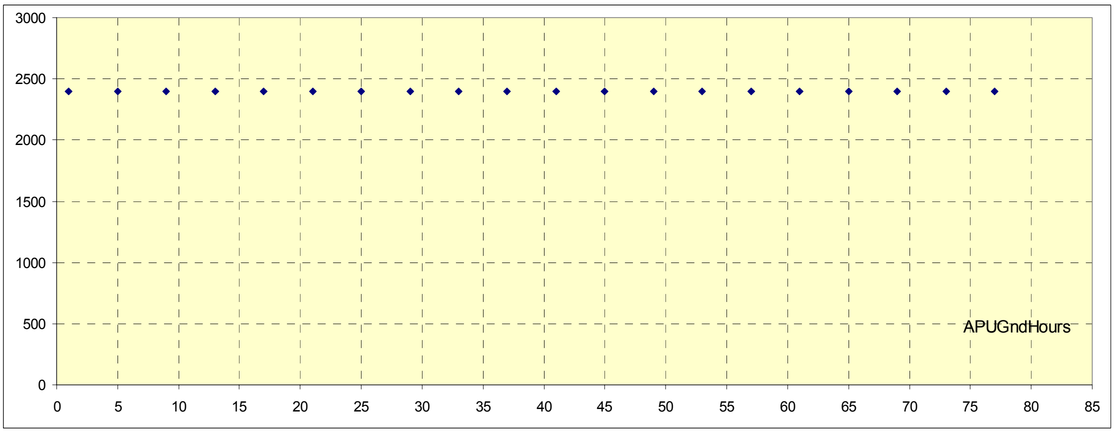
APU Number of Starts



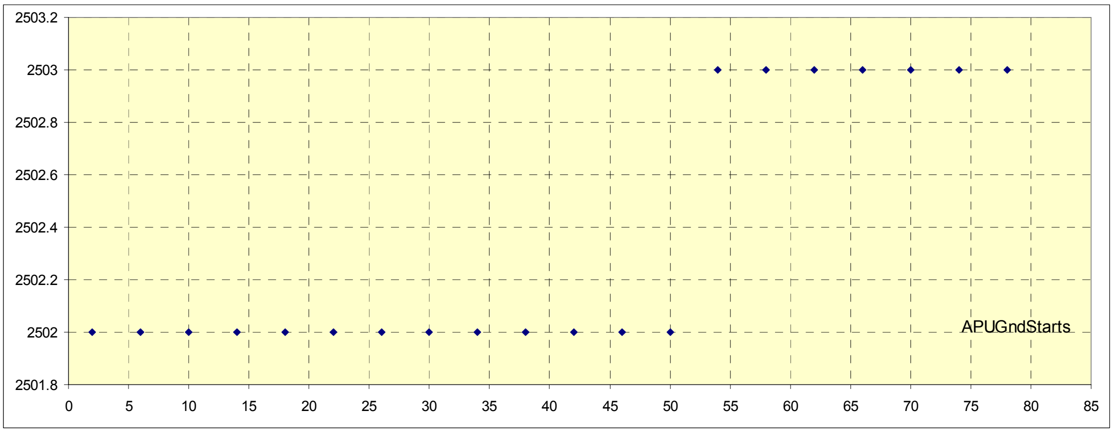
APU Flight hours



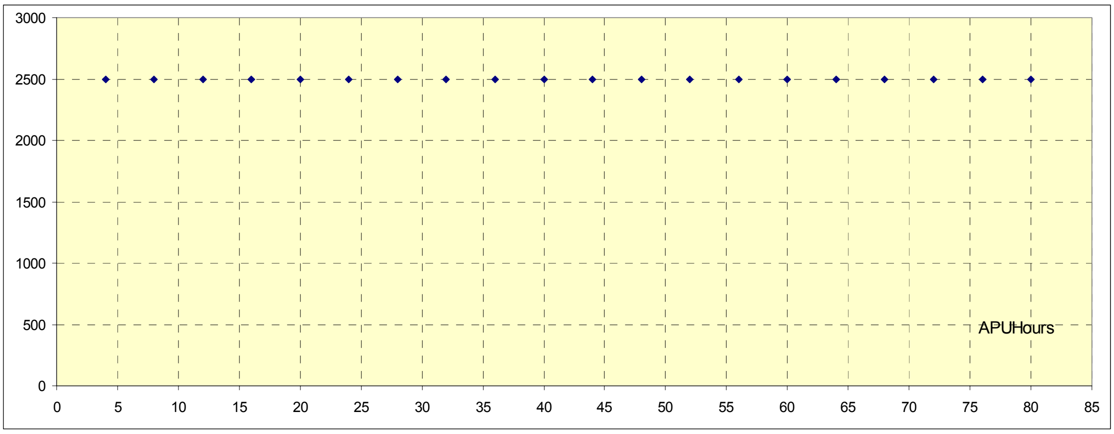
