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NATIONAL TRANSPORTATION SAFETY COMMITTEE

AIRCRAFT ACCIDENT REPORT

PT. Mandala Airlines; MDL 091

Boeing B737-200; PK–RIM

Jl. Jamin Ginting, Medan, North Sumatera

5 September 2005

NATIONAL TRANSPORTATION SAFETY COMMITTEE
MINISTRY OF TRANSPORTATION
REPUBLIC OF INDONESIA
2009

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This report has been prepared based upon the investigation carried out by the National Transportation Safety Committee in accordance with Annex 13 to the Convention on International Civil Aviation, UU No.15/1992 and PP No. 3/2001.

This report was produced by the National Transportation Safety Committee (NTSC), Karya Building 7th Floor Ministry of Transportation, Jalan Medan Merdeka Barat 8 JKT 10110 Indonesia.

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GLOSSARY OF ABBREVIATIONS

AD	**:**	Airworthiness Directives
AGL	**:**	Above Ground Level
AMSL	**:**	Above Mean Sea Level
AOC	**:**	Air Operator Certificate
ATC	**:**	Air Traffic Control
ATPL	**:**	Air Transport Pilot License
CPL	**:**	Commercial Pilot License
CSN	**:**	Cycles Since New
CVR	**:**	Cockpit Voice Recorder
DGAC	**:**	Directorate General of Air Communications
DME	**:**	Distance Measuring Equipment
F/O	**:**	first officer
FDR	**:**	Flight Data Recorder
hrs	**:**	time (24 hour clock)
IFR	**:**	Instrument Flight Rules
IIC	**:**	Investigator-In-Charge
ILS	**:**	Instrument Landing System
kg	**:**	kilogram(s)
km	**:**	kilometre(s)
kts	**:**	knots (nm/hour)
mm	**:**	millimetre(s)
MTOW	**:**	Maximum Take-Off Weight
nm	**:**	nautical mile(s)
NTSC	**:**	National Transportation Safety Committee
°C	**:**	degrees Celcius
PIC	**:**	Pilot-In-Command
QFE	**:**	Height above airport elevation (or runway threshold elevation) based on local station pressure
QNH	**:**	Altitude above mean sea level based on local station pressure
RPM	**:**	Revolutions Per Minute
S/N	**:**	Serial number
TS/RA	**:**	thunder strom and rain
TSN	**:**	Time Since New
TT/TD	**:**	ambient temperature/dew point
UTC	**:**	Universal Time Co-ordinated
VFR	**:**	Visual Flight Rules
VMC	**:**	Visual Meteorological Conditions

SYNOPSIS

On 5 September 2005, at 03:15 UTC a Mandala Airlines B737-200 flight number MDL 091, registration PK-RIM, crashed during take off from Polonia Airport, Medan, North Sumatera. The initial phase of the takeoff from runway 23 was normal. Following liftoff, the airplane was unable to climb away and settled back onto the runway. It then overran the departure end of the runway, and hit several approach lights and continued to travel through a grass area and over a small river. It subsequently impacted several buildings and vehicles before coming to rest on a public road about 540 m from the end of runway 23.

The investigation revealed that the aircraft was not properly configured for take-off. The flaps screw jacks and slat actuators were not in the extended position when it was found in the crash site and examined during investigation.

The scratch marking left at the end of runway 23's surface and the FDR data analysis supported this condition.

Exhaustive examination of the CVR indicated that the investigation was unable to gain important information on what actually happened prior to and during the take-off because the cockpit area microphone channel did not record properly. Specifically, the investigation was unable to determine from the CVR whether the flight crew had extended the flaps and slats for take-off or whether the take-off warning horn activated when the flaps and slats were not extended for take-off.

The disassembly examination of both engines revealed there was no defect with the engines that contributed to the accident.

Weight and balance examination also revealed that the actual aircraft take-off weight and center of gravity met the requirements and standards take-off performance runway 23.

The weather itself was not a factor on this accident.

The survivors reported they left the aircraft from the rear fuselage. According to other witnesses, the fire started a few minutes after the crash.

The lack of an access road from the airport perimeter prevented the airport rescue and fire-fighting crews from expeditiously arriving at the crash site. This fact, coupled with the lack of coordination with other rescue participants (other than AP II), eventually led to fewer survivors.

From 117 persons on board flight MDL 091, 5 crews and 95 passengers on board were killed, 15 passengers seriously injured and 2 passengers (a mother and child) were reported survived without any injuries. There were 49 grounds fatalities and 26 grounds seriously injured.

