Aviation Safety Council

Taipei, Taiwan

# GE 536 Occurrence Investigation
# Factual Data Report

**Runway Overrun During Landing On Taipei Sungshan Airport**

**TRANSASIA AIRWAYS FLIGHT 536**

**A320-232, B-22310**

**October 18, 2004**

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# 1 Factual Information

## 1.1 History of Flight

On October 18, 2004, at 1959[1] Taipei local time, TransAsia Airways (TNA) flight GE 536, an A320-232 aircraft, registration No.B-22310, departed from Tainan Airport (RCNN), rolling off from the stopway in the end of Runway 10, stopped with its nose gear trapped in a ditch during landing roll on Taipei Sungshan Airport (RCSS). The sliding tube of nose landing gear was broken, both engine nacelles came into contact with ground and damaged, none of the 2 pilots (CM-1 and CM-2), 4 cabin crewmembers, and100 passengers aboard were injured.

The flight departed from RCNN at 1924. The pilot-in-commend (CM-1) was on the left seat as the pilot monitor (PM), the first officer (CM-2) was on the right seat as the pilot flying (PF). At 1928, the Automatic Terminal Information service, (ATIS) broadcast for RCSS were "…expect ILS Approach. Runway one zero in use; wind variable at three; visibility four thousand five hundred meters; light rain; cloud scattered eight hundred feet, broken one thousand eight hundred feet, overcast three thousand five hundred feet; temperature two three; dew point two two; Q-N-H one zero zero eight hactopascals; wind shear on runway one zero; Low Level Wind Shear Advisory in effect, moderate to severe…". The aircraft employed RCSS Instrument Landing System (ILS) approach Runway 10. At 1958:12, the flight received landing clearance.

According to the Flight Data Recorder (FDR) and Cockpit Voice Recorder (CVR) data:

Total landing weight were 55,140 kilogram, flaps selected "3", approach speed selected "137 knots", ground spoilers "ARMED", autobrake selected "MEDIUM", antiskid selected "ON" at final approach.

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[1] All of the times herein are in Taipei local time on the 24-hour clock.

At 1959:04, radio altitude 282 feet, auto-pilot disengaged, autothrottle activated. The CVR recorded “RETARD” sound four times between radio altitude 20 feet and the main landing gear touched ground.

At 1959:27, the main landing gear touched ground, air speed 138 knots, ground speed 146 knots, heading 093 degrees, wind direction 297 degrees, wind speed 11 knots, the number 1/2 throttle level angle positioned at 19.7/22.5 degrees. Three seconds later, nose gear touched ground, the number 1/2 throttle level angle positioned at 22.5/22.5 degrees.

At 1959:32, the autothrottle disconnected, number one thrust reverser deployed, number two thrust reverser not deployed.

At 1959:37 CM-1 called out “no brake”, until 1959:50, CM-1 called “no brake” five times. In the meantime, air speed 112 knots, ground speed 109 knots.

At 1959:42, the left/right brake pedal angle positioned at 28/46 degrees. After eight seconds until its full stop, all of the brake pedals angle were positioning between 62 degrees to 80 degrees.

The ground spoilers did not extend.

The aircraft touch down at 1,750 feet on Runway 10, and rolling off 321 feet from the end of Runway 10. The aircraft stopped in the northern side of the stopway with heading 002 degrees, the distance from stopway to the main landing gear was 72 feet.

According to the records in the Technical Log Book of the aircraft: The number 2 engine thrust reverser system was malfunctioned and was transferred to deferred defect (DD) item and the thrust reverser was deactivated in accordance with the procedures in the Minimum Equipment List.

## 1.2 Injury to Persons

There were two pilots, four cabin crews and one hundred passengers aboard. No one sustained injury.

The injury distribution is summarized in Table 1.2-1.

Table 1.2-1 Injury table

| Injuries | Crew | Passengers | Others | Total |
|---|---|---|---|---|
| **Fatal** | 0 | 0 | 0 | 0 |
| **Serious** | 0 | 0 | 0 | 0 |
| **Minor/None** | 6 | 100 | 0 | 106 |
| **Total** | 6 | 100 | 0 | 106 |

## 1.3 Damage to Aircraft

The aircraft rolled off Runway 10 and came to rest in a muddy area 90 degrees to the runway heading（Figure 1.3-1）. The NLG entered a drainage ditch （approx 1m deep）（Figure 1.3-2） and sliding tube of the nose gear was broken（Figure 1.3-3）, both engine nacelles came in contact with the ground （Figure 1.3-4）. Damage the RH pylon structure and some engine fan blades were evident.

Figure 1.3-1 The aircraft rolled off runway and came to rest in a muddy area 90 degrees to the runway heading

Figure 1.3-2 The NLG entered a drainage ditch (approx 1m deep)

Figure 1.3-3  Sliding tube of the nose gear was broken

Figure 1.3-4  Both engine nacelles came in contact with the ground

## 1.4 Other Damage

From the observation of the tire marks, the nose gear passed through two runway threshold lights （Figure 1.4-1）. The right main landing gear passed through two electrical handholds. Wreckages of the damaged electrical handholds were shown in Figure 1.4-2.

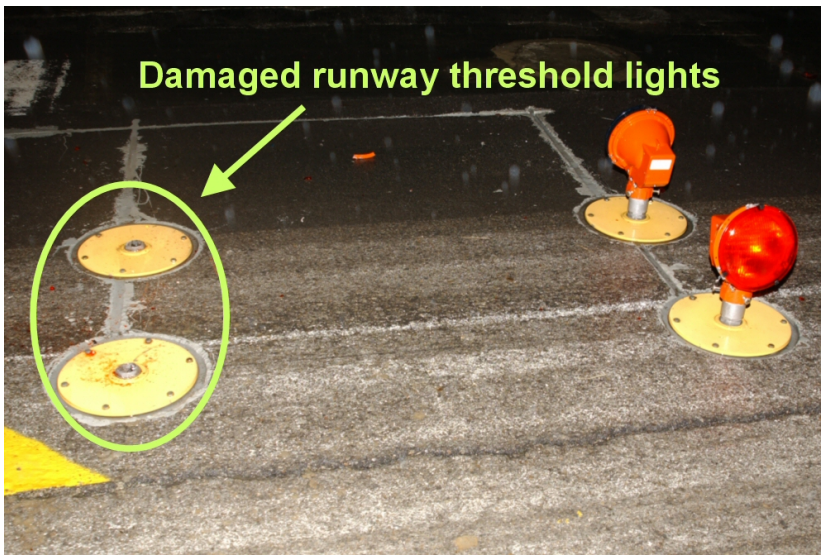


Figure 1.4-1 Damaged runway threshold lights

Figure 1.4-2 Damaged electrical handholds

## 1.5 Personnel Information

### 1.5.1 Backgrounds and Experiences of Pilots

#### 1.5.1.1 CM-1

CM-1 is a national of Republic of China who had served in military as a pilot and his total flight time was 2,686:20 during his military service. He joined TNA in September 1990 as a first officer of ATR42/72, was promoted to captain of ATR42/72 in January 1992, the flight time on ATR42/72 was 1,502:54. CM1 completed transition training of A320 captain at Aeroformation Airbus Training Organization, France in August 1993, and became instructor pilot of A320/A321 in April 1997, and check pilot in April 1998. His total flight time was 12,918:17 which included 8,729:17 on A320/A321.

#### 1.5.1.2 CM-2

CM-2 is a national of Republic of China who had served in military as a pilot and his total flight time was 2,163:30 during his military service. He joined TNA in May 1994 as a first officer of ATR42/72, the flight time on ATR42/72 was 1,219:51. CM2 completed transition training of A320 first officer at Aeroformation Airbus Training Organization, France in April 1996. His total flight time was 10,431:56 which included 7,048:35 on A320/A321.

Table 1.5-1 Basic Information of Pilots

| Item | CM-1 | CM-2 |
|---|---|---|
| Gender | Male | Male |
| Age as of accident | 51 | 45 |
| Date of joining in TNA | SEP 11, 1990 | MAY 24, 1994 |
| License type | Airline Transport Pilot No.101016 | Airline Transport Pilot No. 101475 |
| Type rating Expire date | A320/A321 JUL 18, 2005 | A320/A321 F/O APR 16, 2005 |
| Medical class Expire date | 1st class airman MAR 31, 2005 | 1st class airman DEC 31, 2004 |
| Latest flight check | OCT 16, 2004 | MAY 10, 2004 |
| Total flight time | 12,918 hrs 17min. | 10,431 hrs 56 min. |
| Flight time in last 12 months | 793 hrs 38 min. | 777 hrs 50 min. |
| Flight time in last 90 days | 152 hrs 40 min. | 141hrs 44 min. |
| Flight time in last 30 days | 59 hrs 57 min. | 61 hrs 53 min. |

| | | |
|---|---|---|
| Flight time in last 7 days | 28 hrs 30 min. | 24 hrs 48 min. |
| A320/A321 flight time | 8,729 hrs 03 min. | 7,048 hrs 35 min. |
| Flight time on the day of accident | 3 hrs 11 min. | 3 hrs 11 min. |
| Rest time period before accident | Over 24 hrs | Over 24 hrs |

## 1.5.2 Training and Rating Records of Pilots

### 1.5.2.1 CM-1

**Transition training**

CM1 completed ground academic courses training and simulator training of A320 captain at Aeroformation Airbus Training Organization, France from May 19 to June 30, 1993 and passed the type rating. He completed the training and passed the rating of the performance and flight route between July 12 to August 6 of the same year, passed the deferential training of A320/A321 in July 1995.

**Qualifications training**

Completed instructor pilot qualifications training and simulator training of A320/A321 at Hyderabad Training Center, India from February 24 to March 1, 1997 and passed the rating of the performance and takeoff/landing skills on March 5.

Completed A320/A321's check pilot qualifications training from April 7 to April 8, and passed the check pilot flight route check on April 21.

**Recurrent training**

The simulator recurrent training of TNA pilots had been conducted either at the Airbus Training Center, Toulouse, France, or at Airbus Training Center, Miami, U.S.A., between 1994 and 1996. From 1997, it changed to the Hyderabad Training Center, India; at Asia Pacific Training & Simulator PTE Ltd., Singapore, between 1998 to 2000; and has changed to at GE Capital Aviation Training (GECAT) or at Dragonair Training Center, Hong Kong, since 2001. The pilots are trained by TNA instructor pilots and examined by TNA designated examiners designated by CAA.

CM-1 passed all of the recurrent training and rating, and no abnormal records since he completed the transition training of A320/A321.

### 1.5.2.2 CM-2

**Transition training**

The ground academic courses training of A320/A321 of the first officer was

conducted by TNA instructor pilots at TNA classroom from December 1995 to January 31 1996. He completed the simulator training and differential training of A320/A321 on November 27 at Airbus Training Center, and passed the rating of first officer on performance and flight route in April of the same year.

**Recurrent training**

CM-2 passed all of the recurrent training and rating, and there were no abnormal records since he completed the transition training of A320/A321.

### 1.5.3 Pilots' Ground School Recurrent Training

A one day ground school of recurrent training for TNA flight crew is conducted prior to the twice-per-year's recurrent trainings. The curriculum of the ground school training program includes:

Civil aviation regulations, one hour;

Crew resources management (CRM), one hour;

Standard operation procedures (SOP), two hours

Controlled flight into terrain/approach and landing accident reduction/ground proximity warning system/traffic alert and collision avoidance system (CIFT/ALAR/GPWS), one hour;

Abnormal operations of aircraft systems (including emergency procedures, abnormal attitude recovery, low level windshear warning system and avoidance), two hours;

Special flight operations, three hours;

Adverse weather, one hour;

Check pilot's briefing, one hour;

Other curricula that need to be replenished or reinforced; and

Tests; one hour.

#### 1.5.3.1 CM-1

CM-1's ground academic courses training records in recent two years TNA showed the dates and tests scores as follows: 95 points on October 7, 2004; 100 points on February 17, 2004; 95 points on June27, 2003; and 100 points on January 19, 2003.

#### 1.5.3.2 CM-2

CM-2's ground academic courses training records in recent two years showed the dates and tests scores as follows: 100 points on October 7, 2004; 100 points on April 20, 2004; 100 points on November 5, 2003; and 100 points on April 7, 2003.

### 1.5.4 Pilots' Physical Conditions

#### 1.5.4.1 CM-1

The item of limitations on the Airman Medical Certificate issued by CAA to CM-1 noted: "Holder shall wear correcting glasses"

#### 1.5.4.2 CM-2

The item of limitations on the Airman Medical Certificate issued by CAA to CM-2 noted: "none".

### 1.5.5 Pilots' Activities in 72 hours prior to the Accident

#### 1.5.5.1 CM-1

October 15: Conducted training and check on simulator in Hong Kong from1430 to 2000, departed from Hong Kong at 2145 and backed to home in Taipei at around 0100 (midnight).

October 16: Stayed at home resting.

October 17: Picked up his family from CKS Airport at 1300 and back to home.

October 18: Went swimming after got up, finished lunch, and reported to Sungshan Airport for duty at 1300.

#### 1.5.5.2 CM-2

October 15: Stayed at home resting.

October 16: Stayed at home resting.

October 17: Stayed at home in the daytime, attended a dinner party at 1800 and back to home around 2000.

October 18: Stayed at home resting in the morning. After finished lunch, reported to Sungshan Airport for duty at 1300.

## 1.6 Aircraft Information

The aircraft basic information is shown in Table 1.6-1.

Table 1.6-1 Aircraft basic information

| No | Title | Description |
|---|---|---|
| 1 | Type of Aircraft | A320-232 |
| 2 | Registration Mark | B-22310 |
| 3 | Manufacturer | Air Bus Industries |
| 4 | Manufacturer's Serial Number | 0791 |
| 5 | Date Manufactured | February 1998 |
| 6 | Delivery Date | June 24, 1998 |
| 7 | Operator | TransAsia Airways |
| 8 | Owner | Winner Leasing Company Ltd. |
| 9 | Certificate of Airworthiness Number （Validity Date） | 93-04-041 （March 31,2005） |
| 10 | Total Flight Hours | 12,124：31 Hours |
| 11 | Total Cycles | 16,248 |
| 12 | Date of Last "A" Check | August 13, 2004 |
| 13 | Flight Hours/Cycles Elapsed Since Last ''A'' Check | 331：56 Hours/ 395 Cycles |

Basic information of the two IAE (International Aero Engines) V2527-A5 engines is shown in Table 1.6-2.

Table 1.6-2 Basic information of the engines

| Position | Serial Number | Date Installed | Total Hours | Time Since Overhaul | Total Cycles |
|---|---|---|---|---|---|
| 1 | V10174 | September.8, 2003 | 12,879:53 | 2,039:24 | 17,827 |
| 2 | V10578 | November 6, 2001 | 9,116:27 | 5,384:33 | 12,598 |

### 1.6.1 Maintenance Records

The relevant maintenance records to the brakes、engine thrust reversers and spoilers in the Technical Log Book are stated below:

#### 1.6.1.1 Brakes

In 30 days prior to the occurrence, there was no record of brakes replacement.

On October 6, 2004, there was a defect report regarding the failure of the Channel 1 of Brake/ Steering Control Unit （BSCU）. This defect was closed after the BSCU connector was cleaned and passed the self-test in accordance with AMM[2] 32-46-00.

### 1.6.1.2 Engine Thrust Reverser

The defect report in 90 days prior to the occurrence for both engine thrust reverses are shown in Table 1.6-3 and 1.6-4:

Table 1.6-3 1 Engine 1 thrust reverser defect report

| Item No | Defect Reports | Date （Flight ） | DD[3] item Number | Maintenance Actions |
|---|---|---|---|---|
| 1 | Eng No.1 reverse fault light on | Sept.27 （GE355） | No | IAW[4] AMM 78-31-00 Perform eng FADEC[5] 1 electrical check. All check normal. |
| 2 | Engine 1 reverse after landing amber. Check N2 no work. | Oct. 9 （GE538） | No | Cleaned No.1 engine HCU[6] then IAW AMM 78-31-00 Operating the system through 10 times and all function normal. |

Table 1.6-4 Engine 2 thrust reverser defects report

| Item | Defect Reports | Date (Flight) | Deferred Number | Maintenance Actions |
|---|---|---|---|---|
| 1 | #2 Reverse Fault | Oct. 10 (GE529) | Nil | IAW AMM 78-31-00 Ground tested. Check normal |
| 2 | Engine #2 Reverse Amber | Oct.10 (GE532) | Transferred to DD #27588 | IAW A320 MEL[7]78-30-01 A/C dispatch.No.2 eng thrust reverser deactivated and transferred to DD. |

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[2] AMM: Aircraft Maintenance Manual

[3] DD: Deferred Defect

[4] IAW: In Accordance With

[5] FADEC: Full Authority Digital Engine Control

[6] HCU: Hydraulic Control Unit

[7] MEL-Minimum Equipment List 78-30-01 states the category C should be completed in 10 days..

| | | | | |
|---|---|---|---|---|
| 3 | DD#27588 Transfer No.2 engine reverse amber | Oct.12 (GE572) | DD#27588 Closed | IAW AMM 78-31-00 1.Recheck locking actuator connector loose & some oil 2.Clean up & operation several times ok |
| 4 | #2 Reverse fault | Oct.13 (GE532) | Nil | IAW AMM 78-31-00,No.2 engine reverse operation test normal |
| 5 | #2 Engine reverse fault | Oct.13 (GE571) | Transferred to DD#27589 | Per MEL 78-30-0 #2 T/R deactivated |
| 6 | Transfer from DD#27589 | Oct.13 (GE538) | DD#27589 Closed | IAW AMM 78-32-48 & 78-31-00 replaced # 2 R/H side non-locking actuator & check normal. Operation of No.2 thrust reverse system normal & no hydraulic leak found |
| 7 | #2 Engine reverse fault | Oct.15 (GE563) | Transferred to DD#27590 | IAW MEL78-30-01 #2 T/R deactivated |
| 8 | DD#27590,NO.2 engine reverse deactivated | Oct .16 (GE532) | DD#27590 | IAW AMM 78-30-00 deactivation No.2 eng rev t/r & function check ok pleases keep observe further |
| 9 | Info NO.2 T/R works normal | Oct .16 (GE570) | DD#27590 | Noted and thanks |
| 10 | #2 Engine reverse fault after operated | Oct16 (GE538) | DD#27590 | IAW AMM 78-32-48 L/H No.2 non-locking actuator was replaced. Inspect reverser IAW AMM 78-31-00.keep observes. |

### 1.6.1.3 Spoilers

In 30 days prior to the occurrence, there was no malfunction report regarding the spoiler system.

### 1.6.1.4 Repeat Item and Its Handling Procedures

In accordance with the contents of the Aircraft Maintenance Control Manual （June 30,2003） the definition and handling procedures of the repeat item are listed as below:

*Repeat item: The same defect that occurred again after the last maintenance action was fixed in three days would be considered as a repeat item.*

Handling procedures:

*5.1 Maintenance and Control Center*

*5.1.1 Monitor and record all the maintenance actions of the aircraft. If there is a repeat item occurred, record in the daily review record and will discuss it on the next day morning briefing.*

*5.1.2 Follow up the last maintenance action of the repeat item and discuss the cause of the defect and the effective corrective action with the maintenance crew to avoid the defect repeated.*

*5.1.3 Collect all the repeat item records in each month and list them in tables to Quality Control Center for the review of Reliability Control Board Meeting.*

*5.2 Reliability Control Board Meeting*

*5.2.1 Review the cause and corrective actions and preventions of the repeat items and monitor the result of the actions.*

*5.2.2 Share the information to the working unit to be the reference of the future maintenance actions and recurrent training materials.*

*5.3 The Engineering Section and the aircraft manufacturer will provide technical assistance whenever is needed.*

*5.4 The maintenance unit that found the defects came from the misconduct or human error during the maintenance actions should inform the person who conducted the corrective actions and list the facts on the training materials to avoid that kind of misconduct happening again.*

*5.5 The item on the deferred defects log would not be considered as repeat item when the defect was occurred again.*

### 1.6.2 Aircraft Systems related to Deceleration

In this section, the systems related to deceleration are introduced, these systems are spoilers, braking, and thrust control systems.

### 1.6.2.1 Spoilers

A320 has five spoilers numbered 1 thru 5 inboard to outboard （Refer to Figure 1.6-1）. Five spoiler surfaces are provided on each wing to achieve the functions below:

- Roll spoiler（surfaces 2 to 5）;
- Speedbrake（surfaces 2 to 4）;
- Ground spoilers（all surfaces）。

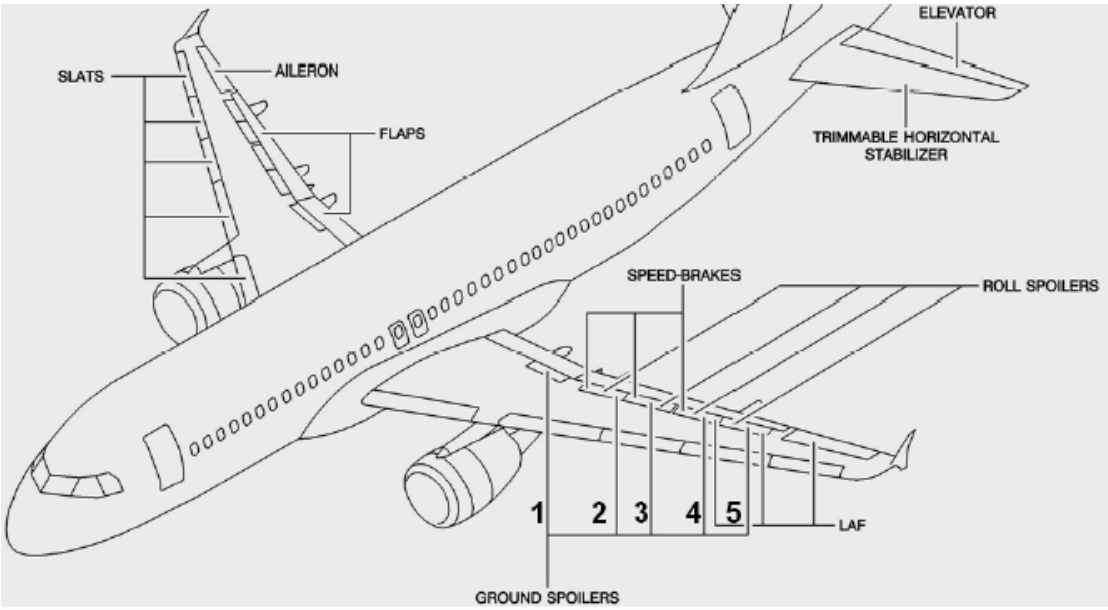


Figure 1.6-1 Spoilers

These surfaces are manually controlled from the side stick controllers （roll spoilers）, speedbrake control lever （speedbrake）or automatically in autopilot and ground spoiler function.

Each surface is controlled by one servocontrol supplied from the Green, Yellow or Blue system and signaled from the SEC 1（Spoiler and Elevator Computer #1）, SEC 2 or SEC 3.

**<u>Mechanism to activate ground spoilers functions</u>**

The purpose of ground spoilers is to increase the effect of deceleration when aircraft on the ground. The activation logic of this function is shown in Figure 1.6-2. Depend on flight phase, ground spoilers activate at two circumstances.

Case 1: Landing phase and meet the following conditions:

1. Speedbrake lever pre-selected at “ARM” position or at least one thrust reverser operated;
2. Both engine at idle position（Throttle Lever Angle, TLA <20 degrees）;

3. Both main landing gear[8] from “not pressed” to “pressed” and RA < 6 feet.

Case 2: When aircraft rejects takeoff and meet the following conditions:

1. Speedbrake lever pre-selected at “ARM” position or at least one thrust reverser operated;

2. Both engine at idle position（Throttle Lever Angle, TLA <20 degrees）;

3. Wheel speed higher than 72 knots.

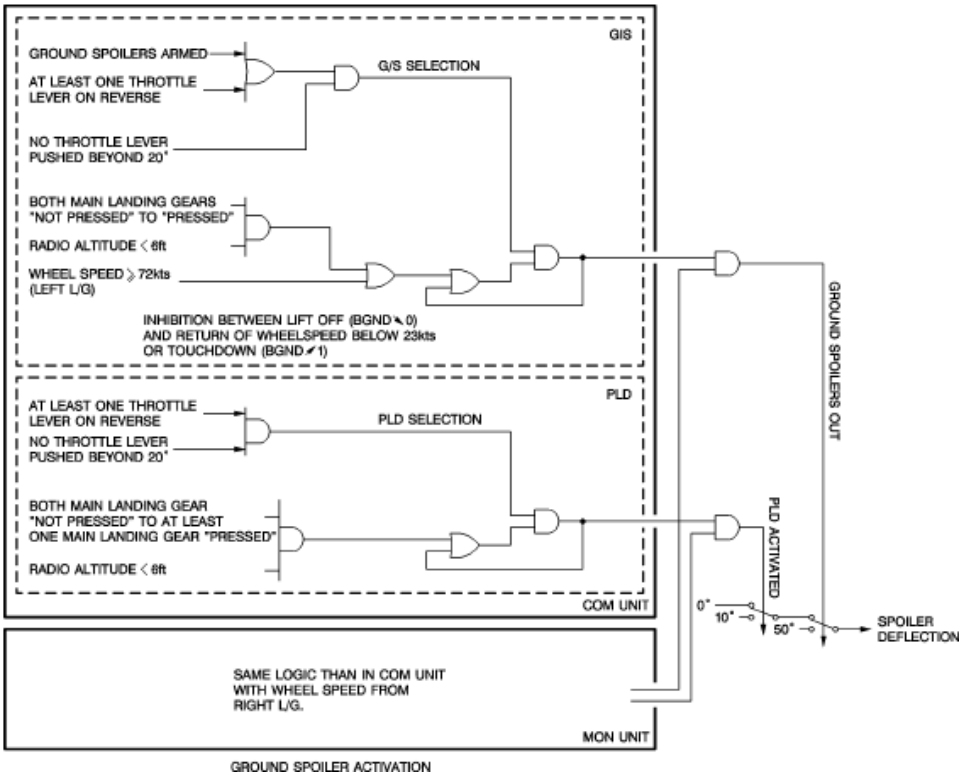


Figure 1.6-2 Ground spoiler activation logic diagram

### 1.6.2.2 Braking System

In auto brake mode, the selection of AUTO/BRK P/BSW（LO, MED or MAX）sets a program to give a set deceleration rate. The BSCU automatically starts the program when the aircraft configuration is correct and then controls the pressure sent to the brakes. In manual brake the movement of the brake pedals operates the brake-pedal transmitter unit. The transmitter unit sends a signal to the BSCU, which in turn sends the required input signal to the

[8] If only single main landing gear from “not pressed” to “pressed”, ground spoilers extend 10 degrees. If both main landing gears from “not pressed” to “pressed”, ground spoilers extend 50 degrees.

servo-valves. The servo-valves let a pressure, in proportion to the pedal travel go to the brakes. The BSCU also controls the anti-skid system; brake release orders generated from BSCU are sent to the servo-valves in the event of any wheel speed does not consist of aircraft ground speed.

**Braking Modes**

During landing and taxi rolls, three braking modes available depend on hydraulic system used and the position of the A/SKID & N/W STRG switch and PARK BRK control switch.

1. Normal Barking

- Supply of green hydraulic high pressure is normal;
- A/SKID & N/W STRG switch is in the “ON” position;
- PARK BRK control switch is in the “OFF” position.

Normal Braking is activated either by the movement of pedal or the activation of auto braking system. Brake pressure is regulated by normal servo-valves.

2. Alternate Braking with Anti Skid

The alternate braking with anti-skid associates the Yellow high-pressure hydraulics regulated by the anti-skid system. It is activated in case of green hydraulic system malfunction. The braking modes are shown on the upper ECAM（Electronic Centralized Aircraft Monitor） DU（Display Unit）. The alternate braking command is applied by pedals only and the pressure is supplied by an auxiliary low-pressure hydraulic-system. The pressure supplied to brakes is shown on a brake Yellow-pressure triple-indicator which was installed on the center instrument panel.

3. Alternate Braking without Anti Skid

The Alternate braking without anti skid differs from the above modes in that the anti skid regulation is no longer available, It could be:

- Disconnected electrically（A/SKID & N/W STRG switch in the OFF position or power supply failure）;
- Disconnected hydraulically if only the brake Yellow-pressure accumulator supplies the brakes（the A/SKID & N/W STRG switch can be in any position）.

The Yellow system interconnects the power accumulator. A fully charged accumulator can provide hydraulic pressure at minimum seven applications of fully braking.

**Auto Brake**

The system decreases the number of flight crew actions if an acceleration-stop （MAX mode）occurs when takeoff, or keeps the

deceleration to a pre-set limit（LOW or MED）when landing. The Auto Brake control panel is shown as Figure 1.6-3.

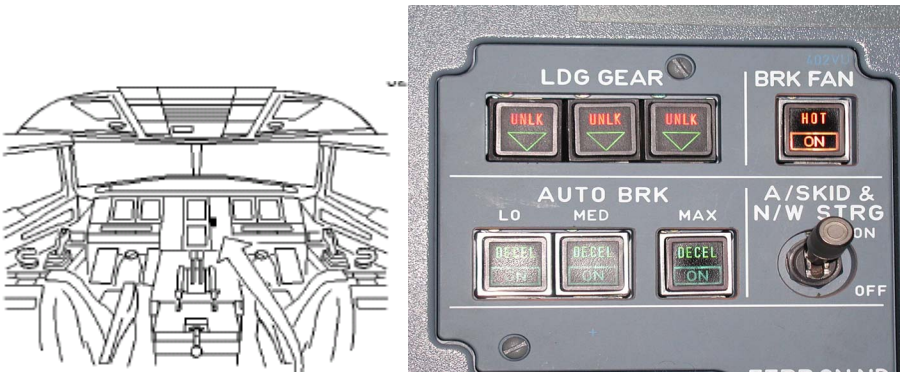


Figure 1.6-3 Auto Brake control panel

The flight crew pushes the LO, MED or MAX[9] pushbutton switch to arm the system. The ON legend on the lower half of the pushbutton switch comes on if the Normal braking is operational. In the automatic mode the selection of an AUTO/BRK P/BSW （LO, MED or MAX）sets a program to give a set deceleration rate. The BSCU automatically starts the program and then controls the pressure sent to the brakes. The ground spoiler extension command starts the braking action. The Green DECEL legend on the upper half of the pushbutton switch comes on while decelerating rate reaches 80% of programmed.

The auto brake system is disengaged and disarmed at the following conditions:

- If ground spoiler return to stow, or;
- If crew apply sufficient pressure to the pedals with the aircraft on the ground（takeover through brake pedals）.

The failure of the auto brake is shown on the upper ECAM DU before and after the selection.