APU Flight Starts



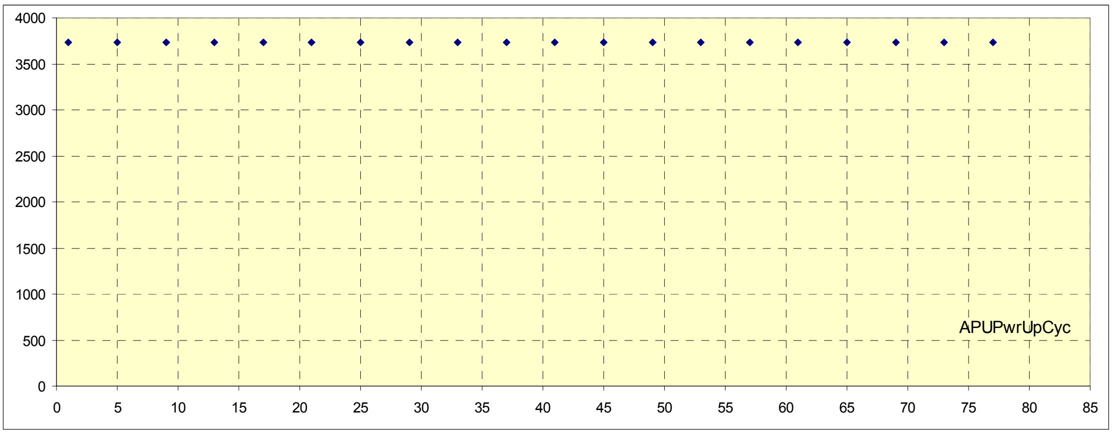
APU Ground hours



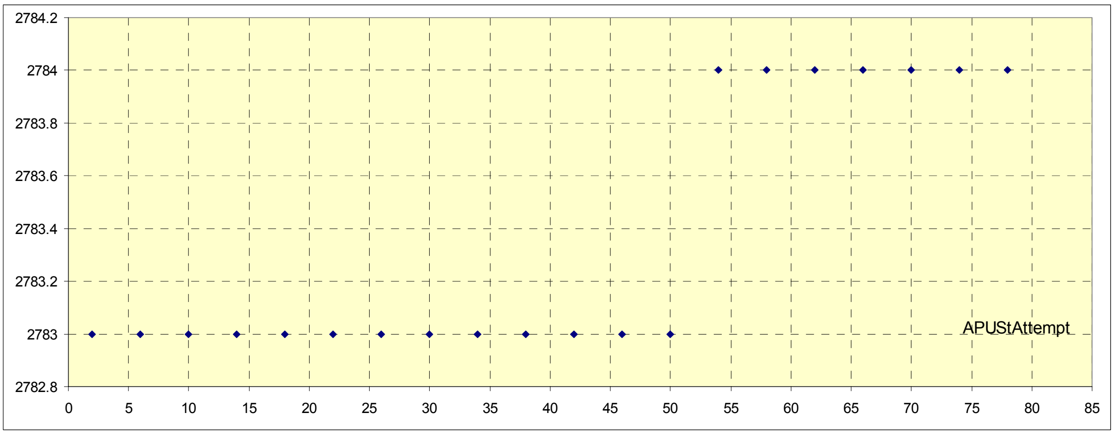
APU Ground Starts