The airplane is considered total loss due to the impact forces and post-crash fire.

1 FACTUAL INFORMATIONS

1.1 History of Flight

On 5 September 2005, at 03:15 UTC, Mandala Airlines registered PK-RIM, operating as flight number MDL 091, a Boeing 737-200 departing for Soekarno-Hatta Airport, Jakarta from Medan. The previous flight was from Jakarta and arrived at Medan uneventfully. The same crew have flight schedule on the same day and returned to Jakarta. The flight was a regular scheduled passenger flight and was attempted to take-off from Polonia Airport, Medan, North Sumatera to Jakarta and it was the second trip of the day for the crew.

At 02.40 UTC information from dispatcher, those embarking passengers, cargo process and all flight documents were ready.

At 02.52 UTC, Mandala/MDL 091 asked for push back and start up clearance bound for Jakarta from the Air Traffic Controller/ATC, after received the approval from the ATC they began starting the engines.

At 02.56 UTC, the controller cleared MDL 091 taxi into position on runway 23 via Alpha.

At 03.02 UTC, MDL 091 received clearance for take off with additional clearance from ATC to turn left heading 120º and maintain 1500 ft. The MDL 091 read back the clearance heading 120º and maintains 1000 ft. The ATC corrected the clearance one thousand five hundred feet. The MDL 091 re-read back as 1500 ft.

Some of the passengers and other witnesses stated that the aircraft has lifted its nose in an up attitude and take off roll was longer than that normally made by similar airplanes. Most of them stated that the aircraft nose began to lift-off about few meters from the end of the runway. The ATC tower controller recalled that after rotation the plane began to “roll” or veer to the left and to the right.

Some witnesses on the ground recalled that the airplane left wing struck a building before it struck in the busy road, then heard two big explosions and saw the flames.

Persons on board in MDL 091, 5 crew and 95 passengers were killed, 15 passengers seriously injured and 2 passengers (a mother and child) were reported survived without any injuries; and other 49 persons on ground were killed and 26 grounds were serious injured.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others	TOTAL
Fatal	5	95	49	**149**
Serious	-	15	26	**41**
Minor	-	-	0	**0**
None	-	2	0	**2**
TOTAL	**5**	**112**	**75**	**192**

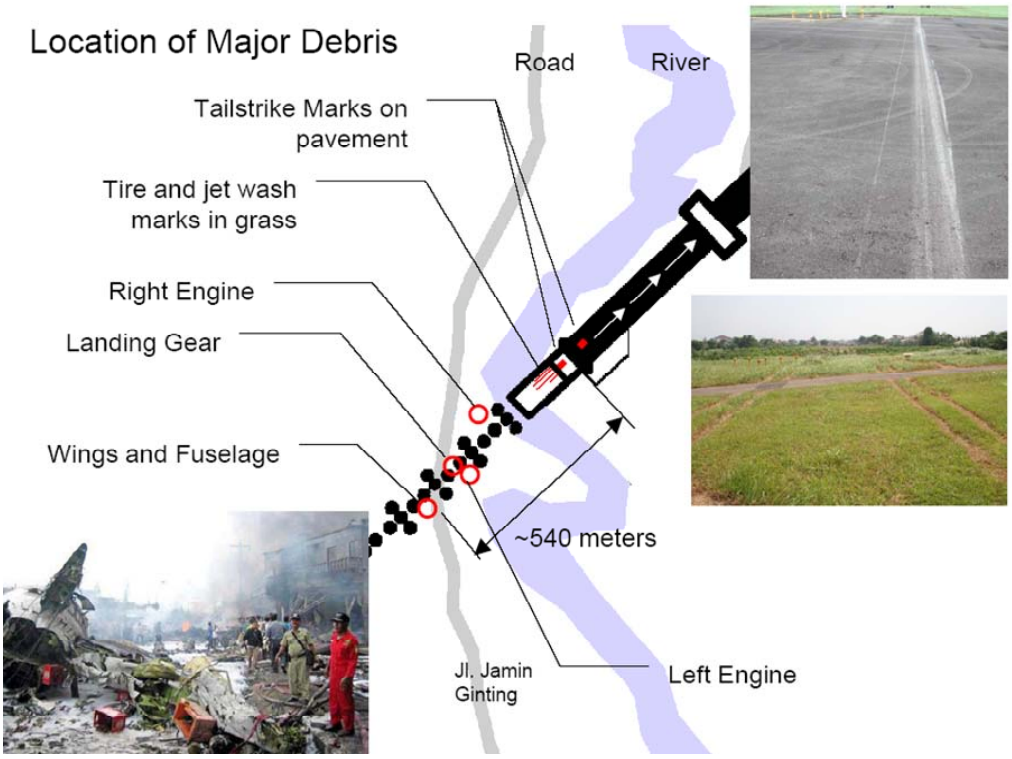
1.3 Damage to Aircraft

The airplane is considered total loss due to the impact forces and post-crash fire.