### 1.6.2.3 Thrust control and Throttle lever position

The throttle control lever moves over a range of 65 degrees from -20 degrees to 45 degrees（TLA）. It includes 3 stops and 3 detents, -20 degrees（MAX REVERSE stop）, -6 degrees（REVERSE IDLE detent）, 0 degree（IDLE stop which could be overridden when using thrust reverser）, 25 degrees（MAX CLIMB）, 35 degrees（MAX CONTINUOUS /FLEX TAKEOFF detent）, and 45 degrees（MAX TAKEOFF stop）, as indicated in Figure1.6-4. When both throttle control levers are between IDLE to MAX CONTINUOUS（0 degrees to

[9]Three default decelerating rates as: 2m/s$^2$（LOW）. 3m/s$^2$（MED）and 0.27 g（MAX）.

35 degrees TLA）the autothrust function can be activated if engaged. This range corresponds to the selection of MAX CLIMB or MAX CONTINUOUS thrust limit mode, except the FLEX TAKE OFF mode. If the autothrust is engaged and active, the engines are controlled by the Autothrust system. If the autothrust is not engaged, the engine is manually controlled by the throttle control lever, as shown in Figure 1.6-5. In automatic landing, the Flight Warning Computer, FWC, auto call out delivers a “RETARD” message at 10 feet RA. The pilot then moves the throttle control levers to the IDLE position to take manual control of the thrust for landing. With the A/THR engaged but not in the automatic landing conditions, the “RETARD” warning message will be delivered at 20 feet RA.

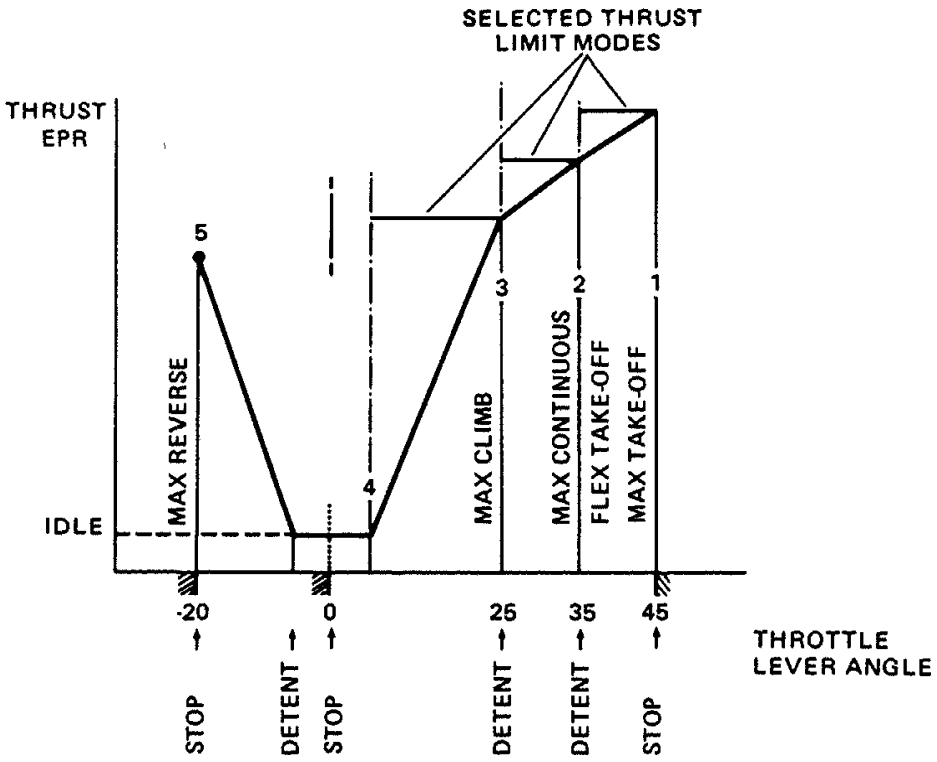


Figure 1.6-4 Thrust control lever angle and associated function

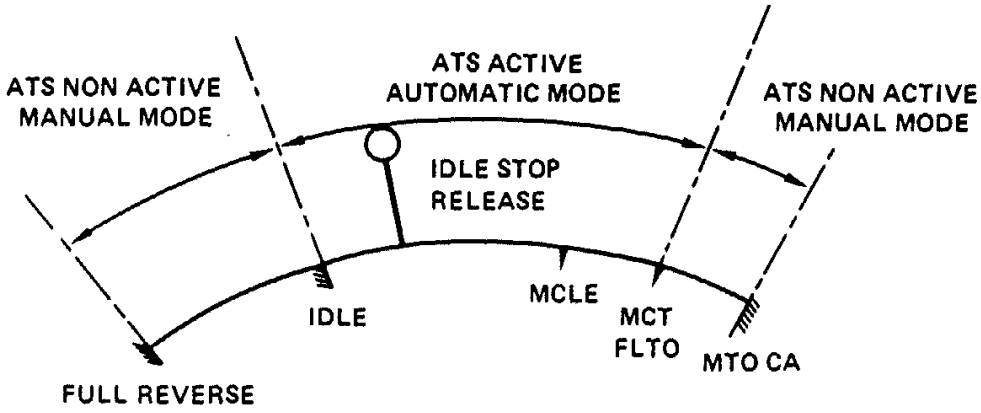


Figure 1.6-5 Throttle control lever vs. manual/autothrust active area

## 1.6.3 Weight and Balance

The maximum takeoff weight of this aircraft was162,038 pounds, the maximum landing weight was142,196 pounds, the maximum zero fuel weight was 134,480 pounds. The center gravity of takeoff and landing were in limit. See Table 1.6-5 for weight and balance data.

Table 1.6-5 GE536 Weight and Balance Data

| | |
|---|---|
| Zero Fuel Weight | 112,707 lb |
| Takeoff Fuel | 12,400 lb |
| Takeoff Weight | 125,050 lb |
| Center Gravity of Takeoff | 25.6% M.A.C. |
| Takeoff Trim | 0.6 |
| Consumed Fuel in Flight | 3,596 lb |
| Landing Weight | 121,454 lb |
| Center Gravity of Landing | 26.3% M.A.C. |

## 1.7 Weather information

### 1.7.1 General information of the typhoon

Typhoon Tokage centered at 23.0N and 126.9E, about 586 kilometers east-southeast of Taipei/Sungshan Airport at 2000, October 18, moving north-northwestly at 15 km/hr and then north-northeastly at 20 km/hr. Maximum wind speed of the storm was 43 knots gusting 53 knots, radius of the storm (average wind speed at 15 meter/sec) was 200 km, and pressure of the storm center was 965 hPa. Figure 1.7-1 and 1.7-2 are Infrared satellite imagery at 2023 and surface analysis chart at 2000 respectively.

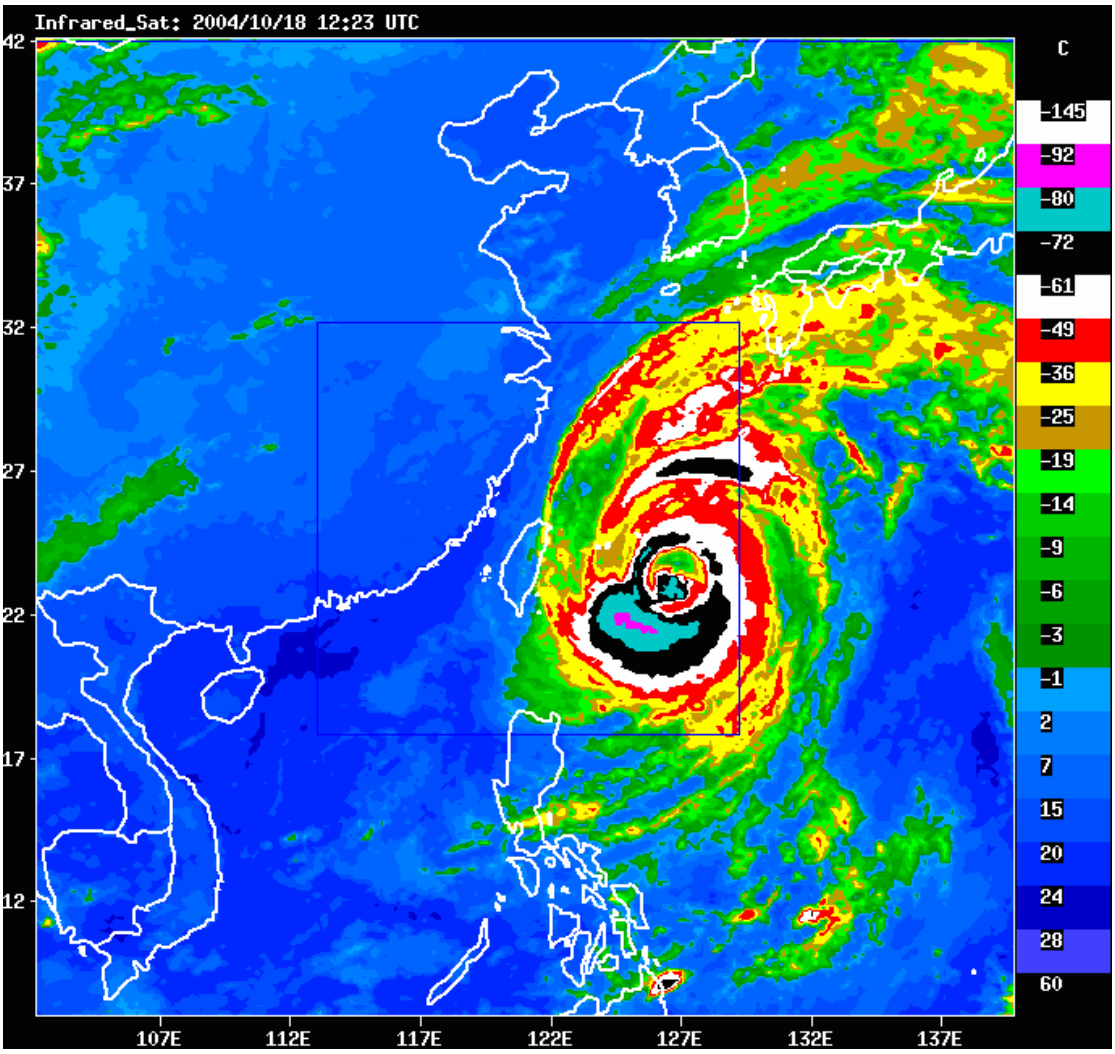


Figure 1.7-1 Infrared satellite imagery at 1223 UTC

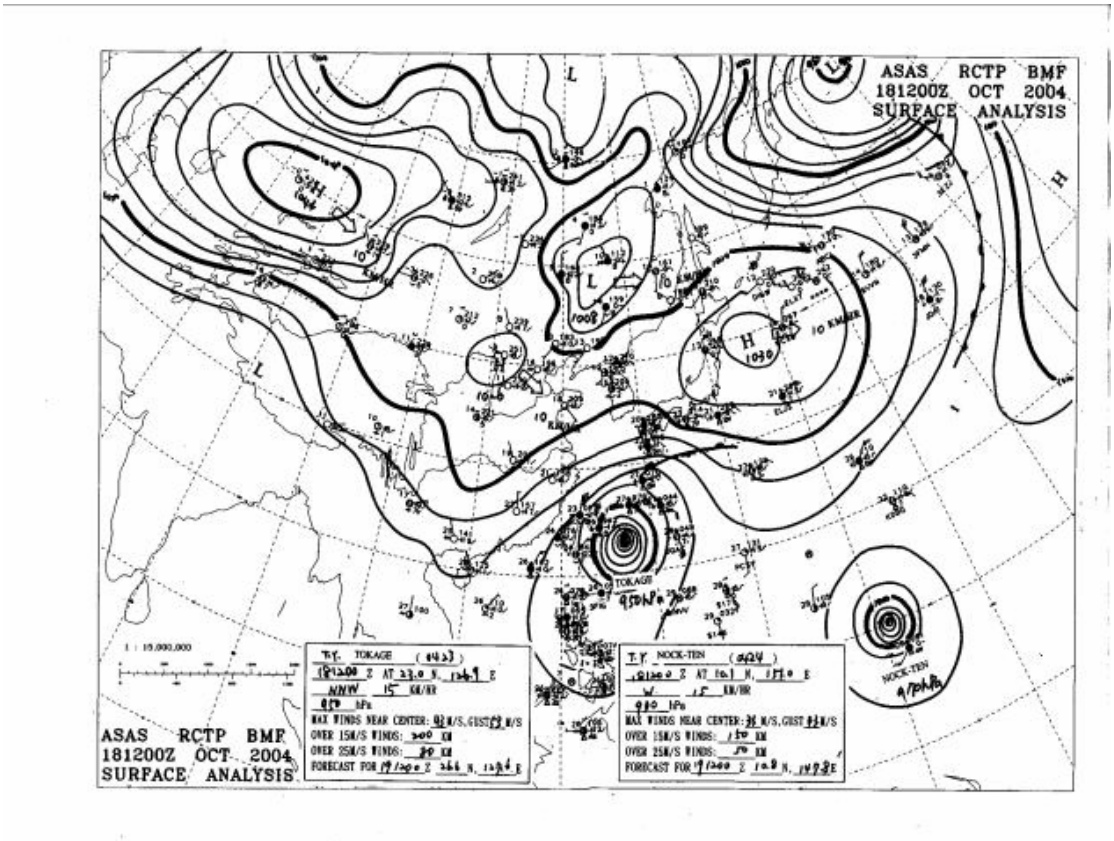


Figure 1.7-2 Surface analysis chart at 1200 UTC

## 1.7.2 Surface Weather Observations

The Taipei/Sungshan Weather Station surface weather records indicated the following:

1930: Wind variable at 3 knots; Visibility—4,500 meters; Present Weather—light rain; Clouds—scattered 800 feet, broken 1,800 feet, overcast 3,500 feet; Temperature—23 degrees Celsius; Dew Point—22 degrees Celsius; Altimeter Setting—1008 hPa; Supplementary information—RWY 10 windshear; Trend Forecast—no significant change.

2000: Wind variable at 2 knots; Visibility—4,500 meters; Present Weather—light rain; Clouds—few 800 feet, broken 1,800 feet, overcast 3,500 feet; Temperature—22 degrees Celsius; Dew Point—22 degrees Celsius; Altimeter Setting—1008 hPa; Supplementary information—RWY 10 windshear; Trend Forecast—no significant change; Remark—rain amount 0.75 millimeters.

There was no low level windshear detected by Low Level Windshear Alert System（LLWAS）of Taipei/Sungshan Airport from 1900 to 2005. The following is the recorded information of Taipei/Sungshan Airport Automated Weather Observing System（1 second average）:

Table 1.7-1 Recorded information of Taipei/Sungshan Airport Automated Weather Observing System

| Time | RWY 10 Wind （degree/knot） | RWY 28 Wind （degree/knot） |
|---|---|---|
| 1952 | 304/01 | 023/06 |
| 1953 | 315/03 | 338/03 |
| 1954 | 354/05 | 349/02 |
| 1955 | 034/05 | 034/06 |
| 1956 | 360/03 | 017/09 |
| 1957 | 068/01 | 321/00 |
| 1958 | 360/00 | 017/03 |
| 1959 | 248/00 | 354/04 |
| 2000 | 332/02 | 006/03 |
| 2001 | 073/04 | 349/04 |

## 1.7.3 Windshear information of METAR/SPECI

### 1.7.3.1 Windshear information of METAR/SPECI of Sungshan Airport

The supplementary information of RWY 10 windshear was included in METAR/SPECI of Sungshan Airport from 1220 to 2030. The following is the windshear information of AIREP and LLWAS[10] from 1220 to 2030.

Table 1.7-2 Windshear information of AIREP and LLWAS from 1220 to 2030

| Time | AIREP | LLWAS |
|---|---|---|
| 1220 | An MD82 encountered windshear at altitude of 1500-2000 feet, 5-6 nm from Sungshan Airport | |
| 1251 | | Windshear alert-RWY 10 arrival |
| 1252 | | Windshear alert-RWY 10 arrival and departure |
| 1255 | | Microburst alert-RWY 10 arrival |
| 1502-1503 | | Windshear alert-RWY 10 arrival |
| 1516-1517 | | Windshear alert-RWY 10 arrival |
| 1520 | An MD90 made a go round by the influence of low level windshear | |

[10] From the records of Sungshan Weather Station, the windshear information was obtained from Air Reports (AIREPs) received by Sungshan Tower or low level windshear / microburst alerts of LLWAS.

| | | |
|---|---|---|
| 1539-1540 | | Windshear alert-RWY 10 arrival |
| 1543-1544 | | Windshear alert-RWY 10 arrival and departure |
| 1553-1554 | | Windshear alert-RWY 10 arrival and departure |
| 1624 | | Windshear alert-RWY 10 arrival and departure |
| 1637-1638 | | Windshear alert-RWY 10 arrival |
| 1705 | | Windshear alert-RWY 10 arrival and departure |
| 1710-1712 | | Microburst alert-RWY 10 arrival and departure |
| 1713 | | Windshear alert-RWY 10 arrival and departure |
| 1753-1755 | | Microburst alert-RWY 10 arrival and departure |
| 1852-1853 | | Windshear alert-RWY 10 arrival |

### 1.7.3.2 The associated regulations concerning windshear information of METAR/SPECI

Chapter 4. METEOROLOGICAL OBSERVATIONS AND REPORTS of ICAO ANNEX 3:

*4.4 Coordination of requirements for observations and reports between the meteorological and ATS authorities*

*Recommendation. — An agreement between the meteorological authority and the appropriate ATS authority should be established to cover, amongst other things:*

*e) Meteorological information obtained from aircraft taking off or landing (for example, on wind shear)*

*4.12 Observing and reporting of supplementary information*

*4.12.1 Recommendation. — Observations made at aerodromes should include the available supplementary information concerning significant meteorological conditions, particularly those in the approach and climb-out areas, and specifically the location of cumulonimbus or thunderstorm, moderate or severe turbulence, wind shear, hail, severe squall line, moderate or severe icing, freezing precipitation, severe mountain waves, sandstorm, duststorm, blowing snow or funnel cloud (tornado or waterspout). Where practicable, the information should identify the vertical extent and direction and rate of movement of the phenomenon. As icing, turbulence and to a large extent, wind shear, for the time being cannot be satisfactorily observed from the ground, evidence of their existence should be derived from aircraft observations during the climb-out or approach*

*phases of flight to be made in accordance with Chapter 5, 5.5 and 5.6.*

Chapter 5. AIRCRAFT OBSERVATIONS AND REPORTS of ICAO ANNEX 3:

*5.6 Other non-routine aircraft observations*

*5.6.1 When other meteorological conditions not listed under 5.5, e.g. wind shear, are encountered and which, in the opinion of the pilot-in-command, may affect the safety or markedly affect the efficiency of other aircraft operations, the pilot-in-command shall advise the appropriate air traffic services unit as soon as practicable.*

*5.6.2 Recommendation. — When reporting aircraft observations of wind shear encountered during the climb-out and approach phases of flight, the aircraft type should be included.*

*5.6.3 Recommendation. — Where wind shear conditions in the climb-out or approach phases of flight were reported or forecast but not encountered, the pilot-in-command should advise the appropriate air traffic services unit as soon as practicable unless the pilot-in-command is aware that the appropriate air traffic services unit has already been so advised by a preceding aircraft.*

Chapter 7. SIGMET AND AIRMET INFORMATION, AERODROME WARNINGS AND WIND SHEAR WARNINGS of ICAO ANNEX 3:

*7.6 Wind shear warnings*

*7.6.1 Wind shear warnings shall give concise information of the observed or expected existence of wind shear which could adversely affect aircraft on the approach path or take-off path or during circling approach between runway level and 500 m (1 600 ft) above that level and aircraft on the runway during the landing roll or take-off run. The warnings shall be prepared and disseminated for aerodromes where wind shear is considered a factor in accordance with local arrangements with the appropriate ATS authority and operators concerned and by the meteorological office designated to provide service for the aerodrome or disseminated directly from automated ground-based wind shear remote-sensing or detection equipment referred to in 7.6.2 a) and b). Where local topography has been shown to produce significant wind shears at heights in excess of 500 m (1 600 ft) above runway level, then 500 m (1 600 ft) shall not be considered restrictive.*

*Note 3. — Information on wind shear is also to be included as supplementary information in local routine and special reports and routine and special reports in the METAR/SPECI code forms in accordance with 4.12.1, 4.12.4 and 4.12.5.*

*7.6.6 Recommendation. — Wind shear warnings for arriving aircraft and/or departing aircraft should be cancelled when aircraft reports indicate that wind shear no longer exists, or alternatively, after an agreed elapsed time. The criteria for the cancellation of a wind shear warning should be defined locally for each aerodrome, as agreed*

*between the meteorological authority, the appropriate ATS authority and the operators concerned.*

Chapter 3. AIRPORT TRAFFIC CONTROL - TERMINAL of AIR TRAFFIC CONTROL PROCEDURE:

*Section 1.GENERAL*

*3-1-8 LOW LEVEL WIND SHEAR ADVISORIES,*

*a. When low level wind shear is reported by pilots or detected by the Low Level Wind Shear Alert Systems (LLWAS) or Weather Systems Processor (WSP), controllers shall issue the alert to all arriving and departing aircraft until the alert is broadcast on the ATIS and pilots indicate they have received the appropriate ATIS code. A statement "LOW LEVEL WIND SHEAR ADVISORIES IN EFFECT" shall be included on the ATIS for 20 minutes following the last report or indication of wind shear.*

## 1.8 Aids to Navigation

This accident was unrelated to aids to navigation.

## 1.9 Communications

This accident was unrelated to communications.

## 1.10 Airport Information

### 1.10.1 General

Sungshan Airport is sited on 2.6 nautical miles northeast of Taipei metropolis. The location of airport reference point is 25◦04’10”N/121◦33’06”E. The aerodrome reference code in this airport is 4D[11]。

According to Aeronautical Information Publication (AIP) -Taipei Flight Information Region（Version of RCCS 2-1, 18th March 2004）, a runway in Sungshan Airport is designated 10/28. Runway 10/28 is 60 meter wide, 2,605 meter long. Non-grooved asphalt concrete was overlayed on runway pavement. The airport elevation is 8ft. The stopway of Runway 10 is 60 meter wide and 160 meter long. And the stopway of Runway 28 is 60 meter wide and 60 meter long.

### 1.10.2 Runway Safety Area

According to AIP, the runway strip is 300 meter wide（990ft）and 2,765 meter long（9,072ft）. The nearest distance from north fence（9 ft height）to the centerline marking and its extension of Runway10 is 44.89 meter, as shown in Figure 1.10-1（RCSS AD 2-40, revised edition on 09/02/2004.）.

According to ASC’s survey, the airport fence is composited of hollow bricks and reinforced concrete. It is located 15 meter to the north of Runway 28 threshold edgeline marking and irregular extension in parallel with runway. Its surface is coloured in alternatively red and white. The area from airport fence to 150 meter to the north of the runway centerline marking and its extension exists some houses constructed with steel and sheet metal, and junk yards some discarded vehicles and materials were stored. There is an uncovered ditch in parallel with runway. The ditch is located on 43 to 69 meter to the north of the centerline of Runway 10 stopway. It is about 1.4 to 2.5 meter wide and 1 to 1.5 meter depth.

There is no information regarding Runway End Safety Area in AIP.

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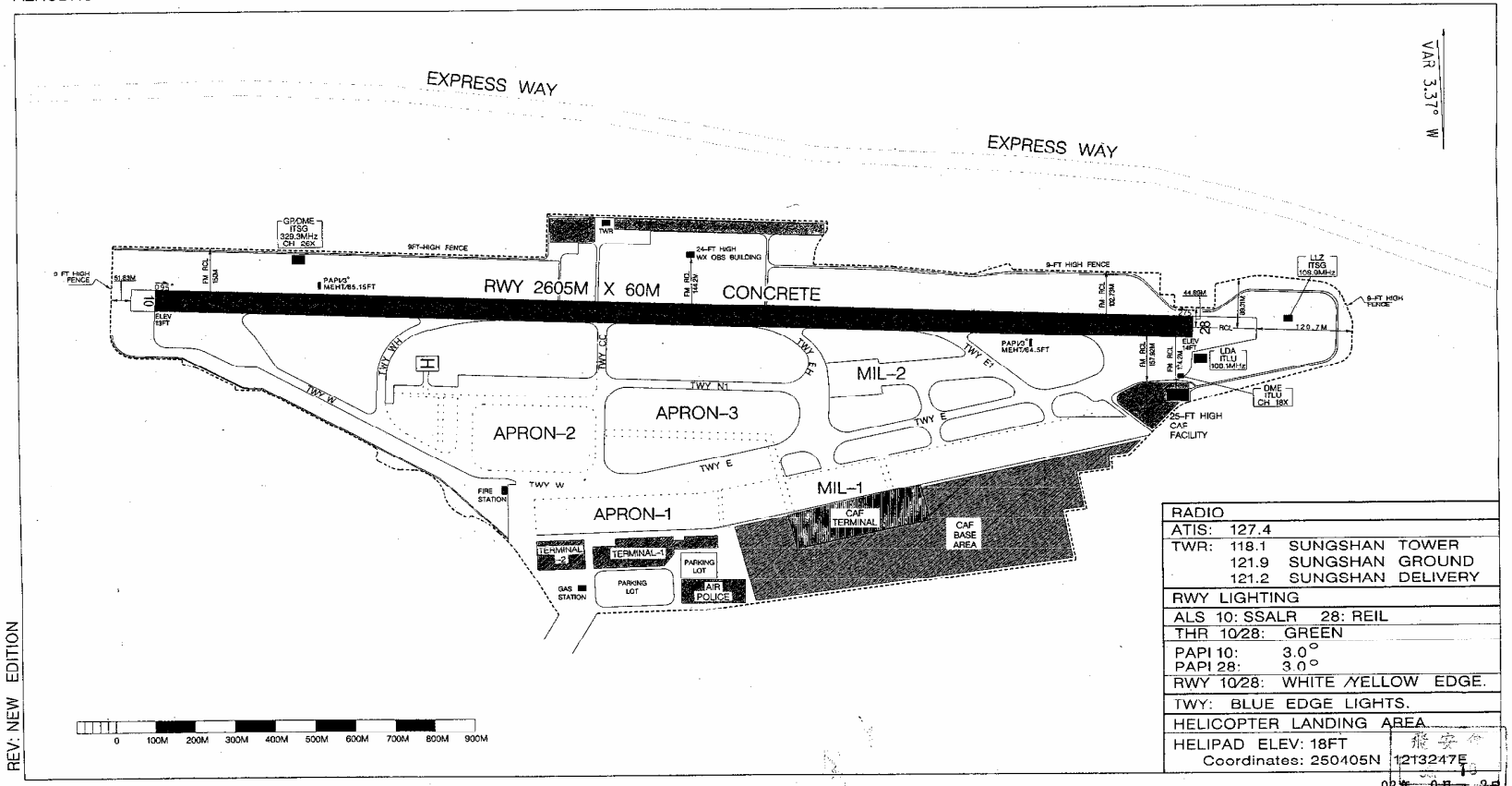
[11] 4(Aerodrome reference code number): The highest value of the aeroplane reference field length of the aeroplanes for which the runway is intended is 1800m and over； D(Aerodrome reference code letter)：The greatest wing span whichever gives the more demanding code letter of the aeroplanes for which the facility is intended is 36m up to but not including 52m, or the greatest outer main gear wheel span is 9m up to but not including 14m.

機場圖
AERODROME CHART

ELEV 18 FT
ARP: 250410N 1213306E

TAIPEI/SUNGSHAN AD




中華民國交通部民用航空局
Civil Aeronautic Administration
Republic of China

Figure 1.10-1Layout of Sungshan Airport

### 1.10.3 Regulations regaring Runway Safety Area

According to 「Civil Aerodrome Design and Operation Standard」（v1.1, July 2004）, paragraph 3.3.2：

*"A strip shall extend before the threshold and beyond the end of the runway or stopway for a distance of at least：*

*- 60m where the code number is 2,3,4…."*

Paragraph 3.3.3：

*"A strip including a precision approach runway shall extend laterally to a distance of at least：*

*- 150 m where the code number is 3 or 4."*

Paragraph 3.3.8：

*"That portion of a strip of an instrument runway within a distance of at least：*

*- 75m where the code number is 3 or 4…*

*from the centre line of the runway and its extended centre line shall provide a graded area for aeroplanes which the runway extended to serve in the event of an aeroplane running off the runway.*

*Note. – Guidance on the grading of a great area of a strip including a precision approach runway where the code number 3 or 4 is given in Attachment A, section8.* " (See Figure1.10-2)

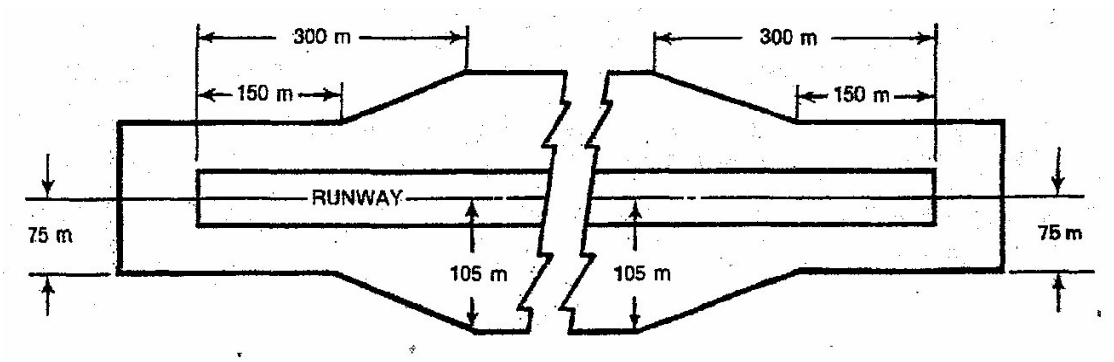



Figure 1.10-2Graded portion of a strip including a precision approach runway where the code number is 3 or 4

Paragraph 3.4.1：

*"A runway end safety area shall be provided at each end of a runway strip where the code number is 3 or 4."*

Paragraph 3.4.2：

*"A runway end safety area shall extend from the end of a runway strip to a distance of at least 90m."*

Paragraph 3.4.4：

*"The width of a runway end safety area shall be at least twice that of the associated runway."*

### 1.10.4 Transverse Slope

According to the Sungshan Airport Elevation Diagram, which was measured and plotted by a CAA's contractor, the transverse slope （from runway centerline to runway edge, 30m for each side）of runway is shown in Table 1.10-1.