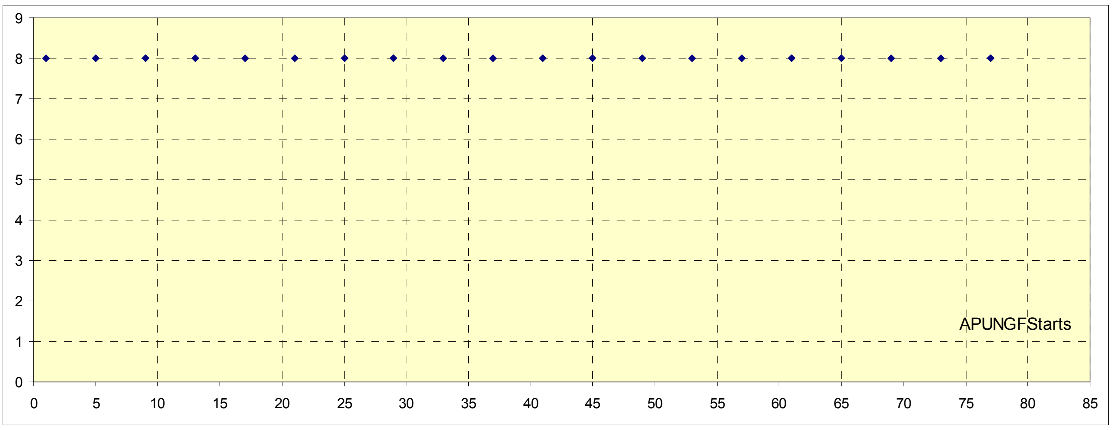
APU hours



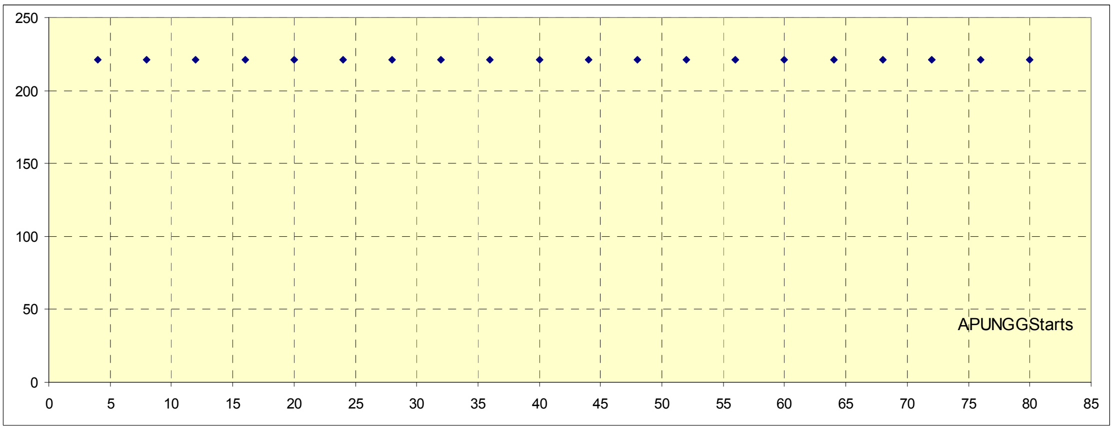
APU Power Up Cycles



APU Start Attempt