The aircraft had been separated due to impact along the flight track beginning from the end of the runway 23, and then the aircraft stopped into a halt 540 m from the end of runway.

Most of the fuselage section was destroyed by post-impact fire. The remaining part of the fuselage is only the tail section (see Appendix A).

Both engines have detached from the aircraft due to impact to the ground. The right engine was found about 300 m and the left engine about 400 m from the end of the runway 23 (see Figure below).



1.3.1 Number-2 (Right) Engine

All of the first stage fan blades and most of the second stage fan blades fractured just above the root platform. This indicates that the engine impacted the ground at high RPM or high thrust setting.

The Low Pressure Turbine (LPT) section was intact or had no indication of rubbing.

1.3.2 Number-1 (Left) Engine

Most of fan blades remained attached. This indicates that this engine impacted the ground at low RPM. The fan airfoil sustained significant damage. The observed fan airfoil damage indicates that the engine was at high RPM when it struck the approach light structures prior to the engine ground impact.

The LPT section was intact or had no indication of rubbing.

1.3.3 Other Recovered Components

The original location of small components such as left fuel pump, flap tracks and flap jack screws, etc could not be determined with confidence due to the effect of the fire-fighting efforts and local residents handling debris.

All landing gears were found detached from the fuselage.

The outboard section of right wing was broken apparently due to the impact and partly burned. Most of left wing was burnt completely. Part of outboard right wing was found close to the tail section and showed fire damage.

There was scratch mark at the lower part of the empennage and the tail cone was punctured by approach lights structure.

By the time the investigation team arrived, the aircraft vertical stabilizer has been moved by the rescue team and locals. This had to be done since the stabilizer was blocking the road.

1.4 Other Damage

There are some other damages as follows:

a. Six approach lights including three support structures were damaged due to the impact.

b. Approximately 30 houses were damaged due the impact and post-impact fire. Some cars, motorcycles and bikes were hit by the aircraft and burned.


1.5 Personnel Information

1.5.1 Cockpit Crew

1.5.1.1 Pilot-in-Command

Gender	:	Male
Date of birth	:	3 May 1971
Nationality	:	Indonesian
Marital status	:	Married
Date of joining company	:	June 1996
License	:	ATPL 4654
Validity period of license	:	28 February 2006
Type rating	:	B 737-200
Instrument rating	:	-
Medical certificate	:	Class 1
Date of last medical	:	01 August 2005
Last line check	:	17 July 2005
Last proficiency check	:	12 July 2005
FLIGHT TIME		
Total time	:	7,522:59 hrs
This make & model	:	7,302:59 hrs (B737-200)
Last 90 days	:	235:08 hrs
Last 30 days	:	88:15 hrs
Last 24 Hours	:	4:45 hrs

1.5.1.2 First Officer

Gender	:	Male
Date of birth	:	23 October 1973
Nationality	:	Indonesian
Marital status	:	Married
Date of joining company	:	January 2004
License	:	CPL 5741
Validity period of license	:	31 January 2006
Type rating	:	B 737-200
Instrument rating	:	-

Medical certificate	:	Class 1
Date of last medical	:	26 July 2005
Last line check	:	-
Last proficiency check	:	22 July 2005
FLIGHT TIME		
Total time	:	2,353:17 hrs
This make & model	:	685 hrs (B737-200)
Last 90 Days	:	209:06 hrs
Lat 30 Days	:	63:10 hrs
Last 24 Hours	:	2:10 hrs

1.5.2 Flight Attendant (F/A)

1.5.2.1 F/A 1

Gender	:	Female
Date of birth	:	12 June 1974
Nationality	:	Indonesian
Date of joining company	:	01 May 2000
License	:	CA 2503
Validity period of license	:	18 July 2006
Medical certificate	:	Class 2
Date of last medical	:	18 July 2005
Last Recurrent	:	26 April 2005

1.5.2.2 F/A 2

Gender	:	Female
Date of birth	:	15 September 1980
Nationality	:	Indonesian
Date of joining company	:	01 December 2001
License	:	FA 3882
Validity period of license	:	08 March 2006
Medical certificate	:	Class 2
Date of last medical	:	08 March 2005
Last Recurrent	:	5 May 2004