Table 1.10-1 the transverse slope of runway 10/28

| **Location** | **Runway 10 threshold** | **100**[12] | **200** | **300** | **400** | **500** | **600** | **700** | **800** | **900** | **1000** | **1100** | **1200** | **1300** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Transverse slope of north side（%） | 1.63[13] | 1.69 | 1.72 | 1.66 | 1.54 | 1.60 | 1.36 | 1.42 | 1.36 | 1.28 | 1.46 | 1.59 | 1.66 | 1.81 |
| Transverse slope of south side（%） | 1.37 | 1.43 | 1.83 | 1.60 | 1.43 | 1.77 | 1.90 | 2.00 | 1.73 | 1.97 | 1.80 | 1.80 | 2.17 | 1.83 |
| **Location** | **1400** | **1500** | **1600** | **1700** | **1800** | **1900** | **2000** | **2100** | **2200** | **2300** | **2400** | **2500** | **Runway 28 threshold** | |
| Transverse slope of north side（%） | 1.63 | 1.69 | 1.72 | 1.66 | 1.54 | 1.60 | 1.36 | 1.42 | 1.36 | 1.28 | 1.46 | 1.59 | 1.66 | |
| Transverse slope of south side（%） | 1.37 | 1.43 | 1.83 | 1.60 | 1.43 | 1.77 | 1.90 | 2.00 | 1.73 | 1.97 | 1.80 | 1.80 | 2.17 | |

[12] meter

[13] %

### 1.10.5 Regulations regarding transverse slope

According to 「Civil Aerodrome Design and Operation Standard」（v1.1, July 2004）, paragraph 3.1.18：

> *"To promte the most rapid drainage of water, the runway surface shall be cambered except where a single crossfall from high to low in the direction of the wind most frequently associated with rain whould ensure rapid drainage. The transverse slope shall ideally be：*
>
> *-1.5 per cent where the code letter is C, D, E or F; and*
>
> *-2 percent where the code letter is A or B;*
>
> *but in any event shall not exceed 1.5 per cent or 2 per cent, as practical, nor be less than 1 percent except at runway or taxiway intersections where flatter slopes may be necessary….*"

### 1.10.6 Maintenance Runway Skid Resistance

According to the interview records of the airport operators as follows：

1. CAA contracted periodical runway surface friction measurement to a consulting company. The measuring frequency at present is once per month based on the landing frequency of jet aircraft in Sungshan Airport.
2. Based on the monthly measurement report, the consulting company will provide recommendations for improvement. If the runway friction is lower than "minimun friction level", another company will clean up the accumulated rubber deposites, and then will measure the runway friction value again to ensure the quality of the corrective work. The runway friction value is based on the average friction value of the one third of the runway length or 100 meter.
3. The lastest time to overlay runway pavement was on June 2002. The runway friction value was ever lower than the minimun friction level before this occurrence.
4. There are no NOTAM regarding "*runway may be slippery when wet*". And airport flight operation division does not have any records regarding runway water patches for three months period before the occurrence.

According to the monthly friction measurement report, the measurement of the runway friction value was from 3 meter of the runway centerline marking on both sides. It was ICAO certified test equipment "Grip Tester". There were two measuring routes, one was from north of Runway 10 threshold to Runway 28

threshold and then turned to south of Runway 10 threshold, and then reverse its route to complete another measurement. The measuring speed was 65 km/hr, and the water depth was 1.00 mm.

The Sungshan Airport conducted monthly friction measurement on September 29th and Octorber 22th..

According to the runway friction monthly measurement report, a measurement was conducted on September 29th, the lowest mean friction value was sited on the first section of one-third of runway from Runway 10 threshold. And the mean friction values between 400 and 700 meter from Runway 10 threshold were lower. This area was the touch down zone and the main area to accumulate rubber deposites. There were recommendations for Sungshan Airport in this report：

1. *Immediately to take corrective action in area between 210 and 810 meter from Runway 10 threshold. The runway friction value in this area was lower than FAA's "the minimum friction level".*
2. *To remove rubber deposites and groove runway pavement to promote the skid resistance performance on runway.*

According to the runway friction monthly measurement report, another measurement was conducted on Octorber 22th, the lowest mean friction value was sited on the first section of the one-third of runway from Runway 10 threshold. Comparing with the previous measurement conducted in September, the friction values in the second and the third section of the one-third of runway from Runway 10 threshold were deteriorating. The mean value friction value between 400 and 600 meter from Runway 10 threshold was lower. This area was touch down zone and the main area to accumulate rubber deposites. There were recommendations for Sungshan Airport in this report：

1. *Immediately to take corrective actions between 210 and 750 meter from Runway 10 threshold. The runway friction value in this area was lower than FAA's "the minimum friction level".*
2. *Comparing with the previous measurement conducted in September, the mean friction values between 900 meter from Runway 10 threshold and Runway 28 threshold were deteriorating due to high frequency of aircraft operating. It should be continuously monitored.*
3. *To remove rubber deposites and groove runway pavement for promote the skid resistance performance on runway.*

There were two rubber deposites removal actions conducted and the measurements were taken on October 7th and14th. On October 14th, this runway conducted three tests including "GripTester friction measurement", "DF-Tester friction measurement" and "Pavement texture depth measurement". The measurement reports stated that the accumulated rubber deposites has severely covered on pavement surface and compacted

into runway texture on the Runway 10 touch down zone. This report also recommended using other rubber removal methods or groove runway to promote the skid resistance performance.

### 1.10.7 Regulations regarding Runway Friction Resistance

Accoring to「Sungshan Airport runway friction measurement and maintenance action regulations」drawed up by Sungshan Airport operater, paragraph 6.1：

> *"…When runway friction value is lower than the minimum friction level, airport operator shall immediately ask the contractor to conduct corrective action.*
>
> *If the duty officers of the flight operation division find standing water or flooded on runway or portion thereof, which may cause risk to aircrafts, they shall ask the maintenance division to inspect.*
>
> *If runway friction value is lower than the minimum friction level, the maintenance division shall ask the flight operation division to report " runway may be slippery when wet" in NOTAM."*

Paragraph 7.1：

> *"The maintenance division shall ask contractor to remove precipitant either the measured friction value lower than the maintenance level or the contaminant covering on runway marking which may cause runway slipperiness when wet."*

According to 「Civil Aerodrome Design and Operation Standard」（v1.1, July 2004）, paragraph 9.4.5：

> *"Measurements of the friction characteristics of a runway surface shall be made periodically with a continuous friction measuring device using self-wetting features."*

Paragraph 9.4.6：

> *"Corrective maintenance action shall be taken when the friction characterictics for either the entire runway or a portion thereof are below a minimum friction level specified by CAA.*
>
> *Note. – A portion of runway in the order of 100m long may be considered significant for maintenance or reporting action."*

Paragraph 9.4.8：

> *"Where there is reason to believe that the drainage characteristics*

*of a runway, or portions thereof, are poor due to slopes or depressions, then the runway friction characteristics shall be assessed under natural or simulated conditions that are representative of local rain and corrective maintenance actions shall be taken as neseccary."*

Attachment A Guidance Material Supplementary

Paragraph 5.1：

*"…The finished surface wearing course is to be of such regularity that, when tested with a 3m straight-edge placed anywhere in any direction on the surface, there is no deviation greater than 3mm between the bottom of the straight-edge and the surface of the pavement anywhere along the straight edge."*

Paragraph 5.4：

*"Deformation of the runway with time may aloso increase the possibility of the formation of water pools. Pools as shallow as approximately 3mm in depth, particularly if they are located where they are likely to be countered at high speed by landing aeroplanes, can induced aquaplaning…."*

Paragraph 7.3：

*"Friction tests of existing surface conditions shall be taken periodically in order to identify runways with low friction when wet. CAA shall define what minimum friction level it considers acceptable before a runway is classified as slippery when wet and publish this value in the State's aeronautical information publication (AIP). When the friction of runway is found to be below this reported value, then such information shall be promulgated by NOTAM. CAA shall also establish a maintenance planning level, below which, appropriate corrective maintenance action shall be initiated to improve the friction. However, when the friction characteristics for either the entire runway or a portion thereof are below the minimum friction level, corrective maintenance action must be taken without delay…."*

Paragraph 7.5：

*"When it is suspected that the friction characteristics of a runway may be reduced because of poor drainage, owing to inadequate slopes or depressions, then an additional test shall be made, but this time under natural conditions representative of a local rain. This test differs from the previous one in that water depths in the poorly cleared areas are normally greater in a local rain condition. The test results are thus more apt to identify problem areas having low friction values that could induce aquaplaning than the previous test.*

*If circumstances do not permit tests to be conducted during natural conditions representative of a rain, then this condition may be simulated."*

Paragraph 7.9：

*"Civil Aerodrome Design and Operation Standard requires to specify two friction levels as follows:*

*a）a maintenance friction level below which corrective maintence action should be initiated;and*

*b）a minimum friction level below which information that a runway may be slippery when wet shall be made available.*

*Furthermore, CAA shall establish criteria for the friction characteristics of new or resurfaced runway surfaces. Table A-1 provides guidance on establishing the design objective for new runway surfaces and maintenance planning and minimum friction levels for runway surfaces in use."*

Table A-1.

| Test equipment | Test tire | | Test speed (km/h) | Test water depth (mm) | Design objective for new surface | Maintenance planning level | Minimum friction level |
|---|---|---|---|---|---|---|---|
| | Type | Pressure (kPa) | | | | | |
| (1) | (2) | | (3) | (4) | (5) | (6) | (7) |
| Mu-meter Trailer | A | 70 | 65 | 1.0 | 0.72 | 0.52 | 0.42 |
| | A | 70 | 95 | 1.0 | 0.66 | 0.38 | 0.26 |
| Skiddometer Trailer | B | 210 | 65 | 1.0 | 0.82 | 0.60 | 0.50 |
| | B | 210 | 95 | 1.0 | 0.74 | 0.47 | 0.34 |
| Surface Friction Tester Vehicle | B | 210 | 65 | 1.0 | 0.82 | 0.60 | 0.50 |
| | B | 210 | 95 | 1.0 | 0.74 | 0.47 | 0.34 |
| Runway Friction Tester Vehicle | B | 210 | 65 | 1.0 | 0.82 | 0.60 | 0.50 |
| | B | 210 | 95 | 1.0 | 0.74 | 0.54 | 0.41 |
| TATRA Friction Tester Vehicle | B | 210 | 65 | 1.0 | 0.76 | 0.57 | 0.48 |
| | B | 210 | 95 | 1.0 | 0.67 | 0.52 | 0.42 |
| GRIPTESTER Trailer | C | 140 | 65 | 1.0 | 0.74 | 0.53 | 0.43 |
| | C | 140 | 95 | 1.0 | 0.64 | 0.36 | 0.24 |

## 1.11 Flight Recorders

### 1.11.1 Cockpit Voice Recorder

This aircraft was equipped with a Solid State Cockpit Voice Recorder (CVR), model Fairchild A200S, part number S200-0012-00, serial number 01471. The recording of 120-minute duration was downloaded properly. Quality of the recording was good.

The last 30 minutes of the recording was transcribed as in Appendix 1. The transcript was synchronized with the Digital Flight Data Recorder (FDR) data based on the FDR time parameter[14]. The transcript contained the GE 536 climbing to the cruising level, cruising, descending, landing, landing rolling, skidding off the runway and the flight crew asking for ground support. After the aircraft skidding off the runway, the CVR was temporarily stopped resulting from shutdown of the engine by the flight crew and resume power after the Auxiliary Power Unit (APU) activated. The CVR finally stopped as the flight crew pulled the Circuit Brake (CB).

### 1.11.2 Flight Data Recorder

This aircraft was equipped with a Flight Data Recorder (FDR), manufacturer L3 Communication Inc, part number S800-3000-00, serial number 00703, and have the ability to record 50 hours of data.

According to the converting algorithms[15], totally 179 parameters were recorded in theFDR. All the recorded parameters were listed in Appendix 2. Detail results are plot in Figure 1.11-1 ~ Figure 1.11-2. Summary of the FDR Readout as follows:

1. The Flight Data Recorder complies with Civil Aviation Law- “07-02A Aircraft Flight Operation Management Regulations,” and ICAO Annex 6 “Type 1” Flight Data Recorder, satisfactory to record the 32 mandatory parameters.
2. The GE 536 flight started recording at 1930.

---

[14] The CVR and FDR recordings were synchronized by VHF keying before the recorders stopped. The time format for the transcript has been transferred to Taipei local time while the DFDR data were described in UTC format.

[15] Source BEA Flight Recorders Lab, A/C:A320/200 Engine: IAE V2527-A5；FDIU SAGEM P/N ED43A1D5；ARINCE 573/717 128 Word/s

3. According to earlier CVR recording, at 1917:21. The first officer said: “brake test” and the captain replied: “check”. After comparing with the FDR data, the brake pedal position and brake pressure quantity varied during 1917:21 to 1917:23 due to the execution of this check item.

4. During final approach, GE536 engaged autopilot and autothrottle. The deceleration rate of Auto Brake armed at “Medium[16],” before landing; “Anti-skid selector” set at “ON”; Three Hydraulic pressures of “Hydraulic pressure Yellow/Green/Blue” are “Normal”; “Normal brake fault” is “no fault”; “Alternate braking” didn’t activate; “Antiskid fault” is “no fault”.

5. At 1940:29, GE536 started descent, airspeed 319 knots.

6. At 1956:45, ground spoiler armed, airspeed 158 knots, radio altitude 1576 feet, magnetic heading 081 deg, wind 001 deg at 43 knots.

7. Configuration of Slat/flap lever position- at 1957:11 flap configured at “3”, flap position 20 deg, with airspeed 151.9 knots, radio altitude 1751 feet, magnetic heading 079 deg, wind 001 deg at 43 knots.

8. At 1959:04, autopilot was disengaged, airspeed 144 knots, radio altitude 282 feet, magnetic heading 094 deg, wind 009 deg at 42 knots. Both Thrust Lever angle (TLA) were 22.5 deg.

9. At 1959:14, radio altitude 100 ft, airspeed 137.6 knots, magnetic heading 092 deg, and wind 340 deg at 7 knots. Both TLAs were22.5 deg.

10. At 1959:21, radio altitude 50 feet, airspeed 135.8 knots, magnetic heading 093 deg, and wind 338 deg at 5 knots. Both TLAs were 22.5 deg.

11. At 1959:23, radio altitude 23 feet, airspeed 141.6 knots, magnetic heading 094 deg, and wind 305 deg at 8 knots. Both TLAs were 22.5 deg.

12. 1 second (1959:26) prior to main landing gear touched ground, airspeed 133.8 knots, radio altitude -1 feet, magnet heading 094 deg, wind 297 deg at 11 knots. Left- and right- TLA were19.7 deg, and 22.5 deg, respectively.

13. At 1959:27, main landing gear touched ground, maximum vertical acceleration 1.38 G, the parameter of “Compressed shock absorber” switched from “Air” to “Ground”, with airspeed 137.6 knots, radio altitude -2 feet, magnetic heading 093 deg, wind 297 deg at 11 knots. Left- and right- TLA were 19.7 deg, and 22.5 deg, respectively,

14. 3 seconds posterior to main landing gear touched ground (1959:30), nose gear touched ground, airspeed 140 knots, magnetic heading 095 deg, wind 269 deg at 4 knots. Left- and right- TLA were -22.5 deg, and 22.5 deg, respectively.

15. At 1959:32, auto-throttle disengaged (posterior 5 seconds to main landing touched ground), airspeed 139.6 knots, magnetic heading 095 deg, Left- and right- TLA were -22.5 deg, and 22.5 deg, respectively.

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[16] Medium deceleration: its deceleration rate is set at 3.0 meter/$s^2$

16. Since main landing touched ground (1959:27) until GE536 stopped (2000:47), the ground spoilers have not been deployed.

17. From 1959:32 to 2000:35, Left- Thrust Reverser was full deployed, and right- Thrust Reverser was retracted. The relevant parameters of magnetic heading, TLA and EPR listing in Table 1.11-1:

Table 1.11-1 The relevant parameters of magnetic heading, TLA and EPR

| Time | Left-TLA (deg)<br>Left- EPR (%) | Right -TLA (deg)<br>Right - EPR (%) |
|---|---|---|
| 1959:32<br>\|<br>1959:38 | -22 ~ -22<br>0.99 ↑ 1.03 | 22.5 ~ 22.5<br>1.08 ~ 1.08 |
| | Magnetic heading: 95.3 → 94.6 →96.3 | |
| 1959:39<br>\|<br>1200:00 | -8 ~ -8<br>1.03 ↓ 0.99 | 22.5 ~ 22.5<br>1.08 ~1.08 |
| | Magnetic heading: 97.0 → 94.0 →98.4 | |
| 1200:01<br>\|<br>1200:12 | -20 ~ -20<br>0.99 ↑ 1.06 | 22.5 ~ 22.5<br>1.08 ~1.08 |
| | Magnetic heading: 97.0 → 95.3 →51.0 | |
| 1200:13<br>\|<br>1200:35 | --8 ~ -8<br>1.05 ↓ 1.00 | 22.5 ~ 22.5<br>1.08 ~1.08 |
| | Magnetic heading: 39.4 → 13 →1.4 | |
| Note: ↑ Increase ; ↓Decrease | | |

18. During landing roll operation, the relevant parameters of brake pedal position (BPP), normal brake pressure(NBP) and ground speed are listing in Table 1.11-2:

Table 1.11-2 The relevant parameters of BPP, NBP and ground speed

| Time | Left-BPP(deg)/<br>Left-NBP(psi) | Right-BPP(deg)/<br>Right-NBP (psi) | Ground speed (GS)<br>Deceleration Rate (DR) |
|---|---|---|---|
| 1959:30<br>\|<br>1959:39 | 0 ~ 0<br>0 ~ 0 | 2 ~ 10<br>0 ~ 64 | GS146 knots ~ 131 knots<br>average DR 1.0 m/s2 |
| 1959:40<br>\|<br>1959:44 | 28 ~ 16<br>192 ~ 256 | 46 ~ 78<br>192 ~ 320 | GS128 knots ~ 124 knots<br>average DR 1.3 m/s2 |
| 1959:45<br>\|<br>1959:48 | 54 ~ 72<br>256 ~ 512 | 78 ~ 80<br>192 ~ 384 | GS121 knots ~ 115 knots<br>average DR 1.6 m/s2 |

| Time | Left-BPP(deg)/ Left-NBP(psi) | Right-BPP(deg)/ Right-NBP (psi) | Ground speed (GS) Deceleration Rate (DR) |
|---|---|---|---|
| 1959:49 \| 2000:00 | 78 ~ 80<br>860 ~ 1536 | 78 ~ 80<br>384 ~ 1088 | GS111 knots ~ 75 knots<br>average DR 1.9 m/s2 |
| 2000:01 \| 2000:15 | 78 ~ 80<br>1280 ~ 192 | 78 ~ 80<br>640 ~ 256 | GS69 knots ~ 12 knots<br>average DR 2.0 m/s2 |
| 2000:16 \| 2000:47 | 78 ~ 72<br>2496 ~ 64 | 70 ~ 74<br>1792 ~ 64 | GS12 knots ~ 0 knots<br>average DR 1.0m/s2 |
| ***Note: Brake pedal position Resolution = 2 deg***<br>***Normal brake pressure Resolution = 64 Psi*** | | | |

19. After touched ground, between 2000:08 and 2000:48, rudder position is recorded at right 25 deg; between 2000:10 and 2000:13, the roll operating of F/O's side stick reached maximum right roll of 20 deg.

20. At 2000:05, GE536 started drifted to left-side. (after main landing gear touched ground 39 seconds), airspeed 56.6 knots, ground speed 55 knots, heading 93.5 deg.

21. Between 2000:15.75 to 2000:17, GE536 stopped rolling, airspeed 0 knots, ground speed decreased from 12 knots to 1 knots, magnetic heading left drafted from 13 deg to 01.4 deg. During this period, the parameter "Compressed shock absorber" transit from "Ground" to "Air".

22. Between 2000:37 to 2000:40, right-TLA retracted to IDLE position (22.5 deg retracted to -3 deg).

23. At 2000:4, FDR stopped recording, airspeed 0 knots, ground speed 0 knots, and magnetic heading 002 deg.

The touched ground position and timing is determined by parameters of "Landing Gear RH/LH Compressed Shock Absorber" and maximum vertical acceleration, as shown in Figure 1.11-3. At 1959:27, main landing gear touched ground at 1,750 feet beyond the threshold of runway 10. At 1959:37, Captain called out "No brake", the GE536 located at 4,000 ft beyond the threshold of Runway 10.

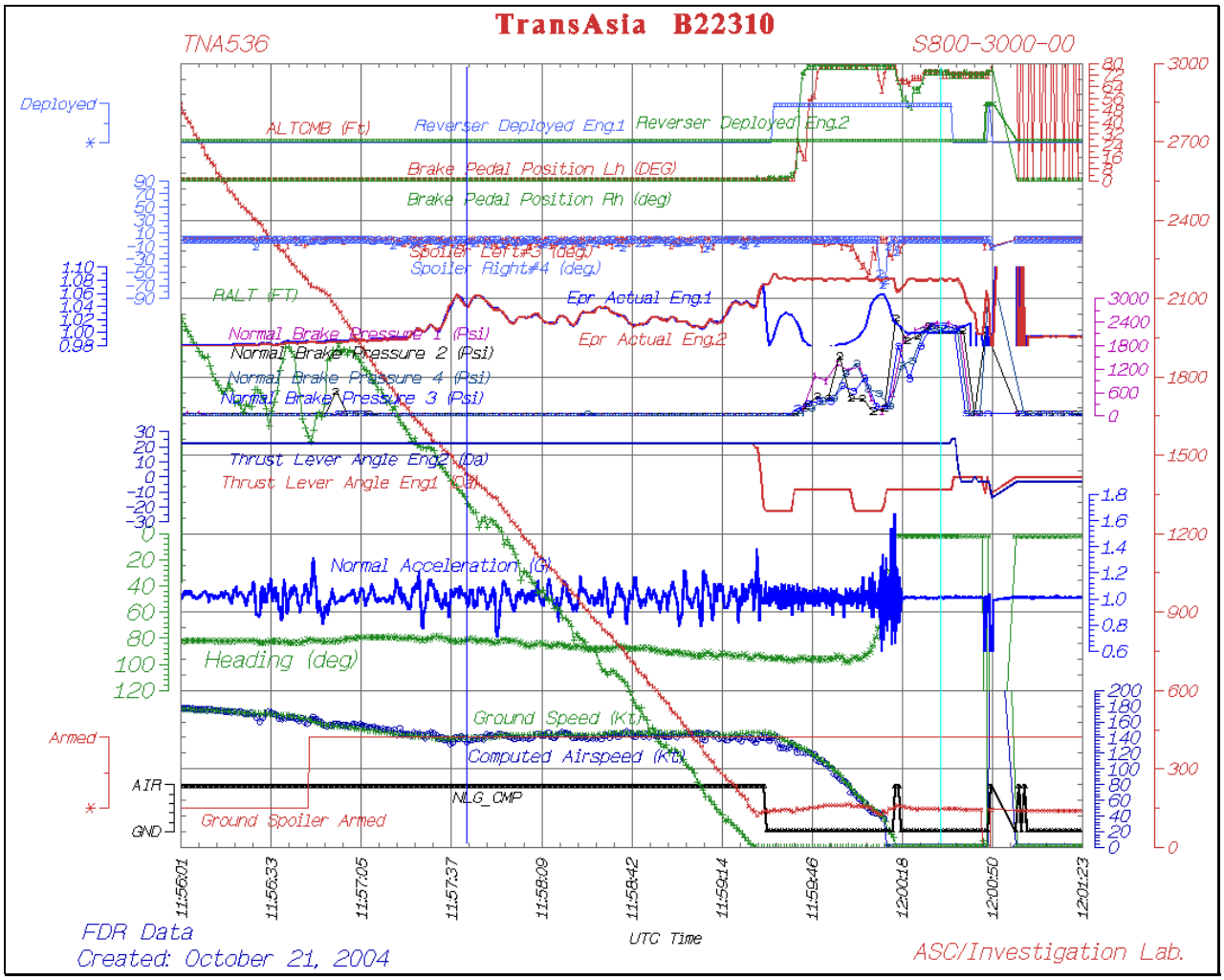



Figure 1.11-1 Flight Data Plot[17] (Final Approach, Landing and Deceleration)

[17] The flight data were all plotted in UTC time format.

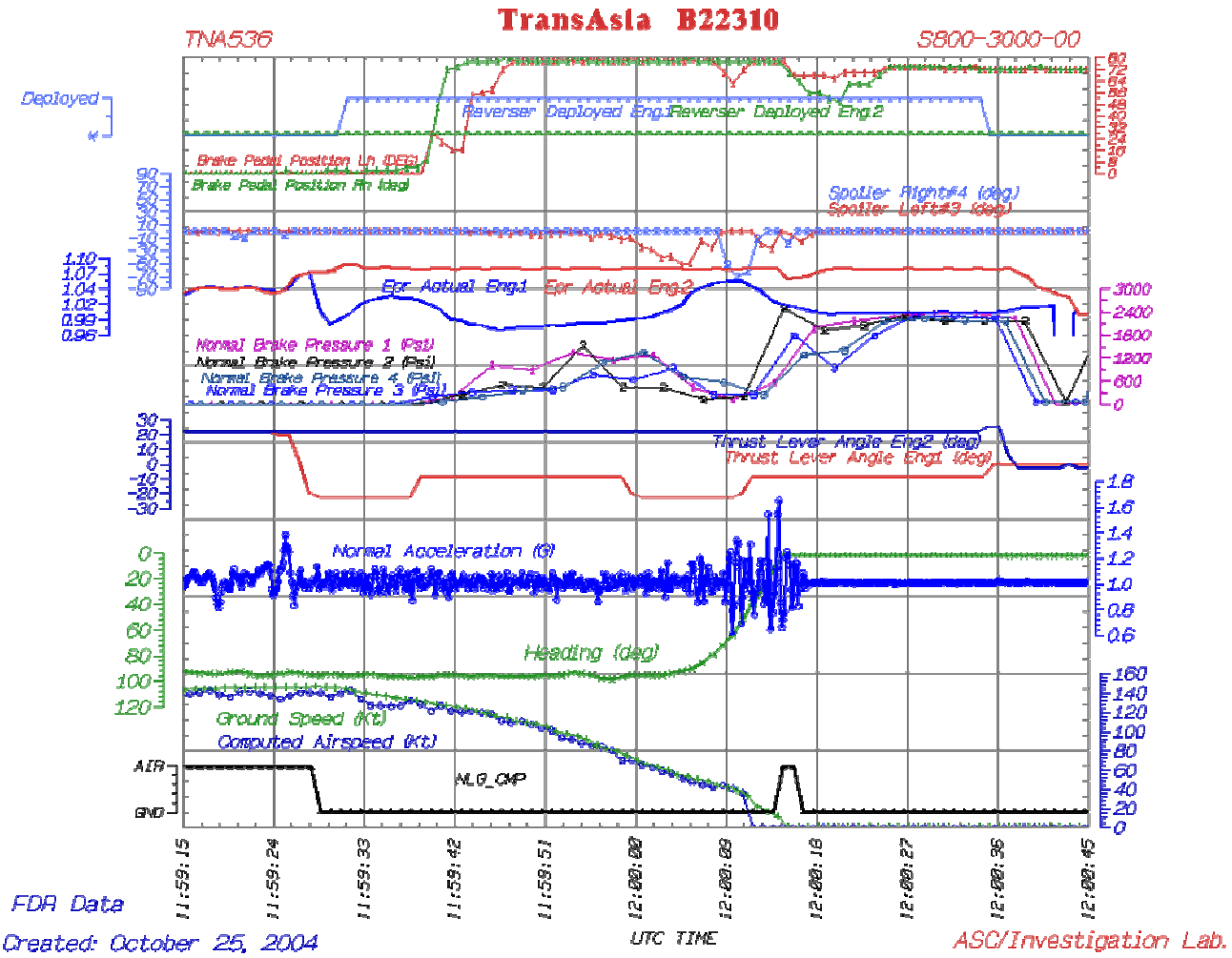
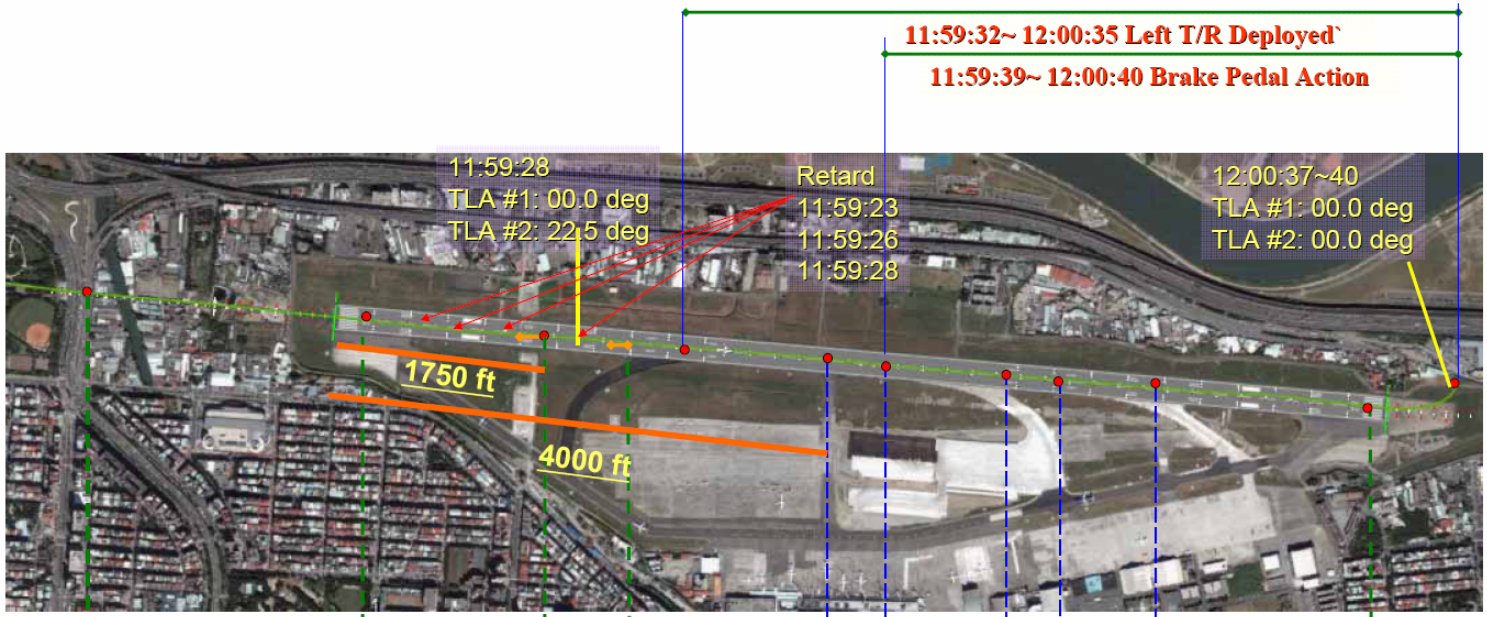



Figure 1.11-2 Flight Data Plot（Landing and Deceleration）




| UTC Time | CVR | CVR | FDR GSPD (Kts) |
|---|---|---|---|
| (a) 1159:37 | CAM1 | 沒有煞車喔 | 135 |
| (b) 1159:39 | CAM1 | 沒有煞車喔 | 132 |
| (c) 1159:44 | CAM1 | 沒有煞車 | 124 |
| (d) 1159:46 | CAM1 | 沒有煞車喔 | 119 |
| (e) 1159:50 | CAM1 | 完全沒有煞車 | 109 |

Figure 1.11-3 Superpose of Flight Path and Satellite Image（Time, Flight Path, FDR Parameters, and CVR Transcripts）

## 1.12 Wreckage and Impact Information

The following damage assessment is based upon A320 AMM task 05-51-24 as a basis.

