APPENDIX 5: Airport Information

HLLT AD 2.10 AERODROME OBSTACLES

In Approach / TKOF areas			In Circling area and at AD		Remark
1			2		3
RWY/Nr/ Area affected	Obstacle type Elev Markings/LGT	Coord.	Obstacle type Elevation Markings/LGT	Coord.	
a	b	c	a	b	
09		3241.18N 1310.32E			
27	3661	3250.00N 1304.00E			
27	920 MAST	324 4.46 N 1307.24E			
27	200MAST 120 MAST	323 9.01 N 1306.36 E			

HLLT AD 2.11 METEOROLOGICAL INFORMATION PROVIDED

1	Associated MET OFFICE	TRIPOLI
2	Hours of service MET office outside hours	24 HOURS
3	Office responsible for TAF preparation Periods of validity	TRIPOLI
4	Trend forecast Interval of issuance	METAR , TAF
5	Briefing/consultation provided	PERSONAL
6	Flight documentation Language (s) used	ENGLISH
7	Charts and other information available For briefing or consultation	SIG WX charts
8	Supplementary equipment available for Providing information	TEL 00218 21 4440106 AFS HLLTYMYX
9	ATS units provided with information	TRIPOLI TWR APP ACC
10	Additional information (limitation of Service. Etc.)	NIL

HLLT AD 2.12 RUNWAY PHYSICAL CHARACTERISTICS

Designations Rwy NR	TRUE BRG	Dimensions of RYW (M)	Strength (PCN) and surface of RWY and SWY	THR coord. RWY end coord. THR geoid undulation	THR elevation and Highest elevation of TDZ of precision APP RWY
1	2	3	4	5	6
09 27	089 269	3600X45	PCN 100 ASPH/CONC LEAN CONC		264 264.9
18 36	177 357	2600X45	PCN75 ASPH EARTH		241.5 267.4
SLOPE OF RWY – SWY	SWY dimensions (M)	CWY dimensions (M)	STRIP dimensions (m)	OFZ	Remarks
7	8	9	10	11	12
2% 29	60 29	60	3840 X 300 3750X150	NIL NIL	NIL NIL

HLLT AD 2.13 DECLARED DISTANCES

RWY Designator	TORA (M)	TODA (M)	ASDA (M)	LDA (M)	Remarks
1	2	3	4	5	6
09/27 18/36	3600	3660	3660	3600	NIL

HLLT AD 2.14 APPROACH AND RUNWAY LIGHTING

RWY Designator	Apch LGT Type LEN INTST	THR LGT colour WBAR	VASIS (MEHT) PAPI	TDZ,LGT LEN	RWY Centre Line LGT Length, spacing, colour, INTST	RWY edge LGT LEN, spacing Colour INTST	RWY End LGT colour WBAR	SWY LGT LEN (M) colour	Remarks
1	2	3	4	5	6	7	8	9	10
09	LIH White		2 Bar			LIH White	Red	NIL	
		LIH Red	LIH Green	Glide		LIML White			
27	LIH White	LIM Green	Slope 3	LIH	LIH White	Last 600			
	LIM Red			White	LIM White				
18	LIH White	Under	Vasis out						
36	LIH White	Maintenance of service							

HLLT AD 2.15 OTHER LIGHTING, SECONDARY POWER SUPPLY

1	ABN/IBN location, characteristics and Hours of operation	On Top Of Control Tower /flashing Green/ White (Night Time)
2	LDI location and LGT Anemometer location and LGT	09/27 THR , Signal Lamp
3	TWY edge and centre line lighting	Available All TWY
4	Secondary power supply to all lighting ad AD Switch-over time : 1 SEC	Available 3 Seconds
5	Remarks	NIL

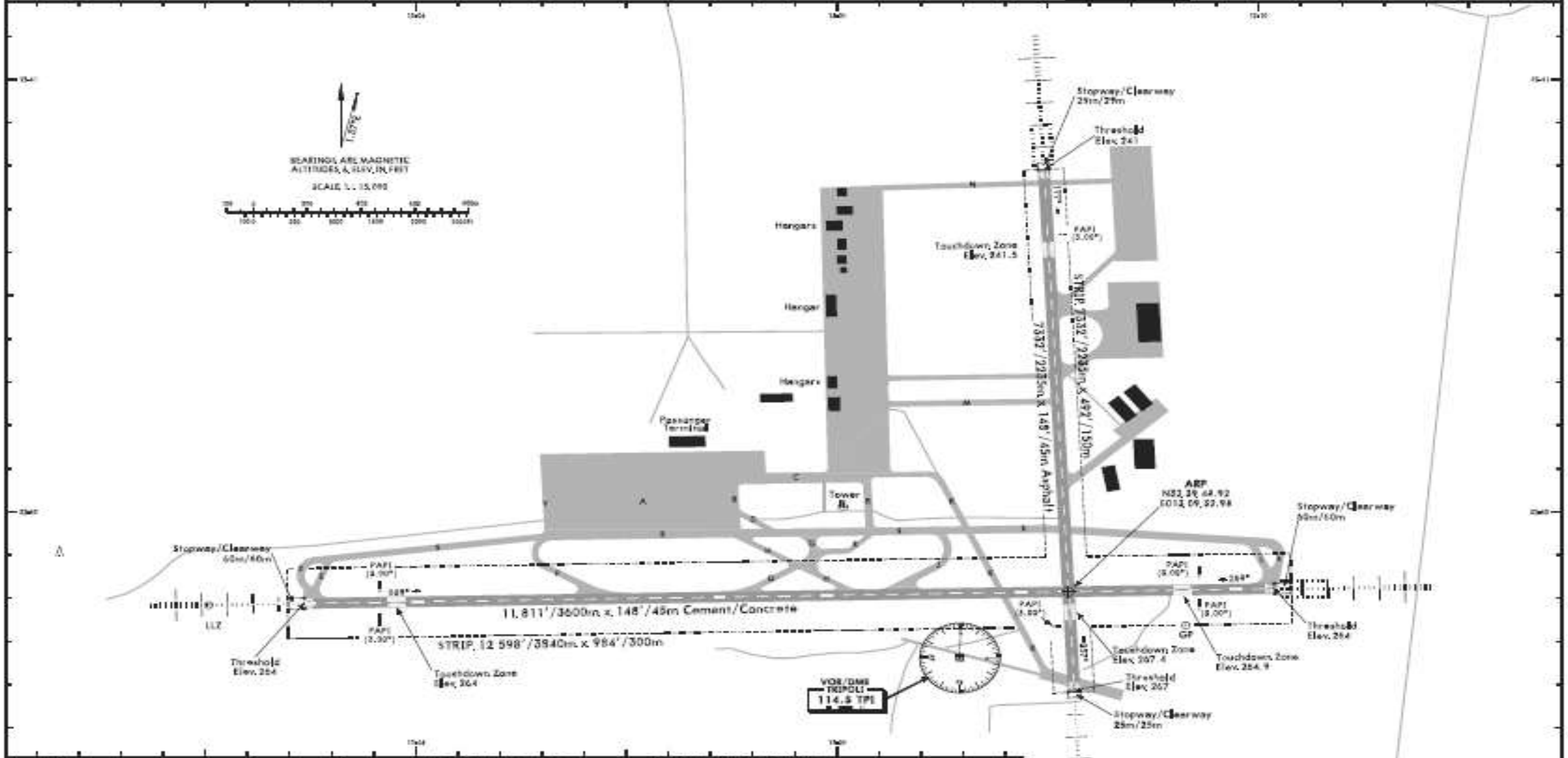
HLLT AD 2.19 RADIO NAVIGATION AND LANDING AIDS

Type of aid, MAG VAR CAT of ILS/MLS (For VOR/ILS/MLS, Give declination)	ID	Frequency	Hours of operation	Position of Transmiting antenna coordinates	Elevation of DM Transmitting antenna	Remarks
1	2	3	4	5	6	7
VOR/DME	TPI	114.5	24H	3239. 48 N 1309.18 E	263	
ILS/LLZ	I-IWT	109.5	24H	3239.30 N 1307.18 E		RWY27 CAT II ANGLE 3°
GP		332.6	24H	3239.30 N 1309.24 E		
PE/L		390	24H	3240.00 N 1314.54 E		
G/L		365	24H	3239.54 N 1310.48 E		
TW/L		301	24H	3239.48 N 1303.01 E		
D/L		435	24H	3239.54 N 1307.01 E		

AERODROME CHART - ICAO | WGS-84 | AD ELEV 263 FT

ATIS	127.000
TRIPOLI TWR	118.100
GND	120.100

TRIPOLI INTL, GSPLAJ
Tripoli Intl



RWY	DIRECTION	THRESHOLD	STRENGTH	DECLARED DISTANCES			
				TORA	TODA	ASDA	LDA
09	090.00°.MAG	N32 39 47.3 E 013 07 44.17	PCN 100	11,811'/ 3600m	12,008'/ 3660m	12,008'/ 3660m	11,811'/ 3660m
27	270.00°.MAG	N 32 39 49.35 E 013 10 02.34	ASPH/CONC	11,811'/ 3600m	12,811'/ 3660m	12,008'/ 3600m	11,811'/ 3660m
18	180.00°.MAG	N32 40 47.5 E 013 09 29.49	PCN 75	7333'/ 2235m	7428'/ 2264m	7428'/ 2264m	7333'/ 2235m
36	360.00°.MAG	N 32 39 25.68 E 013 09 34.36	ASPH	7333'/ 2235m	7415'/ 2260m	7415'/ 2260m	7333'/ 2235m

AERODROME LIGHTING

Approach lighting:
RWY 09 LIH, white, Calvert, CAT I
RWY 27 LIH, white, Calvert, CAT II
RWY 18 LIH, white, Calvert, CAT II
RWY 36 LIH, white, Calvert, CAT I
RWY 09/27 PAPI 3.00°
RWY 18/36 PAPI 3.00°

Runway lighting:
RWY 09/27
RWY 18/36

Taxiway lighting:
Centerline
Rapid exit

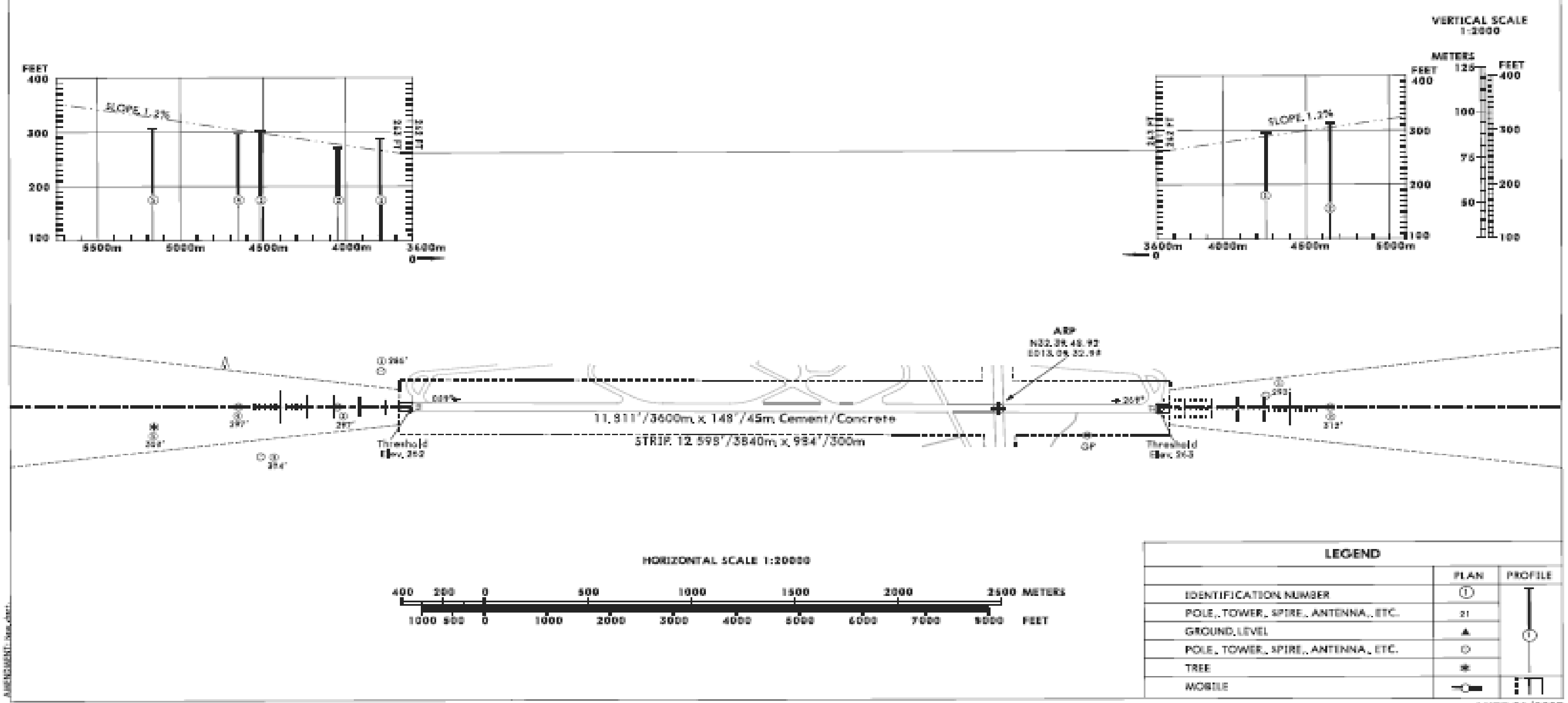
AERODROME OBSTACLE CHART - ICAO
TYPE A (OPERATING LIMITATIONS)