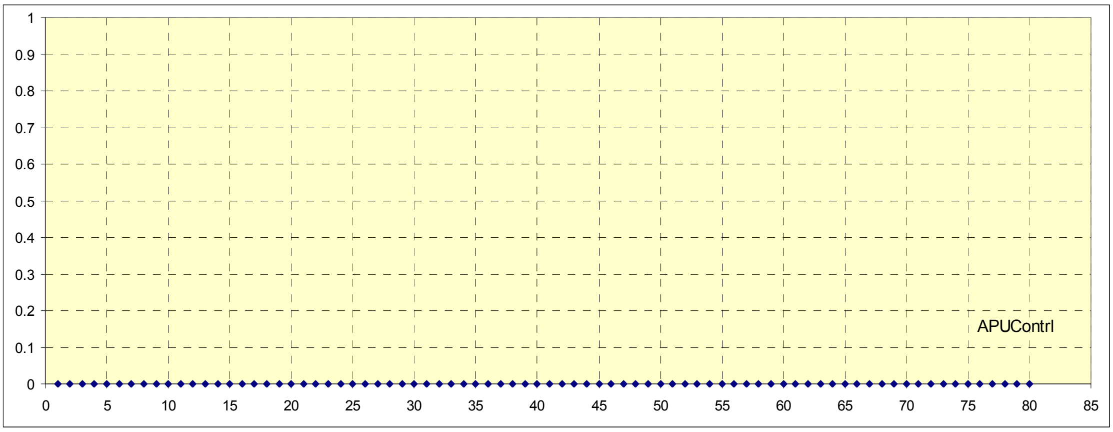


APUNG Flight Starts

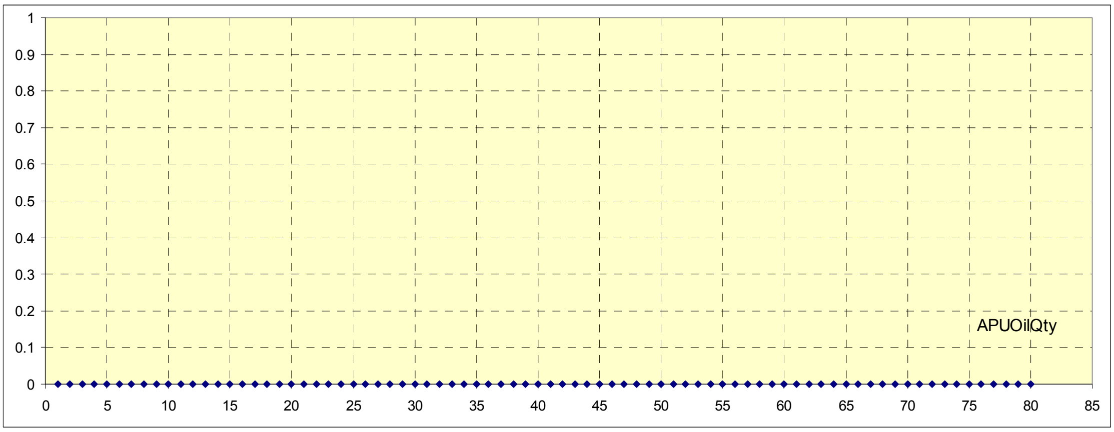


APUNG Ground Start

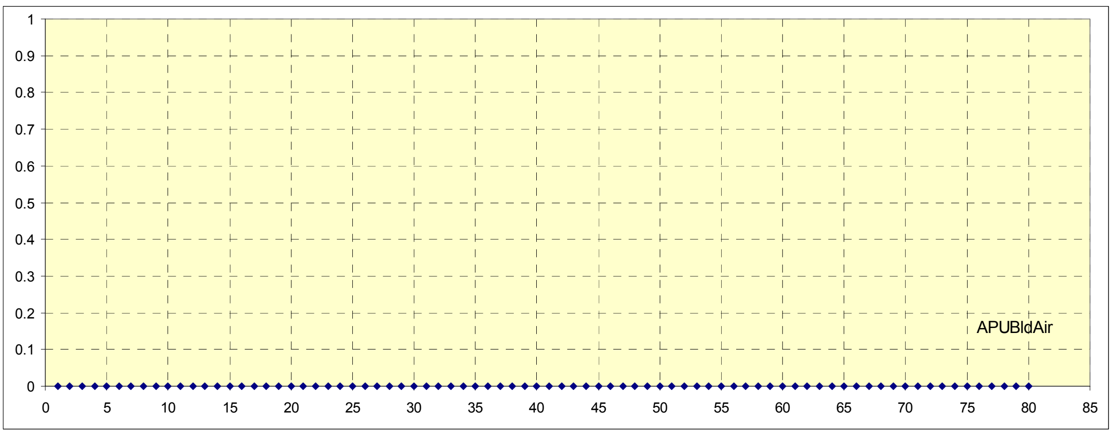