### 1.12.1 Damaged and Contaminated Areas

The damaged（red point） and contaminated area （blue point）of the aircraft are shown in Figure 1.12-1.

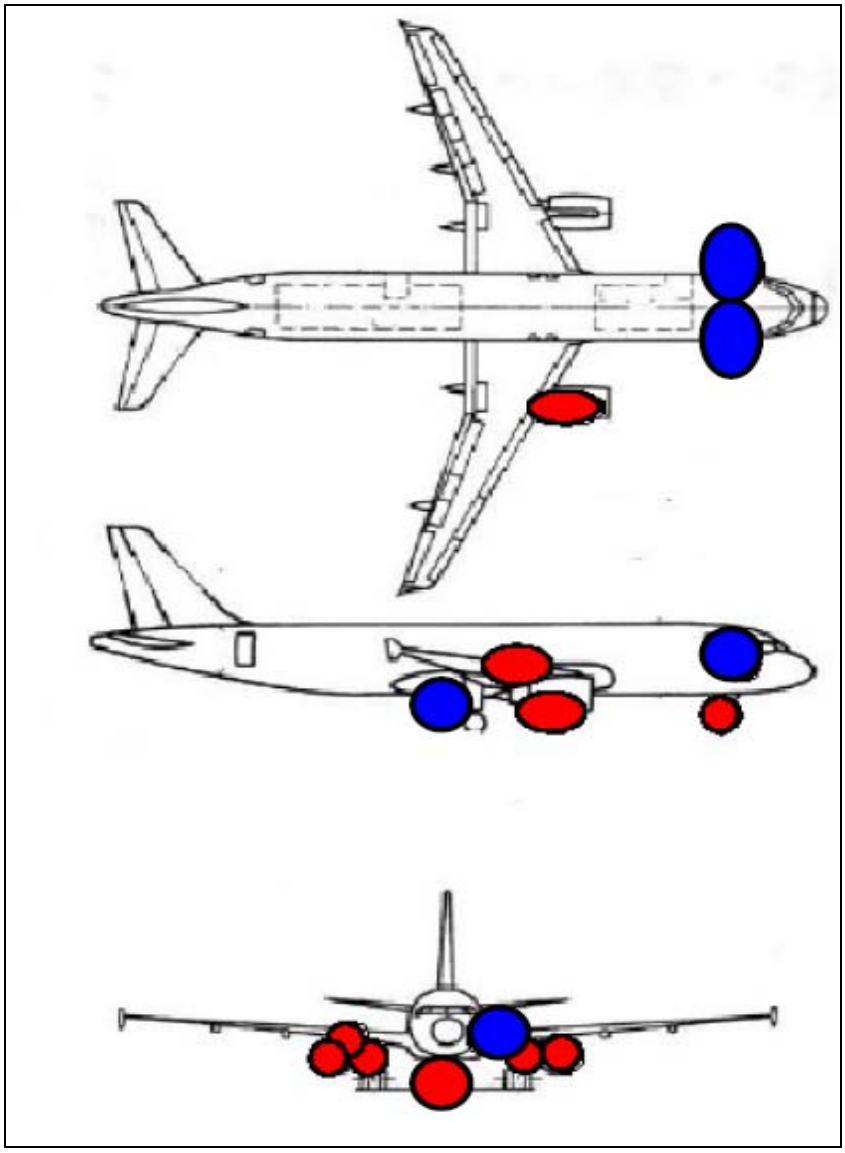


Figure 1.12-1The damaged and contaminated area of the aircraft

**Fuselage Area**

- No fuselage impacts noted.
- Contamination observed at the pitot/ static ports and air conditioning pack intakes.
- Anti collision light lens chipped.

**Nose Landing Gear Area**

- No visual damage noted at the NLG attachment or to the bay structure.
- Sliding tube broken and associated harnesses destroyed（Figure 1.12-2,3）.
- NLG Aft door (LH and RH) damaged during recovery（Figure 1.12-4）.

Figure 1.12-2NLG Sliding tube broken and associated harnesses destroyed

Figure 1.12-3NLG without broken sliding tube

Figure 1.12-4Deformation and dent to NLG Aft doors

**Main Landing Gear Area**

- No visual damage noted at the MLG attachments or to the bay structure.
- Damage noted to LH tire due to contact with runway object.
- LH and RH MLG experienced damage to the electrical and hydraulic systems on the casing during recovery. Compression of the systems against casing has scratches to the surface of both assemblies（Figure 1.12-5, 6）
- LH MLG door minor seal detachment noted. Not considered occurrence related.

Figure 1.12-5LH MLG electrical and hydraulic systems damage

Figure 1.12-6LH MLG Scratches – max depth 0.5mm

**LH Engine**

- Three fan blades and cone damage（Figure 1.12-7, 8）;
- 5 damage locations noted on the LH Nose cowl (four on the inner surface and one external)（Figure 1.12-9, 10）.

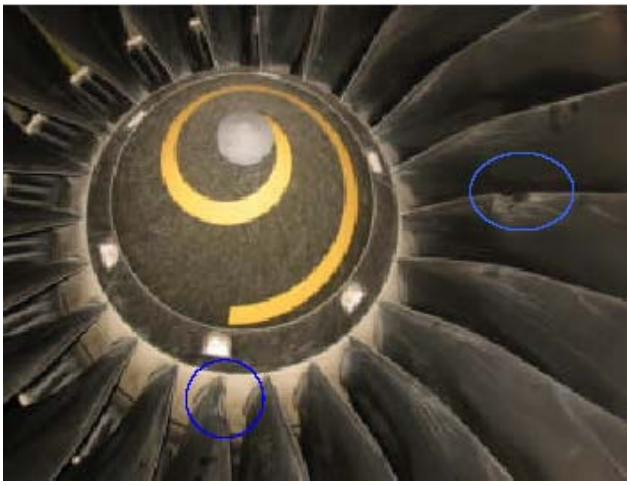


Figure 1.12-7Fan damage

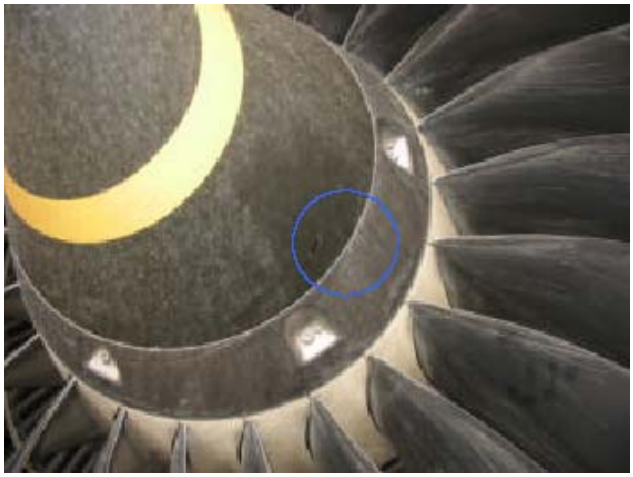


Figure 1.12-8Cone scratch

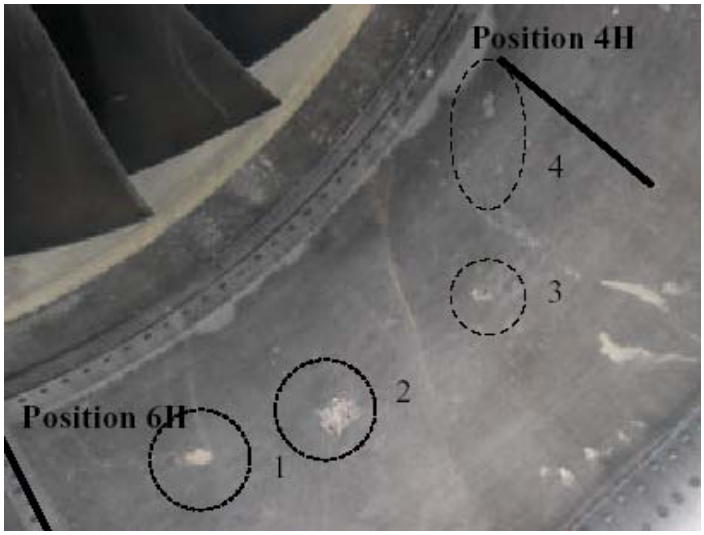



Figure 1.12-9Inner Surface damage

Figure 1.12-10 External Damage

**LH Nacelle Area**

- No visual damage noted to the pylon structure.

**LH Wing**

- Landing light damaged（Figure 1.12-11）

Figure 1.12-11 Landing light damaged

**RH Engine**

- Two fan blades noted damaged（Figure 1.12-12）.
- Piping bent, lower drain missing（Figure 1.12-13）.
- Lateral cooler damaged（Figure 1.12-14）.
- Extensive damage noted on the nose cowl, fan cowl and thrust reverser（Figure 1.12-15）.

Figure 1.12-12 Fan damage

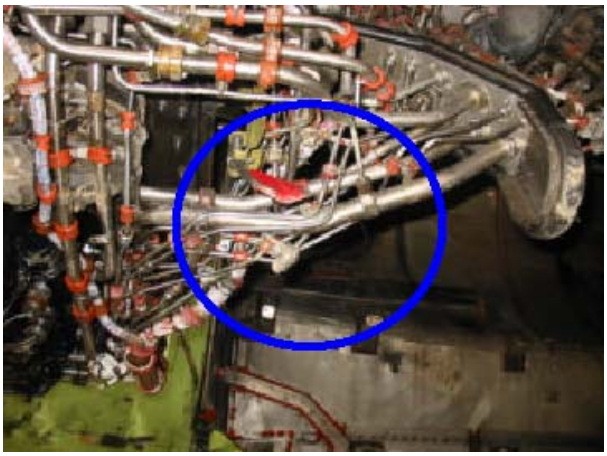


Figure 1.12-13 Bent Pipes, lower drain missing

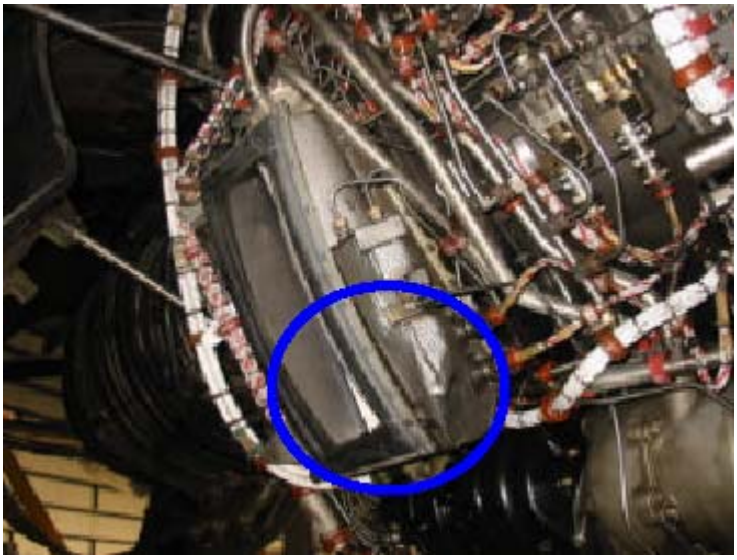


Figure 1.12-14 Lateral cooler damaged

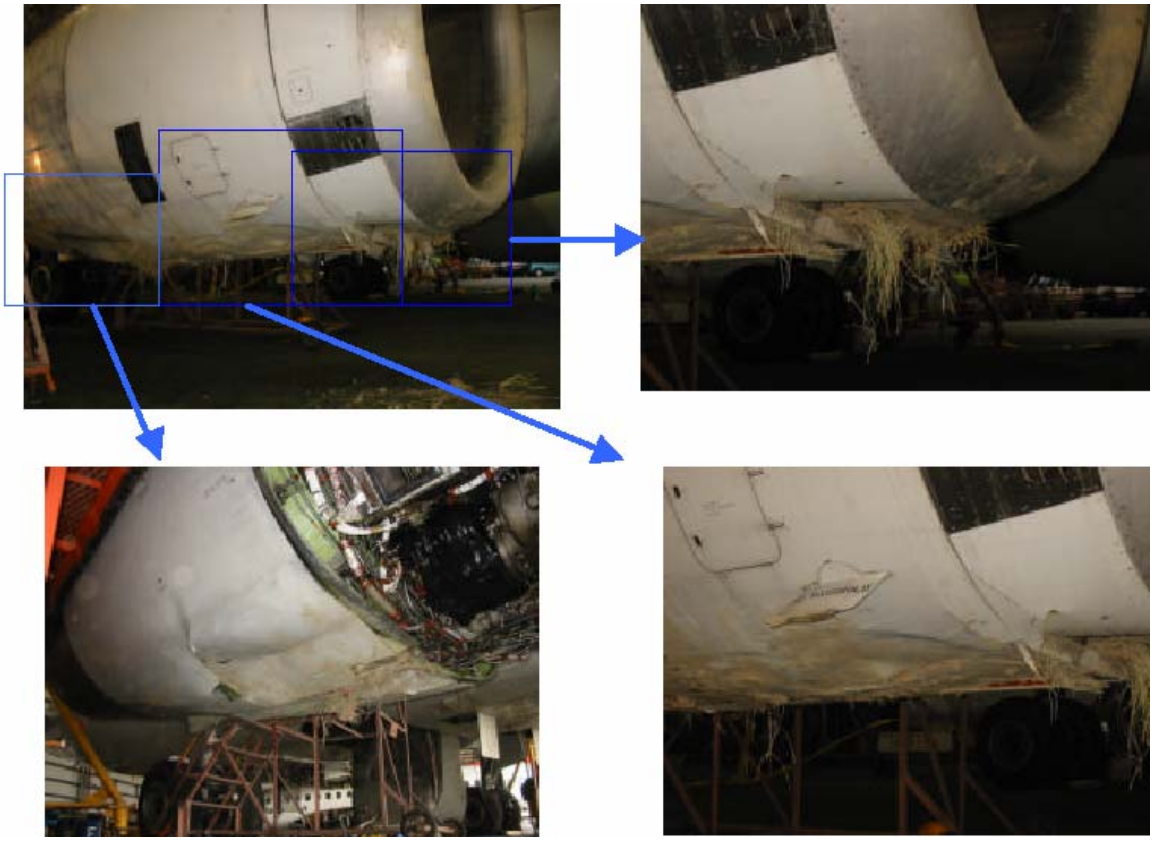


Figure 1.12-15 Nacelle Overview

**RH Pylon**

- No visible damage to the attachment points.
- Lateral panel deformation and fastener pulling（Figure 1.12-16）.
- Upper panel deformation/ fastener pulling（Figure 1.12-17~20）
- Closing panel and fairing damage（Figure 1.12-21）.
- Cantilever deformation（Figure 1.12-22）

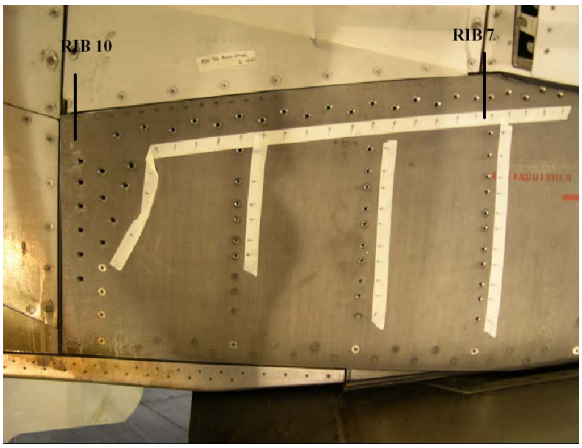



Figure 1.12-16 Lateral Panel Pulled fasteners

Figure 1.12-17 Upper Panel Pulled fasteners

Figure 1.12-18 Internal profile deformed.

Figure 1.12-19 Twisting of the lower profile

Figure 1.12-20 Vertical Profiles deformed

Figure 1.12-21 Fairings deformed

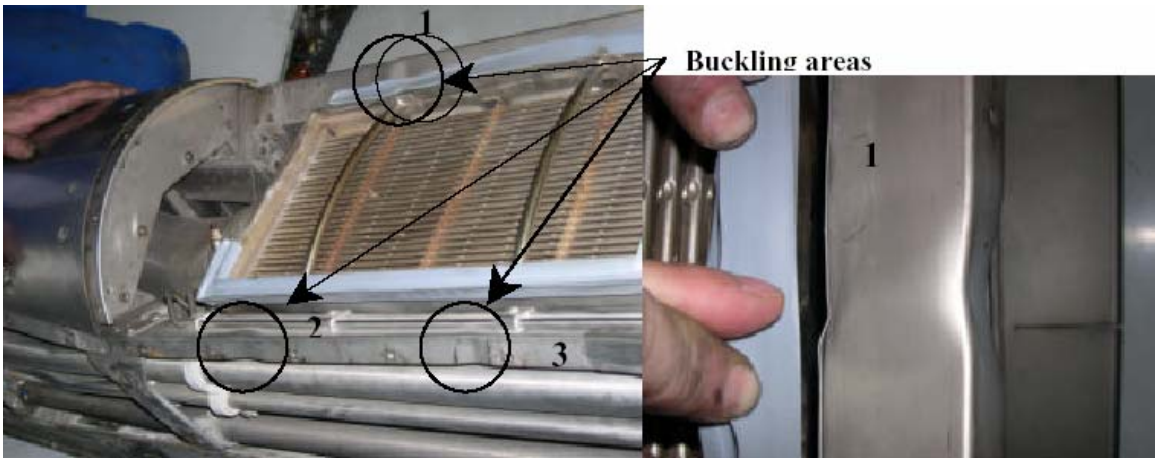



Figure 1.12-22 Upper cantilever angle buckling

**RH Wing**

- Damage noted to No. 1 Slat near pylon, leading edge lower skin exhibited a 25mm ×75mm dent（Figure 1.12-23）, leading edge upper skin exhibited a 25mm ×90mm dent（Figure 1.12-24）.

Figure 1.12-23 leading edge lower skin exhibited a 25mm ×75mm dent

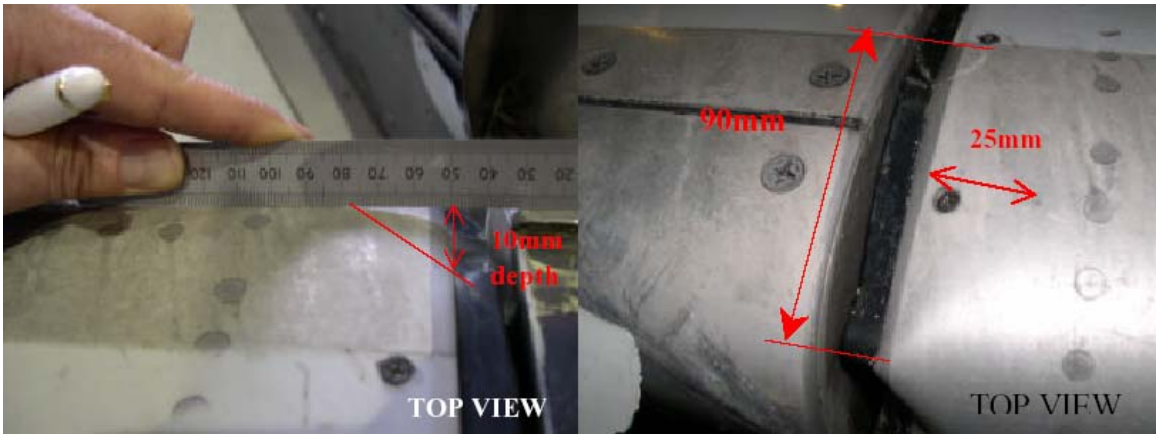



Figure 1.12-24 leading edge upper skin exhibited a 25mm ×90mm dent

## 1.13 Medical and Pathology

The CM-1 and CM-2 got an alcohol test at 2135 on the accident date. The results of the test showed the their alcohol levels were normal. .

## 1.14 Fire

There was no fire in this occurrence.

## 1.15 Survival Factors

Based on the tower control transcript, CVR transcript, and pilot interview records, it is noted that the CM-1 informed tower for help after the aircraft veer-off the runway. The CM-1 used the PA to announce “attention crew at station”. The pilots then shut down the engines and started APU to supply power. CM-1 told the purser to prepare to evacuate the passengers.

Based on the CVR transcript and the purser’s interview record, she sensed the aircraft speed was not reduced as usual during the landing roll. She sensed more severed vibration and noise than routing flight. The aircraft stopped approximately 20 second after touch down. There was no loud bang during the final impact. She heard the announcement of “attention crew at station” from cockpit via PA. The cabin crew judged that the situation was a “forced landing without preparation”. The purser stated that four cabin crews stayed at their designated positions and judged whether their exits were safe for evacuation. The purser used interphone to verify the exit conditions after the visual check with the other cabin crews. The responses from the cabin crews indicated no fire and smoke at the exterior of exits. The purser comforted the passengers and ask them to stay in the seat for further instruction. The CM-1 called the purser to the cockpit and told her that the ground support would arrive very soon. The CM-1 suggested the purser to evacuate passengers from the rear exits via the airport service stairs.

After leaving the cockpit, the purser opened 1L exit and talked to firemen who were on the ground. The firemen and the purser exchanged information to confirm that the aircraft did not catch fire and cabin was safe.

Although the purser was told to evacuate passengers from the rear exit via the airport service stairs, she considered that the height of the rear exit was not suitable to use the airport service stairs. After discussion with the ground handling personnel and other cabin crews, the purser decided to evacuate passengers by 1L door slide, then informed CM-1 and announced it to the passengers.

The purser briefed the passengers of the way to jump slide and asked to

remove all sharp stuffs before stepping on the slide. The purser stated that the situation was not in emergency, and allowed passengers to take their personal belongings, except the big and heavy ones, to jump onto the slide. After all passengers evacuated, the cabin crew gathered the passengers and examined them for injury. No passenger reported injury during the evacuation. The purser stated that there did not use flashlight or megaphone because the electric power supply was normal and the cabin PA system was normal during evacuation.

## 1.16 Test and Research

### 1.16.1 Ground Spoilers Test

To test the automatic extension function of ground spoilers, on November 3, 2004, the investigation team performed tests at Transasia Airlines Hangar. There is no dedicated ground test procedure in A320 Aircraft Maintenance Manual for ground spoilers automatic extension function. Instead, the manufacturer provided a procedure of this test（refer to Appendix 3）. The methodology of this test is to drive the tachometers on each wheel with special tools. It simulated the wheel speed higher than 72 knots. When all wheel speed are higher than 72 knots and both throttle control levers are at idle positions, then all ground spoilers would automatically extend. When all wheel speed are higher than 72 knots and both throttle control levers are at climb position, all ground spoilers should stay at neutral position.

**First test:** Following is the initial conditions of automatic function test,

- Aircraft on ground;
- Speedbrake control lever at ARM position;
- Both throttle control levers at MCT T.O.（engines not running）; and
- Driving all four tachometers about 1,000RPM（589RPM is about ground speed 72 knots）.

While aircraft is at the above mentioned conditions, the test engineer moved both throttle control levers from MCT T.O. to idle position. While both throttle control levers at idle position, all ground spoiler automatically extended.

**Second test:** Following is the initial conditions of automatic function test,

- Aircraft on ground;
- Speedbrake control lever at ARM position;
- Both throttle control levers at MCT T.O.（engines not running）; and
- Driving all four tachometers about 1,000RPM.

While aircraft was at the above mentioned conditions, no.1 throttle control lever was moved from MCT T.O. to idle position. All ground spoilers stayed at neutral position. No.2 throttle control lever was moved to 22.5 degrees all ground spoilers stayed at neutral position. Continued to move no.1 throttle control lever to REV MAX position, all ground spoilers stayed at neutral position. The next step was to move no.2 throttle control lever toward idle position slowly. While no.2 throttle control levers passed 14.9 degrees, all ground spoiler automatically extended.

Under same initial conditions, the test engineer moved no.2 throttle control lever to idle position. All ground spoilers stayed at neutral position. No.1 throttle control lever was moved toward idle position. When no.1 throttle control lever passed 15 degrees, all ground spoilers automatic extended.

This test successfully demonstrated the relationships between throttle control lever position and automatic function of ground spoiler extension. One throttle control lever at 22.5 degrees and the other one throttle control lever stays at idle position or reverse thrust range, all ground spoilers stay at neutral position. When aircraft conditions are met and both throttle control levers position are less than 15 degrees, all ground spoiler extend automatically.

## 1.16.2 Condition Checks of Wheel & Brake and Thrust Reverse System

To verify the conditions and functions of wheel & brake and thrust reverse systems. Investigation team performed associated tests at Transasia Airlines Hangar from October 19, 2004 to October 27, 2004.

### 1.16.2.1 Wheel & Brake System

**Main tires inspection**

All four tires had deep cut damage (depth up to tread reinforcing ply) and diagonal scratch marks, as shown in Figure 1.16-1. There is no tread rubber reversion present.

Figure 1.16-1Deep cut damage and diagonal scratch marks

**Tires pressure check**

Main tires: tire1 175 psi, tire2 185 psi, tire3 185 psi and tire4 185 psi

Nose tires: L/H tire 160 psi, R/H tire165 psi

**Brake hydraulic pressure**

The test engineers pressurized the 3 hydraulic systems by using AC Motor Pump and Power Transfer Unit and then measured hydraulic pressure form brake pressure line as following:

No.1：Yellow system 2,600 psi, Green system2,500~2,600 psi

No.2：Yellow system 2,600 psi, Green system2,500~2,600 psi

No.3：Yellow system 2,600 psi, Green system2,500~2,600 psi

No.4：Yellow system 2,600 psi, Green system2,500~2,600 psi

**Brake assemblies**

The Council conducted brake assembly inspections in accordance with TNA brake shop task card. There was no abnormal finding.

**BSCU**

A malfunction signal[18] was logged, when reviewed the BSCU fault history. The result of BSCU self test was passed.

The Council conducted the following 2 operation tests in accordance with Aircraft Maintenance Manual. There was no abnormal finding.

- Lost of Normal Braking Without Warning Indication;
- Operational Test of Alternate Braking System with Anti-skid.

### 1.16.2.2 Engine Thrust Reverse Operation Test

Operational test of Engine 1 thrust reverse was conducted in order to verify its function. Test result was in compliance with AMM 78-31-00.

## 1.16.3 Throttle Control Lever Position and Indication

To obtain an accurate reading of the throttle lever angle, TLA, for ground spoilers test as indicated in paragraph 1.16.1, on October 26, 2004, the investigation team performed the throttle control lever position and indication test at Transasia Airlines Hangar. The TLA value was read from Multi-purpose Control and Display Unit, MCDU, via Aircraft Integrated Data System, AIDS.

[18] The fault was logged by BSCU after the occurrence.

However the AIDS recognized the alpha “TRA” rather than “TLA”. According to Aircraft Maintenance Manual, AMM, 76.11-00 the relationship between TLA and TRA is linear, as indicated in Figure 1.16-2.

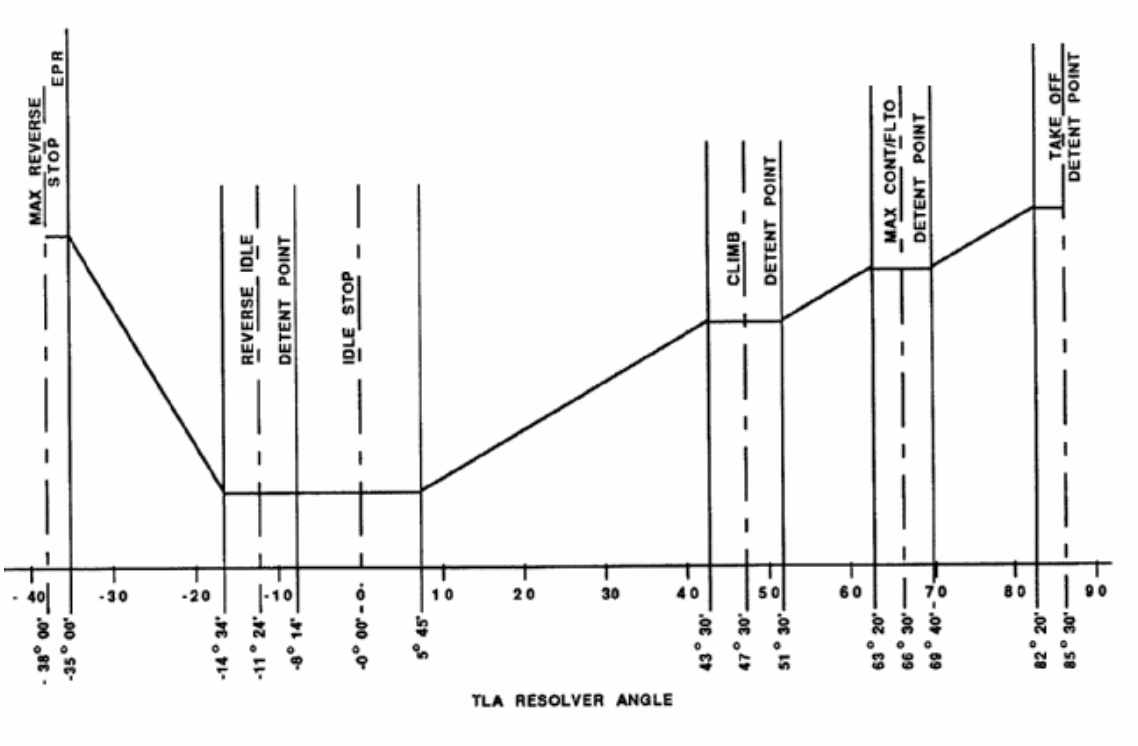



Figure 1.16-2Relationship between TLA and TRA

To understand the relationship between physical position of throttle control lever and the TRA display on MCDU, investigation team performed a test by moving the throttle control lever at full travel and recorded the TRA value. The physical positions and associated TRA reading is recorded in Table 1.16-1. This test indicated the physical positions from REV MAX to TO GA and associated TRA reading from -20 degrees to +45 degrees. The recorded range of TRA conforms the range of TLA. Therefore the indication of TRA on MCDU is TLA.

Table 1.16-1 Physical positions of throttle control lever and reading on MCDU

| Physical positions of throttle control lever | MCDU data parameter | Data source | Indication |
|---|---|---|---|
| REV MAX | TRA | EEC1<br>EEC2 | -20.1<br>-20.2 |
| REV IDLE | TRA | EEC1<br>EEC2 | -6.0<br>-6.0 |
| IDLE | TRA | EEC1<br>EEC2 | 0.0<br>-0.1 |
| CLIMB | TRA | EEC1<br>EEC2 | 25.0<br>25.0 |
| FLX MCT | TRA | EEC1<br>EEC2 | 34.9<br>34.9 |

| Physical positions of throttle control lever | MCDU data parameter | Data source | Indication |
|---|---|---|---|
| TO GA | TRA | EEC1<br>EEC2 | 44.7<br>44.8 |

## 1.16.4 Runway Friction Coefficient of Fixed Locations Test

The purpose of this test was to assess the possible effects of the runway friction as the aircraft overran the end of runway and veered towards left.