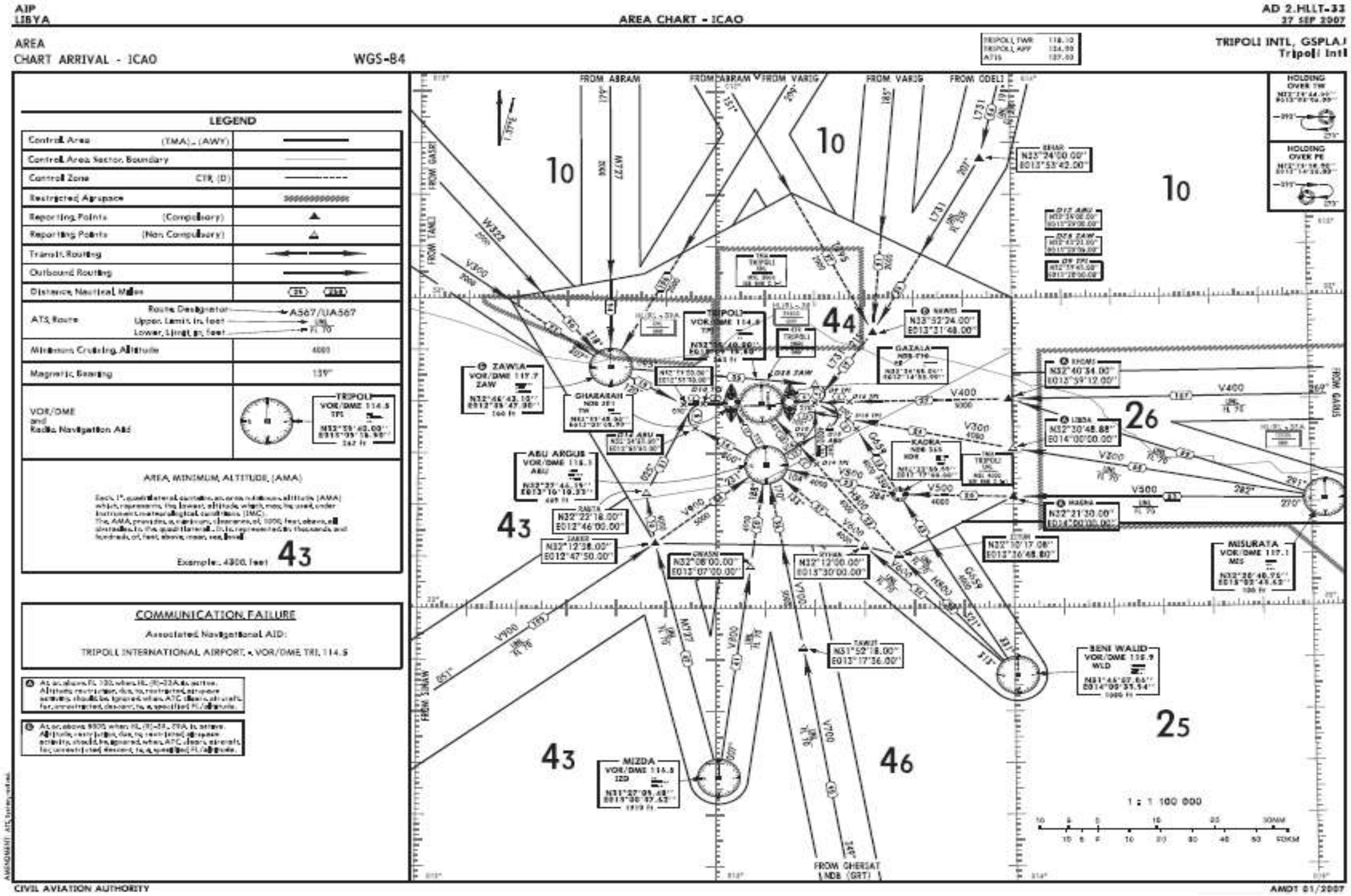
TRIPOLI INTL, GSPLAJ
Tripoli Intl

DISTANCES IN METERS, ELEVATIONS IN FEET
MAGNETIC VARIATION 1.37°E, 2007

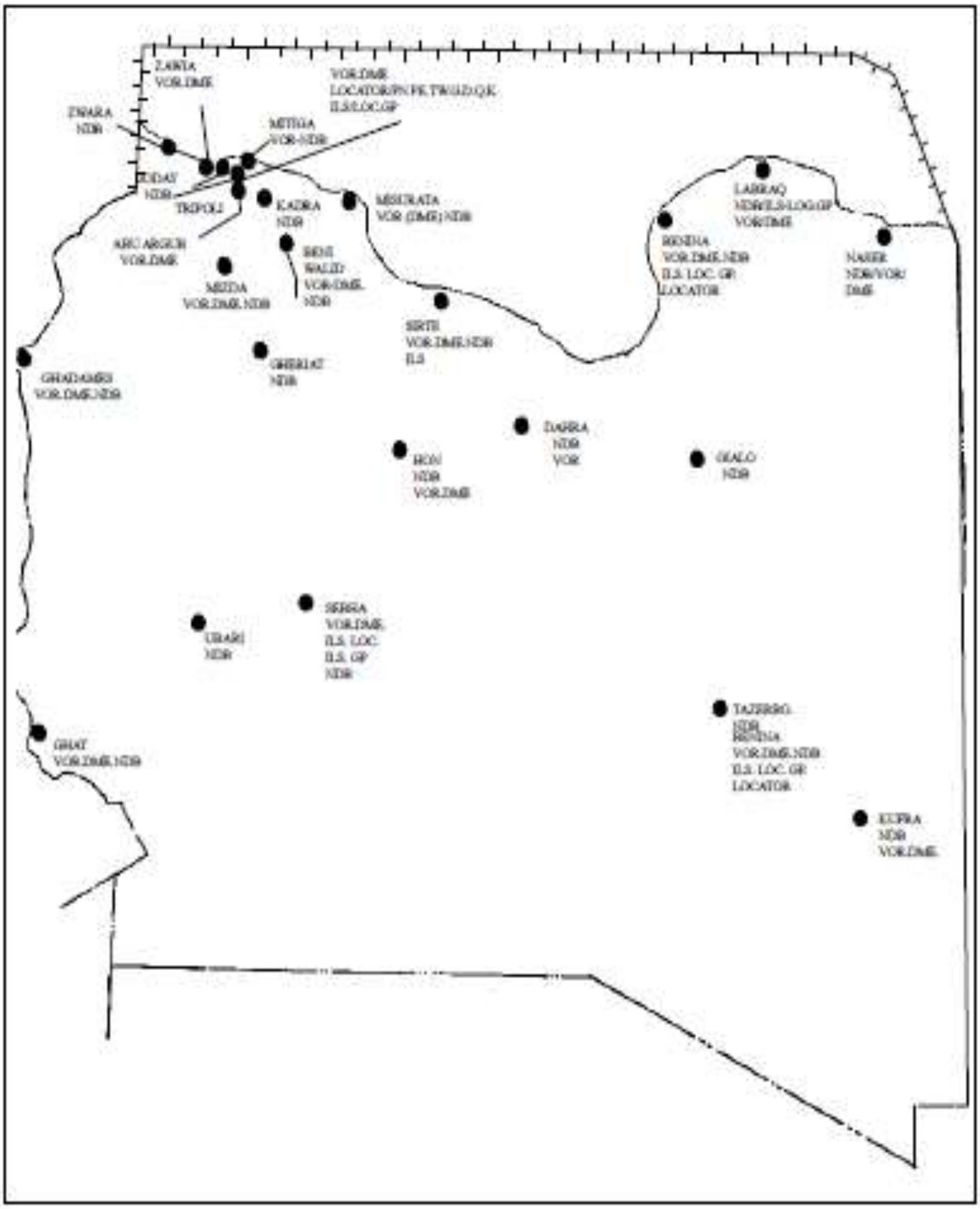
RUNWAY 09-27

DECLARED DISTANCES		
RWY 09		RWY 27
3600m / 11 811'	TAKE-OFF RUN AVAILABLE	3600m / 11 811'
3660m / 12 008'	TAKE-OFF DISTANCE AVAILABLE	3660m / 12 008'
3660m / 12 008'	ACCELERATE STOP DISTANCE AVAILABLE	3660m / 12 008'
3600m / 11 811'	LANDING DISTANCE AVAILABLE	3600m / 11 811'




AIP
LIBYA
AREA CHART - ICAO
AD 2.HLLT-33
27 SEP 2007
AREA
CHART ARRIVAL - ICAO
WGS-84
TRIPOLI INTL, GSPLA/
Tripoli Intl
LEGEND
Control Area (TMA) (AWY)
Control Area Sector Boundary
Control Zone CTR (D)
Restricted Airspace
Reporting Points (Compulsory)
Reporting Points (Non Compulsory)
Transit Routing
Outbound Routing
Distance, Nautical Miles
ATS Route
Minimum Cruising Altitude
Magnetic Bearing
VOR/DME and Radio Navigation Aid
AREA MINIMUM ALTITUDE (AMA)
Example: 4300 feet
COMMUNICATION FAILURE
Associated Navigational AID:
TRIPOLI INTERNATIONAL AIRPORT - VOR/DME TRI 114.5
FROM ABRAM
FROM VARIG
FROM ODELI
FROM TANLI
FROM GARIS
FROM SIRAM
FROM GHERSAT NDB (GRT)
ZAWIA
TRIPOLI
GHARABAH
ABU ARGUB
GAZALA
KADRA
KHOMS
LEBDA
MISURATA
BENI WALID
MIZDA
HOLDING OVER TW
HOLDING OVER PE
V400
V300
V500
V900
V700
1 : 1 100 000
CIVIL AVIATION AUTHORITY
AMDT 01/2007

RADIO FACILITY INDEX CHART



APPENDIX 6: Study of Spatial Disorientation

1. General

Spatial disorientation is a human being's inability to correctly sense his position, attitude or motion with respect to the earth's surface and the gravitational vertical plan. In flight, it may take different forms depending on the flight phase and the pilot response to the situation. Spatial disorientation results from gaps in interpreting and integrating the information, sometimes altered in certain conditions, from sensory receptors (mainly the eyes, vestibular system and proprioceptive receptors) by the central nervous system that provides situational awareness. The responses to these perceptions depend on the personality, physical and mental condition and experience of each individual. These are limited by the characteristics of tasks to be performed by pilots as well as the environment in which these tasks must be performed.

2. Somatogravic perceptual illusions

On the surface of the earth, Man is accustomed to living in the earth's field of gravity, which is always constant, and represents a stable reference of verticality. During a flight, because of the movements of the aeroplane, the body is subjected to inertial and gravitational forces which combine into a gravito-inertial resultant equivalent to a variation in intensity and/or direction of the gravity field vector. This set of forces can change the perception of the body's orientation relative to the gravitational vertical. For example, an acceleration of the aeroplane can give the same impression as a backward tilt, i.e. the perception of a climbing aeroplane. The reference of verticality taken into account by the pilot's central nervous system is no longer the earth's gravity but the resulting gravito-inertial force, which is the sum of the earth's gravity and the inertial forces. The somatogravic perceptual illusion therefore leads to a misperception of the body's orientation in space.

During go-around or takeoff phases in low visibility conditions, while the aeroplane is accelerating, pilots may try to counteract this perception of climb by dropping the aeroplane's nose until the dive counterbalances the apparent backward tilt caused by acceleration, which may end in impact with the ground. Furthermore, if this false- climb illusion is reinforced by the presence of a false visible horizon (such as a shoreline or a string of lights with the ocean or unlit background terrain), a pilots' desire to push the stick may become difficult to control.
The conditions required for the occurrence of a somatogravic perceptual illusion are listed below:

- Lack of monitoring of the artificial horizon; Degraded external visual reference points;
- Sufficient linear acceleration experienced between the moment when the pilot begins to perceive acceleration and the moment when he stops pulling on the side stick;
- Acceleration maintained so that the illusion persists and the pilot always feels nose up in spite of an actual descending flight path;
- No correction by the pilot by collecting information on the actual position of the aeroplane.

The state of awareness and experience (training and actual experience of go- around) may be factors favouring the occurrence of this type of illusion.

3. *Model for estimating the perceived orientation*

Certain existing models can be used to calculate an estimate of the orientation perceived by the pilot based on different accelerations. These models, of course, cannot predict the perception of a given pilot but do provide an estimate of the influence of inertial forces and rotational movements on the orientation perceived by a pilot during flight. The estimate calculated by these models assumes that pilots have no external visual information, and that they do not watch their instruments, especially the artificial horizon, during the flight phase studied. It is precisely in such circumstances that spatial disorientation occurs most often.

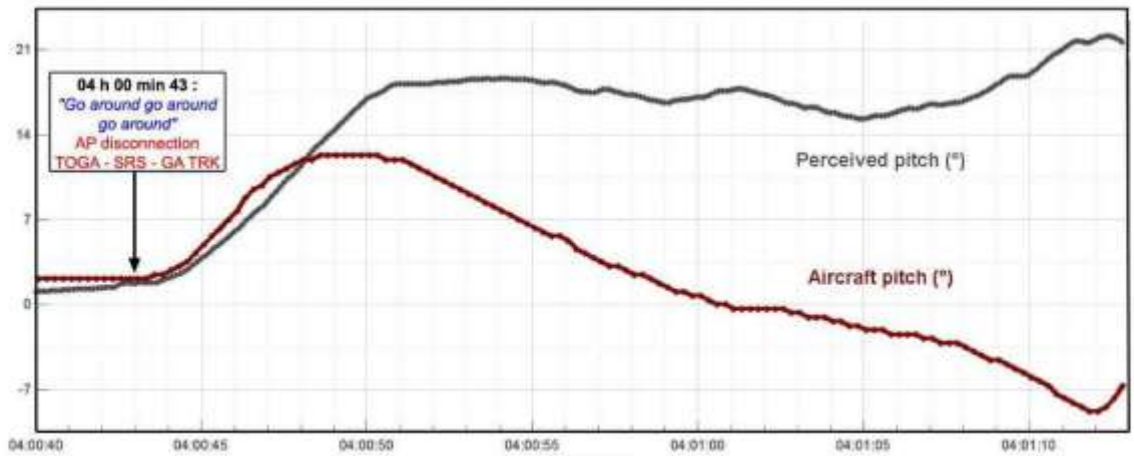
The model developed by the BEA is based on a theory for estimating the spatial orientation using filters or constant gain estimators for the vestibular organs (Merfeld, 2001). This model uses the parameters recorded by the flight data recorder from the physical characteristics of the vestibular organs (equivalent to three accelerometers and three gyroscopes).

Nevertheless, it is not possible to have knowledge of the pilot's head movements and the influence of proprioceptive receptors. Therefore the estimate does not take these parameters into account. The pilot's head is thus assumed to be fixed, its position corresponding to a position directly related to the seat position. The different axes of the vestibular organs are thus considered parallel to the axes of the aeroplane.

4. *Results and applications*

As part of the investigation, the model for estimating the perceived orientation was used with SSFDR parameters. The figure below shows that at the time of the missed approach, the attitude perceived by a pilot, provided that his perception is based exclusively on the interpretation of vestibular inputs (without external visual reference and without monitoring the artificial horizon), is initially close to the real attitude. It then deviates from the actual attitude from about 11 degrees to increase and remain between 15 and 22 degrees nose up. The first nose-down inputs recorded for the co-pilot's side stick occur at a moment corresponding to this deviation. The difference observed between the actual attitude and estimation of the perceived attitude may be related to the occurrence of a somatogravic perceptual illusion.

The following diagram shows the aeroplane pitch attitude against perceived pitch estimated by the model. It is taken from a plate that is included in appendix 10.



Real and perceived pitch attitudes during the missed approach

APPENDIX 7: Study of Fatigue

Plateforme d'Evaluation, de Prototypage et de TeSts d'UsageS

Technopole Izarbel - 64210 BIDART
****

ASSISTANCE ON HUMAN FACTORS ANALYSIS

1 STATE OF CURRENT SCIENTIFIC KNOWLEDGE ON FATIGUE

1 USE OF A PREDICTIVE MODEL TO AVALUATE SLEEP: ANALYSIS OF THE A330 5A-ONG ACCIDENT

MAY 2011

1 – STATE OF CURRENT SCIENTIFIC KNOWLEDGE ON FATIGUE

Before considering the probable state of fatigue of the pilots of the A330, it seems useful to prepare a synthesis of the current state of scientific knowledge about fatigue, particularly in aeronautics. This presentation is based on the syntheses carried out during recent work in France under the STARE project (Mollard et al., 2006, Cabon et al. 2009 a, b, Cabon et al., 2010, Cabon et al ,. 2011). This state of knowledge is built around four axes:

- Definition and installation of fatigue mechanisms,
- Acute fatigue versus chronic fatigue,
- Fatigue and safety,
- Fatigue risk management systems.

a) Definition and installation of fatigue mechanisms

Crew fatigue is widely recognized as a safety risk. This risk has been classified by the NTSB as one of its seven "most wanted" improvements and identified as the cause of several accidents and serious incidents. Although there is no real consensus in defining fatigue (we can identify more than one hundred definitions in the literature!), mainly because of the multidimensionality of the concept, it can generally be defined as a physiological and psychological state reflecting a need for recovery (Figure 1). This recovery process corresponds to two distinct types of manifestations of fatigue:

- Events associated with drowsiness or tendency to sleepiness. These events are generated mainly by three processes:
  - the C or Circadian process, regulated by the biological clock that induces a time variation at the arousal level, mainly with a reduction between zero and six hours,
  - the S process, or Sleep pressure that increases with the duration of wakefulness,
  - the W process, which corresponds to a state of sleep inertia (transient state of drowsiness after waking that dissipates gradually).
- The recovery process associated with the drowsiness corresponds to the start of sleep. These processes are affected by many internal factors (individual "morning" or "Evening", "light" or "heavy sleeper", personal concerns, or external (ambient temperature, noise, ..).
- The manifestations of such mental fatigue, physical and muscle associated with the magnitude of service and workload. The recovery process occurs by stopping the activity.

In most situations, these two forms of fatigue coexist. However, most scientific studies, including those conducted in air transport, have mainly concerned the somnolence dimension in fatigue. Recent developments in this work have enabled the development of tools for predicting fatigue (fatigue predictive models).

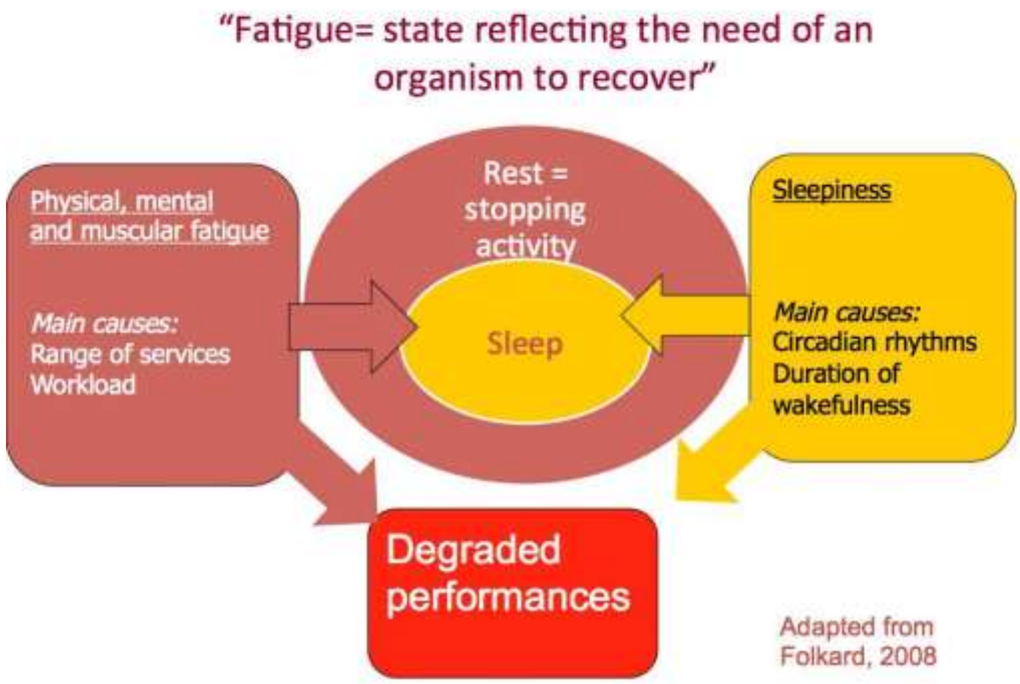


Figure 1. General definition of fatigue

b) Acute fatigue versus chronic fatigue

Another distinction is also made in the manner of installation and recovery from fatigue over time:

- Acute, over 24 hours, such deprivation of all or part of sleep. Depending on the extent of sleep debt, it will be recouped in one or more nights,
- Chronic, over a week or month. It is recovered more slowly and requires several days of rest.

Recent studies suggest that chronic fatigue can have similar effects on cognitive performance as fatigue acute. And repeated sleep deprivation over several days leads to the same performance degradation as a night of sleep deprivation (Van Dongen et al., 2003).

It is essential to remember that fatigue is, in most cases (apart from states of fatigue-related diseases), a normal and reversible physiological phenomenon that reflects a need for recovery (such as hunger, which reflects the need for food intake). However, sleep deprivation or shifts in biological rhythms, repeated over several years, are likely to lead to pathological conditions within the scope of occupational medicine.

c) Fatigue and Safety

The relationship between fatigue and safety is one of the central issues in the recent implementation of the Fatigue Risk Management System (FRMS). Several scientific studies suggest that this link is not completely linear: an increase in the level of fatigue does not systematically and proportionately increase risk. Folkard and Akerstedt (2004) postulate that low levels of fatigue could create a high level of confidence in the operator which would tend to control safety performance less well. This seems especially true in so-called complex systems such as aerospace where team work and automation are likely to "lessen" the impact of fatigue on performance. One critical element that seems to impact the relationship between fatigue and safety is the degree of awareness of one's own fatigue (Cabon et al., 2008). Indeed, when an individual is aware of his/her fatigue, he/she tends to develop strategies to either reduce the level of fatigue, or to ensure this level of fatigue does not degrade his/her performance. Of course, these strategies are effective only for intermediate levels of fatigue. At high levels, fatigue presents a safety risk because of poor performance (increased response times, degradation of situational awareness, deterioration of mood, reduction of communication within the crew , ...).

Although fatigue constitutes a "danger" to safety - in the sense of the French Decree of 22 December 2008 on Safety Management Systems - it cannot be fully assimilated with other risk factors. To summarize, four properties are considered:

Sources of fatigue, both professional and extra-professional: travel time between home and base are particularly likely to be factors favoring fatigue, The sources of occupational fatigue are multidimensional, affecting both work schedules that the nature and context of the activity,
The existence of individual differences in susceptibility to fatigue and the ability to manage fatigue,
That link between fatigue and safety is not linear at high levels of fatigue, and a pilot may need to develop strategies for managing safety that he/she would not need at a lower level of fatigue.

d) Fatigue Risk Management Systems

Traditionally, prevention of fatigue in airlines involves a prescriptive approach governing limitations on service time and calculating minimum rest periods. This approach has its origins in the early 20th century and was adapted to the physical fatigue that tends to become fixed and to decrease linearly. It seems to be much less dominant for "cognitive" activities. Indeed, the establishment and recovery from mental fatigue exhibit nonlinear dynamics (McCullough and Dawson, 2004). Changes related to our biological rhythms mean that an equivalent period of rest does not represent the same potential recovery in daytime. We note that these regulations set criteria level where these variations are rarely taken into account (Cabon et al., 2002). Overall, very few are based on chrono-biological criteria. It is also though that the simultaneous consideration of all the scientific criteria would make the regulations over-complex or inapplicable.