1.5.2.3 F/A 3

Gender	:	Female
Date of birth	:	28 November 1984
Nationality	:	Indonesian
Date of joining company	:	15 September 2002
License	:	FAL 4042
Validity period of license	:	18 August 2006
Medical certificate	:	Class 2
Date of last medical	:	18 August 2005
Last Recurrent	:	15 June 2005

1.6 Aircraft Information

1.6.1 Aircraft Data

Registration Mark	:	PK–RIM
Manufacturer	:	Boeing
Country of Manufacturer		United State
Type/ Model	:	B737–200
Serial Number	:	22136
Date of manufacture	:	11 August 1981
Certificate of Airworthiness	:	1663
Issued	:	25 November 2004
Validity	:	24 November 2005
Certificate of Registration	:	1663
Issued	:	25 November 2004
Validity	:	24 November 2005
Category	:	Transport
Crew (Cockpit/Cabin)	:	2 + 3
Passengers seats	:	110
Time Since New	:	51,599:32 Hrs
Cycles Since New	:	51,335 Cycles
Last C Check Inspection	:	10 March 2002 (50,819 FH)
Next Major Inspection	:	53,819 FH
Last B1 Check Inspection	:	20 August 2005

1.6.2 Engine Data

Engine Type	:	JT8D
Manufacturer	:	Pratt & Whitney
Type/ Model	:	JT8D-15
Serial Number #1	:	P 702988
▪ TSN	:	48,430:59 Hrs
▪ CSN	:	41,771 Cycles
Serial Number #2	:	P 665485
▪ TSN	:	51,374:58 Hrs
▪ CSN	:	45,198 Cycles

1.6.3 Weight and Balance

Data according to the load sheet are:

Actual Zero fuel weight	:	41,597 kg
Maximum Zero Fuel Weight	:	43,092 kg
Dry Operating weight	:	30,175 kg
CG from MAC	:	18.57% MAC
Maximum Take Off Weight	:	52,390 kg
		Condition; R/W 23, Temp 30ºC, Bleed ON, R/W Analysis
Actual Take-off weight	:	51,997 kg
Capt Requested, MTOW	:	52,000 kg

Referring to the load manifest, the actual take-off weight of 51,997 kg was 3 Kg less than the captain requested and 393 kg less than MTOW for particular condition.

The load manifest shows also that aircraft weight and the CG position are sufficient to provide stability.

1.6.4 Flap and Slat Actuation, Indication and Warning System

There are three separate systems involved in the actuation, indication and warning functions related to the trailing edge flaps and leading edge flaps and slats.

Flap actuation system – flap handle to flap transmissions and leading edge flap and slat actuators

Flap position indication system – trailing edge position indicator dial, leading edge position lights and associated sensors.

Takeoff configuration warning system – intermittent horn and associated sensors

The three systems are independent with the following exceptions:

Flap Actuation and Flap Position Indication: The flap asymmetry protection function of the trailing edge position indication system can shutdown the flap actuation system. However, faults within the shared components (trailing edge flap position transmitter and indicator) have no effect on the configuration warning system.

Flap Position Indication and Takeoff Configuration Warning: There are three flap position sensors that provide input to the takeoff configuration warning horn. If any of these three sensors indicate the flaps are not in the takeoff position, the warning horn will sound when the throttles are advanced on the ground.

a. Trailing edge flap position switch - this switch is dedicated to the takeoff configuration warning system and is separate from the trailing edge flap position transmitters that provide a signal to the flap position dial in the flight deck.

b. Left wing LE Krueger Flap No. 1 sensor - this sensor provides signals to both the LE flap position lights and the takeoff configuration warning.

c. Right wing LE Krueger Flap No. 4 sensor - this sensor provides signals to both the LE flap position lights and the takeoff configuration warning. Sensors (b) and (c) listed above provide input to both the position indication lights and the takeoff configuration warning horn. However, even if both sensors (b) and (c) malfunction, the input from sensor (a)

is sufficient to cause the warning horn to sound. Further, none of these sensors affect the flap actuation system.

No single faults have been identified that can cause malfunctions in all three systems (actuation, position indication, and takeoff configuration warning) and only limited single faults that can affect two of the three systems simultaneously.