APU Serial Number: 1451



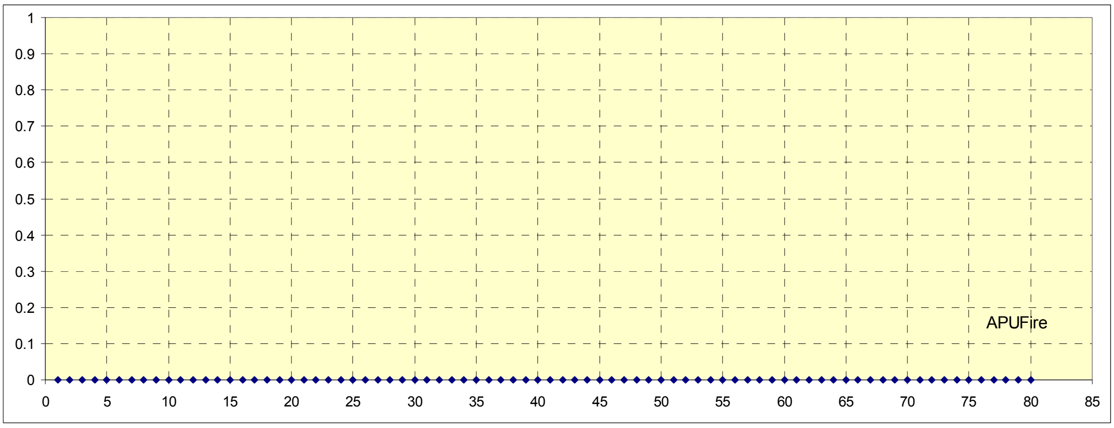
APU Control



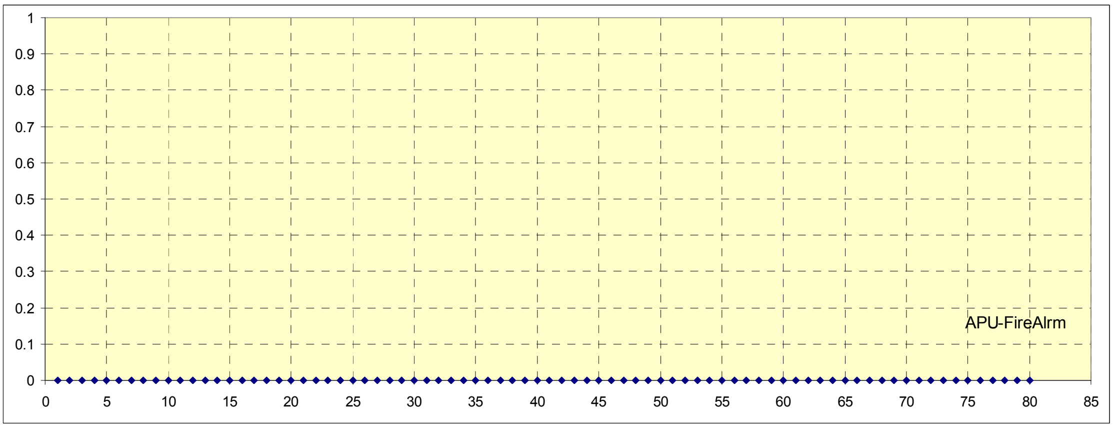
APU Oil Quantity