Prescriptive approaches also have limits in that they are generally not adapted to consideration of the high diversity of situations encountered in airlines and the flexibility to design rotations in a highly competitive industry. Moreover, working time is a major issue in social relations within an airline. To cope with these pressures, the system makes use of exceptions leading to reductions of rest periods or extensions of service time without the impact of such measures being checked, despite any negative impact on safety.

From these findings the idea of SMS-RF emerged, which are intended to replace part or all of the limitations of prescriptive duty time and rest requirements. In other words, the limits are set either from universal regulatory criteria, though based on risk-assessed tiredness case by case. For a history and a review of SGS-RF, see Gander et al (2011).

In air transport, the Civil Aviation Authorities of New Zealand were pioneers in this field. Since 1995, they have offered airlines either to apply the duty and rest time rules in force or to implement a much more flexible approach in terms of limits, but with an obligation to take into account the risk of fatigue, a system akin to SGS-RF.

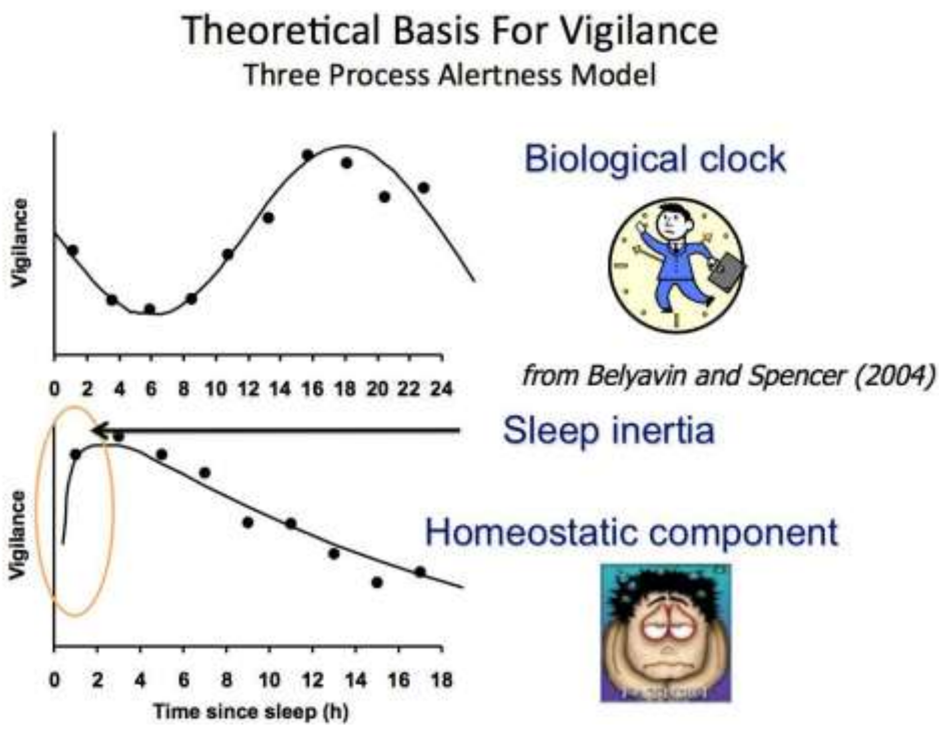
To date, the principles of SGS-RF have also been applied by two airlines: Singapore Airlines, for the introduction of Ultra Long Haul flights that exceeded regulatory limits (Spencer and

Robertson, 2007) and then by Easy Jet for the introduction of new short-haul rotations (Steward, 2006). The common point in these systems is that they use predictive models to assess upfront the risk of fatigue associated with service hours and a continuous or periodic monitoring of safety indicators and fatigue assessments (questionnaires, observations). On an international level, in 2009 ICAO created a "Fatigue Risk Management System Task Force" comprised of operators, authorities and experts to guide the future development of SGS-RF.

2 - USE OF A PREDICTIVE MODEL FOR EVALUATION OF SLEEP: ANALYSIS OF THE A-330 5A-ONG ACCIDENT

The use of predictive models on drowsiness or fatigue is increasingly common in studies of the effects of work schedules on the management of rest for personnel assigned to shift work or unsociable hours, which is the case for pilots of long-haul flights at night. This use is also now common for airlines that have adopted the principles of SGS-RF or FRMS (see previous §).

Simulations were performed using one of the most common models to assess the risk of sleepiness: the Sleep Wake Predictor or SWP. This model accounts for variations in alertness and sleepiness over time. The predictions of this tool are based on the TPMA model (Three Process Model of Alertness) developed by Simon Folkard in the late 80's and integrates the three components mentioned above: the C process which represents the influence of circadian processes, where S represents the homeostatic sleep pressure during wakefulness, and the W process which corresponds to sleep inertia (Figures 2 and 3).



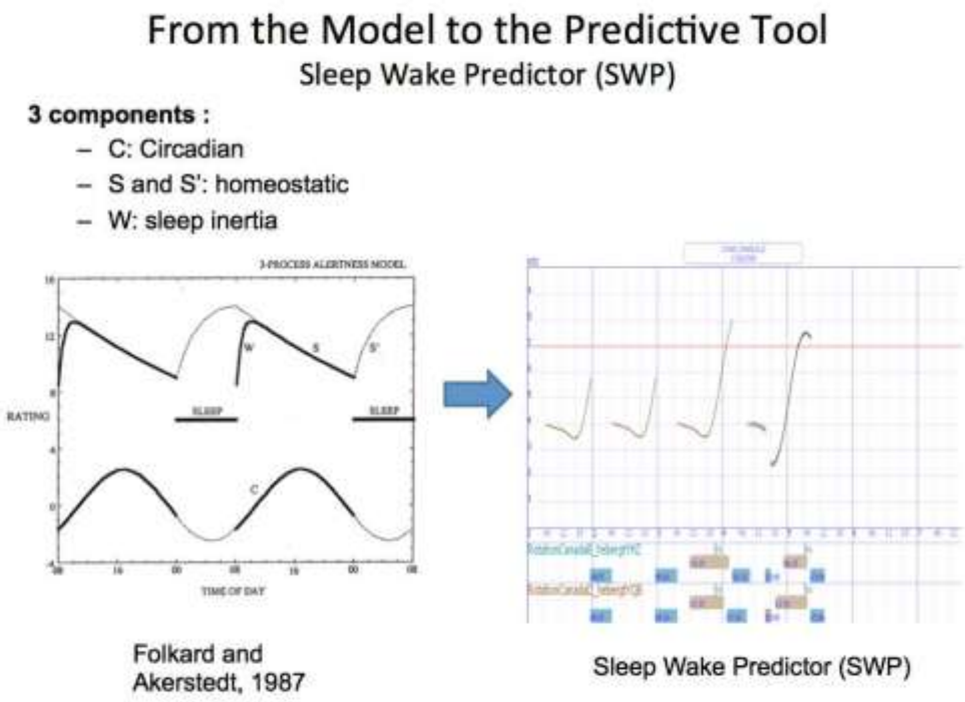


Figure 3. Components of SWP and predictions of sleepiness

The fatigue index is obtained on the KSS (Karolinska Sleepiness Scale). This scale consists of 9 points starting at "extremely alert" corresponding to a score of 9. From a score of 7, the objective signs of drowsiness began to appear, so this value of 7 is conventionally used. Fig 4 presents the levels of sleepiness predicted by SWP for different durations of continuous wakefulness. It was found that level 7 is reached after 21 hours of continuous wakefulness.

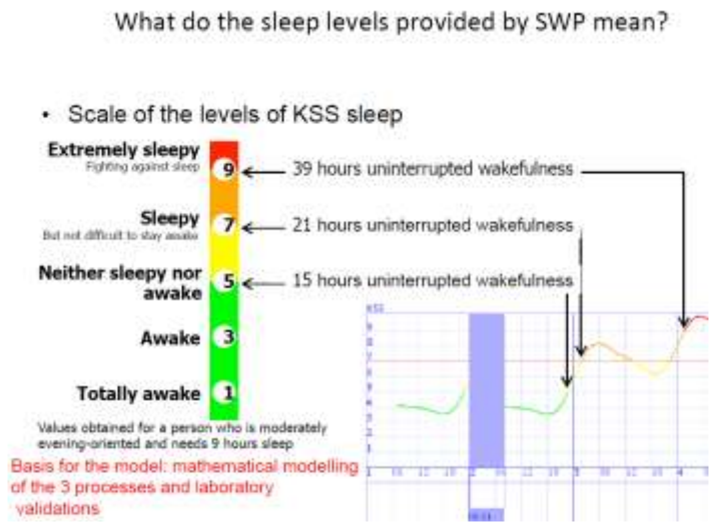


Figure 4. the levels of sleepiness predicted by SWP for different durations of continuous wakefulness

The parameters required as input to the SWP software to plot the curves correspond to the sleep hours in work and sleep schedules.

Since we did not have data on pilots' sleep, we used a software function that can generate, automatically and optimally, these periods of sleep. The sleep durations thus evaluated also take into account certain individual characteristics of sleepers: sleep need and circadian typology.

Two configurations were selected for the simulations:

- Pilot with a need to sleep eight hours and "evening" type profile
- Pilot needing to sleep 10 hours and in the “morning" type profile.

Flight schedules for rotations of 09, 10 and 11 May were taken as input into the software, adding 1 h 30 before and after the end of the flight for the calculation of opportunities for sleep. Opportunities that were incorporated included naps before night flights and during the rest day from night flights and an evaluation of the effect of postprandial sleepiness early in the afternoon. For sleep during the night flights, they were placed according to selected types of sleep for the simulations. It is assumed that the pilots were without sleep debt when they started their duty on May 9. With this input data, SWP calculates the maximum sleep and nap opportunities, then sleepiness levels during periods of wakefulness.

Simulation results for the two selected configurations are shown in Figure 5. One can see that the day flight on May 9 had no effect on the level of sleepiness, identical to that on May 8 On the other hand, the night flights on 10 and 11 May induced partial sleep deprivation, of the order of 40-50% of normal time, it was the same for the daytime rest after the night flights. These findings are not surprising, and there is abundant scientific literature on this subject.

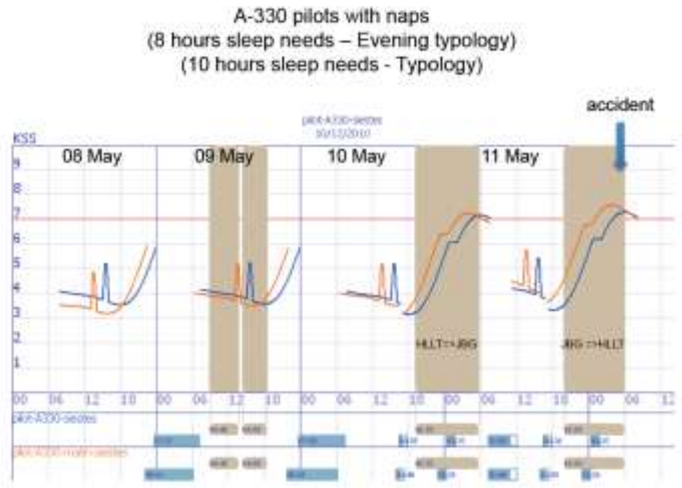


Figure 5. Simulation results for the two selected configurations

Because of the durations of wakefulness and repeated partial sleep deprivation, levels of sleepiness become critical at the end of late night flights (KSS > 7), which again is not surprising.

Altogether, these results lead to a conclusion of a possible contribution of fatigue for both pilots in the accident occurrence.

Bibliography

Åkerstedt, T., Folkard, S., Portin, C. (2004). Predictions from the three-process model of alertness. *Aviation, Space, and Environmental Medicine, 75* (3), section II, A75-A83.

Cabon, P., Deharvengt, S., Grau, JY., Maille, N., Berechet, I., & Mollard, R. (2011). Research and guidelines for implementing Fatigue Risk Management Systems for the French regional airlines. *Proceedings of the 8th International Conference on Managing Fatigue, March,* *Fremantle, Australia.*

Cabon, P., Deharvengt, S., Berechet, I., Grau ; J. Y., Maille, N., & Mollard, R. (2010). Research and guidelines for implementing Fatigue Risk Management Systems for the French regional Airlines. Aviation, Space and Environmental Medicine, Vol 81.

Cabon, P., Mollard, R., Debouck, F., Grau ; J. Y., Maille, N., & Deharvengt, S. (2009, a) Development of the scientific basis of a fatigue risk management system : application to the reduced rest and split duties . Aviation, Space and Environmental Medicine, Vol 80.

Cabon, P.; Mollard, R.; Debouck, F.; Sarrazin, J-C.; Grau, J-Y.; Deharvengt, S. (2009, b) Towards a Fatigue Risk Management System for the French Regional Airlines: Applications to the Reduced Rests and Split Duties." In Proceedings of the 2009 International Conference on Fatigue Management in Transportation Operations in Boston, March 24–26.

Gander, P., Hartley, L., Powell, D., Cabon, P., Hitchcock, E., Mills, A., Popkin, S. (2011) Fatigue Risk Management I : Organizational Factors. Accident analysis and Prevention, Vol 43, Issue 2, 573-590.

Cabon, P., Bourgeois-Bougrine, S., Mollard, R., Coblentz, A., & Speyer, J.J. (2002). Flight and Duty Time Limitations in Civil Aviation and Their Impact on Crew Fatigue: A comparative Analysis of 26 National Regulations. Human Factors and Aerospace Safety: An International Journal, 2, 4, 379-393.

Dawson, D., McCullough, K. Managing Fatigue as an Integral part of a Fatigue Risk Management System. ISASI, 2004.

Folkard, S., & Akerstedt, T. (2004). Trends in the risk of accidents and injuries and their implications for models of fatigue and performance. Aviation, Space and Environmental Medicine; 75(3, Suppl.):A161–7.

Mollard, R. Cabon, P., Berechet, I., Grau ; J. Y., Maille, N. (2006).Mise en oeuvre d'un observatoire sur la sécurité du transport aérien régional français vis à vis du risque fatigue et développement d'une méthodologie pour un système de gestion du risque fatigue au sein d'une compagnie aérienne. Doc LAA – 537/2006, Septembre.

Spencer, M. Robertson, K. The application of an alertness model to ultra-long-range civil air operations. Somnologie 11:159–166 (2007)

Stewart, S. An Integrated System for Managing Fatigue Risk Within a Low Cost Carrier. In : proceedings of the International Aviation Safety Seminar, Flight Safety Foundation, October 23-26, 2006, Paris, France.

Van Dongen HP, Maislin G, Mullington JM, Dinges DF. The cumulative cost of additional wakefulness: dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. Sleep.
2003 Mar 15;26(2):117-26.

APPENDIX 8: Side Stick Analysis and Examination

RATIER-FIGEAC
Design-office

RF9329-11 vers00

A330 LH SSU INVESTIGATION REPORT

Subject : to report the investigation performed on A/P Disconnect & Priority Switch of LH side-stick P/N F27310011000AN S/N RF1024.

Document owner :

Application date (JJ/MM/AA) **: 17/03/2011**

Reference language :
In case of dispute, only the English version of this document is valid, except contractual requirements.

FOR-RF-0005_V00

CONTENTS

1 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to report the investigation performed on the A/P Disconnect & Priority Switch and its wiring up to the SSU connector.

This investigation was performed on the LH SSU P/N F27310011000AN S/N RF1024.

This investigation occurred on Wednesday 3rd, 2011, in Ratier-Figeac Company with the following participants:

-
-
-
-
-
-
-

1.2 ACCRONYMS – DEFINITION

- A/P : Auto/Pilot
- ATP : Acceptance Test Procedure
- LH : Left Hand
- OEM : Original Equipment Manufacturer
- P/N : Part/Number
- PTT : Push To Talk
- S/N : Serial NUmber
- SSTU : Side-Stick Transducer Unit
- SSU : Side-Stick Unit

2 INVESTIGATION REPORT

All the investigations described in this section were witnessed by AFRIQIYAH Airways, BEA, Airbus and Ratier-Figeac people and are presented in chronological order.

2.1 STEP1: SSU UNPACKING

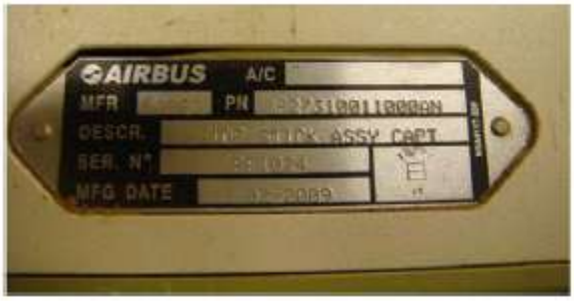
- SSu was brought by AFRIQIYAH Airways representatives, sealed in a plastic film.

<u>**Partial conclusion:**</u> nothing to report

- SSU was removed from its box.

Partial conclusion: nothing to report

2.2 STEP2 : SSU IDENTIFICATION



Partial conclusion: identification is correct

2.3 STEP3 : VISUAL INSPECTION

- View looking outboard

Evidences of dried liquid

Brown tracks = track of sand/dust on the covers, below, grip.