### 1.16.4.1 Test Method

The Safety Council appointed "Yen Tjing Ling Industrial Research Institute" to conduct the runway friction test[19] in the vicinity of the runway 28 threshold and the runway 10 stopway on December, 2004. The equipment of this test was a Dynamic Friction Tester（DF Tester）[20] made by Japan.

There were three test areas as follows:

(1) Threshold marking of runway 28

This area included 16 threshold marking lines. Totally 8 groups of test points were chosen, and there was a marking between one group to another. Each group included two test points, one was on the marking and the other was on the pavement between two lines. The location of the test points and number are showed in Figure 1.16-3.

[19] The test process is to put the test equipment at the certain test point, and then connect the water-providing machine with the test equipment. When test beginning, at first make the tire out of ground, and accelerate the rotating speed of tire. When the rotating speed reaches to the scheduled speed（90 km/hr）, make the tire touch ground. The friction will make the tire decelerate to totally stop, so the data about the relationship between speed and friction can be got through the recorder.

[20] The results measuring by DF tester should not be compared with the results measuring by continuous friction measuring devices. The DF tester is not certified by ICAO.

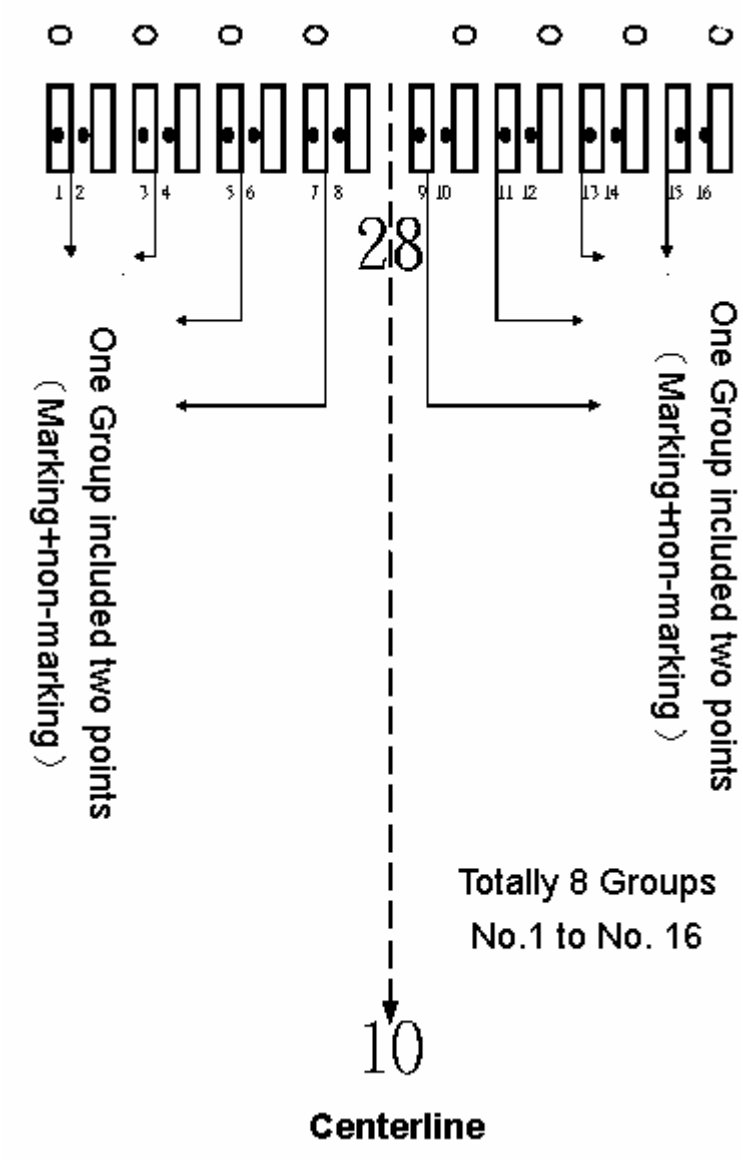



Figure 1.16-3 The distribution chart of test points on the threshold marking of runway 28

(2) The 100 meters long area after threshold marking of runway 28

The test in this area was conducted from 3 meter to both sides of the runway centerline. Two test points separated by the runway centerline comprised one group, 10 meter long between one group to another. Totally 10 groups, 20 test points were chosen. The distribution chart of the test points is showed in Figure 1.16-4.

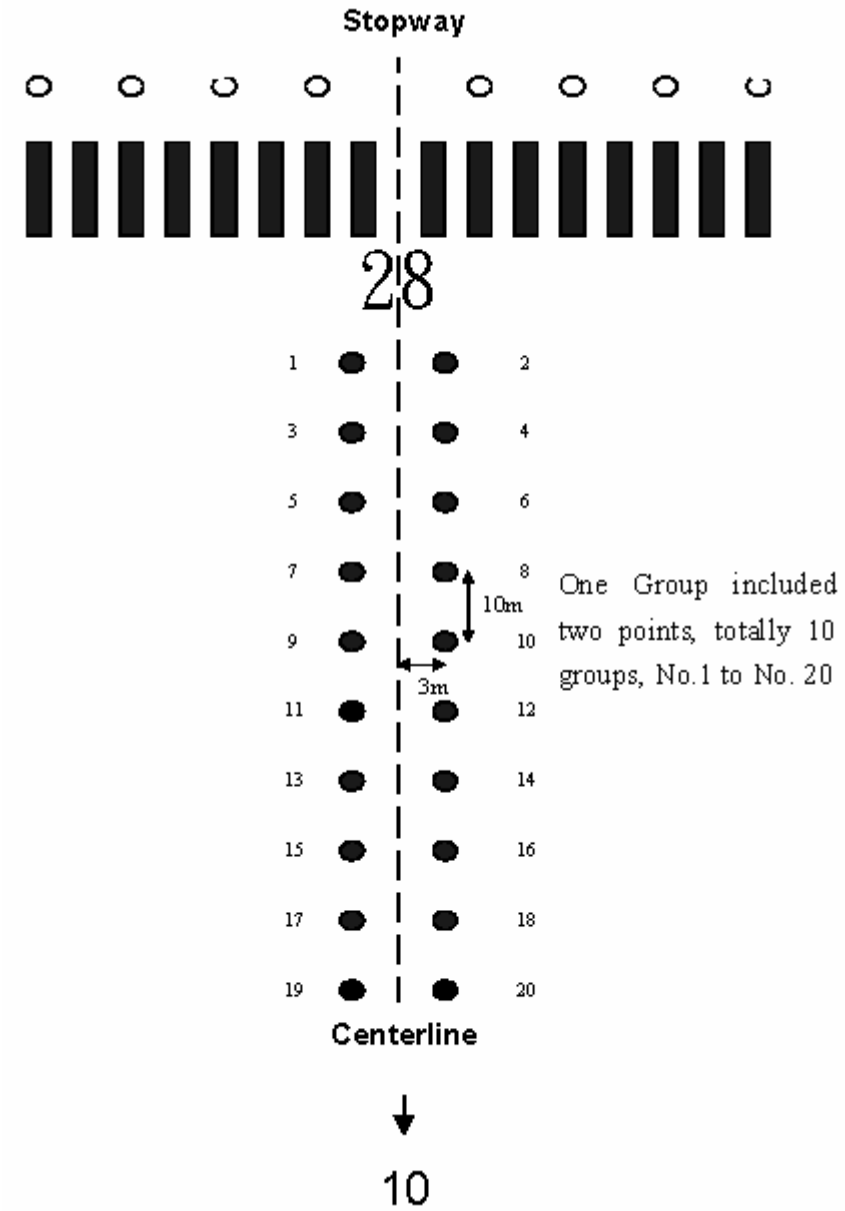



Figure 1.16-4The distribution chart of test points on the 100 meters long area after threshold marking of runway 28

(3) Stopway of runway 10

The test in this area was conducted after the runway end lights, from 0 to 100 meter on the stopway, and 3 meter to both side of extended line of runway centerline. Two test points separated by extended centerline comprised one group, 10 meter long between on group to another. Totally 10 groups, 20 test points were chosen. The distribution chart of the test points is showed in Figure 1.16-5.

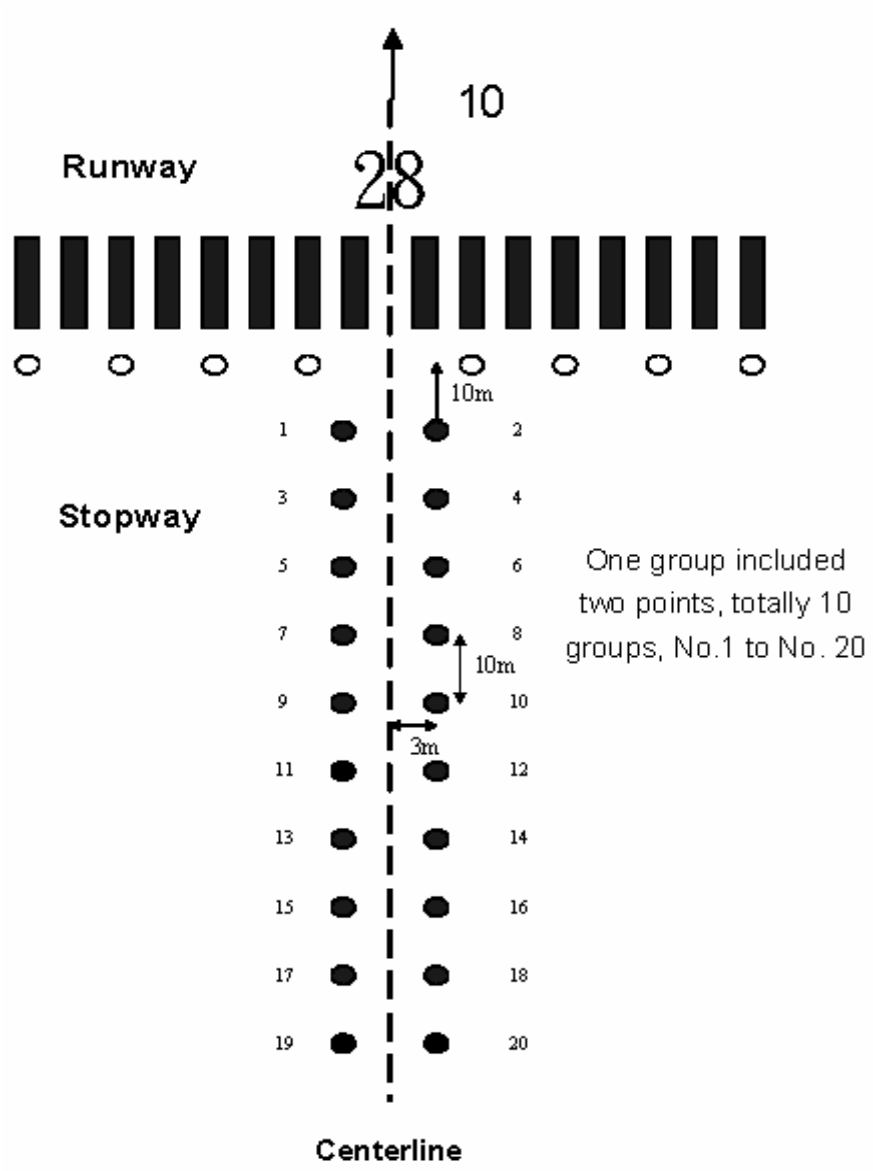



Figure 1.16-5 The distribution chart of test points on the stopway of runway 10 from 0 to 100 meter

### 1.16.4.2 Test Results

The test results are showed with the friction coefficient at the speed of 20, 40, 60 and 80 km/hr, listed from Table 1.16-2 to 1.16-4 according to the test areas.

Table 1.16-2 The test result of threshold marking of runway 28

| Marking area | | | | | Non-marking area | | | | |
|---|---|---|---|---|---|---|---|---|---|
| No. | 20 | 40 | 60 | 80 | No. | 20 | 40 | 60 | 80 |
| 1 | 0.57 | 0.47 | 0.40 | 0.35 | 2 | 1.03 | 0.96 | 0.86 | 0.62 |
| 3 | 0.50 | 0.38 | 0.33 | 0.28 | 4 | 1.06 | 1.01 | 0.92 | 0.63 |
| 5 | 0.46 | 0.38 | 0.34 | 0.27 | 6 | 1.06 | 0.99 | 0.89 | 0.60 |
| 7 | 0.48 | 0.41 | 0.37 | 0.31 | 8 | 1.03 | 0.94 | 0.84 | 0.62 |
| 9 | 0.68 | 0.59 | 0.54 | 0.41 | 10 | 1.00 | 0.92 | 0.82 | 0.58 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 11 | 0.56 | 0.51 | 0.45 | 0.38 | 12 | 1.04 | 0.98 | 0.87 | 0.61 |
| 13 | 0.50 | 0.42 | 0.37 | 0.34 | 14 | 1.02 | 0.94 | 0.83 | 0.55 |
| 15 | 0.63 | 0.55 | 0.49 | 0.40 | 16 | 1.05 | 0.98 | 0.90 | 0.61 |
| Average of marking area | 0.55 | 0.46 | 0.41 | 0.34 | Average of non-marking area | 1.04 | 0.97 | 0.87 | 0.60 |

Table 1.16-3 The test result of 100 meter long area after threshold marking of runway 28

| No. | 20 | 40 | 60 | 80 | No. | 20 | 40 | 60 | 80 |
|---|---|---|---|---|---|---|---|---|---|
| **1** | 0.38 | 0.33 | 0.28 | 0.25 | **2** | 0.96 | 0.88 | 0.77 | 0.52 |
| **3** | 0.45 | 0.37 | 0.33 | 0.27 | **4** | 0.38 | 0.33 | 0.30 | 0.25 |
| **5** | 1.00 | 0.90 | 0.83 | 0.51 | **6** | 0.96 | 0.93 | 0.78 | 0.54 |
| **7** | 0.94 | 0.90 | 0.80 | 0.51 | **8** | 0.96 | 0.87 | 0.80 | 0.55 |
| **9** | 0.99 | 0.92 | 0.80 | 0.53 | **10** | 0.99 | 0.93 | 0.80 | 0.56 |
| **11** | 0.99 | 0.93 | 0.83 | 0.57 | **12** | 0.96 | 0.92 | 0.76 | 0.52 |
| **13** | 1.01 | 0.95 | 0.83 | 0.54 | **14** | 1.03 | 0.94 | 0.85 | 0.57 |
| **15** | 1.00 | 0.92 | 0.82 | 0.53 | **16** | 1.03 | 0.93 | 0.82 | 0.58 |
| **17** | 1.02 | 0.95 | 0.84 | 0.54 | **18** | 0.99 | 0.93 | 0.83 | 0.60 |
| **19** | 1.02 | 0.98 | 0.85 | 0.55 | **20** | 0.92 | 0.83 | 0.76 | 0.54 |

Table 1.16-4 The test result of the runway 10 stopway

| No. | 20 | 40 | 60 | 80 | No. | 20 | 40 | 60 | 80 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.00 | 0.94 | 0.82 | 0.54 | 2 | 1.17 | 0.97 | 0.88 | 0.60 |
| 3 | 0.95 | 0.93 | 0.83 | 0.53 | 4 | 1.02 | 0.97 | 0.89 | 0.59 |
| 5 | 0.94 | 0.89 | 0.84 | 0.57 | 6 | 0.94 | 0.93 | 0.89 | 0.65 |
| 7 | 0.87 | 0.84 | 0.77 | 0.55 | 8 | 0.96 | 0.93 | 0.84 | 0.55 |
| 9 | 0.94 | 0.92 | 0.85 | 0.59 | 10 | 0.97 | 0.94 | 0.87 | 0.58 |
| 11 | 0.97 | 0.93 | 0.87 | 0.57 | 12 | 0.97 | 0.94 | 0.88 | 0.62 |
| 13 | 0.98 | 0.96 | 0.90 | 0.57 | 14 | 0.93 | 0.90 | 0.84 | 0.57 |
| 15 | 0.94 | 0.92 | 0.85 | 0.58 | 16 | 0.95 | 0.94 | 0.84 | 0.57 |
| 17 | 0.96 | 0.93 | 0.86 | 0.56 | 18 | 0.97 | 0.94 | 0.86 | 0.56 |
| 19 | 0.99 | 0.95 | 0.87 | 0.55 | 20 | 0.93 | 0.88 | 0.80 | 0.50 |

| Speed | 20 | 40 | 60 | 80 |
|---|---|---|---|---|
| Average | 0.97 | 0.93 | 0.85 | 0.57 |

### 1.16.5 Runway Surface Texture Depth Measurements

The purpose of this test is to assess the runway drainage effectiveness through measuring of the runway surface texture depth.

### 1.16.5.1 Test Method

The Safety Council appointed “Yen Tjing Ling Industrial Research Institute” to perform the average texture depth measurements in the vicinity of the runway 28 threshold and the runway 10 stopway in December, 2004. The test method used is Sand Patch Method. The computations involved in determining texture depths were conducted according to AC 150/5320-12C by the Federal Aviation Administration（FAA）. The texture depths standards and recommended improvements described in that AC are listed in Table 1.16-5.

Table 1.16-5 Texture depths standards and recommended improvements

| Texture Depths Standards | Recommended Improvements |
|---|---|
| <1.14mm | Conduct texture depth measurements each time a runway friction survey is conducted |
| 0.76mm~0.40mm | Initiate plans to correct the pavement texture deficiency within a year |
| <0.25mm | Correct the pavement texture deficiency within 2 months |

The distribution chart of test points is showed in Figure 1.16-6. There were three test areas as follows: The first area was located at the threshold marking of runway 28. There were 8 test points chosen in this area, four of them were on the marking line, and the others were on the non-marking pavement for making the comparison of the texture depth of marking area to non-marking; The second was located at the stopway of runway 10. The range of length for measuring the texture depth was from 0 to 100 meter in the stopway. The test points were uniformly distributed like a oblique line, the longitudinal space was 10 meters and the transverse space was 6 meter; The third was located within 100 meter after the threshold marking of runway 28. Two test points, comprising one group, were respectively located at 3 meter to both sides of runway centerline. The longitudinal space was 20 meter. These three test areas have 28 test points total.

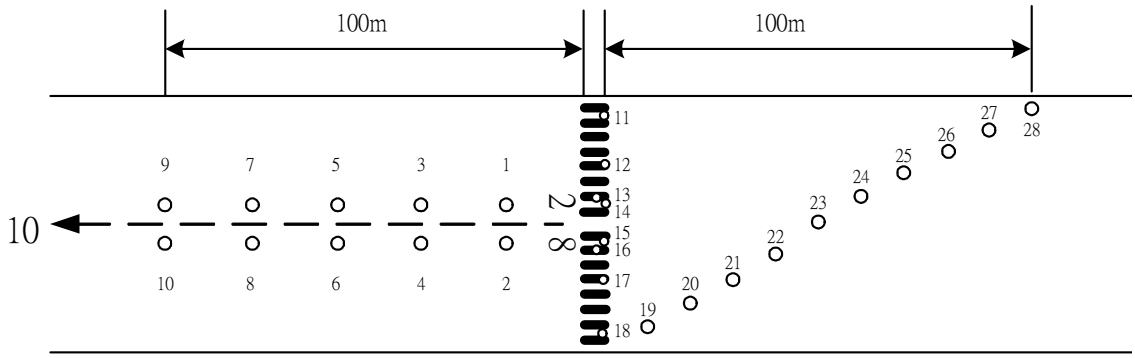



Figure 1.16-6The distribution chart of test points for runway surface texture depth measurement

## 1.16.5.2 Test Rusults

The test results are listed from Table 1.16-6 to 1.16-8.

Table 1.16-6 The test results of sand patch method within 100 meters after the threshold marking of runway 28

| | No. | Volume of Sand（ml） | Average Texture Depth（mm） | No. | Volume of Sand（ml） | Average Texture Depth（mm） | Average per 100 meter |
|---|---|---|---|---|---|---|---|
| Within 100 meter after the Threshold Marking of Runway 28 | 1[21] | 5.0 | 0.250 | 2 | 9.0 | 0.450 | |
| | 3 | 6.0 | 0.300 | 4 | 8.0 | 0.400 | |
| | 5 | 10.0 | 0.500 | 6 | 9.0 | 0.450 | |
| | 7 | 9.0 | 0.450 | 8 | 8.0 | 0.400 | |
| | 9 | 9.0 | 0.450 | 10 | 8.0 | 0.400 | |
| Average | 0.390 | | | 0.420 | | | 0.405 |
| Average after deleting the point on making line | 0.425 | | | 0.420 | | | 0.422 |

[21] This point was located at the marking line.

Table 1.16-7 The test results of sand patch method within the threshold marking of runway 28

| No. | Volume of Sand （ml） | Average Texture Depth（mm） | No. | Volume of Sand （ml） | Average Texture Depth（mm） |
|---|---|---|---|---|---|
| **Non-marking area** | | | **Marking area** | | |
| 11 | 9.0 | 0.450 | 12 | 7.0 | 0.350 |
| 13 | 11.0 | 0.550 | 14 | 9.5 | 0.475 |
| 16 | 11.0 | 0.550 | 15 | 7.5 | 0.375 |
| 18 | 9.0 | 0.450 | 17 | 8.5 | 0.425 |
| Average | - | 0.500 | Average | - | 0.406 |

Table 1.16-8 The test results of sand patch method within the stopway of runway 10

| No. | Volume of Sand （ml） | Average Texture Depth （mm） | No. | Volume of Sand （ml） | Average Texture Depth （mm） |
|---|---|---|---|---|---|
| 19 | 5.0 | 0.250 | 24 | 4.0 | 0.200 |
| 20 | 5.0 | 0.250 | 25 | 5.0 | 0.250 |
| 21 | 6.0 | 0.300 | 26 | 4.0 | 0.200 |
| 22 | 4.0 | 0.200 | 27 | 5.0 | 0.250 |
| 23 | 5.0 | 0.250 | 28 | 5.0 | 0.250 |
| Average | 0.240 | | | | |

## 1.17 Organizational and Management Information

### 1.17.1 Organization and Management pertaining to TNA

TNA is composed of Security & Safety Office, System Operation Center, and Flight Operations Department among other units. See Figure 1.17-1 for details.

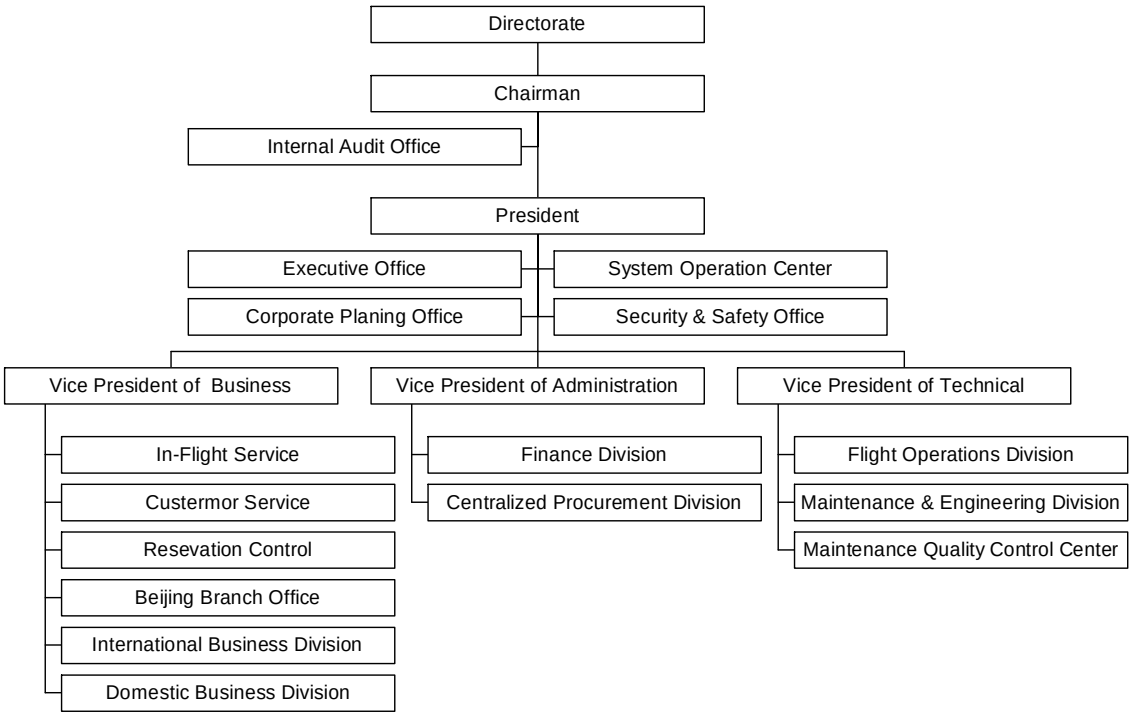



Figure 1.17-1 TNA Organizational Chart

#### 1.17.1.1 Security & Safety Office（SSO）

The Flight Safety Office was under TNA's Flight Operations Department in the past. It was separated and transferred to under the Executive Office in May 1995. The functions of security protection and labors safety were incorporated into the Safety Control Office to become Security & Safety Office (SSO) on January 1, 2002, which are manned with 6 persons: 1 Director, 2 Officers, 2 Engineers and 1 Staff Member.

The functions of Safety Control Office involve units of flight operation, engineering and maintenance operation, QC, and ground services. Its main tasks include:

1. Carry out the analysis of the Line Operations Monitor System (LOMS) of the Flight Operations Quality Assurance (FOQA) and dealing with general

business regarding flight safety;

2. The LOMS operation is divided into two parts: the SCO is responsible for operation management and analysis of overall trend, and the Flight Operations Department designating pilots to provide assistance in confirming incidents and handling the follow-on work;

3. Participating daily maintenance meeting to have an awareness of operating conditions;

4. Directing each of the related department to conducting self-inspection operations, and collect the records submitted to Executive Office on a regular time schedule;

5. Implementing hazardous material education to all employees of TNA;

6. Organizing a mobile education team to instill the concept of “all-employees flight safety” in which each unit is responsible for flight safety of its own; and

7. Flight Operations Department is responsible for handling “flight crew reports” while units involving flight safety are providing assistances together with SCO.

### 1.17.1.2 Flight Operations Department（FOD）

The Flight Operations Department（FOD）is subordinated to Deputy General Manager for Flight/Maintenance. According to Operations Manual of TNA FOD, its functions include:

1. Promoting Flight Operation policy;

2. Assuring flight safety;

3. Developing and implementing relevant operating manuals and procedures;

4. Implementing manpower planning, training, employment, evaluation and management of flight pilots; and

5. Assigning and implementing flight missions.

The establishment of FOD includes Fleet Management Department (FMD) and Standard & Training Department (STD). The FMD is composed of AIRBUS fleet, ATR fleet and Crew Scheduling Management Section. Under the STD department, there are three sections: Academic Courses Planning, Standard & Training, and Planning & Development.

The (deputy) assistant vice president of FOD acts as the leader of FOD whose responsibilities include:

1. Overseeing internal affairs and communicating with other units;

2. Supervising and developing policies and procedures of TNA flight operations;
3. Supervising the implementation of flight operations;
4. Supervising training of flight crew members;
5. Supervising and planning policies to ensure flight safety; and
6. Supervising, evaluating and managing subordinates.

### 1.17.1.2.1 Fleet Management Department

AIRBUS fleet contains 8 AIRBUS 320/321 aircrafts with 28 captains (of which 2 CAA designated examiners, 3 check pilots and 3 instructor pilots) and 26 first officers with 54 in total. ATR fleet has 10 ATR72 passenger aircraft.

According to Operations Manual of TNA Flight Operations Department, the responsibilities of chief pilot include:

1. Implementing test and evaluation of pilots;
2. Conducting selection review of new pilots, pilots for advanced training and pilots for transfer training, and manpower planning;
3. Attending and supervising required study classes;
4. Management of fleet personnel including pilot flight skills, disciplines and habits in daily life;
5. Conducting checks on various skills and evaluation of annual individual pilot performance; and
6. Handling “Flight Crew Member Report”

### 1.17.1.2.2 Standard & Training Department（STD）

**Standard & Training Section (STS)**

STS is staffed with Director, one Staff Member, and a task-based team composed of check pilots and instructor pilots.

According to Operations Manual of TNA Flight Operations Department, the functions of STS include:

1. Revising and enlarging various standard flight operation doctrines such as Standard Operations Procedures, Flight Operations Manual, Flight Training Management Manual, Flight Training Manual and Route Manual;
2. Collecting and compiling teaching material and questions pool regarding ground academic training, simulator training and flight training of each

type of aircraft;

3. Supervising the instructor pilots in conducting training, qualifying techniques and skills, evaluating training results and tracking shortcomings, as well as conducting checks on lag of training progress and events of poor grade examination and raising suggestions;

4. Taking part in the process of selecting and evaluating new pilots and pilots for advanced and transferring training, and attending the fleet manpower appraisal meeting; and

5. Holding meetings to check pilots' flight competence and skills.

According to Operations Manual of TNA Flight Operations Department, the responsibilities of Check pilots and Instructor Pilots of the task-based team include:

1. Conducting checks and tests on various pilot techniques and skills;

2. Implementing various flight trainings (including flight-related ground academic subjects and civil aviation regulations and laws);

3. Reflecting training problems and improving training or operational procedures;

4. Appraising and checking the qualifications of pilots; and

5. Participating regular instructor pilot meetings as well as personnel techniques and skills appraisal meetings.

**Academic Courses Planning Section**

Academic Courses Planning Section (ACPS) is staffed with Director, Deputy Director and one Staff Member.

According to Operations Manual of TNA Flight Operations Department, the functions of ACPS include:

1. Developing training programs and tracking the implementation of them.

2. Coordinating with Dispatch Center to arrange the recurrent training of pilots;

3. Safekeeping, sorting out and replenishing training material, books and training equipment;

4. In charge of various flight and ground academic trainings, and collecting and assessing the opinions from instructors and trainees.

5. Arranging trainees for simulator recurrent training and handling information; and

6. Tracking trainees' stage trainings and their examination records.

## 1.18 Additional Information

### 1.18.1 Site Survey

The result of site survey was presented on the airport satellite image as shown in Figure 1.18-1. The ground tracks of left main landing gear, right main landing gear and nose gear were represented with green, orange and red lines respectively.

According to the site-survey result, the nose gear of the occurrence aircraft skipped off the pavement of the stopway at 321 feet outward the threshold of Runway 28. The nose gear stopped in the uncovered ditch at about 130 feet in the north of the stopway (Figure 1.18-2). The aircraft stopped with heading 002 and nose downward slightly.

The tire marks of the aircraft could be tracked from the grass area, via the pavement of the stopway, continuously to the runway threshold markings of Runway 28 (Figure 1.18-3). No apparent tire marks of the occurrence aircraft could be found on the runway.