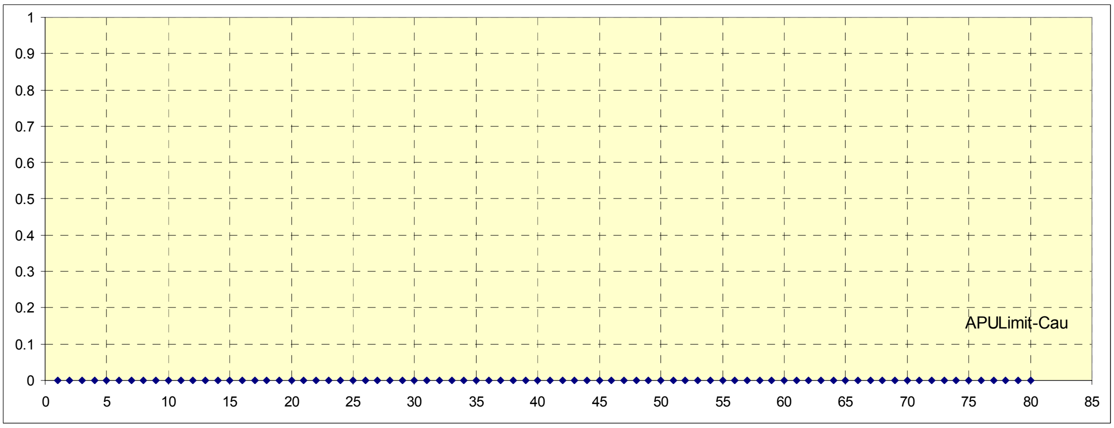
APU Bleed Air



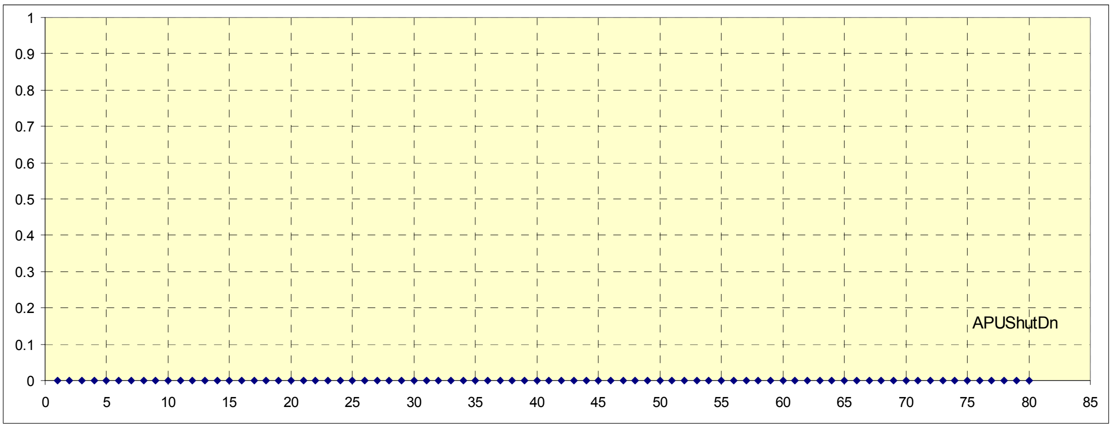
APU Fire



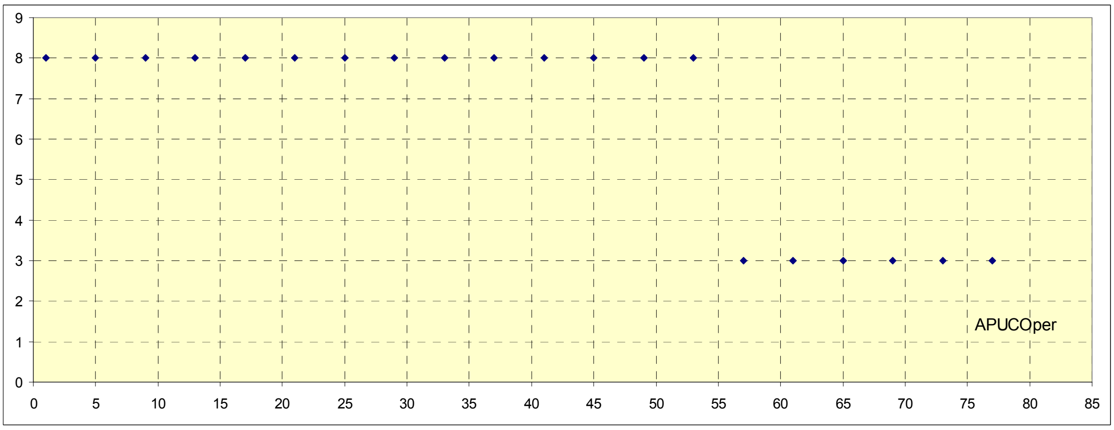
APU Fire Alarm