Black tracks = friction tracks

Partial conclusion: tracks of brown sand/dust and of friction

- View looking inboard

Evidences of dried liquid

Brown tracks = track of sand/dust on the covers, below, grip

Partial conclusion: tracks of brown sand/dust

- View looking downward

Partial conclusion: tracks of brown sand/dust

- View looking forward

Partial conclusion: tracks of brown sand/dust. Torn below and of friction

- Grip

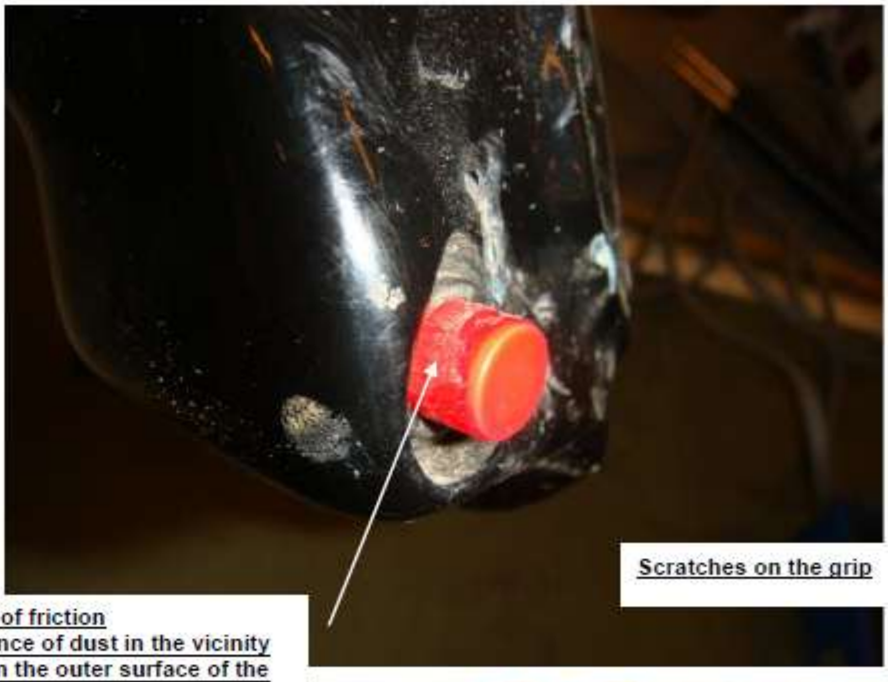
A/P Disconnect and priority Switch

Scratches on the grip

Scratches on the grip

Scratches on the grip

Scratches on the grip

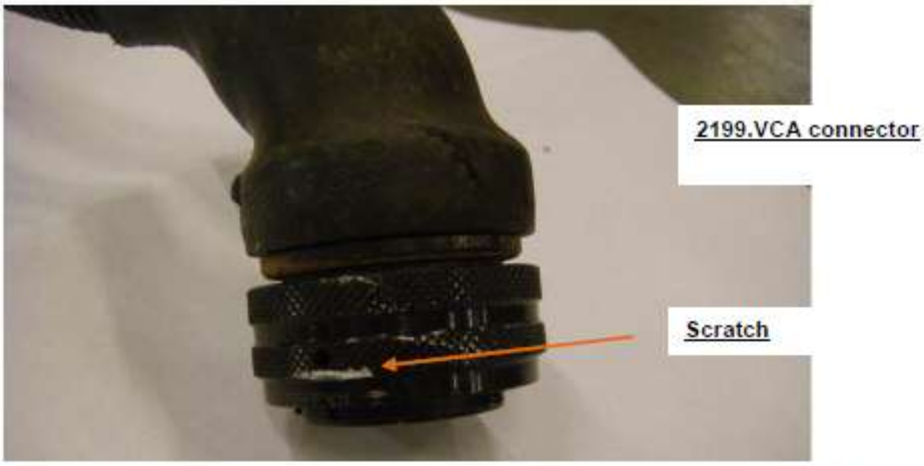


Partial conclusion: numerous scratches on the grip. Track of friction on the side of the button.

- Cables

SSU cable bundles

Cable bundles including the grip wiring

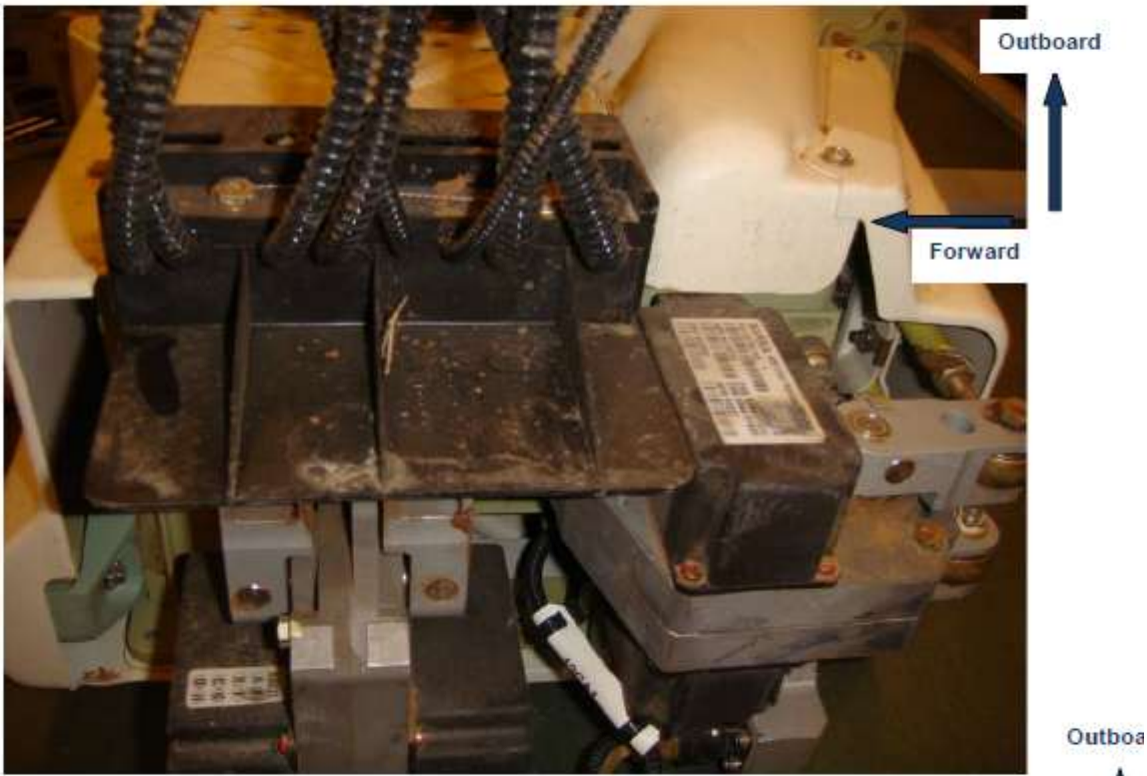

2199.VCA connector
Scratch

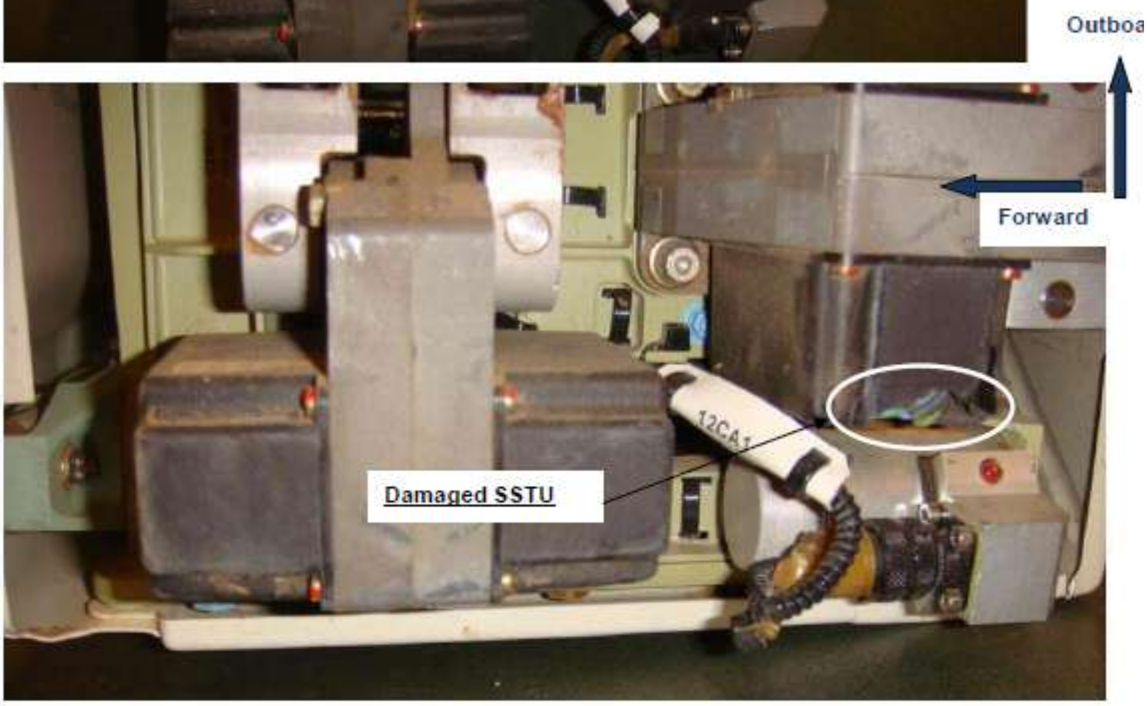

2199.VCA connector

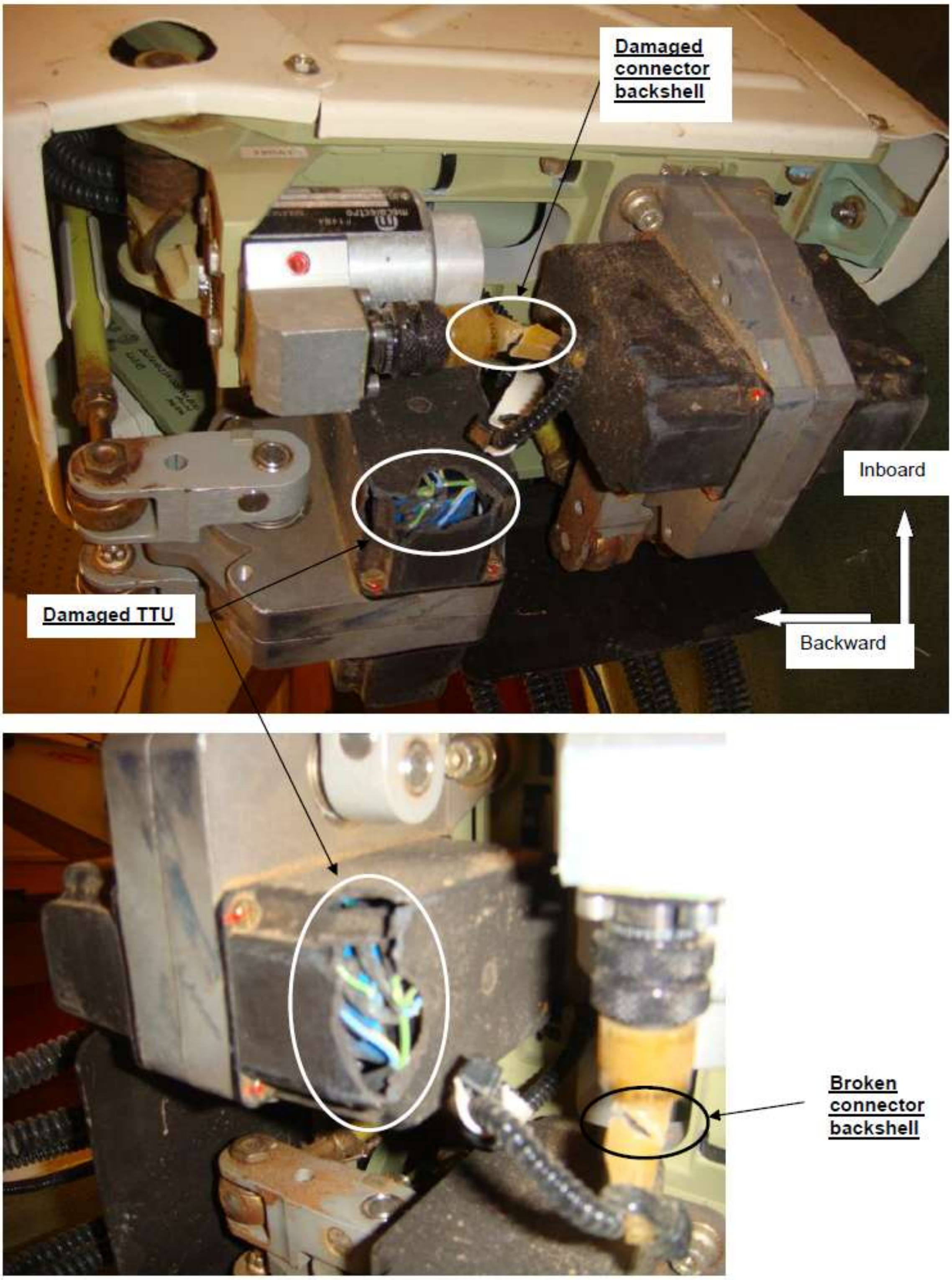

2199.VCA connector
No pin damaged

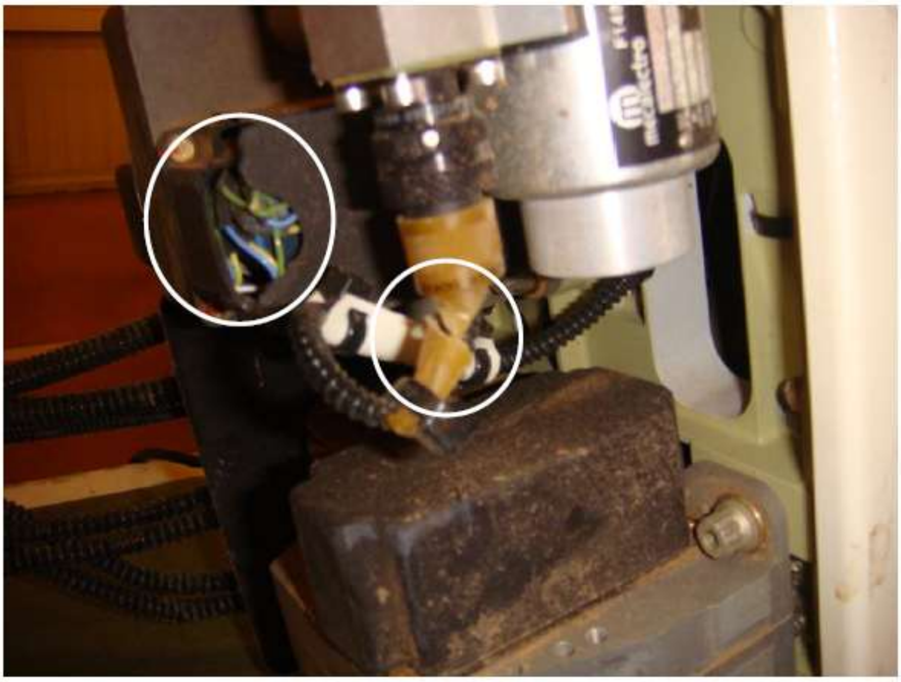
Partial conclusion: scratch on 2199.VCA connector. No cable damaged. No pin damaged.

- Bottom view






Damaged connector backshell
Inboard
Damaged TTU
Backward
Broken connector backshell



Partial conclusion: track of brown sand / dust inside the SSU. One TTU cover damaged. Connector backshell of the solenoid is broken.

2.4 STEP4 : ELECTRICAL CONTINUITY (1)

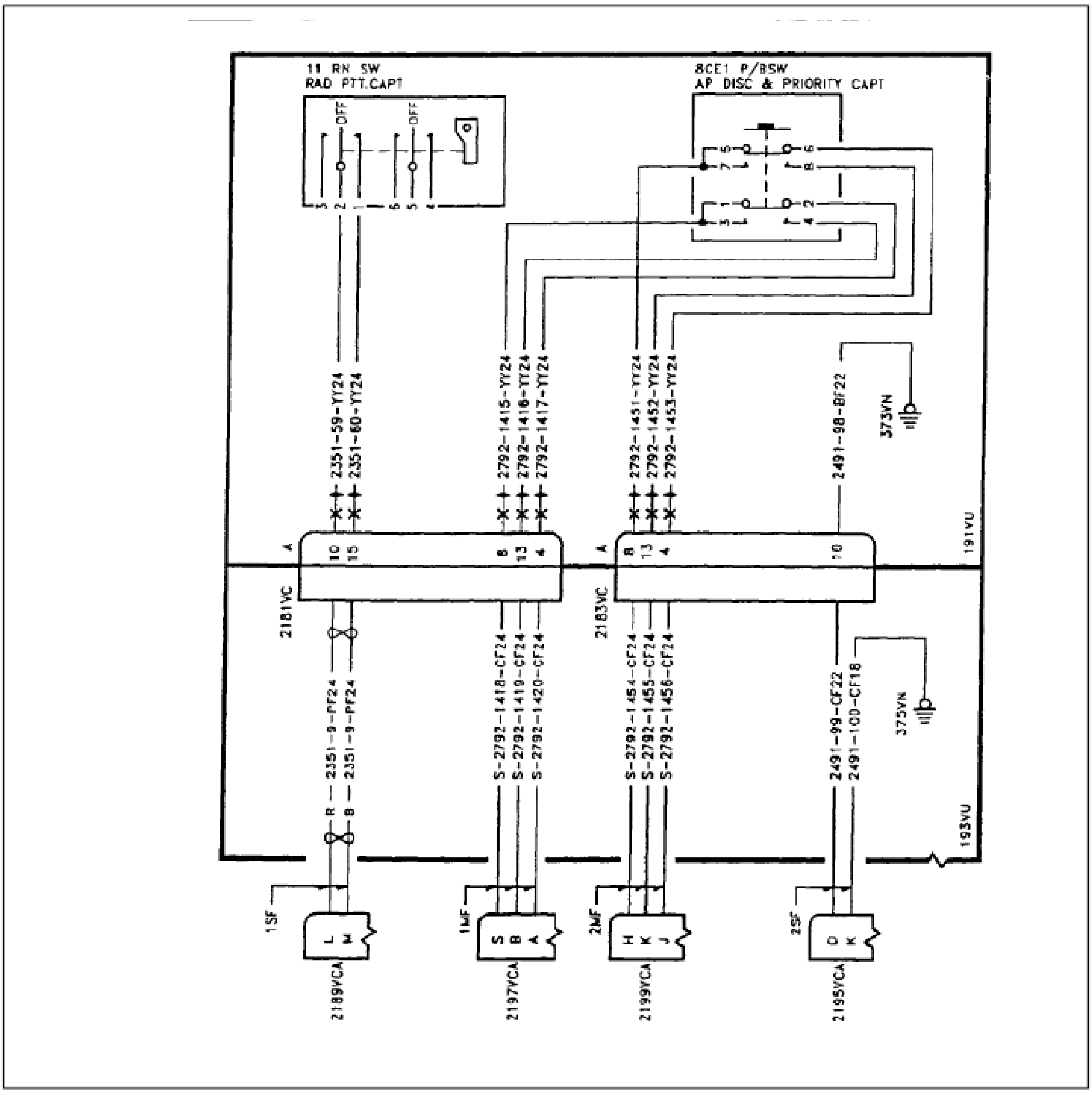
A electrical test continuity was performed on the switch in its released position at the SSU connector level according to CMM 27-92-41 rev July 01/2010.