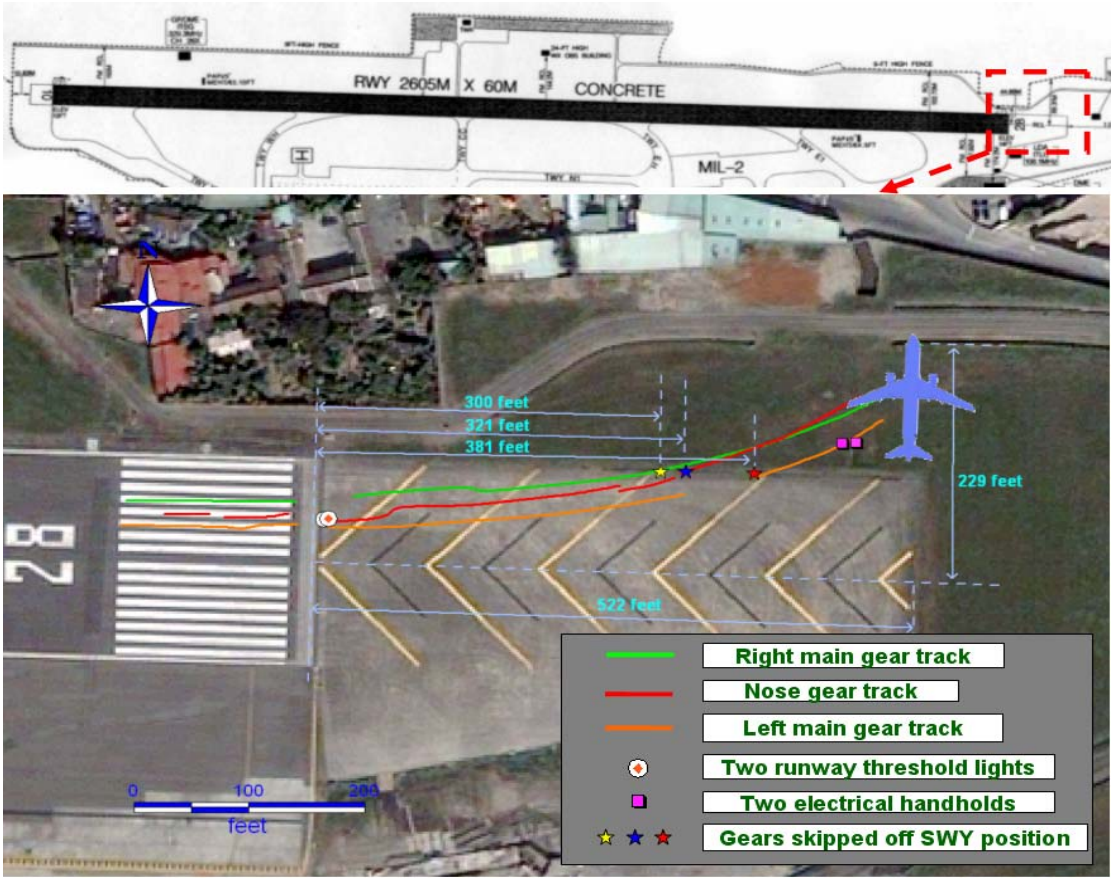



Figure 1.18-1Sungshan airport chart and site-survey results with the satellite image

Figure 1.18-2The nose gear stopped in the ditch

Figure 1.18-3Ground tracks from the stopway pavement to the grass area

### 1.18.2 Aircraft Recovery

Recovery of the aircraft was performed by TNA. An airbag was placed at the RH wing root but did not have sufficient height to enable recovery. The lifting of

the fuselage was carried out with slings at Frame 15, 21 and 62（Figure 1.18-4）. With the damaged NLG resting on a trolley and slings around the two main landing gear the aircraft was pulled directly backwards with a vehicle to a solid surface（Figure 1.18-5）.

Figure 1.18-4 Aircraft with slings at Frame 15, 21 and 62

Figure 1.18-5 Aircraft towing with straps around both MLG casings

## 1.18.3 Summary of Interview with Pilots

### 1.18.3.1 CM-1

He stated that he was told the number two engine thrust reverser of B-22310 was deactivated while he reported to the System Operations Center, so he briefed to the CM-2 that the thrust reverser fault meet the dispatch standard but should pay attention to the deceleration and direction control at landing roll.

He stated the ATIS reported the visibility at Sungshan Airport was 5 miles, ceiling at 1,800 ft and their existed low level windshear and moderate turbulence on final. Then he agreed with CM-2's selections of flaps 3 and autobrake medium.

They received landing clearance at around 1,000 ft, on final approach had turbulence, and the visibility was good. He stated the aircraft's touch down was normal, he called out "Spoiler, one reversal green" once and "no brake" several times after landing, but the deceleration were not enough, so he applied the brake pedal also. He stated that CM-2 did advance the number one throttle lever and then pull it full back.

The aircraft rolled off from the left side of stopway into grass, the speed decreased rapidly and came into a full stop while the nose gear collapsed into a ditch. He shut down both engines and broadcasted "Cabin crew at station" for three times by Public Address (PA) system. Then he started the Auxiliary Power Unit (APU) after checked there was no fire warning, and then contacted tower to request the ground support.

He talked to purser regarding the situation and released the passenger via slide out from the left passenger front door because the ladder at the rear exit could not be linked to the aircraft.

### 1.18.3.2 CM-2

He stated the ATIS reported the visibility at Sungshan Airport was 5 miles, ceiling at 1,800 ft, wind speed varies at 3 knots and windshear existed on Runway 10. The approach briefing was conducted following the card; the approach speed was computed as 137 knots, set flaps 3 and select autobrake at medium. Auto-pilot was engaged.

On final approach, at about 400 feet, the auto-pilot was disengaged due to unstable wind. CM-1 call out "reverse one green" after the number 1 thrust reverser was applied at landing. He applied the brake immediately after CM-1 call out "no brake", but even with more brake pedal actions, the aircraft did not effectively deceleration. He could felt that the CM-1 was applied the brake simultaneously.

He decreased the thrust of number one thrust reverser to try to control the aircraft's direction, and then, advanced the thrust to the maximum.

The aircraft decelerated rapidly after rolling toward the left side stopway. From the aircraft landed till full stop, the CM-1 did not announce that he took over the control.

## 1.18.4 Summary of Flight Crew Operating Manual



**A/THR ACTIVATION**

The A/THR is active when it controls thrust or speed. The position of the thrust lever determines the maximum thrust that the A/THR system can command (except in α-floor condition).

R The A/THR being armed, is activated :

- when the pilot sets both thrust levers between the CL and IDLE detents (two engines operative)

R – when the pilot sets one thrust lever between the MCT and IDLE detents (one engine
R inoperative).

R The A/THR being disconnected, is activated when the pilot pushes the FCU pushbutton
R while the thrust levers are within the active range, including IDLE position.

R

R *Note : When the pilot sets both thrust levers to IDLE position, the A/THR disconnects but,*
R *if the pilot pushes the A/THR pushbutton of the FCU, he will simultaneously arm and*
R *activate the autothrust. Due to the thrust levers position, IDLE thrust will be*
R *maintained.*

- when ALPHA FLOOR is activated, regardless of the initial status of A/THR and the position of the thrust levers.

When A/THR is active :

- The A/THR pushbutton on the FCU lights up.

R – The FMA displays A/THR mode in green in the first column and A/THR in white in the
R fifth column.

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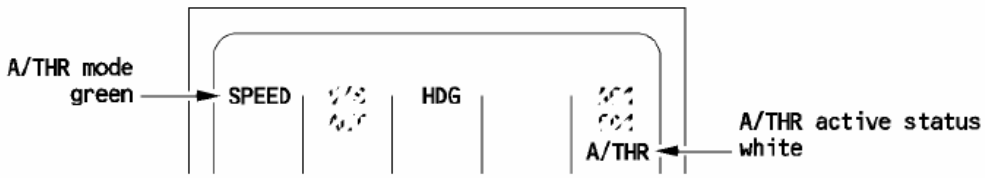


**EFFECTS OF THRUST LEVER MOVEMENT WHILE A/THR IS ACTIVE**

- When both thrust levers are set above the CL detent (both engines operative) or one thrust lever is set above MCT (one engine operative) the A/THR reverts from active to armed. "A/THR" turns to blue on the FMA and the thrust levers control the thrust directly. The FMA displays "MAN THR" white in its first column.
  The thrust levers provide the crew with an immediate increase of thrust when both thrust levers are pushed above the CL detent (2 engines) or the active thrust lever above the MCT detent (one engine operative).
- When both thrust levers are set below the CL detent (both engines operative) or one thrust lever is set below MCT (one engine operative), a repeating warning (amber caution, single chime, ECAM message "A/THR LIMITED") is activated every 5 seconds until the pilot moves the lever back into the detent. "THR LVR" green is displayed on the FMA
  "LVR CLB" (both engines operative) or "LVR MCT" (one engine operative) flashes white in the first column of the FMA.
  This device reminds the crew that the normal operating position of the thrust levers, when A/THR is active, is the CL detent (2 engines) or the MCT detent (one engine operative).
- When one thrust lever is in the CL detent and the other one out of the detent, the "LVR ASYM" amber message comes up until both levers are set in the CL detent (only with both engines operative).

**A/THR DISCONNECT**

When the A/THR is disconnected, it is neither armed nor active.
The A/THR can be disconnected in two ways :

* Standard disconnection
  - The pilot pushes the instinctive disconnect pushbutton on the thrust levers (which immediately sets the thrust corresponding to the lever positions) or
  - The pilot sets both thrust levers to IDLE detent.
* Non-standard disconnection
  - The pilot pushes the A/THR pushbutton on the FCU while A/THR is armed/active, or
  - The system loses one of the arming conditions.

R **Below 100 feet radio altitude**
R When the radio altitude is below 100 feet and the pilot sets both thrust levers above the
R CL detent or one above the MCT detent, the autothrust will disconnect. It will rearm
R automatically when at least one of the thrust levers is set to TOGA.
R If the PF sets the thrust levers slightly above CL detent but below TOGA and come back
R to CL detent, the A/THR will disconnect and remain disconnected. As a result, the thrust
R will increase up to CLIMB thrust. The crew has to manually set the appropriate thrust for
R landing (or go around).

CAUTION

If the pilot pushes and holds one instinctive disconnect pushbutton for more than 15 seconds, the A/THR system is disconnected for the remainder of the flight. All A/THR functions including ALPHA FLOOR are lost, and they can be recovered only at the next FMGC power-up (on ground).

## THRUST LOCK FUNCTION

The THRUST LOCK function is activated when the thrust levers are in the CL detent (or the MCT detent with one engine out) and the pilot pushes the A/THR pushbutton on the FCU or the A/THR disconnects due to a failure.

- "THR LK" flashes amber on the FMA.
- ECAM "ENG THRUST LOCKED" flashes every five seconds.
- ECAM displays "THR LEVERS..... MOVE"
- A single chime sounds and the Master Caution Light flashes every five seconds.

The thrust is locked at its level prior to disconnection. Moving the thrust levers out of CL or MCT suppresses the thrust lock and gives the pilot manual control with the thrust levers. All warnings cease when the pilot moves the thrust levers out of the detent.

## A/THR DISCONNECT CAUTION

| | | A/THR DISCONNECTION | |
|---|---|---|---|
| | | **BY INSTINCTIVE DISCONNECT OR SETTING TWO LEVERS TO IDLE (if above 50 ft RA)** | **BY OTHER MEANS** |
| CONSEQUENCE | MASTER CAUTION | illuminated-3 sec max | illuminated |
| | ECAM MESSAGE | amber A/THR OFF message 9 sec maximum | Flashing "ENG THRUST LOCKED" (amber AUTO FLT A/THR OFF THR LEVERS..... MOVE (blue) |
| | AUDIO | single chime | single chime |
| | CLR pushbutton on ECAM CONTROL PANEL | extinguished | illuminated |
| ACTION | MASTER CAUTION pushbutton | extinguishes MASTER CAUTION light erases ECAM message | extinguishes MASTER CAUTION light |
| | CLR puhbutton on ECAM CONTROL PANEL | No effect | extinguishes MC light and CLR pushbutton, erases ECAM message calls status |
| | INSTINCTIVE DISCONNECT pushbutton | extinguishes MASTER CAUTION light erases ECAM message | extinguishes MASTER CAUTION light |
| ECAM STATUS MESSAGE | | NO | YES |

R – Standard disconnection triggers temporary ECAM message and caution light. Single
R chime sounds.
R – Non standard disconnection triggers caution light and ECAM message removed only by
R a pilot action. Single chime sounds.

## A/THR MODES

Except in takeoff and go around situations, normal operation of the A/THR system requires the thrust levers to be :

- In the CL detent for the two-engine configuration. If they are not set in the CL detent, "LVR CLB" flashes white on the FMA.
- In MCT detent when in the one-engine-out configuration. If the appropriate lever is not set in the MCT detent, "LVR MCT" flashes white on the FMA.

The A/THR modes are selected automatically in conjunction with the AP/FD modes (except for ALPHA FLOOR).

| | |
|---|---|
| A/THR in THRUST mode | AP/FD pitch mode maintains the speed : OP CLB - OP DES - CLB - EXP CLB◁ - EXP DES◁ - SRS - FLARE and DES (IDLE path) |
| A/THR in SPEED/MACH mode | If neither AP nor FD is engaged |
| | If AP/FD controls a vertical path V/S-FPA-ALT*- ALT CST*-ALT-ALT CRZ-G/S* -G/S-FINAL and DES (geometric path) |
| A/THR in RETARD mode | Automatic landing (AP engaged in LAND mode). |

## THRUST mode

- In THRUST mode, autothrust commands a specific thrust level in conjunction with the AP/FD pitch mode. This thrust level is limited by thrust lever position.

| FMA display | Meaning |
|---|---|
| THR MCT | Single engine thrust in climb. The live engine is at maximum continuous thrust (thrust lever in MCT detent) |
| THR CLB | Climb thrust two engine configuration (at least one thrust lever in the CL detent, the other one below CL) |
| THR LVR | Undetermined thrust (neither CLB or MCT thrust) |
| THR IDLE | Minimum thrust (both engines at IDLE thrust) |

*Note : When the A/THR is armed for takeoff or go around, the FMA displays "MAN TOGA" (or "MAN FLX") in white to remind the crew that the thrust levers have been positioned properly.*

## RETARD MODE

The RETARD mode is only available during automatic landing (AP engaged in LAND mode). At approximately 40 feet RA, the RETARD mode engages and remains engaged after touchdown. The A/THR commands IDLE thrust during the flare, and the FMA and engine warning display "IDLE". If the autopilot is disengaged during the flare before touchdown, the SPEED mode replaces the RETARD mode, and the pilot has to manually reduce thrust.

*Note : In an automatic landing, the system generates a "RETARD" callout at 10 feet radioaltitude (RA), which prompts the pilot to move the thrust levers to IDLE in order to confirm thrust reduction. In manual landing conditions, the system generates this callout at 20 feet RA, as a reminder.*

## ALPHA FLOOR

ALPHA FLOOR is a protection that commands TOGA thrust, regardless of the thrust levers' positions. This protection is available from lift-off to 100 feet RA on approach.
ALPHA FLOOR calls up the following indications :
- "A FLOOR" in green, surrounded by a flashing amber box on the FMA, and in amber on the engine warning display, (as long as $\alpha$-floor conditions are met).
- "TOGA LK" in green, surrounded by a flashing amber box on the FMA, when the aircraft leaves the $\alpha$-floor conditions. TOGA thrust is frozen.

To cancel ALPHA FLOOR or TOGA LK thrust, the pilot must disconnect the autothrust.

## SPEED/MACH mode

In SPEED/MACH mode, the A/THR adjusts the thrust in order to acquire and hold a speed or Mach target.
The speed or Mach target may be :
- Selected on the FCU by the pilot.
- Managed by the FMGC.

When in SPD/MACH mode, the A/THR does not allow speed excursions beyond the following limits, regardless of the target speed or Mach number :
- For a selected speed target, the limits are VLS and VMAX (VMO-MMO, VFE-VLE, whichever applies).
- For a managed speed target, the limits are maneuvering speed (Green Dot, S, F, whichever applies) and maximum speed (340/.80-VFE-VLE, whichever applies).

The changeover from SPEED to MACH mode is either automatic, performed by the FMGC, or manual, with the pilot pushing the SPD/MACH changeover pushbutton.
The FMA displays "SPEED" or "MACH".

**Approach autothrust :**

R Below 3200 feet radioaltitude, with at least CONF 1, the A/THR logic is modified to be more responsive to speed variation. This is referred to as approach autothrust.

## GROUND SPOILER CONTROL

Spoilers 1 to 5 act as ground spoilers.
When a ground spoiler surface on one wing fails, the symmetric one on the other wing is inhibited.

### Arming

The pilot arms the ground spoilers by pulling the speedbrake control lever up into the armed position.

### Full extension

The ground spoilers automatically extend during rejected takeoff, at a speed greater than 72 knots, or at landing when both main landing gears have touched down, when :

R · Ground spoilers are armed and all thrust levers are at or near idle, or
· Reverse is selected on at least one engine (other thrust lever at or near idle), if ground
R spoilers were not armed.

*Note : · In autoland, the ground spoilers fully extend at half speed one second after both main landing gear touch down.*
R *· The spoiler roll function is inhibited when spoilers are used for the ground spoiler*
R *function.*

### Partial extension

The ground spoilers partially extend (10°) when reverse is selected on at least one engine (other engine at idle), and one main landing gear strut is compressed. This partial extension, by decreasing the lift, eases the compression of the second main landing gear strut, and consequently leads to full ground spoiler extension.

### Retraction

The ground spoilers retract :
· After landing, or after a rejected takeoff, when the ground spoilers are disarmed.

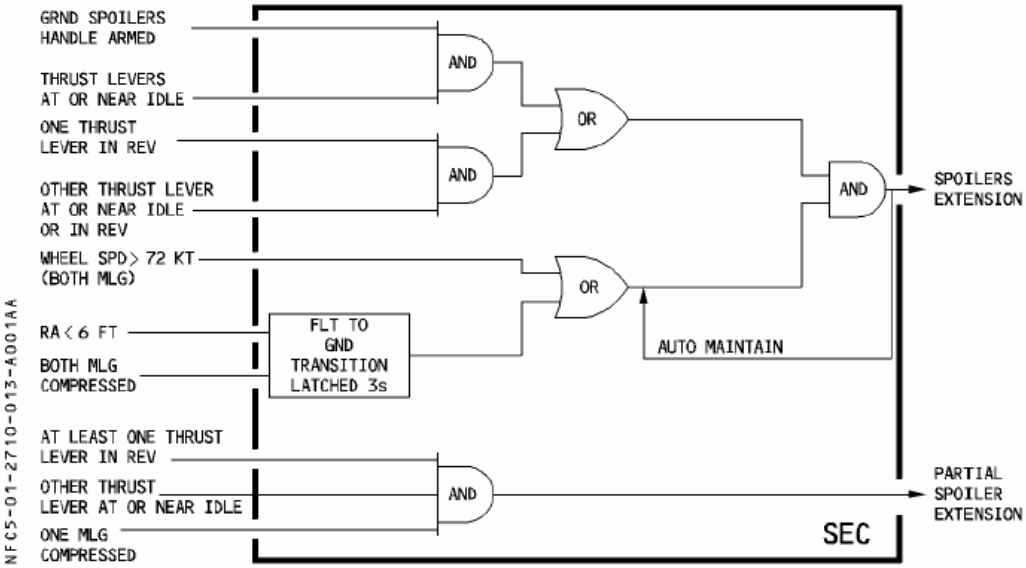
*Note : If ground spoilers are not armed, they extend at the reverse selection and retract when idle is selected.*

· During a touch and go, when at least one thrust lever is advanced above 20°.

*Note : After an aircraft bounce, the ground spoilers remain extended with the thrust levers at idle.*

**FOR INFO**

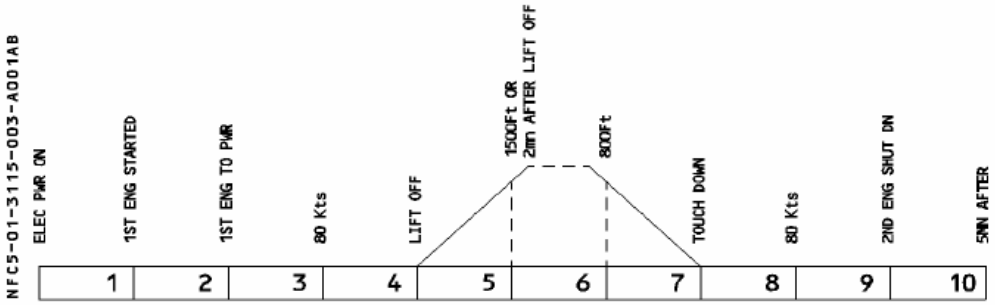
R *The landing gear touchdown condition is triggered for both main landing gear, either when*
R *their wheel speed is greater than 72 knots, or when their landing gear struts are*
R *compressed and the radio altitude is very low (RA < 6 feet).*
R *For the ground spoiler logic, idle signifies :*
R *Thrust lever position < 4° or < 15° when below 10 ft*
R



## FLIGHT PHASES

### GENERAL

The FWC divides its functions according to these ten flight phases :

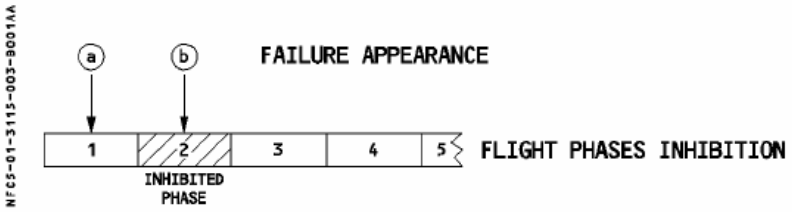



To improve its operational efficacy, the computer inhibits some warnings and cautions for certain flight phases. It does so to avoid alerting the pilots unnecessarily at times when they have high workloads, such as during takeoff or landing. In these two phases, the DU displays magenta memos : "T.O. INHIBIT" (flight phases 3, 4, and 5), and "LDG INHIBIT" (flight phases 7 and 8).

*Note : These flight phases are different from and independent of the ones that the FMGC uses.*

### FLIGHT PHASE INHIBITION

Two cases are possible (for instance) :




Effect on E/WD :

(a) The failure occurs during phase 1. The E/WD displays the warning immediately and continues to display it as long as the failure is present, even in phase 2.

(b) The failure occurs during phase 2. The E/WD displays the warning only when the aircraft has entered phase 3, where it is not inhibited. Then the warning remains displayed as long as the failure is present.

## AUTO BRAKE

The purposes of this system are :
- to reduce the braking distance in case of an aborted takeoff
- to establish and maintain a selected deceleration rate during landing, thereby improving passenger comfort and reducing crew workload.

### R SYSTEM ARMING

The system arms when the crew presses the LO, MED, or MAX pushbutton switch if :
- Green pressure is available.
- The anti-skid system has electric power.
- There is no failure in the braking system.
- At least one ADIRS is functioning.

*Note : Auto brake may be armed with the parking brake on.*

### R SYSTEM ACTIVATION

R Automatic braking activates when the ground spoilers extend (Refer to 1.27.10 SPEED BRAKES AND GROUND SPOILERS). Therefore, if the aircraft makes an acceleration stop and begins to decelerate when its speed is under 72 knots, the automatic braking will not
R activate because the ground spoilers will not extend.
For autobrake to activate, at least two SEC's must be operative.

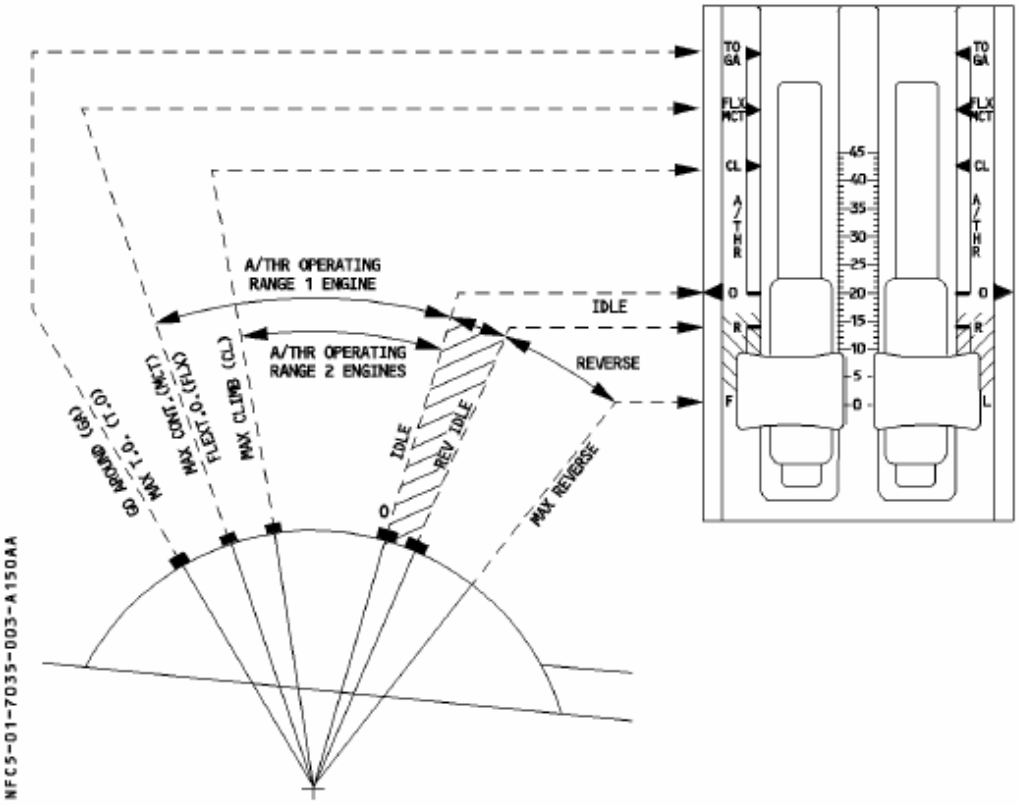
### R SYSTEM DEACTIVATION

R The system deactivates :
R – When it is disarmed (see below).
R – When the ground spoilers retract. In this case it remains armed.

### R SYSTEM DISARMING

The system disarms when :
- Flight crew presses the pushbutton switch or,
- One or more arming conditions is lost or,
R – Flight crew applies enough deflection to at least one brake pedal when autobrake is active in MAX, MED or LO mode.
R – After take-off/touch and go.

## THRUST LEVERS



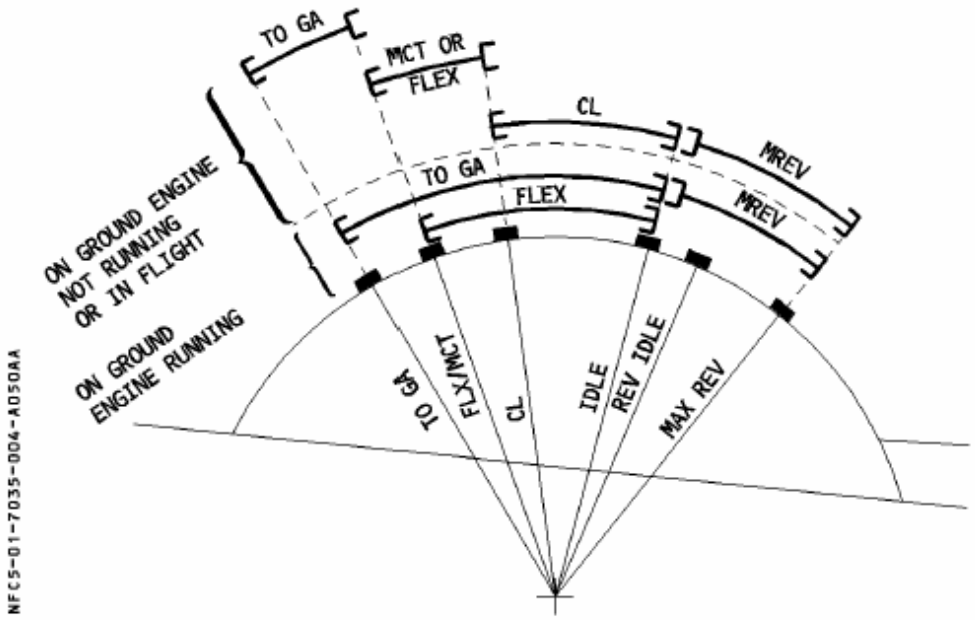

The thrust levers can only be moved manually.
They move over a sector that is divided into four operating segments.
The sector has five positions defined by detents or stops.
Thrust lever position is transmitted to the FADEC, which computes and displays the thrust rating limit and the N1 for that Thrust Lever Angle (TLA).

*Note : There is no reverse idle detent. When the pilot moves the lever out of the idle stop by pulling up the reverse lever on the front of the thrust lever, he selects reverse idle.*

## THRUST RATING LIMIT

The FADEC computes the thrust rating limit for each thrust lever position, as shown below. If the thrust lever is set in a detent, the FADEC selects the rating limit corresponding to this detent.
If the thrust lever is set between two detents, the FADEC selects the rating limit corresponding to the higher detent.

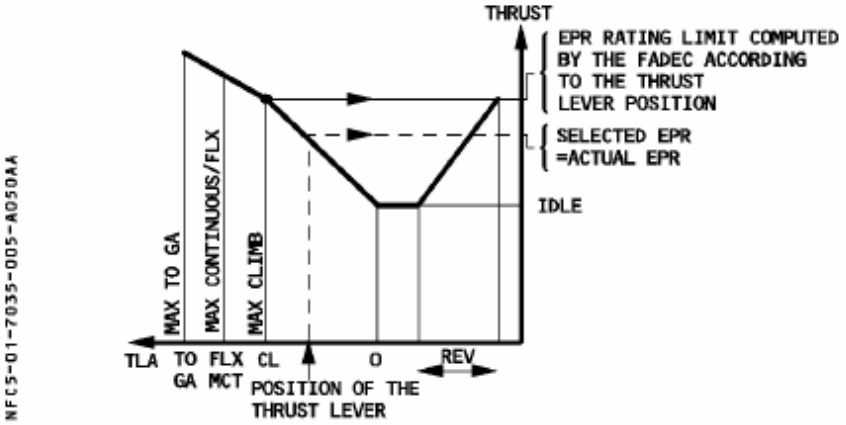
**RATING LIMITS :**



## THRUST CONTROL

### MANUAL MODE

The engines are in the manual mode provided the A/THR function is :
– not armed or
– armed and not active (thrust lever not in the A/THR operating range and no alpha floor).
In these conditions, each engine is controlled by the position of its thrust lever.
The pilot controls thrust by moving the thrust lever between IDLE and TOGA positions. Each position of the thrust lever within these limits corresponds to an EPR.
When the thrust lever is in a detent, the corresponding EPR is equal to the EPR rating limit computed by the FADEC for that engine.