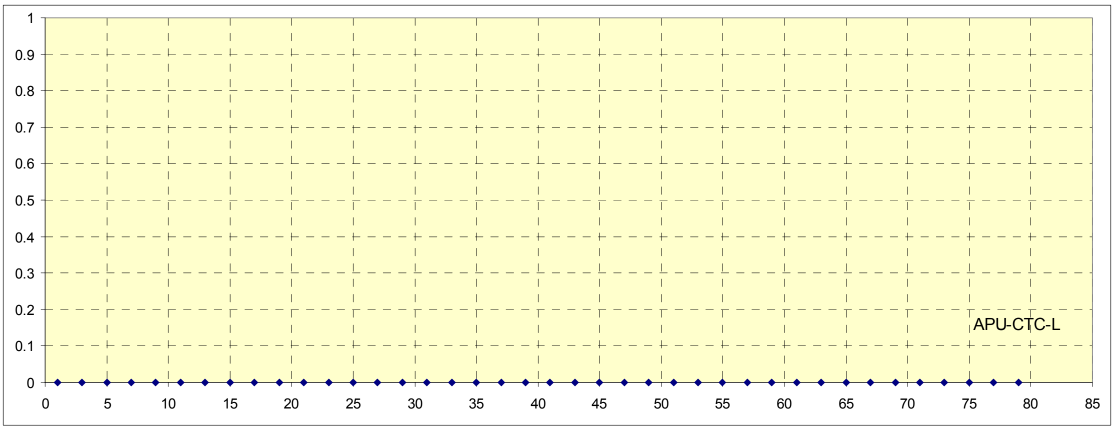


APU limit- Caution

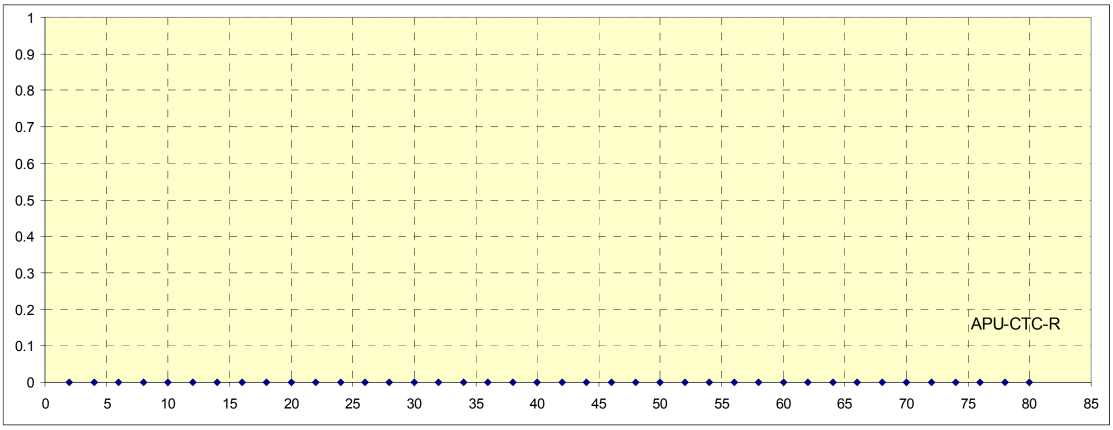


APU Shut Down





APU Control L



APU Control R