AIRBUS

COMPONENT MAINTENANCE MANUAL
D27310001000A0

(1) Testing of electrical circuits

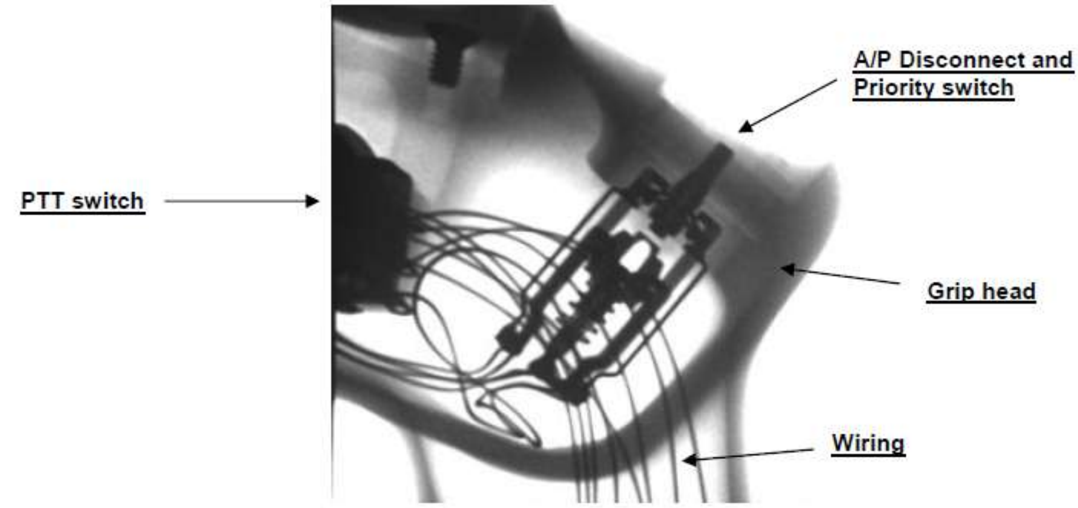
	ACTION	RESULT
1	(1) Capt takeover and priority pushbutton switch 8CE1 (Ref. FIGURE 27-92-41-991-033-AFIGURE 27-92-41-991-033-BFIGURE 27-92-41-991-033-C). Note: Use an ohmmeter that operates with current less than 1 mA to prevent damage to the components.	
	(a) Press and hold takeover and priority pushbutton 8CE1.	Check that there is no continuity between terminals S and A of connector 2197VCA. Check that there is no continuity between terminals H and J of connector 2199VCA. Check continuity between terminals S and B of connector 2197VCA . Check continuity between terminals H and K of connector 2199VCA .
	(b) Release takeover and priority pushbutton switch 8CE1.	Check that there is no longer continuity between terminals S and B of connector 2197VCA. Check that there is no longer continuity between terminals H and K of connector 2199VCA. Check continuity between terminals S and A of connector 2197VCA . Check continuity between terminals H and J of connector 2199VCA .



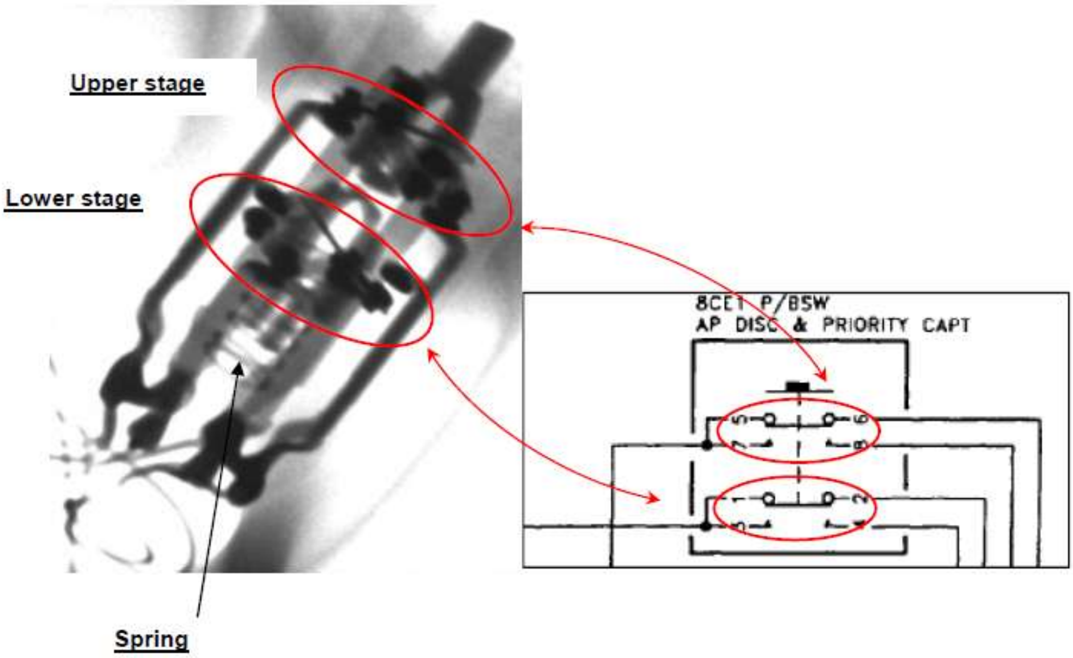
Partial conclusion: no fault found.

2.5 STEP5: XRAY INSPECTION

- Complete grip view



- Switch details



Partial conclusion: nothing to report

2.6 STEP6: PRESSING FORCE (1)

The force to press the button was [11.62 - 12.76] daN on the investigated SSU (see video RF1) instead of 6.73 daN, as recorded on a brand new SSU (see video RF2).

Qualitatively speaking, when pressing the button, a smooth damping / friction was felt.

Button release is not instantaneous (refer to video RF3&4) whereas it should (refer to video RF5).

Partial conclusion: when the switch is pressed force to apply is higher than a brand new one. When the switch is released, time to come back to the extended position is longer than a brand new one.

2.7 STEP7: ELECTRICAL CONTINUITY (2)

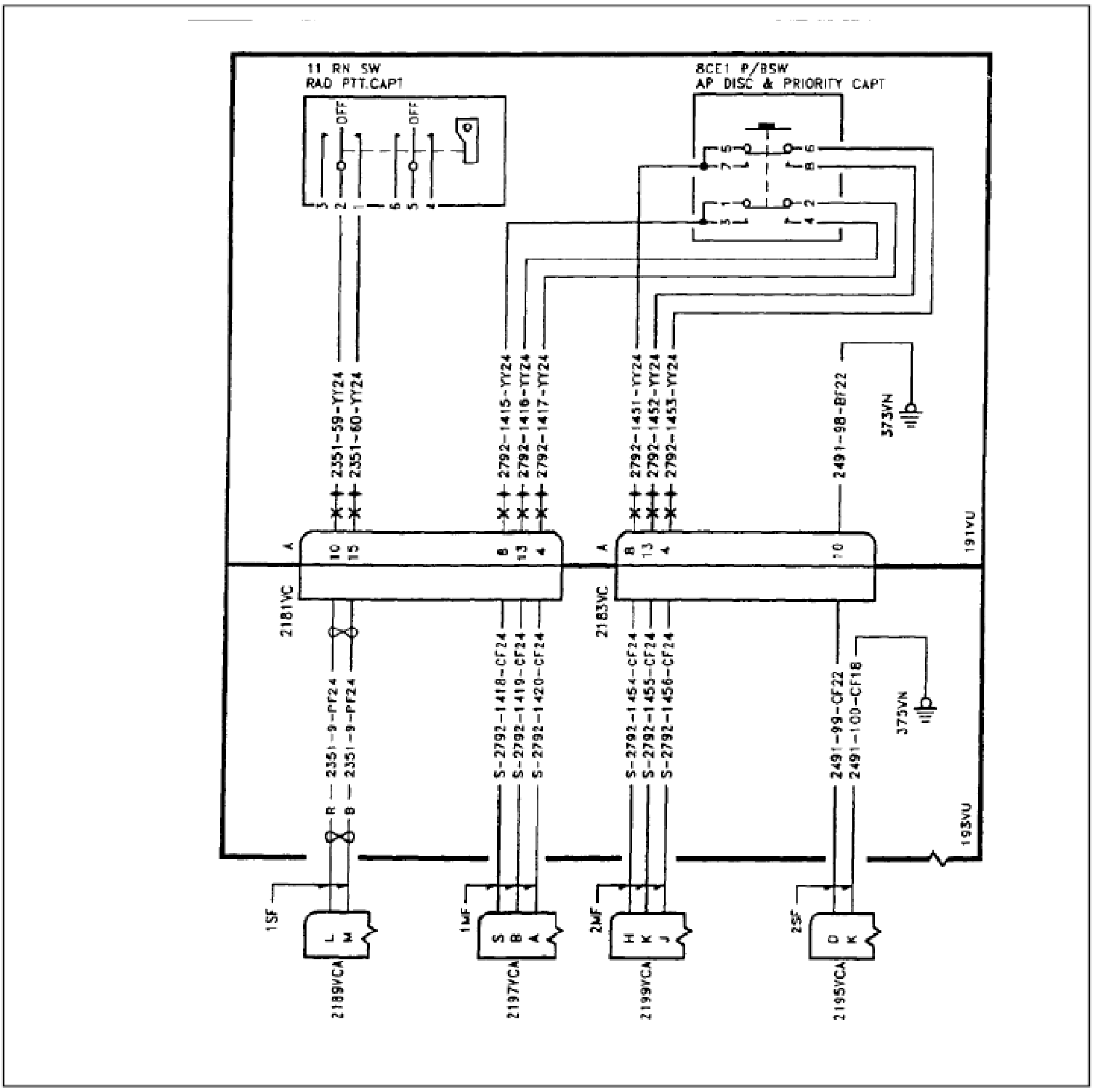
An electrical test button successively released / pressed / released was performed at the SSU connector level according to CMM 27-92-41 rev July 01/2010.

AIRBUS

COMPONENT MAINTENANCE MANUAL
D27310001000A0

(1) Testing of electrical circuits

	ACTION	RESULT
1	(1) Capt takeover and priority pushbutton switch 8CE1 (Ref. FIGURE 27-92-41-991-033-AFIGURE 27-92-41-991-033-BFIGURE 27-92-41-991-033-C). Note: Use an ohmmeter that operates with current less than 1 mA to prevent damage to the components.	
	(a) Press and hold takeover and priority pushbutton 8CE1.	Check that there is no continuity between terminals S and A of connector 2197VCA. Check that there is no continuity between terminals H and J of connector 2199VCA. Check continuity between terminals S and B of connector 2197VCA . Check continuity between terminals H and K of connector 2199VCA .
	(b) Release takeover and priority pushbutton switch 8CE1.	Check that there is no longer continuity between terminals S and B of connector 2197VCA. Check that there is no longer continuity between terminals H and K of connector 2199VCA. Check continuity between terminals S and A of connector 2197VCA . Check continuity between terminals H and J of connector 2199VCA .



Partial conclusion: no fault found.

2.8 STEP8: PRESSING FORCE (2)

The force to press the button was around 11.50 daN.

When pressing the button, the smooth damping / friction remained.

The release time was still not instantaneous.

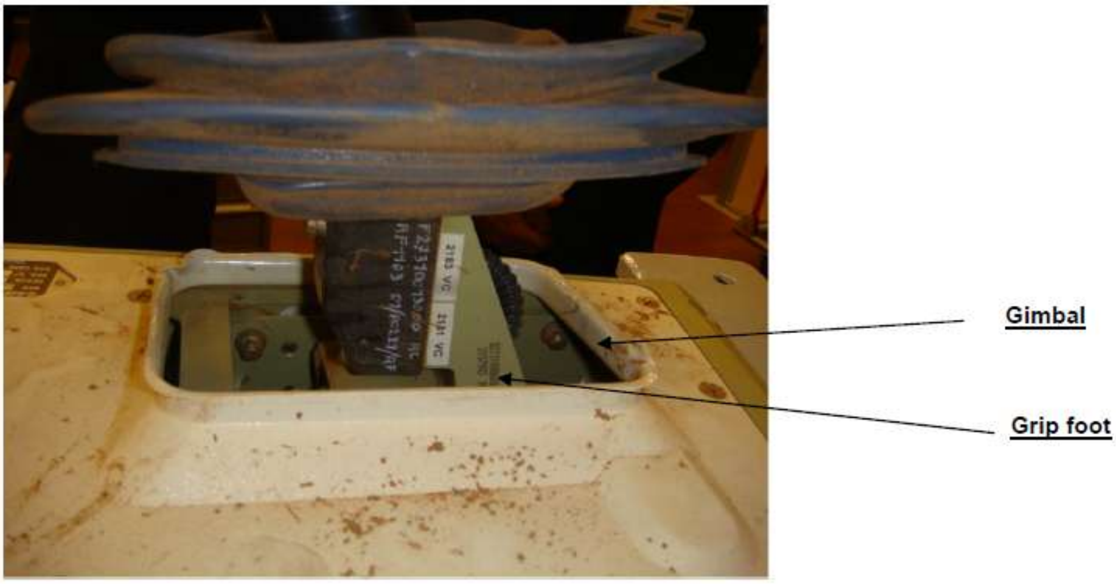
Partial conclusion: when the switch is pressed force to apply is higher than a brand new one. When the switch is released, time to come back to the extended position is longer than a brand new one.

2.9 STEP9: INSPECTION AFTER BELOW REMOVA LIFTING

- View looking forward

Brown tracks = track of sand/dust

- View looking inboard



- View looking outboard

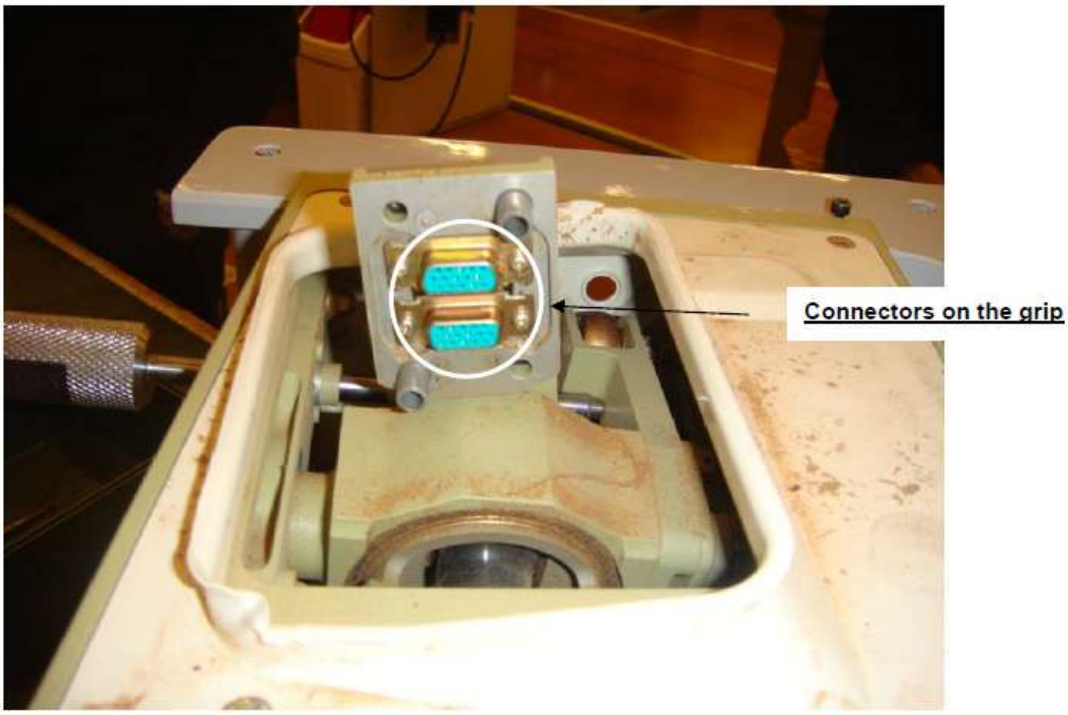
Brown tracks = track of sand/dust

- View looking backward

Brown tracks = track of sand/dust

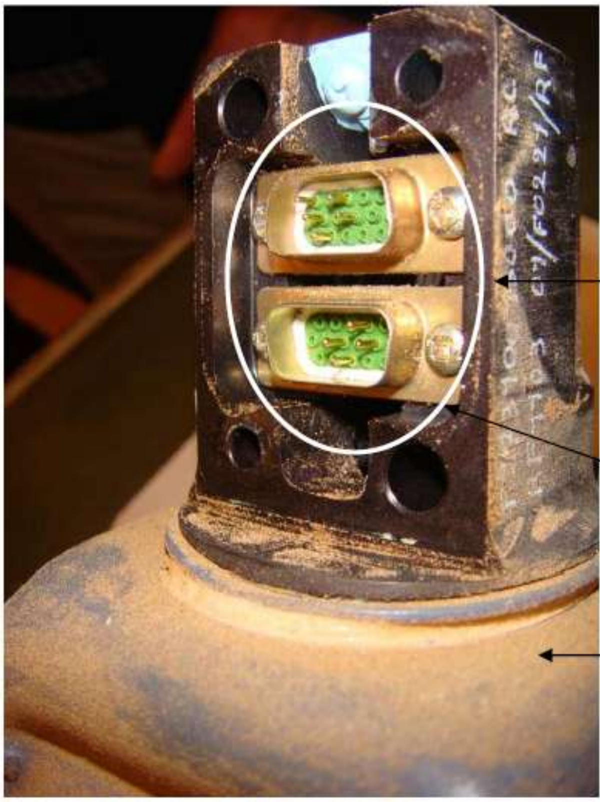
Partial conclusion: numerous tracks of brown sand / dust inside the SSU.