When the thrust lever is in the FLX/MCT detent :

– **On the ground**
The engine runs at the flex takeoff thrust rating if the crew has selected a flex takeoff temperature on the MCDU that is higher than the current Total Air Temperature (TAT). Otherwise the engine produces Maximum Continuous Thrust (MCT).

*Note : A change in FLEX TEMP during the takeoff has no effect on the thrust.*

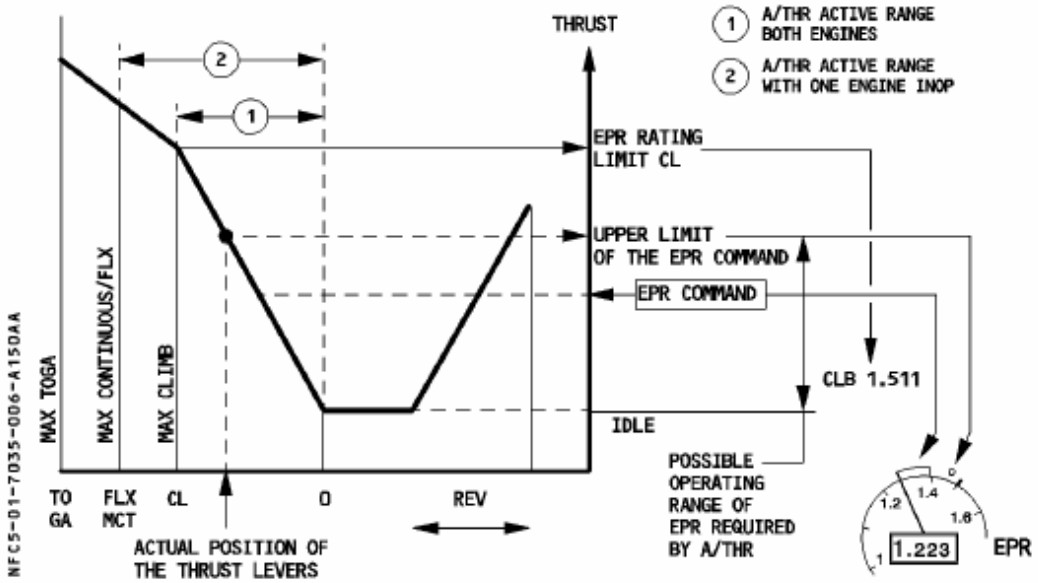
– **After takeoff**
The pilot can change from FLX to MCT by moving the thrust lever to TOGA or CL, then back to MCT. After that, he cannot use the FLX rating.

R *Note : Setting the thrust lever out of FLX/MCT detent without reaching TOGA or CL*
R *detent has no effect.*

The pilot can always get MAX TO thrust by pushing the thrust lever all the way forward.

## AUTOMATIC MODE

In the autothrust mode (A/THR function active), the FMGC computes the thrust, which is limited to the value corresponding to the thrust lever position (unless the alpha-floor mode is activated).




## INDICATIONS ON FMA

The FADECs monitor the positions of the thrust levers, and trigger appropriate indications on the FMA.

LVR ASYM : appears in amber (3rd line on the FMA) if, with A/THR active and both engines running, one thrust lever is set out of the CLB detent.

LVR CLB : flashes white (3rd line on the FMA) if the thrust levers are not in CL position while the aircraft is above the altitude of thrust reduction with both engines running.

LVR MCT : flashes white (3rd line on the FMA) if the thrust levers are not in MCT position after an engine failure (with speed above green dot).

The ECAM does not display black squares.

· If an action depends on a precondition, a black dot identifies the precondition. If the precondition appears on ECAM, it appears in large letters. If not, it appears in small letters.

For example :

NFC3-03-0201-002-A001AA

| F / CTL FLAPS FAULT |
|---|
| – FLAPS LEVER . . . . . RECYCLE |
| • **If unsuccessful :** |
| – GPWS FLAP MODE . . . . . OFF |

"If unsuccessful" does not appear on ECAM

· Titles of the procedures appear in the following ways :

NFC3-03-0201-002-B001AA

| | |
|---|---|
| TITLE | Abnormal procedure displayed on ECAM |
| TITLE | Abnormal procedure not displayed on ECAM |
| TITLE | Emergency procedure displayed on ECAM |
| TITLE | Emergency procedure not displayed on ECAM |

## TASK SHARING

The general task sharing shown below applies to all procedures.
The pilot flying remains pilot flying throughout the procedure.
PF, the pilot flying, is responsible for :
– thrust levers
– control of flight path and airspeed
– aircraft configuration (request configuration change)
– navigation
– communications.
PNF, the pilot not flying, is responsible for :
– reading aloud the ECAM and checklists
– executing required actions or actions requested by the PF, if applicable
– operating the engine master switch and ENG FIRE pushbutton (monitored by the PF).

## R MEMORY ITEMS

R The following procedures are to be applied without referring to paper : Windshear ◁ ,
R windshear ahead ◁, TCAS ◁, EGPWS ◁, loss of braking, beginning of EMER DESCENT,
R beginning of UNRELIABLE SPEED INDICATION.

## F/CTL GND SPLR / 1 + 2 / 3 + 4 / FAULT

Crew awareness.

- **GND SPLR FAULT :**
  *Loss of ground spoiler function in SEC 1 + 3, or 1 + 2, or 2 + 3, or 1 + 2 + 3.*
- **GND SPLR 1 + 2 (3 + 4) FAULT :**
  *Loss of ground spoiler function in SEC 3 (or 1).*

| | | STATUS |
|---|---|---|
| – LDG DIST PROC | APPLY | INOP SYS<br>GND SPLR<br>(affected) |

R *Refer to the QRH Part 2, or to the FCOM 3.02.80.*

## F/CTL SPD BRK DISAGREE

■ **Surfaces 3 + 4 affected**

*Surfaces' position not in agreement with the handle position.*

– SPD BRK LEVER . . . . . RETRACT
– SPD BRK . . . . . DO NOT USE

| | | STATUS |
|---|---|---|
| – SPD BRK | DO NOT USE | INOP SYS<br>SPD BRK 3 + 4 |

■ **Surfaces 2 + 3 + 4 affected :**

*After automatic retraction (due to activation of alpha protection or slats/flaps in configuration FULL), surface position is not in agreement with the handle position.*

– SPD BRK LEVER . . . . . RETRACT

## LOSS OF BRAKING

- **IF AUTOBRAKE IS SELECTED :**
  - BRAKE PEDALS ..... PRESS
    *This will override the autobrake.*
- **IF NO BRAKING AVAILABLE :**
  - REV ..... MAX
  - BRAKE PEDALS ..... RELEASE
    *Brake pedals should be released when the A/SKID & N/W STRG selector is switched OFF, since the pedal force or displacement produces more braking action in alternate mode than in normal mode.*
  - A/SKID & N/W STRG ..... OFF
    *Braking system reverts to alternate mode.*
  - BRAKE PEDALS ..... PRESS
    *Apply brake with care, since initial pedal force or displacement produces more braking action in alternate mode than in normal mode.*
  - MAX BRK PR ..... 1000 PSI
    *Monitor brake pressure or BRAKES PRESS indicator. Limit brake pressure to approximately 1000 psi and, at low ground speed, adjust brake pressure as required.*
- **If STILL NO BRAKING :**
  - PARKING BRAKE ..... USE
    *Use short successive parking brake applications to stop the aircraft. Brake onset asymmetry may be felt at each parking brake application. If possible, delay the use of the parking brake until low speed, to reduce the risk of tire burst and lateral control difficulties.*

## WHEEL HYD SEL FAULT

R *Failure of normal brake selector valve, or the steering selector valve, in the open position.*
R – *If the normal brake selector valve is failed open, full green hydraulic pressure is present*
R *at normal servovalves' entry.*
R *Nosewheel steering remains available.*
R – *On ground, do not tow the aircraft with the green hydraulic system pressurized :*
R *Nosewheel steering remains pressurized, and so towing may either break the towbar*
R *shear pin, or the nose gear (if towbarless towing).*
R – *Selecting A/SKID & N/W STRG OFF, or resetting the BSCU, will cause the nosewheel to*
R *go to maximum deflection.*

- A/SKID & N/W STRG ..... KEEP ON
  *As long as antiskid is operative, brake pressure is regulated by normal servovalves.*

## 1.18.5 Summary of A320 SOP



● **At touchdown:**

- **REV** ..... **MAX**
  - Select MAX REV immediately after the main landing gear touches down.
    If the airport regulations restrict the use of reversers, select and maintain reverse idle until taxi speed is reached.
    A slight pitch-up, easily controlled by the crew, may appeared when the thrust reversers are deployed before the nose landing gear touches down.
    Lower the nosewheel without undue delay if MED is selected.
  - In case of engine failure, the use of the remaining reverser is recommended.
  - Braking may be commenced before nosewheel is down, if required for performance reasons, but when comfort is the priority it should be delayed until the nose wheel has touched down.
    During roll out, sidestick inputs (either lateral or longitudinal) should be avoided.
    If directional control problems are encountered, reduce thrust to reverse idle until directional control is satisfactory.
  - After reverse thrust is initiated, a full stop landing must be made.

- **GROUND SPOILERS** ..... **CHECK**
  Check that the ECAM WHEEL page shows the ground spoilers fully deployed after touchdown. Announce "Ground spoilers" then "reverse green"

- **DIRECTIONAL CONTROL** ..... **ENSURE**
  - Use rudder pedals for directional control.
  - Do not use the nose wheel steering control handle before reaching taxi speed.

- **BRAKES** ..... **AS RQRD**
  - Monitor the autobrake, if it is on. When required, brake with the pedals.
  - Although the green hydraulic system supplies the braking system, if pedals are pressed quickly a brief brake pressure indication appears on the BRAKE PRESS indicator.

● **At 80 knots:**

- **THRUST levers** ..... **REV IDLE**
  70 knots is the minimum recommended speed with full reverse thrust.

| CAUTION |
|---|
| Avoid using high levels of reverse thrust at low airspeed, because gases re-entering the compressor can cause engine stalls that may result in excessive EGT. |

## 1.18.6 Summary of Quick Reference Hand Book

| A319 A320 A321 | EMERGENCY PROCEDURES | REV 36 | 1.13 |
|---|---|---|---|
| | | SEQ 001 | |

### LOSS OF BRAKING

- **IF AUTOBRAKE IS SELECTED :**
  - BRAKE PEDALS ..... PRESS
- **IF NO BRAKING AVAILABLE :**
  - REV ..... MAX
  - BRAKE PEDALS ..... RELEASE
  - A/SKID & N/W STRG ..... OFF
  - BRAKE PEDALS ..... PRESS
  - MAX BRK PR ..... 1000 PSI
- **If STILL NO BRAKING :**
  - PARKING BRAKE ..... SHORT AND SUCCESSIVE APPLICATIONS

TNA MSN 0441 0602-0822

| LANDING | |
|---|---|
| PF | PNF |
| **At 20 feet :** | |
| FLARE . . . . . PERFORM | ATTITUDE . . . . . MONITOR |
| THRUST LEVERS . . . . . IDLE | |
| **At touchdown :** | |
| REV . . . . . MAX | ANNOUNCE . . . . . "GRND SPLRS" |
| BRAKES . . . . . AS RQRD | ANNOUNCE . . . . . "REVERSE GREEN" |
| **At 70 knots :** | |
| REV . . . . . IDLE | ANNOUNCE . . . . . "70 KT" |
| **At taxi speed :** | |
| REV . . . . . STOW | |
| **Before 20 knots :** | |
| AUTOBRK . . . . . DISENGAGE | |

| GO AROUND (WITH FD ON) | |
|---|---|
| PF | PNF |
| THRUST LEVERS . . . . . TOGA | |
| ANNOUNCE . . . . . "GO AROUND-FLAPS" | |
| ROTATION . . . . . PERFORM | FLAPS . . . . . RETRACT ONE STEP |
| ANNOUNCE . . . . . FMA | ANNOUNCE . . . . . "POSITIVE CLIMB" |
| ORDER . . . . . "GEAR UP" | L/G . . . . . UP |
| | ANNOUNCE . . . . . "GEAR UP-FLAPS" |
| | NAV or HDG . . . . . SELECT |
| **At GA thrust red. altitude :** | |
| THRUST LEVERS . . . . . CL | |
| **At GA accel altitude :** | |
| SPEED . . . . . MONITOR | FLAPS . . . . . RETRACT ON SCHEDULE |

| GO AROUND (WITH FD OFF) | |
|---|---|
| PF | PNF |
| THRUST LEVERS . . . . . TOGA | |
| ANNOUNCE . . . . . "GO AROUND-FLAPS" | |
| ROTATION . . . . . 15° OF PITCH | FLAPS . . . . . RETRACT ONE STEP |
| | ANNOUNCE . . . . . "POSITIVE CLIMB" |
| ORDER . . . . . "GEAR UP" | L/G . . . . . UP |
| | ANNOUNCE . . . . . "GEAR UP-FLAPS" |
| **At GA thrust red. altitude :** | |
| THRUST LEVERS . . . . . KEEP TOGA | |
| **At GA accel altitude :** | |
| SPEED . . . . . SELECT | |
| PITCH . . . . . + 10°/12° | |
| THRUST LEVERS . . . . . CL | |
| A/THR (if GA alt < 100 feet) . . . . . ENGAGE | FDs . . . . . ON |
| | NAV or HDG . . . . . SELECT |
| | OPEN CLIMB . . . . . ENGAGE |
| | FLAPS . . . . . RETRACT ON SCHEDULE |
| ANNOUNCE . . . . . FMA | |

## 1.18.7 Summary of A320 Minimum Equipment List

| 復興航空 TransAsia Airways | A320 FAMILY MEL / CDL | PAGE: 1-78-1 SEQ: 001 |
|---|---|---|

**78 EXHAUST**

| 1. SYSTEM & SEQUENCE NUMBER ITEM | 2. RECTIFICATION INTERVAL | 3. NUMBER INSTALLED | 4. NUMBER REQUIRED FOR DISPATCH | 5. REMARKS OR EXCEPTIONS |
|---|---|---|---|---|
| **78-30 THRUST REVERSER** | | | | |
| 30-01 Thrust Reverser | C | 2 | 0 | * **(m) (o)** One or both may be inoperative provided:<br>1) The inoperative reverser is deactivated and secured in the stowed position, and no operation or procedure is predicated on thrust reversers use, and<br>2) No REV PRESSURIZED warning is displayed on ECAM. |
| **OPERATING PROCEDURES**<br>**AT LANDING:**<br>**Note:** *It is recommended not to select reverse thrust on the affected engine.* | | | | |
| 30-02 Reverser Inhibition Relay Switch | C | 4 | 0 | One or more may be inoperative provided the associated reverser is deactivated.<br>Refer to **78-30-01.** |
| 30-03 Reverser Indication | C | 2 | 0 | One or both may be inoperative provided the associated reverser is deactivated.<br>Refer to **78-30-01** |
| 30-04 Thrust Reverser Shut Off Valve *(Applicable to **B22310, B22311, B22606** and **B22607** only)* | C | 2 | 0 | One or both may be inoperative in open position. |

***ALL***

# Appendix 1 GE536 CVR Transcript

## Legend:

CM1: radio communication from captain (pilot not flying)

CM2: radio communication from first officer (pilot flying)

CAM: sounds from cockpit area microphone

CAM1: captain voice from CAM

CAM2: first officer voice from CAM

PA: recording of public address

KHH：Kaohsiung approach

TCH：Taichung approach

ACC: Taipei area control center

APP: Taipei approach

TWR: Sungshan tower

---: source unknown

…: content unintelligible

*: communication not related to operation

() : remarks

~: communication interrupted

CAL616、CAL678、CAL688、CPA401、EVA228、FEA082、FEA137、MDA280、MDA732、MDA747、TNA242、TNA374、TNA535、UNI615、UNI829、UNI830、UNI831、UNI93 stand for other flights appeared in the recording

| Time | Source | Content | Translation |
|---|---|---|---|
| 1931:32 | PA | 各位貴賓現在扣緊安全帶的警示燈已經熄滅了 但是為了要預防突然間不穩定的氣流所以請您在座位上將安全帶扣好 在機艙內請不要使用行動電話及相關電子用品 謝謝您的合作(以台語複述)ladies and gentlemen please fasten your seat belt whenever seated according to last CAA regulation may we remind you cell phone radio transmitter remote control for any other electronic devices must not be used please kindly switch it off thank you for your cooperation 各位貴賓在本段的航程中我們將提供您選擇的飲料有熱咖啡熱烏龍茶柳橙汁以及熱的蜂蜜菊花茶希望您對我們的服務感到滿意謝謝 | (public address in Chinese, Taiwanese and English) |
| 1931:34 | KHH | （KHH 與 UNI829 間對話） | (communication between KHH and UNI829) |
| 1931:37 | UNI829 | （KHH 與 UNI829 間對話） | (communication between KHH and UNI829) |
| 1931:40 | KHH | transasia five tree six climb and maintain flight level one niner zero | |
| 1931:43 | CM1 | climb and maintain flight level one niner zero transasia five tree six | |
| 1931:47 | KHH | （KHH 與 AR55 間對話） | (communication between KHH and AR55) |
| 1932:02 | CAM | （不明聲響） | (unknown sound) |
| 1932:13 | CAM2 | 它在我們後面一點 | It’s just behind us |
| 1933:12 | CAM2 | * | |
| 1933:15 | KHH | （KHH 與 UNI829 間對話） | (communication between KHH and UNI829) |
| 1933:17 | CAM1 | * | |
| 1933:19 | CAM2 | * | |
| 1933:21 | UNI829 | （KHH 與 UNI829 間對話） | (communication between KHH and UNI829) |
| 1933:24 | KHH | （KHH 與 UNI829 間對話） | (communication between KHH and UNI829) |

| Time | Source | Content | Translation |
|---|---|---|---|
| 1933:31 | UNI829 | （KHH 與 UNI829 間對話） | (communication between KHH and UNI829) |
| 1933:33 | CAM1 | * | |
| 1933:34 | CAM2 | * | |
| 1933:36 | CAM1 | * | |
| 1933:38 | KHH | transasia five tree six contact taichung approach one two niner point six | |
| 1933:42 | CM1 | 嗯 taichung approach one two niner point six good day ma'am transasia five tree six | Uh taichung approach one two niner point six good day ma'am transasia five tree six |
| 1933:48 | KHH | （KHH 與 MDA280 間對話） | (communication between KHH and MDA829) |
| 1933:49 | CAM1 | * | |
| 1933:54 | CAM2 | * | |
| 1933:59 | CAM1 | * | |
| 1934:09 | CM1 | taichung approach good evening transasia five tree six climbing to flight level one niner zero | |
| 1934:14 | TCH | transasia five tree six taichung approach roger | |
| 1934:18 | CAM1 | * | |
| 1934:22 | CAM2 | * | |
| 1934:23 | CAM1 | * | |
| 1934:25 | UNI615 | （TCH 與 UNI615 間對話） | (communication between TCH and UNI615) |
| 1934:30 | TCH | （TCH 與 UNI615 間對話） | (communication between TCH and UNI615) |
| 1934:33 | UNI615 | （TCH 與 UNI615 間對話） | (communication between TCH and UNI615) |
| 1934:42 | CAM2 | * | |
| 1934:59 | CAM1 | * | |
| 1935:04 | TCH | （TCH 與它機間對話） | (communication between TCH and an unknown aircraft) |
| 1935:25 | CAM2 | * | |
| 1935:29 | CAM1 | * | |
| 1935:30 | TCH | （TCH 與 UNI615 間對話） | (communication between TCH and UNI615) |
| 1935:33 | UNI615 | （TCH 與 UNI615 間對話） | (communication between TCH and UNI615) |
| 1935:46 | CAM1 | * | |
| 1936:33 | TCH | （TCH 與 UNI9631 間對話） | (communication between TCH and UNI615) |
| 1936:50 | CAM1 | * | |
| 1936:56 | CAM2 | * | |
| 1936:58 | CAM1 | * | |

| Time | Source | Content | Translation |
|---|---|---|---|
| 1937:18 | CAM1 | 你先用那個天氣吧 我這個還收不到 喔 來了 那我來收 | You use that weather report first I haven't received the ATIS yet uh it's coming I'll take it |
| 1937:21 | CAM2 | … | |
| 1937:21 | ATIS | three thousand five hundred feet temperature two three QNH one zero zero eight hacto pascal low level wind shear advisory in effect moderate to sever ~mation zulu sungshan airport information zulu one one two eight zulu expect ILS approach runway one zero in use wind variable at three ~five hundred meter light rain cloud scatter ~ one thousand eight hundred feet overcast three thousand ~ temperature two three dew point two two QNH one zero zero eight hacto pascal wind shear on runway one zero low level wind shear advisory in effect moderate to severe inform taipei approach or sungshan tower~ | |
| 1937:26 | CAM | （機械聲） | (mechanical sound) |
| 1937:27 | CAM1 | you have radio please | |
| 1937:27 | TCH | transasia five tree six contact taipei control one two six point seven good day | |
| 1937:32 | CM2 | five tree six good day | |
| 1937:39 | CM2 | taipei control good evening transasia five tree six flight level one niner zero four nine dme to houlung identing | |
| 1937:46 | ACC | transasia five tree six taipei control roger | |
| 1937:54 | ACC | （ACC 與 CAL616 間對話） | (communication between ACC and CAL616) |
| 1938:00 | CAL616 | （ACC 與 CAL616 間對話） | (communication between ACC and CAL616) |
| 1938:06 | ACC | （ACC 與 CAL616 間對話） | (communication between ACC and CAL616) |
| 1938:25 | ACC | （ACC 與 TNA374 間對話） | (communication between ACC and TNA374) |

| Time | Source | Content | Translation |
|---|---|---|---|
| 1938:29 | TNA374 | （ACC 與 TNA374 間對話） | (communication between ACC and TNA374) |
| 1938:31 | CAM1 | 還是一樣 low level wind shear moderate turbulence | Still the same low level wind shear moderate turbulence |
| 1938:37 | CAM2 | sir moderate turbulence | |
| 1938:37 | ACC | （ACC 與 CAL688 間對話） | (communication between ACC and CAL688) |
| 1938:38 | CAM | （機械聲） | (mechanical sound) |
| 1938:41 | CAL688 | （ACC 與 CAL688 間對話） | (communication between ACC and CAL688) |
| 1938:42 | CAM1 | I have radio sir | |
| 1938:47 | CAM1 | 現在台北 control 好 | Now at taipei control okay |
| 1938:49 | CAM2 | 對 | Right |
| 1939:04 | ACC | （ACC 與 CAL688 間對話） | (communication between ACC and CAL688) |
| 1939:08 | PA | 晚安各位先生各位女士這是副機師報告 歡迎各位搭乘復興航空第五三六班次由台南飛往台北松山 我們現在飛行的高度是一萬九千英呎 Average 的地速大約每小時八百公里 目前松山天氣嗯多雲下雨地面氣溫二十三度 C 預計抵達的時間大約在晚間的八點鐘左右 感謝各位的搭乘 全體組員敬祝各位身體健康旅途愉快謝謝 good evening ladies and gentlemen this is the first officer speaking welcome board transasia airways flight number five thee six from tainan to sungshan and now we are flying at nineteen thousand feet average ground speed is about eight hundred kilometer per hour with forecast at sungshan is raining now ground temperature about twenty three degrees and estimate arrival at eight o’clock PM thanks for flying with us have nice trip thank you | (public address in Chinese and English) |
| 1939:09 | CAL688 | （ACC 與 CAL688 間對話） | (communication between ACC and CAL688) |

| Time | Source | Content | Translation |
|---|---|---|---|
| 1939:41 | ACC | （ACC 與 CPA401 間對話） | (communication between ACC and CPA401) |
| 1939:47 | CPA401 | （ACC 與 CPA401 間對話） | (communication between ACC and CPA401) |
| 1940:03 | ACC | transasia five tree six descend and maintain flight level one five zero descend now | |
| 1940:08 | CM1 | descend to one five zero we are leaving transasia five tree six | |
| 1940:17 | CAM1 | VS descend flight level one five zero | |
| 1940:18 | ACC | (communication between ACC and TNA374) | |
| 1940:21 | CAM2 | sir cruise checklist complete… | |
| 1940:26 | CAM2 | weather at sungshan wind shear VMC …approach speed... radio nav houlung zero five two anpu lima kilo oscar progress... MDA two six three... approach chart... ITSG... outer marker position two thousand… houlung one zulu after houlung via zero five two radial zonli four thousand cross zonli descend three thousand five hundred feet until tazan inbound course zero niner five go around procedure oscar lima uniform ...oscar lima uniform four thousand hold at lima uniform or radar vector... cleared for approach flight director autopilot autothrust decelerate approach one thousand stable in case go around I will call out ... | |
| 1940:26 | TNA374 | (communication between ACC and TNA374) | |
| 1940:31 | ACC | (communication between ACC and CAL688) | |
| 1940:36 | CAL688 | (communication between ACC and CAL688) | |
| 1940:58 | ACC | (communication between ACC and EVA228) | |

| Time | Source | Content | Translation |
|---|---|---|---|
| 1941:03 | EVA228 | (communication between ACC and EVA228) | |
| 1941:06 | ACC | (communication between ACC and EVA228) | |
| 1941:09 | ACC | (communication between ACC and TNA374) | |
| 1941:13 | TNA374 | (communication between ACC and TNA374) | |
| 1941:22 | CAL678 | (communication between ACC and CAL678) | |
| 1941:26 | ACC | (communication between ACC and CAL678) | |
| 1941:31 | CAL678 | (communication between ACC and CAL678) | |
| 1941:37 | ACC | (communication between ACC and MDA280) | |
| 1941:39 | PA | 各位貴賓我們正經過不穩定的氣流請務必留在座位上扣好安全帶謝謝 (同時以國語、台語及客語複述) ladies and gentlemen we are now passing through turbulence please fasten your seat belt thank you | (public address in Chinese, Taiwanese, Hakka and English) |
| 1941:41 | MDA280 | (communication between ACC and MDA280) | |
| 1941:55 | ACC | transasia five tree six contact taipei approach one one niner point seven | |
| 1942:00 | CM1 | one niner point seven good night sir five tree six | |
| 1942:04 | ACC | Right | |
| 1942:04 | APP | (communication between APP and FEA082) | |
| 1942:06 | FEA082 | (communication between APP and FEA082) | |
| 1942:07 | CAM1 | you have control | |
| 1942:09 | CAM2 | yes I have control | |
| 1942:10 | CAM1 | VS descend to one five zero | |
| 1942:11 | CAM2 | check | |
| 1942:11 | APP | (communication between APP and FEA137) | |
| 1942:12 | CAM1 | 我把速度減到… | I reduce the speed to… |
| 1942:14 | FEA137 | (communication between APP and FEA137) | |
| 1942:21 | APP | (communication between APP and FEA137) | |

| Time | Source | Content | Translation |
|---|---|---|---|
| 1942:24 | FEA137 | (communication between APP and FEA137) | |
| 1942:29 | CM1 | taipei approach good evening transasia five tree six descend flight level one five zero | |
| 1942:34 | APP | transasia five tree six taipei approach ident taipei QNH one zero zero niner | |
| 1942:39 | CM1 | one zero zero niner transasia five tree six | |
| 1942:45 | TNA535 | (communication between APP and TNA535) | |
| 1942:56 | APP | (communication between APP and TNA535) | |
| 1942:58 | TNA535 | (communication between APP and TNA535) | |
| 1943:02 | APP | (communication between APP and TNA535) | |
| 1943:05 | TNA535 | (communication between APP and TNA535) | |
| 1943:08 | APP | (communication between APP and MDA747) | |
| 1943:11 | MDA747 | (communication between APP and MDA747) | |
| 1943:13 | APP | (communication between APP and MDA747) | |
| 1943:14 | MDA732 | (communication between APP and MDA732) | |
| 1943:17 | APP | (communication between APP and MDA732) | |
| 1943:19 | MDA732 | (communication between APP and MDA732) | |
| 1943:20 | APP | (communication between APP and TNA242) | |
| 1943:24 | TNA242 | (communication between APP and TNA242) | |
| 1943:28 | CM1 | taipei approach transasia five tree six approaching flight level one five zero | |
| 1943:32 | APP | transasia five tree six descend and maintain five thousand | |
| 1943:36 | CM1 | descend five thousand five tree six | |
| 1943:39 | APP | (communication between APP and TNA242) | |
| 1943:42 | CAM2 | idle descend five thousand | |

| Time | Source | Content | Translation |
|---|---|---|---|
| 1943:42 | TNA242 | (communication between APP and TNA242) | |
| 1943:43 | CAM1 | check | |
| 1943:44 | APP | (communication between APP and TNA242) | |
| 1943:48 | TNA242 | (communication between APP and TNA242) | |
| 1943:52 | APP | (communication between APP and TNA242) | |
| 1943:53 | APP | transasia five tree six proceeding ATR over putin speed two one zero | |
| 1943:57 | CM1 | TCAS contact we are adjust our speed transasia five tree six | |
| 1944:11 | APP | (communication between APP and FEA082) | |
| 1944:17 | FEA082 | (communication between APP and FEA082) | |
| 1944:26 | MDA280 | (communication between APP and MDA280) | |
| 1944:30 | CAM2 | idle descend | |
| 1944:31 | CAM1 | check | |
| 1944:31 | APP | (communication between APP and MDA280) | |
| 1944:38 | MDA280 | (communication between APP and MDA280) | |
| 1944:42 | CAM2 | one zero zero niner… | |
| 1944:43 | APP | transasia five tree six cleared ILS runway one zero approach | |
| 1944:46 | CAM1 | check | |
| 1944:48 | CAM2 | 教官 我們許可 ILS | Sir we are cleared for ILS |
| 1944:51 | CM1 | cleared ILS runway one zero approach transasia five tree six | |
| 1945:20 | APP | (communication between APP and FEA082) | |
| 1945:24 | FEA082 | (communication between APP and FEA082) | |
| 1945:44 | APP | (communication between APP and FEA137) | |
| 1945:48 | FEA137 | (communication between APP and FEA137) | |
| 1945:49 | APP | (communication between APP and FEA137) | |
| 1945:51 | APP | (communication between APP and MDA280) | |