2.10 STEP10 : GRIP REMOVAL



Brown tracks = track of sand/dust

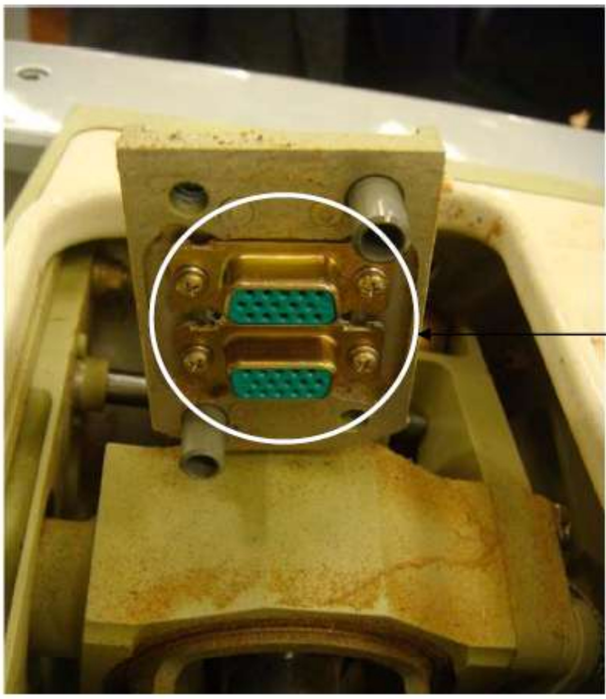
Partial conclusion: numerous tracks of brown sand / dust inside the SSU



Connectors on the grip foot

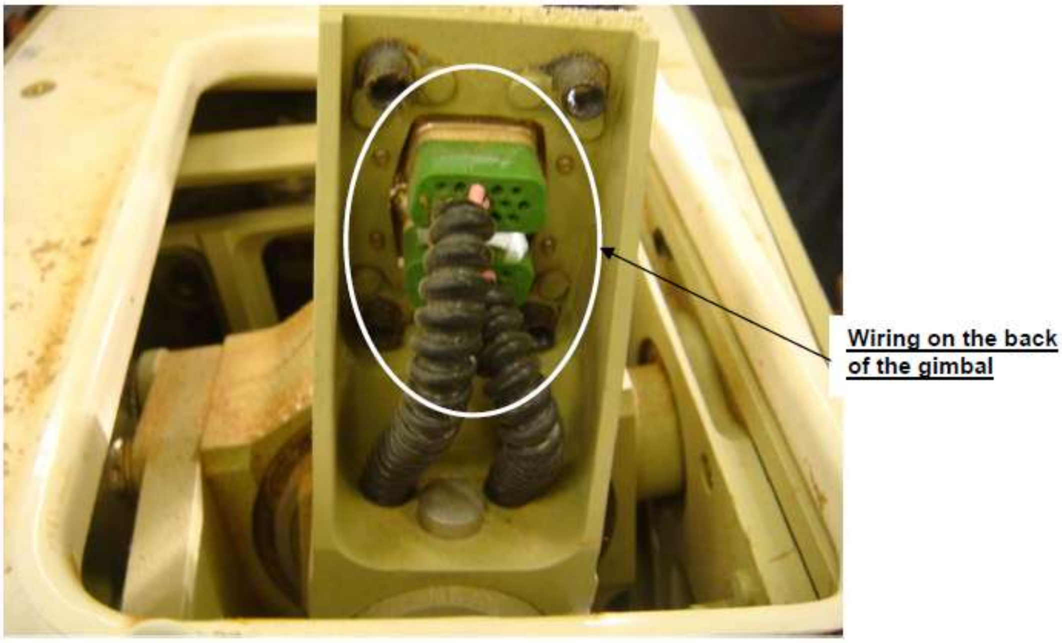
No damaged pin

Below



Brown tracks = track of sand/dust

Connectors on the gimbal

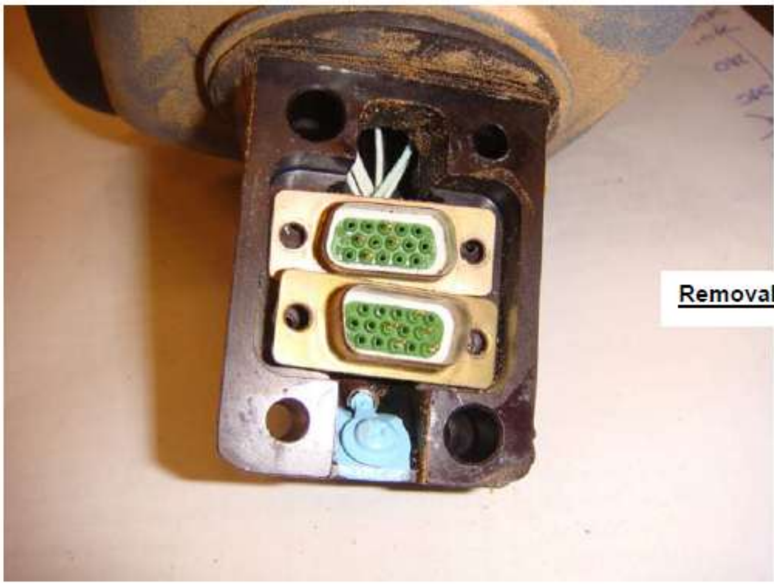


Partial conclusion: numerous tracks of brown sand / dust inside the SSU. Wiring not damaged

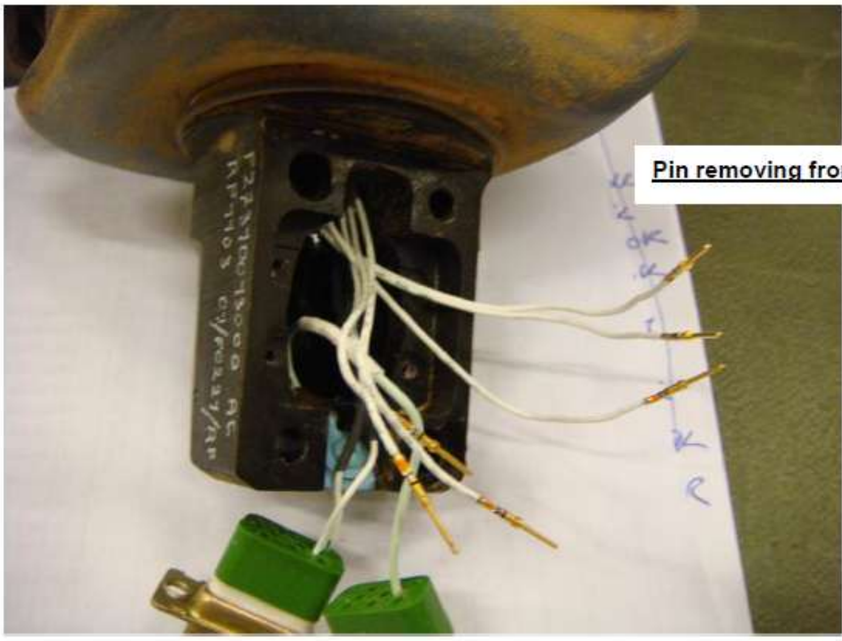
2.11 STEP11 : GRIP IDENTIFICATION

Partial conclusion: numerous tracks of brown sand / dust inside the SSU

2.12 STEP12: A /P DISCONNECT AND PRIORITY SWITCH REMOVAL



Removal of the 4 screws



Pin removing from the connectors

Partial conclusion: nothing to report


removal of the 2 plate screws


Removal of the plate

Plate

Removal of the PTT switch cap

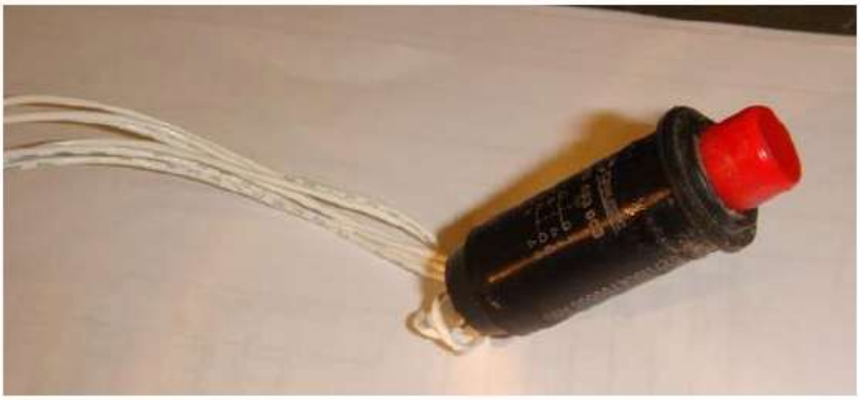
Removal of the PTT switch trigger

**Removal of the A/P Disconne
and Priority switch**

Brown tracks = track of sand/dust

Partial conclusion: numerous tracks of brown sand / dust inside.

2.13 STEP13: A/P DISCONNECT AND PRIORITY SWITCH INSPECTION



Partial conclusion: no mechanical nor electrical damaged observed.

2.14 STEP14: A/P DISCONNECT AND PRIORITY SWITCH IDENTIFICATION

Partial conclusion: identification is correct

3 CONCLUSION

Regarding the A/P Disconnect and Priority switch and its wiring up to the SSU connector which was the purpose of the investigation, the conclusion is:

- Evidences of SSU impact damage
- Evidences of exposure to liquid (nature undetermined)
- Significant pollution by dust and sand
- no component failure observed
- No electrical failure on A/P Disconnect and priority Switch function
- Pushbutton stiffness to be further investigated at the manufacturer (Crouzet)
- Presence of dust on the outer surface of the A/P Disconnect and Priority switch housing
- Unit recovered by BEA

APPENDIX A. DOCUMENT ADMINISTRATION

DOCUMENT DESCRIPTION

Reference	RF9329-11
Version	00
Title	A330 LH SSU – Investigation report
Owner	
Administrator	

KEY WORDS

A330, LH SSU, A/P Disconnect and Priority switch, investigation report

INITIAL DISTRIBUTION (the updated list of addressees is available in our information system)

Distribution mode : ☐ **Paper (P)** **Electronic :** ☐ **Intranet (I)** ☐ **E-mail (E)** ☒ **Other (A)**

Comments :

INTERNAL DISTRIBUTION			
Name	**Function**	**Nber of copies**	**Distrib. Mode.**
		1	A
		1	A
EXTERNAL DISTRIBUTION			
Name	**Function and Company**	**Nber of copies**	**Distrib. Mode.**
		1	E
		1	E
		1	E
		1	E

DOCUMENT VALIDATION (signs are available on original hard copy)

Validation	Name and function	Date and Visa (DD/MM/YY)
Written by		
Checked and approved by		

EVOLUTION CHART

Version	Writer	Reason for change	Application date
00	JP CARRIE	Initial release	17/03/2011

DOCUMENT COMPOSITION

	Main document	Appendixes							
		A	B	C	D	E	F	G	H
Number of pages	37	2							
Total number of pages	39								

REPLACED DOCUMENTS

Reference	Title

ASSOCIATED DOCUMENTS

Reference	Title

For any information regarding this document, please contact the owner mentioned in page 1.

RATIER-FIGEAC
BP n°2
46101 FIGEAC CEDEX
FRANCE
Tél. : 33 (0)5.65.50.50.50
Fax : 33 (0)5.65.50.00.80

Crouzet

REFERENCE : C.CT.GNC.00231.GB
EDITION : 0
DATE : 19/06/2012

OBJET / SCOPE : **INVESTIGATION REPORT 12172-SML1-0749**

TITRE / TITLE : *BUTTON 83453003 INVESTIGATION*

Edition *Issue*	Pages *Pages*	Description de la modification *Modification description*	Etabli par *Author*	Date *Date*
0	All	First Issue	S MICHEL	19/06/2012

La révision de ce document annule la révision précédente.
Revision of this document supersedes previous revision.

SOMMAIRE / *CONTENTS*

1 *SUBJECT*

The subject of this document is to report the investigation performed on button 83453003 manufactured 08/49 (Week 49 of year 2008)

2 INVESTIGATION PURPOSE

2.1 Investigation cause

Further to an airplane accident the LH SSU P/N F27310011000AN S/N RF1024 has been expertised by RATIER-FIGEAC.

During this investigation the button 83453003 manufactured by Crouzet was detected with a slow come back in rest position (see RATIER6FIGEAC report RF9329-11 vers00)

2.2 Investigation conditions

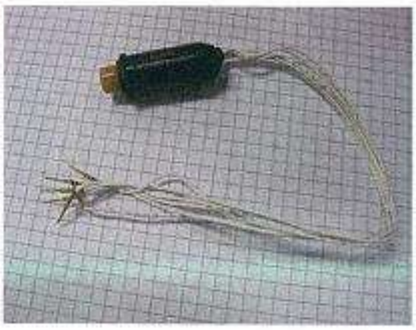
The investigation has been performed in Crouzet facilities in Valence (France) on June 19th 2012.

The investigation has been managed by:

The investigation has been witnessed by:

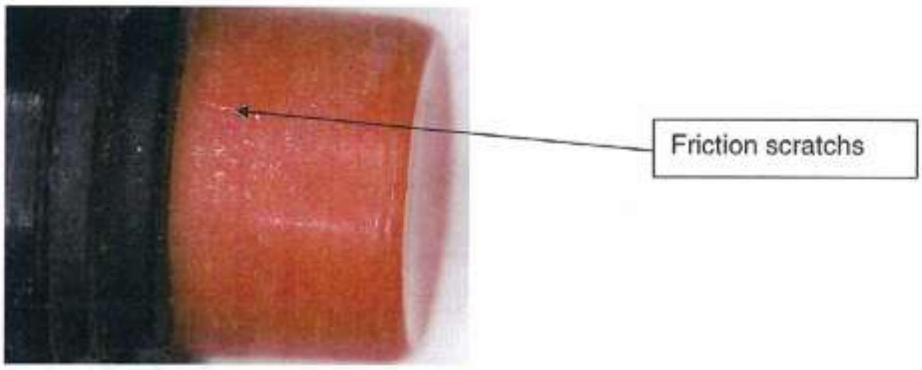
3 INVESTIGATION

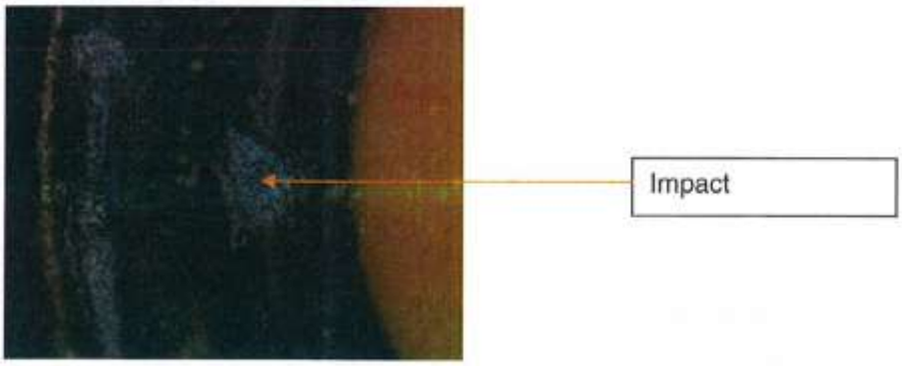
3.1 Step 1 Unpacking and identification



Partial conclusion: Identification is correct

3.2 Step 2 Visual inspection

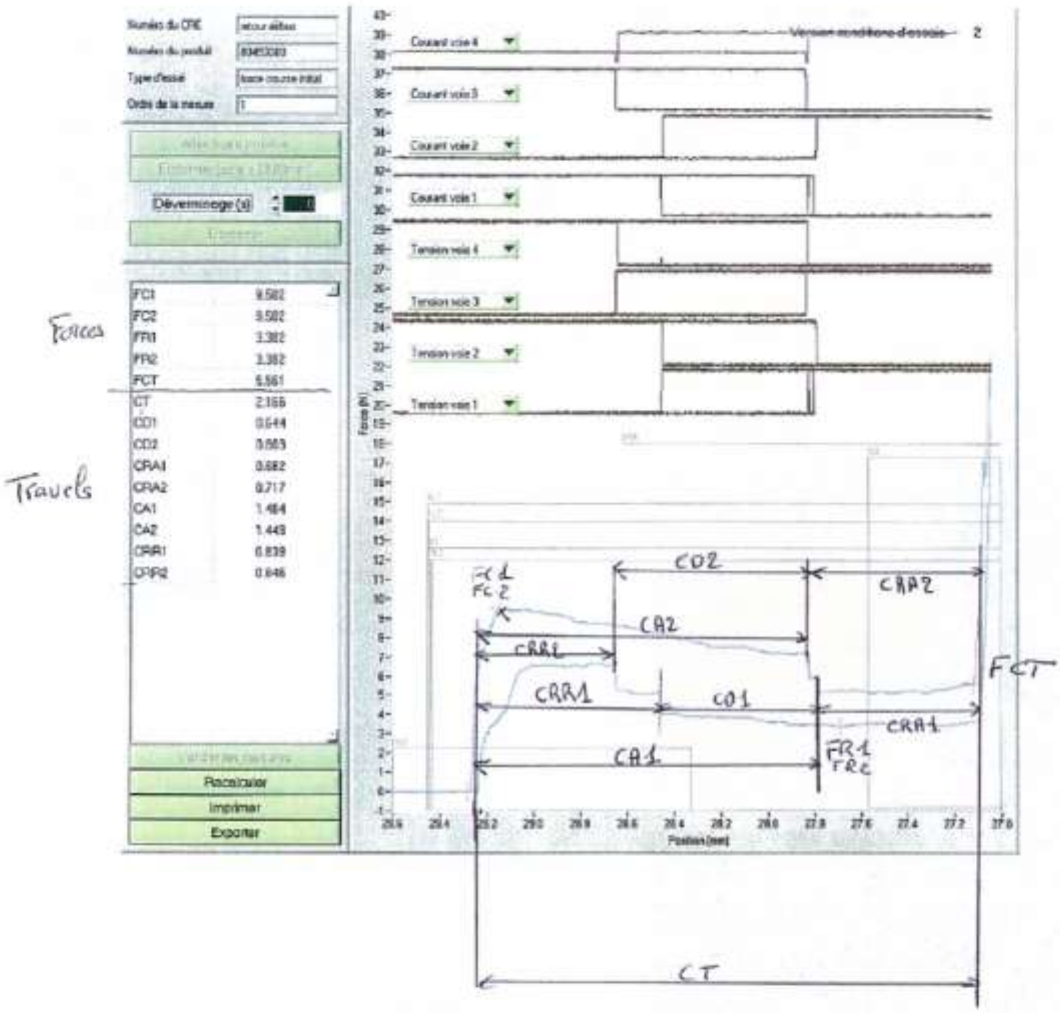




Weight 12, 34 g with pin crimped on the wires

Partial conclusion: Scratch and impact are visible under binocular. The plunger activation is normal .Weight conform to ATP requirement

3.3 Step 3 Mechanical ATP



Measures

	Measured	Requested	Sanction
Safety travel	0,68/0,72 mm	0,4mm mini	OK
Total travel	2,17mm	1,4 to 2,4mm	OK
Differential travel	0,64/0,80mm	1,4 maxi	OK
Residual return travel	0,84/0,65mm	0,4mm mini	OK
Operating force	9,5N	12N maxi	OK
Release force	3,38N	3N mini	OK

Partial conclusion: The defect detected during RATIER FIGEAC has not been reproduced.

The performances are conform to ATP requirements

3.4 Step 4 Electrical ATP

Insulating resistance measured > 1000 MOhms conform according to the ATP requirements

Dielectric strength measured 1450Vac 5 sec without no crack conform according to ATP requirement

Contact resistor

Requirements 12mOhms without wires

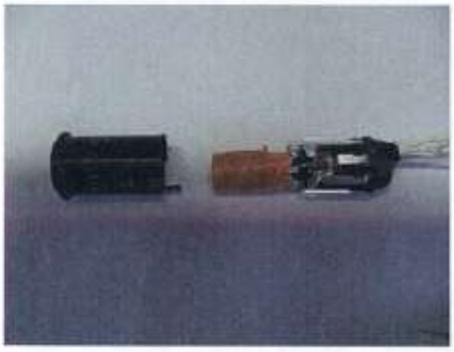
Measures

Contact 1-2 45mOhms	OK the gap is due to the wires resistor
Contact 3-4 50mOhms	OK the gap is due to the wires resistor
Contact 5-6 175mOhms	Not OK
Contact 7-8 not stable enough to be measured	Not OK

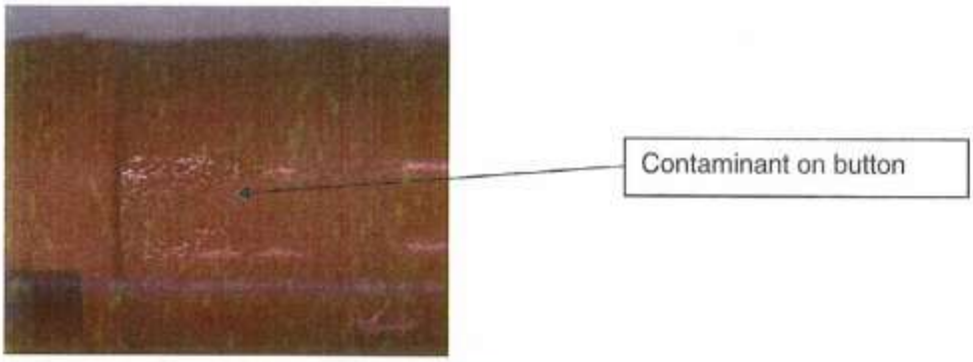
Partial conclusion: The product is not conform for Contact resistor on contacts 5-6 and 7-8

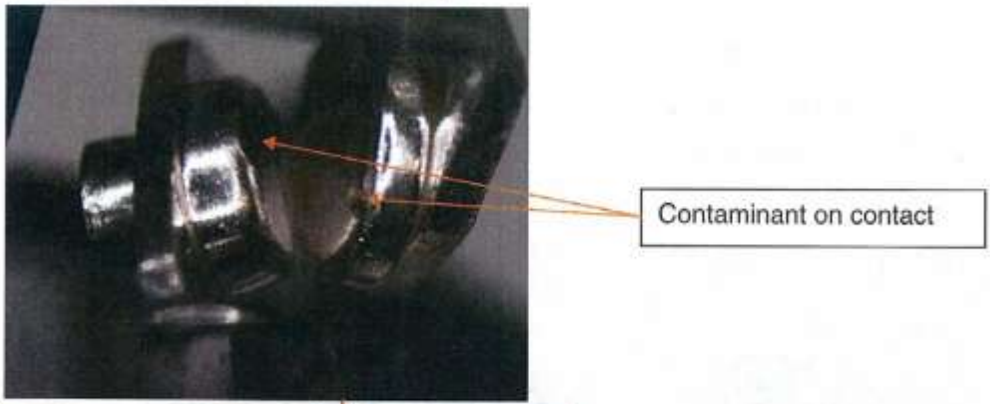
The other electrical parameters are correct

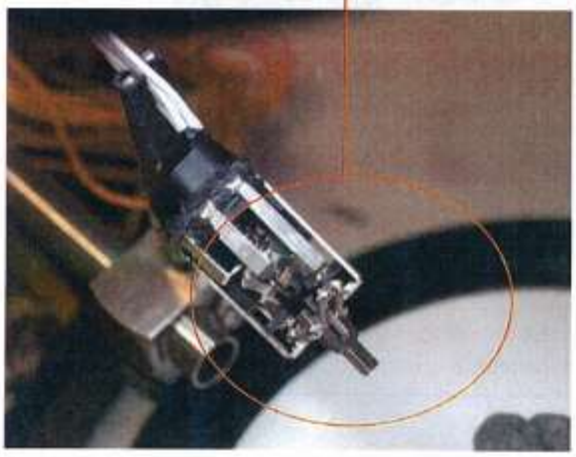
3.5 Product opening



Sand and dust inside the housing







Partial conclusion: sand, dust, contaminant, have been detected inside the button

4 CONCLUSION

-Evidences of exposure to sand and dust and contaminant

-The mechanical function is conform to the requirement

- Contact resistance is not conform on 2 contacts

-Unit recovered by BEA

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

MINISTÈRE DE LA DÉFENSE

DGA
DIRECTION GENERALE DE L'ARMEMENT
DGA Essais propulseurs

RAPPORT D'INVESTIGATIONS

41- DAI-12
OT n°5739

Objet : Airbus 330 immatriculé 5A-ONG – accident survenu à Tripoli le 12/05/2010 – Analyse de dépôts ou particules observés sur un bouton de prise de priorité du mini-manche (Disconnect & Priority Switch)

Référence : Demande du BEA n°06/2012 du 03/07/2012

Date de réception des pièces : 02/07/2012
Début des investigations : 05/07/2012
Fin des investigations : 31/07/2012

Suite à l'accident de l'avion A330 survenu le 12/05/2010 à Tripoli (Libye), le BEA a demandé à DGA Essais propulseurs (DGA Ep) de déterminer la nature chimique de dépôts ou particules observés sur un bouton de prise de priorité du mini-manche "Disconnect & Priority Switch" lors de l'expertise chez Ratier-Figeac.

Les examens et analyses ont montré que :

- Les particules et dépôts retrouvés à l'intérieur et sur la surface externe du manchon noir sont constitués de grains de sable et de carbonate de calcium. Les particules et les dépôts peuvent correspondre à des poussières atmosphériques ou avoir pour origine le sol où a eu lieu l'accident.
- Les particules retrouvées sur la surface externe du bouton rouge sont constituées de grains de sable.
- Le dépôt gras retrouvé sur le bouton rouge est similaire à celui d'un dépôt retrouvé sur un plot de contact. Le spectre infrarouge est proche de celui de la gomme de guar (guar gum). L'origine précise de ce produit reste toutefois indéterminée.

COMPOSITION

Pages	Planches	Annexes	Références bibliographiques
9	3	1	-

REPERES D'ARCHIVAGE

Thème d'identification : BEA – A330 – Bouton priorité -

Mots clés : BEA – A330 – Libye – bouton priorité – mini-manche – IR - GCMS

DIFFUSION INTERNE : D⇨SDA⇨SDT⇨DAI⇨DAI/St - DAI/I (N. Baczynski, H. Sylvestre)

DIFFUSION EXTERNE :
BEA : A l'attention de : MM.Ménez et Hervelin (3 ex + 1 support informatique)

SOMMAIRE

1 - INTRODUCTION

Suite à l'accident de l'avion A330 survenu le 12/05/2010 à Tripoli (Libye), le BEA a demandé à DGA Essais propulseurs (DGA Ep) de déterminer la nature chimique de dépôts ou particules observés sur un bouton de prise de priorité du mini-manche "Disconnect & Priority Switch" lors de l'expertise chez Ratier-Figeac.
Les résultats ont été communiqués par messagerie le 9 août 2012.

2 - PRODUITS LIVRES AU LABORATOIRE

Les matériels réceptionnés au laboratoire le 2 juillet 2012 sont listés ci-dessous :

- Bouton de priorité équipant l'avion A330 incidenté
  Marque Crouzet
  SP 3823
  N°: D2711004700000 A00
  83 453 003
  08-49

- Bouton de priorité neuf.
  Marque Crouzet
  SP 3823
  N°: D2711004700000 A00
  83 453 003
  12-22

Le BEA a demandé d'analyser :

- les dépôts ou particules présents sur la surface externe du manchon noir situés vers l'extrémité (côté bouton rouge),
- les dépôts ou particules présents sur la partie interne du manchon noir
- le dépôt gras présent à la surface du bouton rouge,
- les dépôts ou particules présents sur deux plots de contact.

Les clichés du BEA indiquant les zones et l'aspect des dépôts et des particules sont reportés en planche 1 et 2 (colonne de gauche). Les zones sont matérialisées par une flèche bleue.

3 – DEROULEMENT DES INVESTIGATIONS

Le bouton de priorité équipant l'A330 accidenté a fait l'objet d'un examen visuel au stéréomicroscope dans le but de repérer les dépôts ou particules observés lors de l'expertise chez Ratier-Figeac.

L'ensemble des dépôts et des particules retrouvés ont été analysés par spectrométrie d'absorption infrarouge à transformée de Fourier couplée à la microscopie (FTIR) afin de déterminer leurs natures chimiques.

Afin de tenter d'affiner le résultat obtenu par FTIR, le dépôt à l'aspect gras sur la surface du bouton rouge a fait l'objet d'une extraction et d'une analyse complémentaire par chromatographie en phase gazeuse couplée à la spectrométrie de masse (GC/MS).

4 – RESULTATS

4.1 - Examen visuel

Les clichés effectués à réception à DGA Ep sont présentés en planche 1 et 2. Les zones présentant des particules sont indiquées par une flèche bleue.

Aucune zone de dépôt comparable à celle identifiée par le BEA (cliché 1) n'a été observée sur la surface externe du manchon noir. Néanmoins des particules bloquées vers l'extrémité du manchon ont pu être isolées (cliché 2 flèche rouge).

Plots de contact : le cliché 5 montre les particules photographiées par le BEA lors de l'expertise chez Ratier-Figeac. Aucune particule n'a été observée sur les plots de contact reçus à DGA Ep (cliché 6).

Ces écarts de constats sont vraisemblablement dus aux manipulations successives subies lors de l'expertise chez Ratier-Figeac.

Il est à noter que certains plots présentent des stries importantes. Un cliché caractéristique est présenté en planche 3. Un dépôt à l'apparence organique a été observé sur un autre plot de contact. Celui-ci a été analysé afin d'identifier sa nature chimique.

Des particules ou dépôts ont bien été retrouvés à l'intérieur de la partie cylindrique en plastique noirâtre et sur la surface du bouton rouge.

4.2 – Détermination de la nature chimique

Les résultats des analyses sont présentés dans le tableau suivant.

Echantillon		Résultats d'analyses FTIR
Manchon noir		polyamide
Surface externe du manchon noir situés vers l'extrémité	Dépôt blanchâtre	Carbonate de calcium
	Dépôt rose	Carbonate de calcium
	Particules	produit de nature minérale semblant correspondre à des grains de sable (oxyde de silicium ou dérivé)
Surface interne du manchon noir	Particules	produit de nature minérale semblant correspondre à des grains de sable (oxyde de silicium ou dérivé)
Bouton rouge		Polyoxyméthylène (ou polyformaldéhyde)
*Surface externe du bouton rouge	Dépôt gras	Spectre IR se rapprochant de celui de « Guar gum » (gomme de guar).
	Particule	produit de nature minérale semblant correspondre à des grains de sable (oxyde de silicium ou dérivé)
Dépôt sur plot de contact		Guar gum (spectre similaire à celui trouvé pour le dépôt gras sur le bouton rouge

Manchon noir

Les dépôts retrouvés sur le manchon noir sont constitués de carbonate de calcium. Ce produit est utilisé dans des domaines très variés de l'industrie. Ce produit, également connu sous le nom usuel de calcaire, peut dans certaines zones géographiques provenir simplement du sol ou du sous-sol.

Les particules retrouvées à l'intérieur et sur la surface externe du manchon noir sont constitués de grains de sable (oxyde de silicium).

Bouton rouge

Les particules retrouvées sur la surface externe du bouton rouge sont constituées de grains de sable (oxyde de silicium).

Le dépôt gras retrouvé sur la surface externe présente un spectre se rapprochant de la gomme de guar (guar gum). Ce produit a également été retrouvé sur un plot de contact. Les plots de contact sont localisés à l'intérieur du manchon noir (cliché 10 planche 3).

Le laboratoire a rarement rencontré ce type de produit. Il est couramment utilisé :

- comme retardant de flamme,
- pour la réalisation de travaux de fracture hydraulique,
- ou dans l'industrie des explosifs.

Ce produit est également très largement utilisé dans l'industrie alimentaire.

*Analyses complémentaires par GC/MS du dépôt gras situé sur la surface externe du bouton rouge :

Les analyses par GC/MS indiquent la présence de phtalates et de molécules présentant des fonctions « ester ».

Les phtalates sont couramment utilisés comme plastifiants dans les plastiques. Ils pourraient provenir du plastique rouge.

Les produits à base d'ester peuvent être utilisés notamment dans les lubrifiants. Toutefois la faible quantité de produit analysée après extraction n'a pas révélé la présence d'une huile ou d'une graisse connue.

5 – SYNTHESE

Les examens et analyses ont montré que :

- Les particules et dépôts retrouvés à l'intérieur et sur la surface externe du manchon noir sont constitués de grains de sable et de carbonate de calcium. Les particules et les dépôts peuvent correspondre à des poussières atmosphériques ou avoir pour origine le sol où a eu lieu l'accident.

- Les particules retrouvées sur la surface externe du bouton rouge sont constituées de grains de sable.

- Le dépôt gras retrouvé sur le bouton rouge est similaire à celui d'un dépôt retrouvé sur un plot de contact. Le spectre IR est proche de celui de la gomme de guar (guar gum). L'origine précise de ce produit reste toutefois indéterminée.

PLANCHE 1 : Clichés du bouton endommagé

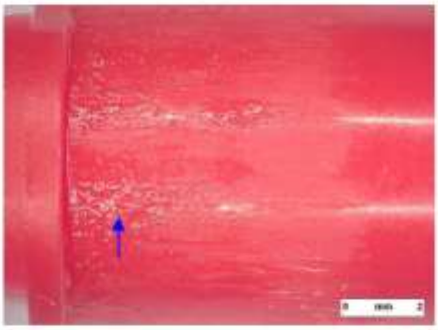
Clichés BEA (Ratier-Figeac)

Cliché 1 : Vue d'ensemble
Traces de dépôts sur manchon noir

Clichés à réception à DGA Essais propulseurs

Cliché 2 : Vue d'ensemble
absence des dépôts observés chez Ratier-Figeac sur manchon noir

Cliché 3 : Bouton rouge
Traces d'un produit à l'apparence gras

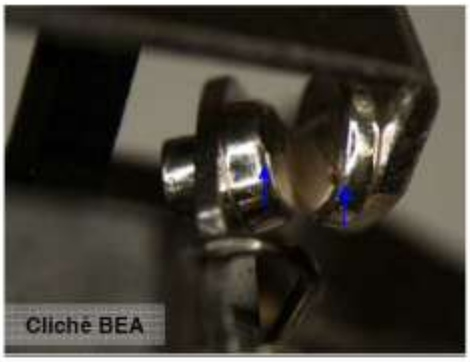


Cliché 4 : Bouton rouge
Même constat à réception à DGA Ep

PLANCHE 2 : Clichés du bouton endommagé

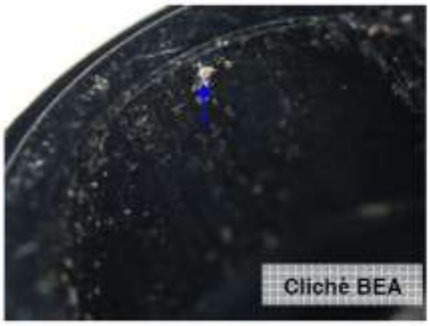
Cliché BEA (Ratier Figeac)

Clichés à réception à DGA Essais propulseurs

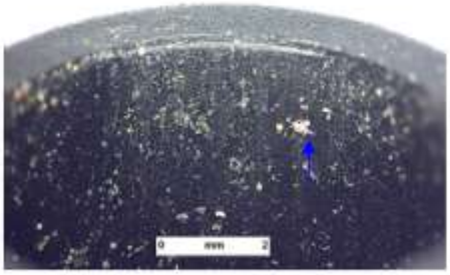


Cliché 5 : plots de contact
Présence de pollution

Cliché 6 : plots de contact
Absence de particules

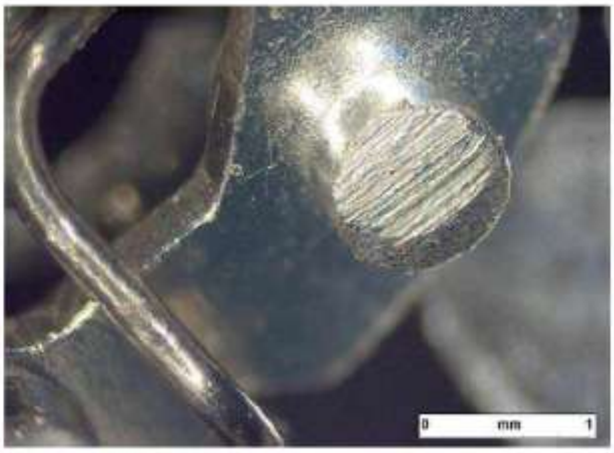


Cliché 7 : Manchon noir
Présence de sable à l'intérieur du manchon noir

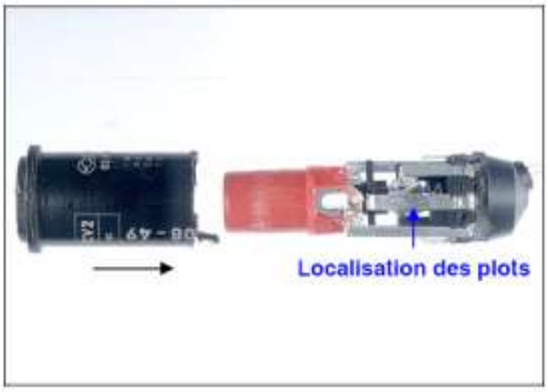


Cliché 8 : Manchon noir
Même constat - Présence de sable

PLANCHE 3 : Clichés de plots de contact présentant des stries



Cliché 9 : Autre plots de contact
Exemple de stries observées»



Cliché 10 : Vue démontée du bouton endommagé

ANNEXE

BEA

Accident de l'Airbus A330

immatriculé 5A-ONG

survenu le 12/05/2010

à Tripoli (Libye)

Résumé de l'événement :

Collision avec le sol lors d'une approche interrompue sur l'aéroport de Tripoli.

But des analyses :

Les travaux demandés à DGA Essais Propulseurs ont pour but de déterminer la composition des contaminants observés dans le bouton de prise de priorité du mini-manche du commandant de bord.