| Time | Source | Content | Translation |
|---|---|---|---|
| 1945:54 | MDA280 | (communication between APP and MDA280) | |
| 1945:57 | APP | (communication between APP and MDA280) | |
| 1946:03 | PA | 各位貴賓 我們已經開始航機的下降了 受到天氣的影響下降的氣流不穩定 請您務必扣好安全帶 靠椅扶正 面前的餐桌歸回原處 (同時以國語及台語複述) ladies and gentlemen we are now descending due to turbulence please fasten your seat belt kindly put your seat upright and lock your tray table in place thank you | (public address in Chinese, Taiwanese and English) |
| 1946:03 | MDA280 | (communication between APP and MDA280) | |
| 1946:09 | APP | (communication between APP and MDA280) | |
| 1946:13 | MDA280 | (communication between APP and MDA280) | |
| 1946:14 | CAM1 | with ATR speed | |
| 1946:14 | APP | (communication between APP and MDA280) | |
| 1946:17 | MDA280 | (communication between APP and MDA280) | |
| 1946:25 | CAM | (unknown sound) | |
| 1946:25 | CAM2 | approach checklist please sir | |
| 1946:26 | CAM1 | yes sir | |
| 1946:28 | APP | (communication between APP and FEA082) | |
| 1946:28 | CAM1 | briefing | |
| 1946:29 | CAM2 | confirmed | |
| 1946:30 | CAM1 | status | |
| 1946:31 | CAM2 | no status | |
| 1946:33 | CAM1 | v bugs | |
| 1946:34 | CAM2 | set | |
| 1946:35 | CAM1 | seat belt | |
| 1946:36 | CAM2 | on | |
| 1946:36 | CAM1 | QNH MDA | |
| 1946:37 | FEA082 | (communication between APP and FEA082) | |
| 1946:38 | CAM2 | one zero zero niner MDA two six three | |
| 1946:41 | CAM1 | TAD on ND | |
| 1946:42 | CAM2 | … | |

| Time | Source | Content | Translation |
|---|---|---|---|
| 1946:43 | CAM1 | engine mode select | |
| 1946:44 | CAM2 | normal | |
| 1946:45 | CAM1 | checklist completed | |
| 1946:56 | CAM1 | * | |
| 1947:37 | CAM2 | * | |
| 1947:38 | CAM1 | * | |
| 1947:39 | APP | transasia five tree six say airspeed | |
| 1947:42 | CM1 | speed two five zero | |
| 1947:45 | APP | roger | |
| 1947:46 | APP | (communication between APP and FEA082) | |
| 1947:50 | FEA082 | (communication between APP and FEA082) | |
| 1947:54 | APP | (communication between APP and FEA082) | |
| 1947:57 | FEA082 | (communication between APP and FEA082) | |
| 1948:09 | CAM1 | * | |
| 1948:19 | FEA082 | (communication between APP and FEA082) | |
| 1948:20 | CAM1 | * | |
| 1948:22 | APP | (communication between APP and FEA082) | |
| 1948:26 | CAM | (unknown sound) | |
| 1948:26 | FEA082 | (communication between APP and FEA082) | |
| 1948:29 | APP | (communication between APP and FEA082) | |
| 1948:30 | CAM1 | * | |
| 1948:57 | APP | (communication between APP and MDA280) | |
| 1949:01 | MDA280 | (communication between APP and MDA280) | |
| 1949:10 | FEA678 | (communication between APP and FEA678) | |
| 1949:18 | CAM2 | * | |
| 1949:21 | CAM1 | * | |
| 1949:23 | APP | (communication between APP and FEA678) | |
| 1949:26 | FEA678 | (communication between APP and FEA678) | |
| 1949:36 | CAM1 | * | |
| 1951:32 | APP | (communication between APP and MDA280) | |
| 1951:35 | MDA280 | (communication between APP and MDA280) | |
| 1951:38 | APP | (communication between | |

| Time | Source | Content | Translation |
|---|---|---|---|
| | | APP and MDA280) | |
| 1951:49 | CAM | (unknown sound) | |
| 1951:53 | TNA242 | (communication between APP and TNA242) | |
| 1951:56 | APP | (communication between APP and TNA242) | |
| 1951:59 | TNA242 | (communication between APP and TNA242) | |
| 1952:00 | APP | (communication between APP and TNA242) | |
| 1952:14 | CAM2 | zonli three thousand five | |
| 1952:15 | CAM1 | check | |
| 1952:16 | CAM2 | activate approach phase | |
| 1952:21 | CAM1 | 嗯奇怪你為什麼不再等一下呢 等 automatically activate approach phase | Uh why don't you keep waiting until it automatically activates approach phase |
| 1952:28 | CAM2 | 看他已經進去了 速度又減 | Yeah the preceding traffic is established and the speed is reducing |
| 1952:28 | CAM1 | 對呀 你看你現在也到啦 | See we reach the point (automatically activates approach phase) |
| 1953:06 | UNI830 | (communication between APP and UNI830) | |
| 1953:14 | APP | (communication between APP and UNI830) | |
| 1953:16 | CAM2 | heading | |
| 1953:17 | CAM1 | check | |
| 1953:18 | CAM2 | glide slope loc blue cat three dual | |
| 1953:21 | CAM1 | check | |
| 1953:21 | CAM2 | cat three dual autopilot one and two | |
| 1953:22 | CAM1 | check | |
| 1953:22 | UNI830 | (communication between APP and UNI830) | |
| 1953:45 | APP | (communication between APP and MDA280) | |
| 1953:50 | MDA280 | (communication between APP and MDA280) | |
| 1953:52 | CAM2 | flap one sir | |
| 1953:53 | CAM1 | speed check flap one | |
| 1954:50 | CAM2 | loc alive | |
| 1954:51 | CAM1 | check | |
| 1954:52 | CAM2 | loc star | |
| 1954:53 | CAM1 | check | |
| 1954:58 | UNI93 | (communication between APP and UNI93) | |

| Time | Source | Content | Translation |
|---|---|---|---|
| 1955:04 | CAM2 | glide slope star four thousand set | |
| 1955:05 | APP | (communication between APP and UNI93) | |
| 1955:05 | CAM1 | check | |
| 1955:10 | UNI93 | (communication between APP and UNI93) | |
| 1955:15 | CM1 | taipei approach transasia five tree six establish | |
| 1955:23 | CAM2 | flap two | |
| 1955:24 | APP | transasia five tree six contact tower one one eight point one | |
| 1955:27 | CM1 | contact tower good night mam five tree six | |
| 1955:34 | CM1 | sungshan tower good evening transasia five tree six ILS approach and ten mile on final | |
| 1955:40 | TWR | good evening transasia five three six sungshan tower runway one zero wind zero one zero at four QNH one zero zero eight continue approach | |
| 1955:49 | CM1 | one zero zero eight runway one zero continue approach five three six | |
| 1955:56 | CAM2 | 么洞洞八 | One zero zero eight |
| 1955:57 | CAM1 | check | |
| 1955:59 | CAM1 | RA alive | |
| 1956:00 | CAM2 | check | |
| 1956:26 | CAM | (unknown sound) | |
| 1956:34 | CAM | (mose code sound - outer marker signal) | |
| 1956:38 | CAM2 | outer marker | |
| 1956:39 | CAM1 | check two thousand | |
| 1956:40 | CAM2 | gear down | |
| 1956:41 | CAM1 | gear down | |
| 1956:42 | CAM | (sound similar to landing gears down) | |
| 1956:47 | PA | 各位貴賓我們即將降落 請扣緊安全帶豎直椅背收回桌子謝謝 組員請就座 (同時以國語及台語複述) ladies and gentlemen we are about to land please fasten your seat belt kindly put your seat | (public address in Chinese, Taiwanese and English) |

| Time | Source | Content | Translation |
|---|---|---|---|
| | | upright and lock your tray table in place thank you | |
| 1957:05 | CAM2 | flap three | |
| 1957:05 | CAM1 | three | |
| 1957:09 | CAM1 | final set | |
| 1957:11 | CAM2 | landing checklist | |
| 1957:12 | CAM1 | before landing cabin crew | |
| 1957:13 | CAM2 | advised | |
| 1957:14 | CAM1 | auto thrust | |
| 1957:15 | CAM2 | speed | |
| 1957:15 | CAM1 | go around altitude | |
| 1957:17 | CAM2 | four thousand set | |
| 1957:17 | CAM1 | landing memo | |
| 1957:18 | CAM2 | no blue | |
| 1957:19 | CAM1 | correct runway | |
| 1957:20 | CAM2 | runway one zero | |
| 1957:21 | CAM1 | standby landing clearance | |
| 1957:21 | TWR | (communication between TWR and TNA242) | |
| 1957:25 | TNA242 | (communication between TWR and TNA242) | |
| 1957:28 | TWR | (communication between TWR and TNA242) | |
| 1957:30 | TNA242 | (communication between TWR and TNA242) | |
| 1958:03 | CAM2 | one thousand | |
| 1958:03 | CAM1 | stable | |
| 1958:11 | --- | … | |
| 1958:12 | TWR | transasia five tree six the wind calm cleared to land | |
| 1958:15 | CM1 | wind calm cleared to land five tree six | |
| 1958:18 | CAM2 | wind calm cleared to land | |
| 1958:19 | CAM1 | yah | |
| 1958:51 | CAM | four hundred (altitude alert) | |
| 1958:51 | MDA280 | (communication between TWR and MDA280) | |
| 1958:53 | CAM1 | hundred above minimum | |
| 1958:55 | TWR | (communication between TWR and MDA280) | |
| 1958:56 | CAM2 | land green | |
| 1958:58 | CAM1 | check | |
| 1959:01 | MDA280 | (communication between TWR and MDA280) | |
| 1959:02 | CAM | three hundred (altitude alert) | |
| 1959:02 | CAM2 | insight landing | |
| 1959:03 | CAM1 | cleared to land | |
| 1959:04 | CAM | cricket cricket cricket (sound | |

| Time | Source | Content | Translation |
|---|---|---|---|
| | | of autopilot disengaged) | |
| 1959:05 | CAM | (morse code sound - middle marker signal) | |
| 1959:05 | UNI831 | (communication between TWR and UNI831) | |
| 1959:06 | CAM | two hundred (altitude alert) | |
| 1959:08 | TWR | (communication between TWR and UNI831) | |
| 1959:10 | UNI831 | (communication between TWR and UNI831) | |
| 1959:15 | CAM | one hundred (altitude alert) | |
| 1959:21 | CAM | fifty (altitude alert) | |
| 1959:23 | CAM | twenty (altitude alert) | |
| 1959:23 | CAM | retard retard | |
| 1959:26 | CAM | (sound similar to landing gears touching down) | |
| 1959:26 | CAM | retard | |
| 1959:27 | CAM | (mechanical sound) | |
| 1959:28 | CAM | retard | |
| 1959:29 | CAM1 | spoiler one reverse green and | |
| 1959:37 | CAM1 | 沒有煞車喔 | No brake |
| 1959:37 | TWR | (communication between TWR and UNI831) | |
| 1959:39 | CAM1 | 沒有煞車喔 | No brake |
| 1959:40 | UNI831 | (communication between TWR and UNI831) | |
| 1959:43 | TWR | (communication between TWR and UNI831) | |
| 1959:44 | CAM1 | 沒有煞車 | No brake |
| 1959:46 | CAM1 | 沒有煞車喔 | No brake |
| 1959:47 | UNI831 | (communication between TWR and UNI831) | |
| 1959:50 | CAM1 | 完全沒有煞車 | No brake at all |
| 1959:50 | TWR | (communication between TWR and UNI831) | |
| 1959:53 | CAM1 | 煞車 | Brake |
| 1959:54 | CAM2 | 怎麼回事兒教官 | What’s going on sir |
| 1959:55 | CAM1 | 我不知道 | I have no idea |
| 1959:57 | CAM1 | 哇噻 | Wow |
| 1959:57 | CAM | (sound similar to impact) | |
| 1959:58 | CAM | (sound similar to impact) | |
| 1959:59 | CAM | chime (single chime) | |
| 2000:01 | CAM2 | 嗯 | Uh |
| 2000:03 | CAM1 | 哇噻 | Wow |
| 2000:03 | CAM | (sound similar to impact) | |

| Time | Source | Content | Translation |
|---|---|---|---|
| 2000:04 | CAM1 | 哇噻 | Wow |
| 2000:05 | CAM | (sound similar to impact) | |
| 2000:06 | TWR | transasia five three six ground | |
| 2000:08 | CM1 | 我們沒有煞失效煞車 | We have no brake brake failed |
| 2000:10 | CAM | (sound similar to impact) | |
| 2000:11 | CAM | (sound similar to impact) | |
| 2000:15 | CAM | (sound similar to impact) | |
| 2000:15 | TWR | 教官請問你們出跑道了嗎 | Sir are you off the runway |
| 2000:17 | CAM | chime (single chime) | |
| 2000:18 | CM1 | 我們需要地面支援 | We need ground support |
| 2000:19 | TWR | roger | |
| 2000:20 | CAM | chime (single chime) | |
| 2000:21 | CM1 | attention crew at station attention crew at station | |
| 2000:22 | CAM | chime (single chime) | |
| 2000:24 | CM1 | attention crew at station | |
| 2000:31 | CAM1 | 唉 | Sigh |
| 2000:34 | CAM | (mechanical sound) | |
| 2000:34 | MDA280 | (communication between TWR and MDA280) | |
| 2000:36 | PA | 組員請就位 | Crew at station |
| 2000:37 | CAM | (mechanical sound) | |
| 2000:37 | CAM | chime (single chime) | |
| 2000:38 | TWR | (communication between TWR and MDA280) | |
| 2000:40 | CAM2 | 關車嗎 | Shall we shutdown |
| 2000:41 | CAM1 | 關車 | Shutdown |
| 2000:42 | CAM | (sound of switch) | |
| 2000:43 | CAM | (sound of switch) | |
| 2000:46 | MDA280 | (communication between TWR and MDA280) | |
| 2000:48 | | (recording stopped) | |
| 2002:15[22] | | (recording restarted) | |
| 2002:15 | CM1 | 需要這個在目前的地點疏散旅客 | We need to evacuate passengers right here |
| 2002:20 | TWR | 復興五三六 roger 我們會請相關人員支援 | Transasia five three six roger we will send the ground support |
| 2002:20 | PA | 各位貴賓我們現在已經看過外界的狀況 目前我們是在跑道頭這邊停下來了 很抱歉造 | Ladies and gentlemen we have checked the situation outside we stopped at the |

[22] Time reference of restarting recording is according to the ATC time.

| Time | Source | Content | Translation |
|---|---|---|---|
| | | 成各位讓各位受驚 那麼外界目前的狀況看嗯是 看起來目前看起來是安全正常的 那麼各位先保持在您的座位上 我們機長已經在跟相關單位做一個聯絡~ | end of the runway sorry for the frightening the situation seems safe and normal so far please stay on your seat our captain is contacting with related agencies right now~ |
| 2002:41 | TWR | (communication between TWR and TNA280) | |
| 2002:42 | | (recording ended) | |

# Appendix 2  B-22310 Flight Parameters List

A/C:A320/200 Engine: IAE V2527-A5

FDIU SAGEM P/N ED43A1D5 ARINCE 573/717 128 Word/s

| | Ident | Bus | Label/SDI | Description |
|---|---|---|---|---|
| 1 | A01a01 | Clock | 260/00 | Day of Date |
| 2 | A02a01 | FWC | 126/01 | Flight Phase |
| 3 | A03a01 | DMC | 233/01 | Flight Number |
| 4 | A05a01 | DMC | 230/01 | Data Base Update |
| 5 | A06a01 | DMC | 075/01 | Gross Weight |
| 6 | A07a01 | | | Fleet Identification |
| 7 | A07c01 | | | A/C Type |
| 8 | A07d01 | | | A/C Tail Number |
| 9 | A07f01 | | | Result Parameter Check |
| 10 | A07g01 | | | FDIU BITE |
| 11 | A08a01 | DMC | 046/01 | Engine 1 Ident |
| 12 | A08a02 | DMC | 046/01 | Engine 2 Ident |
| 13 | M01a01 | Clock | 125/00 | UTC Hours |
| 14 | M01a04 | Clock | 150/00 | Clock Synchronized by GPS |
| 15 | M01b01 | | | Frame Counter |
| 16 | M02a01 | DMC | 203/XX | Altitude standard fine |
| 17 | M02a02 | DMC | 203/XX | Altitude standard coarse |
| 18 | M03a01 | DMC | 206/XX | Indicated Airspeed |
| 19 | M04a01 | DMC | 320/XX | True Heading |
| 20 | M04b02 | FWC | 126/10 | Warning HDG Discrepancy |
| 21 | M05a01 | SDAC | 333/01 | normal acceleration |
| 22 | M06a01 | DMC | 324/01 | Pitch attitude |
| 23 | M06a02 | FWC | 124/01 | Warning Pitch discrepancy |
| 24 | M07a01 | DMC | 325/XX | Rall attitude |
| 25 | M07a02 | FWC | 124/01 | Warning Roll discrepancy |
| 26 | M08a01 | SDAC | 002/01 | VHF Keying |
| 27 | M08a02 | SDAC | 002/01 | HF Keying |
| 28 | M09a01 | DMC | 346/01 | N1/EPR Actual Eng 1 |
| 29 | M09a02 | DMC | 346/10 | N1/EPR Actual Eng 2 |
| 30 | M09tl01 | DMC | 133/01 | Throttle Lever Angel Eng 1 |
| 31 | M10a01 | FWC | 137/00 | Flaps Position |
| 32 | M11a01 | FWC | 127/00 | Slats Position |
| 33 | M11tl01 | SDAC | 046/01 | Lever Position (Matrix 1) |
| 34 | M12a01 | DMC | 270/01 | Reverser Unlock Eng 1 |
| 35 | M12a02 | DMC | 270/01 | Reverser Unlock Eng 2 |
| 36 | M12a05 | DMC | 270/01 | Rev Deployed Eng 1 |
| 37 | M12a06 | DMC | 270/01 | Rev Deployed Eng 2 |
| 38 | M13a03 | FCDC | 043/01 | Left Spoiler 1 Out |
| 39 | M13a04 | FCDC | 043/01 | Right Spoiler 1 Out |
| 40 | M14a01 | DMC | 211/XX | True Air Temperature (TAT) |
| 41 | M15a01 | DMC | 276/01 | A/P 1 Engaged |
| 42 | M15a02 | DMC | 276/01 | A/P 2 Engaged |
| 43 | M15a09 | DMC | 271/01 | ATS Thrust N1 Mode |
| 44 | M15a0l | DMC | 271/01 | ATS Speed Mach Mode Activated |
| 45 | M15a10 | DMC | 271/01 | Thrust EPR Mode |
| 46 | M15a35 | DMC | 301/01 | H/Path submode NAV engaged |

| | Ident | Bus | Label/SDI | Description |
|---|---|---|---|---|
| 47 | M15a36 | DMC | 301/01 | HDG submode NAV engaged |
| 48 | M15a38 | DMC | 301/01 | VOR submode NAV engaged |
| 49 | M15a39 | DMC | 301/01 | Loc submode Runway engaged |
| 50 | M15a3l | DMC | 301/01 | Track submode NAV engaged |
| 51 | M15a40 | DMC | 301/01 | Track submode Runway engaged |
| 52 | M15a41 | DMC | 300/01 | Roll out submode LAND TRACK engaged |
| 53 | M15a42 | DMC | 300/01 | Align submode LAND TRACK engaged |
| 54 | M15a43 | DMC 3 | 02/01 | Altitude Capture Mode |
| 55 | M15a44 | DMC 3 | 02/01 | Altitude Track Mode |
| 56 | M 18a0 | FCDC | 314/0 | Left Elevator Position |
| 57 | M 19a0 | FCDC | 315/01 | Stabilizer Position |
| 58 | M15a45 | DMC | 302/01 | G/S Track Mode |
| 59 | M15a46 | DMC | 302/01 | G/S Capture Mode |
| 60 | M15a48 | DMC | 302/01 | Expedite Climb Mode |
| 61 | M15a49 | DMC | 302/01 | Immediate Climb Mode |
| 62 | M15a4l | DMC | 302/01 | Open Climb Mode |
| 63 | M15a50 | DMC | 302/01 | Open Descent Mode |
| 64 | M15a51 | DMC | 302/01 | Expedite Descent Mode |
| 65 | M15a52 | DMC | 302 /01 | Immediate Mode |
| 66 | M16a01 | SDAC | 331/01 | Longitudinall Acceleration |
| 67 | M17a01 | SDAC | 332/01 | Lateral Acceleration |
| 68 | M18a02 | FCDC | 334/01 | Left Elevator Position |
| 69 | M18a05 | FCDC | 041/01 | Right Elevator Position |
| 70 | M18c01 | SDAC | 312/00 | Rudder Position |
| 71 | M18c02 | FWC | 126/00 | Yaw Damper 1 fault |
| 72 | M18c03 | FWC | 126/00 | Yaw Damper 2 fault |
| 73 | M18c04 | FCDC | 304/01 | Rudder pedal Position |
| 74 | M18c05 | FWC | 313/01 | Rudder trim Position |
| 75 | M18tl03 | FCDC | 310/01 | Left Aileron Position |
| 76 | M18tl04 | FCDC | 330/01 | Right Aileron Position |
| 77 | M18tl20 | FCDC | 363/01 | Left Spoiler 3 Position |
| 78 | M18tl21 | FCDC | 374/01 | Right Spoiler 4 Position |
| 79 | M20a01 | DMC | 164/01 | Radio Altitude 1 |
| 80 | M21a01 | DMC | 174/01 | Glide Slope Deviation 1 |
| 81 | M22a01 | DMC | 173/01 | Localizer Deviation 1 |
| 82 | M23a01 | DMC | 274/01 | Marker Beacon Passage |
| 83 | M24a02 | FWC | 126/00 | APU Fire |
| 84 | M24a03 | FWC | 126/00 | Engine 1 Fire |
| 85 | M24a04 | FWC | 126/00 | Engine 2 Fire |
| 86 | M24a05 | FWC | 126/00 | Cabin Press Warning |
| 87 | M24a06 | FWC | 126/00 | Avionic Smoke Warning |
| 88 | M24a18 | FWC | 126/00 | Red Warning |
| 89 | M24a19 | FWC | 126/10 | A/P oft Warning |
| 90 | M24a20 | FWC | 126 /11 | Sidestick not in T.O. configuration |
| 91 | M24a21 | FWC | 126/11 | L+R elevator fault |
| 92 | M24a22 | FWC | 126/11 | Gear not downlocked |
| 93 | M24a23 | SDA | 002/00 | Parking brake oft |
| 94 | M24a24 | FCDC | 044/01 | Left sidestick fault |
| 95 | M24a25 | FCDC | 044/01 | Right sidestick fault |
| 96 | M28a01 | FWC | 016/01 | GPWS Warning |
| 97 | M28tl01 | DMC | 307/01 | Capt EGPWS valid |

| | Ident | Bus | Label/SDI | Description |
|---|---|---|---|---|
| 98 | M28tl02 | DMC | 307/10 | F/O EGPWS valid |
| 99 | M28tl03 | DMC | 307/01 | Capt WXR valid |
| 100 | M28tl04 | DMC | 307/10 | F/O WXR valid |
| 101 | M28tl05 | DMC | 307/01 | Capt EGPWS installed |
| 102 | M28tl06 | DMC | 307/10 | F/O EGPWS installed |
| 103 | M28tlol | SDAC | 002/00 | EGPWS TERR ON ND switch |
| 104 | M29a01 | DMC | 221/XX | Angle of Attack LH |
| 105 | M2la03 | FWC | 021/01 | LDG Squat Switch LH |
| 106 | M30a01 | FWC | 126/00 | Hyd Low Press Yellow |
| 107 | M30a02 | FWC | 126/00 | Hyd Low Press Green |
| 108 | M30a03 | FWC | 126/00 | Hyd Low Press Blue |
| 109 | M31a01 | DMC | 312/XX | Ground Speed |
| 110 | M32b01 | FWC | 022/01 | Gear Up locked |
| 111 | M32b02 | FWC | 020/01 | Gear down locked |
| 112 | R01d01 | DMC | 310/DD | Present Pos Latitude Fine |
| 113 | R01d02 | DMC | 310/DD | Present Pos Latitude Coarse |
| 114 | R01d03 | DMC | 311/DD | Present Pos Long Fine |
| 115 | R01d04 | DMC | 311/DD | Present Pos Long Coarse |
| 116 | R01e01 | DMC | 307/01 | GPS Primary Capt |
| 117 | R01e02 | DMC | 307/10 | GPS Primary F/O |
| 118 | R02a02 | BSCU | 331/01 | Left brake pedal angle |
| 119 | R02b06 | SDAC | 026/01 | Alternate braking |
| 120 | R02b08 | SDAC | 002/00 | Antiskid Selector ON |
| 121 | R02b09 | FWC | 126/11 | Normal brake fault |
| 122 | R02bOl | FWC | 126/11 | Antiskid fault |
| 123 | R02c01 | BSCU | 300/01 | Normal brake pressure 1 |
| 124 | R02c02 | BSCU | 301/01 | Normal brake pressure 2 |
| 125 | R02c03 | BSCU | 302/01 | Normal brake pressure 3 |
| 126 | R02c04 | BSCU | 303/01 | Normal brake pressure 4 |
| 127 | R02c05 | BSCU | 304/01 | Normal brake pressure 5 |
| 128 | R02c06 | BSCU | 305/01 | Normal brake pressure 6 |
| 129 | R02c08 | BSCU | 307/01 | Normal brake pressure 8 |
| 130 | R02cOl | BSCU | 306/01 | Normal brake pressure l |
| 131 | R03b01 | DMC | 345/01 | EGT Eng 1 (1 495) |
| 132 | R03c01 | DMC | 244/01 | Fuel flow Eng 1 |
| 133 | R05b01 | DMC | 350/01 | Pred W/S internal failure |
| 134 | R05b02 | DMC | 350/01 | Pred W/S external failure |
| 135 | R05b03 | DMC | 350/01 | Pred W/S alert/terrain Caution Capt |
| 136 | R05b04 | DMC | 350/10 | Pred W/S alert/terrain Caution F/O |
| 137 | R05b05 | DMC | 350/01 | Pred W/S warning/terrain warning Capt |
| 138 | R05b05 | DMC | 350/01 | Pred W/S warning/terrain warning Capt |
| 139 | R05b06 | DMC | 350/10 | Pred W/S warning/terrain warning F/O |
| 140 | R05b08 | DMC | 350/01 | Pred W/S oft |
| 141 | R05bOl | FWC | 16/00 | Pred W/S pinprog |
| 142 | R06a04 | DMC | 276/10 | Altitude STDQHNQFE F/O |
| 143 | R09b05 | DMC | 271/01 | Mach Selection |
| 144 | R12c01 | DMC | 276/01 | Heading0rack Selection |
| 145 | R14a34 | DMC | 307/01 | Radar/EGPWS operating Mode Capt |
| 146 | R14a35 | DMC | 307/01 | Radar/EGPWS operating Mode F/O |
| 147 | R15a19 | DMC | 275/01 | System page origin |
| 148 | R17a02 | SDAC | 002/01 | AC 1 bus ON |

| | Ident | Bus | Label/SDI | Description |
|---|---|---|---|---|
| 149 | R17a03 | SDAC | 002/00 | AC ess bus ON |
| 150 | R18a03 | SDAC | 004/11 | DC ess bus ON |
| 151 | R19a05 | SDAC | 067/01 | Eng 1 HPV not fully closed |
| 152 | R19a06 | SDAC | 066/01 | Eng 2 HPV not fully closed |
| 153 | R19a08 | SDAC | 066/01 | Eng 2 PRV not fully closed |
| 154 | R19a11 | SDAC | 055/01 | Cross Feed Valve Eng 1l2 not fully closed |
| 155 | R19a12 | SDAC | 003/01 | Pack 1 flow control valve not fully closed |
| 156 | R19a13 | SDAC | 003/10 | Pack 2 flow control valve not fully closed |
| 157 | R19a14 | SDAC | 003/01 | Eng 1 anti ice P/B On |
| 158 | R19a15 | SDAC | 003/10 | Eng 2 anti ice P/B On |
| 159 | R19a16 | SDAC | 003/11 | wing anti ice P/B off |
| 160 | R19a18 | SDAC | 001/00 | Eng 2 AntiIce valve not fault |
| 161 | R19al7 | SDAC | 001/11 | Eng 1 AntiIce valve not fault |
| 162 | R19aOl | SDAC | 067/01 | Eng 1 PRV not fully closed |
| 163 | R21b01 | FWC | 126/00 | Slats Fault |
| 164 | R21b02 | FWC | 126/00 | Flaps Fault |
| 165 | ROlb02 | | | Constraint Altitude (SSM) |
| 166 | R21c01 | FWC | 126/11 | Engine 1 FADEC fault |
| 167 | R21c02 | FWC | 126/11 | Engine 2 FADEC fault |
| 168 | R21d01 | SDAC | 006/01 | GPWS terrain det. Fault |
| 169 | R28d01 | DMC | 033/01 | ILS1 Frequency I MMR 1 frequency I channel modes(coarse) |
| 170 | R28d02 | DMC | 033/01 | ILS1 Frequency I MMR 1 frequency I channel modes (fine) |
| 171 | R28d03 | DMC | 033/01 | MMR 1 modes |
| 172 | R28d04 | DMC | 033/10 | ILS2 Frequency I MMR 2 frequency I channel modes(coarse) |
| 173 | R28d05 | DMC | 033/10 | ILS2 Frequency I MMR 2 frequency I channel modes (fine) |
| 174 | R28d06 | DMC | 033/10 | MMR 2 modes |
| 175 | R28e01 | DMC | 032/01 | ADF 1 Frequency 100khz, 10khz, 1khz |
| 176 | R28e02 | DMC | 032/01 | ADF 1 Frequency 1000khz, 0.5khz |
| 177 | R28e03 | DMC | 032/10 | ADF 2 Frequency 100khz, 10khz, 1khz |
| 178 | R28e04 | DMC | 032/10 | ADF 2 Frequency 1000khz, 0.5khz |
| 179 | R30a01 | | | Event Marker |

# Appendix 3 AIRBUS Ground Spoilers Test Procedure

Subject: TNATPE/60/05 TNA A320 MSN 791 Runway Excursion - Ground Spoiler Extension Procedure

Please find following a Ground Spoiler Extension procedure, as requested by the ASC, which has been verified on a production aircraft here in Toulouse.

This procedure requires the use of a Main Landing Gear Wheel Tachometer Driving Tool part number 355M03190000.

Procedure:

1) Aircraft configuration:

> > 1.1 Energize the aircraft electrical circuits.

> > 1.2 Do the IR alignment procedure.

> > 1.3 On the panel 23 VU verify that the SEC1 SEC3, ELAC1 P/B are engaged.

> > 1.4 On the panel 24VU verify that the SEC2, ELAC 2 P/B are engaged.

> >

> > 2) Test :

> > 2.1 Install the MLG WHEEL TACHYMETER DRIVING TOOL (355M03190000) on the wheel 1 and wheel 4

> > 2.2 Pressurize the 3 hydraulic systems (elec. pump and power transfer unit)

> > 2.3 on the cockpit put the throttle control levers to the idle position and pre-select the speed brake control lever

> > 2.4 on the driving tool set a wheel speed around 1000 rpm and verify that the spoilers 1, 2 and 5 are extended;

> > 2.5 in case of problem perform a ground scanning and record the maintenance message

> > 2.6 on the cockpit put the throttle control levers to climb position and verify that the spoilers 1,2 and 5 reach the neutral position.

> > 2.7 depressurize the 3 hydraulic systems.

> > 2.8 remove the MLG WHEEL TACHYMETER DRIVING TOOL to the

wheels 1 and 4 and install it on the wheels 2 and 3

> > 2.9 repeat the test cited in ?2.2 to ?2.6 the spoilers 3 and 4 must move.

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