-:-:-

- 2 -

APPENDIX 9: Normal procedures / Non-precision approach in managed guidance

AIRBUS TRAINING A330 SIMULATOR	NORMAL PROCEDURES	REV 14 / SEQ 001	3.07

NON PRECISION APPROACH (MANAGED GUIDANCE)
NON ILS APPROACH IN NAV DATA BASE, <u>AND</u>, NAV ACCY CHECK POSITIVE

	PF	PNF
	Initial approach :	
		ENG START SEL . . . . AS RQRD
	SEAT BELTS . . . . ON/AUTO	
	Approx 15 NM from touchdown :	
	APPR PHASE . . . . ACTIVATE or set green dot	NAV ACCURACY . . . . MONITOR
	POSITIONING . . . . MONITOR	
	RADAR TILT . . . . ADJUST	
	APPR C/L	
	Intermediate/Final approach :	
	When cleared for approach :	
	APPR . . . . PRESS	
	At green dot :	
	ORDER . . . . "FLAPS 1"	FLAPS 1 . . . . SELECT
		CONFIRM/ANNOUNCE . . . . "FLAPS 1"
	CHECK OR SET S SPEED *	
		TCAS . . . . TA or TA/RA
	ND MODE RANGE . . . . AS RQRD	ND MODE RANGE . . . . AS RQRD
	FMA . . . . ANNOUNCE	FMA . . . . CHECK
	At S speed :	
	ORDER . . . . "FLAPS 2"	FLAPS 2 . . . . SELECT
		CONFIRM/ANNOUNCE . . . . "FLAPS 2"
	CHECK OR SET F SPEED*	
	When FLAPS 2	
	ORDER . . . . "GEAR DOWN"	L/G DOWN . . . . SELECT
		GRND SPLRS . . . . ARM
		AUTO BRAKE . . . . AS RQRD
		CONFIRM/ANNOUNCE . . . . "GEAR DOWN"
	When L/G down, below VFE	
	ORDER . . . . "FLAPS 3"	FLAPS 3 . . . . SELECT
		CONFIRM/ANNOUNCE . . . . "FLAPS 3"
		ECAM WHEEL PAGE . . . . CHECK
	When FLAPS 3, below VFE :	
	ORDER . . . . "FLAPS FULL"	FLAPS FULL . . . . SELECT
R		CONFIRM/ANNOUNCE . . . . "FLAPS FULL"
	CHECK OR SET VAPP*	
	After the FAF :	FINAL APP . . . . CHECK
		GA ALTITUDE . . . . SET
		A/THR . . . . CHECK SPD or OFF
	POSITION/FLT PATH . . . . MONITOR	WING A. ICE (if not required) . . . . OFF
R		EXTERIOR LIGHTS . . . . SET
	SLIDING TABLE . . . . STOWED	SLIDING TABLE . . . . STOWED
		LDG MEMO . . . . CHECK NO BLUE
	CABIN REPORT . . . . OBTAIN (CM1)	
R	CABIN CREW . . . . ADVISE	
	LDG C/L	
	ANNOUNCE ANY FMA MODIFICATION	FLT PARAMETERS . . . . CHECK
		Announce any deviation in excess of : V/S : 1000 ft/mn IAS : speed target + 10 kt, speed target - 5 kt PITCH : 0° NOSE DN, 10° NOSE UP BANK : 7°
	At MDA + 100 :	MONITOR OR ANNOUNCE . . "ONE HUNDRED ABOVE"
	At MDA	
R	ANNOUNCE . . . . "LANDING" or "GA/FLAPS"	MONITOR or ANNOUNCE . . . . "MINIMUM"
	AP (if applicable) . . . . OFF	

* PF FOR AUTO APPR, PNF FOR MAN APPR

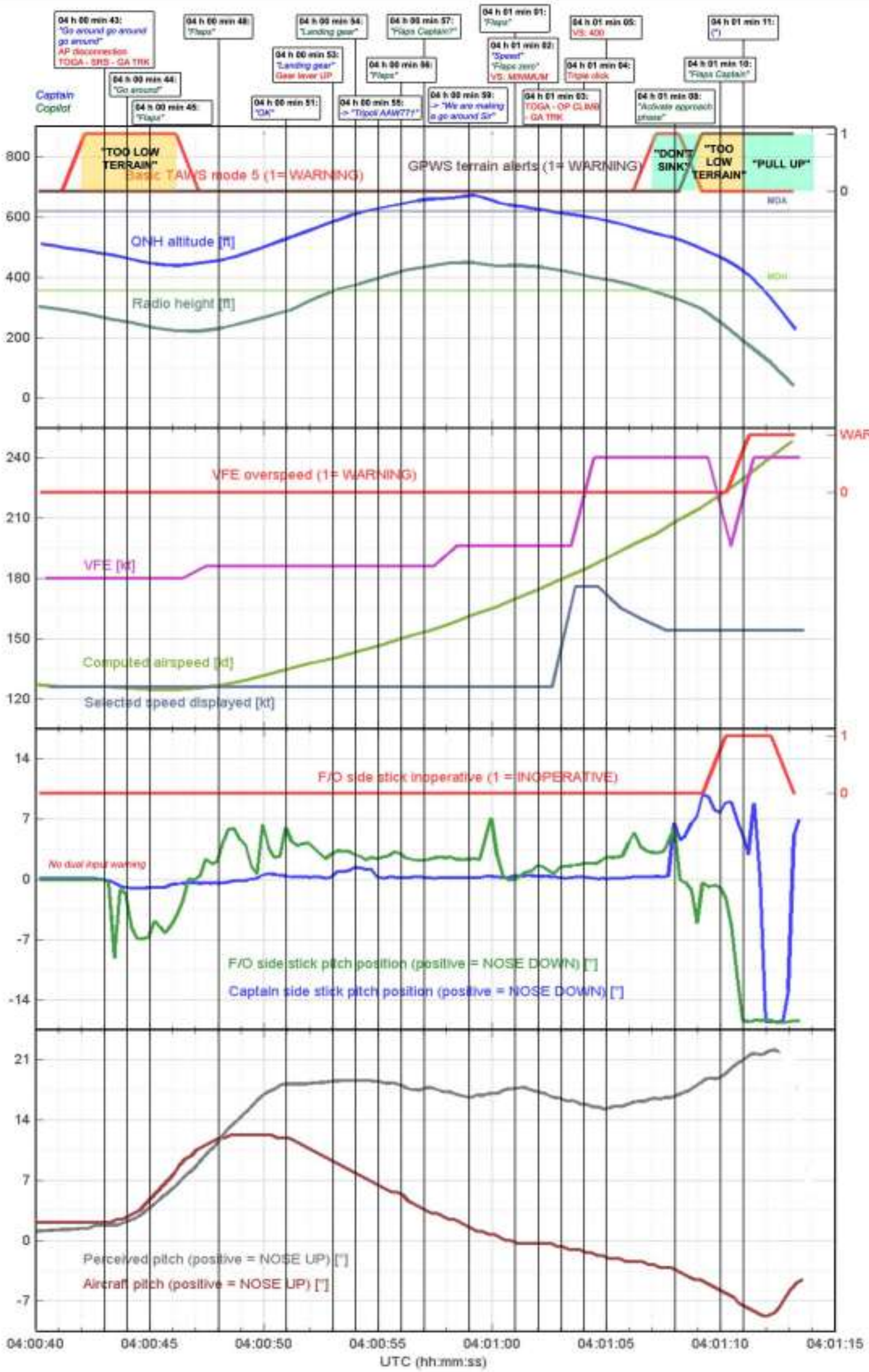
SIMU 1.1+UP2 *for training only*

NON PRECISION APPROACH (SELECTED GUIDANCE)
NON ILS APPROACH NOT IN NAV DATA BASE, OR, NAV ACCY CHECK NEGATIVE

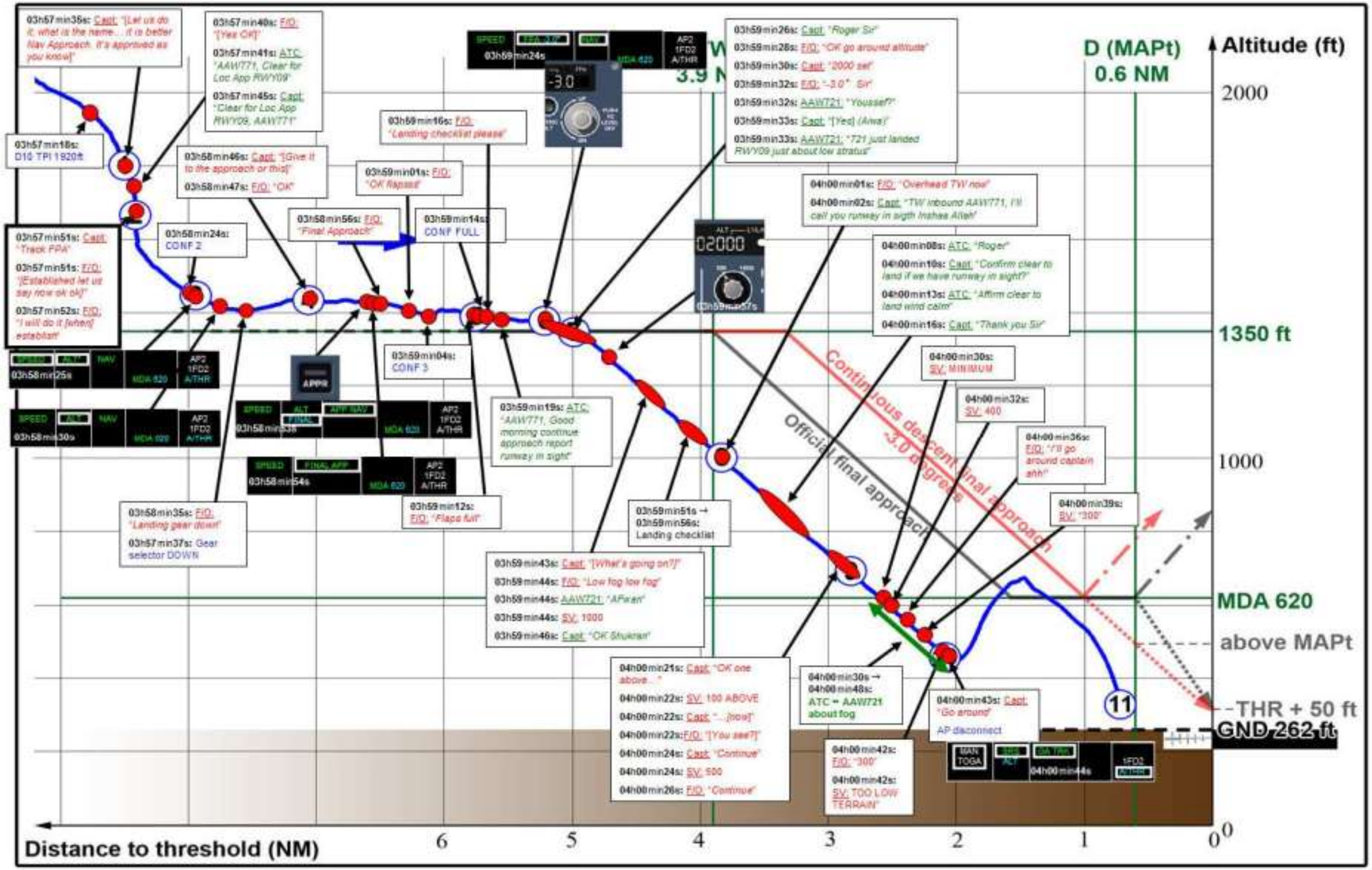
PF	PNF
Initial approach :	
	ENG START SEL . . . . AS RQRD
SEAT BELTS . . . . ON/AUTO	
Approx 15 NM from touchdown :	
APPR PHASE . . . . ACTIVATE or set green dot	NAV ACCURACY . . . . MONITOR
POSITIONING . . . . MONITOR	
RADAR TILT . . . . ADJUST	
APPR C/L	
Final approach :	
At green dot :	
ORDER . . . . "FLAPS 1"	FLAPS 1 . . . . SELECT
	CONFIRM/ANNOUNCE . . . . "FLAPS 1"
CHECK OR SET S SPEED *	
	TCAS ◁ . . . . TA or TA/RA
ND MODE RANGE . . . . AS RQRD	ND MODE RANGE . . . . AS RQRD
At S speed :	
ORDER . . . . "FLAPS 2"	FLAPS 2 . . . . SELECT
	CONFIRM/ANNOUNCE . . . . "FLAPS 2"
CHECK OR SET F SPEED *	
When FLAPS 2	
ORDER . . . . "GEAR DOWN"	L/G DOWN . . . . SELECT
	GRND SPLRS . . . . ARM
	AUTO BRAKE . . . . AS RQRD
	CONFIRM/ANNNOUNCE . . . . "GEAR DOWN"
When L/G down, below VFE :	
ORDER . . . . "FLAPS 3"	FLAPS 3 . . . . SELECT
	CONFIRM/ANNOUNCE . . . . "FLAPS 3"
	ECAM WHEEL PAGE . . . . CHECK
When FLAPS 3, below VFE	
ORDER . . . . "FLAPS FULL"	FLAPS FULL . . . . SELECT
	CONFIRM/ANNOUNCE . . . . "FLAPS FULL"
CHECK OR SET VAPP*	
AT the FAF :	
SET FPA TO FINAL APPROACH PATH*	
After the FAF :	
SET GA ALTITUDE ON FCU*	
POSITION/FLT PATH . . . . CHECK/ADJUST	
	A/THR . . . . CHECK SPD or OFF
	WING A. ICE (if not required) . . . . OFF
R	EXTERIOR LIGHTS . . . . SET
SLIDING TABLE ◁ . . . . STOWED	SLIDING TABLE ◁ . . . . STOWED
	LDG MEMO . . . . CHECK NO BLUE
CABIN REPORT . . . . OBTAIN (CM1)	
CABIN CREW . . . . ADVISE	
LDG C/L	
ANNOUNCE ANY FMA modification	FLT PARAMETERS . . . . CHECK Announce any deviation in excess of : V/S : 1000 ft/mn IAS : speed target + 10 kt, speed target - 5 kt PITCH : 0° NOSE DN, 10° NOSE UP BANK : 7°
At MDA + 100 :	MONITOR OR ANNOUNCE . . "ONE HUNDRED ABOVE"
R **At MDA :**	MONITOR or ANNOUNCE . . . . "MINIMUM"
ANNOUNCE . . . . "LANDING" or "GA/FLAPS" AP (if applicable) . . . . OFF	

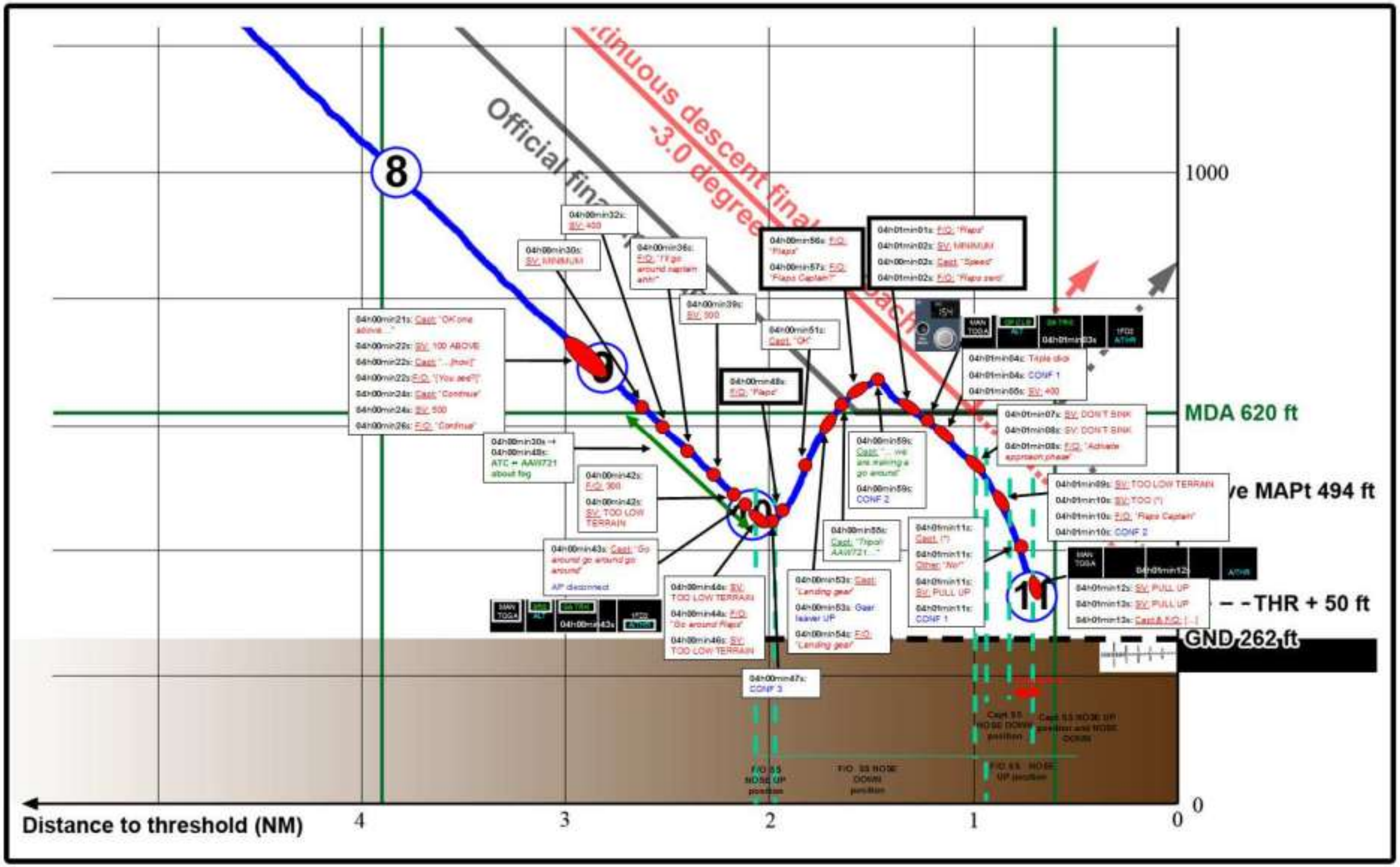
* PF FOR AUTO APPR, PNF FOR MAN APP

APPENDIX 10 : Parameters from accident flight, with SSCVR extracts



APPENDIX 11 : Chronology of end of accident flight





8
10
11
MDA 620 ft
THR + 50 ft
GND 262 ft
1000
0
Distance to threshold (NM)
4
3
2
1
0

APPENDIX 12 : Parameters from the 28 April 2010 flight