1.6.5 Take-off Warning Horn Maintenance

Review of maintenance records and continue airworthiness maintenance program for aircraft PK-RIM are as follows:

- The take take-off warning horn had been checked according to FAA AD (Airworthiness Direction) 88-22-09 about "Takeoff Configuration Aural Warning System test" (repeat inspection at every 200 FH) at 02 August 2005, referring the work order No. 262/ENG/B737-2/VIII/05 (see Appendix D), meanwhile the operator repeat the functional test of the AD at every A Check (125 hours);
- Refer to aircraft maintenance log for the last six months, there were no pilot complains or problem about take-off warning system.

1.7 Meteorological Information

		02.00 UTC	02.30 UTC	03.00 UTC
Wind	:	Calm	150/05	150/06
Visibility	:	5000	4000 m	5 km
Weather	:	Haze	Haze	Haze
Cloud	:	SCT 1700 ft Scatter (3-4 octave) with cloud base 1700 feet	SCT 1700 ft	SCT 1600 ft
TT/TD	:	28° C/26° C	29° C/26° C	30° C/25° C
QNH	:	1008	1008	1008
QFE	:	1004	1004	1004

The weather was above minima for take-off, and not a contributing factor to the accident.

1.8 Aids to Navigation

Not relevant

1.9 Communications

Communication between the tower (ATC) and the aircraft (MDL 091) as well as to other aircrafts was recorded in the ATC record and in the CVR through the channel 1 (captain's) and channel 2 (first officer's).

There was no evidence of a distress call from the crew.

1.10 Aerodrome Information

1.10.1 General

Airport Name	:	Polonia
Airport Identification	:	WIMM
Airport Operator	:	Angkasa Pura II
Certificate Number	:	Adm. OC/007/2005
Runway Direction	:	23 – 05
Runway Length	:	2900 m
Runway Width	:	45 m
Surface Condition	:	Asphalt Concrete

1.10.2 Airport Emergency Plan

The Polonia Airport, Medan has an Airport Emergency Plan that was published in 2003 and was distributed to several units within the airport organization and other external related organizations such as Police, Armed Forces, Hospitals and other medical facilities, Local Authority, etc.

The review on AEP (Airport Emergency Plan) of the Polonia Airport, Medan is as follows:

- Some units within airport which are related to the crisis handling did not receive the AEP and some not available, e.g. the ATC.
- The AEP does not mention the location of the emergency center.
- The last emergency exercise was carried out in October 2002.

1.10.3 Rescue Operation

At the time of the accident, the tower had difficulty to determine the exact location of the crash area. It was due to the unavailability of the grid map covering the crash area.

At 10.25 AM local time, the ATC declared the airport closed and issued a NOTAM.

The airport fire brigade immediately responded to the crash bell activated by the ATC. When they arrived at the end of runway 23 they realized that the crash site was outside the airport perimeter, and there is no access road to reach the accident site.

The fire brigade returned to the apron and decided to use the city/ public road to reach the crash site with only one command car, ambulances and one fire truck to continue for the rescue. The other fire trucks were kept standby at the airport to keep the airport operation maintained at the minimum level of fire fighting capability.

The airport fire fighting unit arrived about 20 to 25 minutes after leaving the airport. They found difficulties to reach the crash site due to the traffic jam despites the Traffic Police attempted to clear the road for the rescue operations. The roads were jammed by the people on the street.

When they arrived, the fire was still burning at the crash site. Several fire fighting units of the local government and ambulances participated in rescue operation. The local people, Police and others were involved in the first hour of the rescue, and later on the Indonesian Air Force and Army. Some victims were evacuated using commercial as well as private cars; it was due to late arrival of the ambulances to the crash side and their limited number.

At the crash site, there was no person in charge as the coordinator among the rescue teams. The overly crowded situation caused difficulties to the rescue teams in evacuating the victims. According to the witnesses, there was no label to the victims and no triage area set-up as mentioned in the AEP. Moreover, the rescue team did not know where the uninjured passengers should be transferred to the collection area. The records/ labels and the location of the victims were not well documented.

Information from witnesses and rescue teams were as follows:

- The local people tried to rescue one of the pilots; however they were unable to release the pilot from his harness. It is because they were not familiar with aircraft components. While they were trying to save the pilot, suddenly the fire blast came from behind. When they saw the fire, they ran away to avoid the flame. According to them, one of the pilots was still alive at the time they found him. However after the fire was extinguished, the pilot's body was not found. The pilot seat was totally burnt.
- A person who stood close to a store saw that the fire started a few minute after the aircraft crashed. He could not recall the exact time of the crash. He tried to rescue one of the victims to avoid the fire.
- According to other witnesses, the fire started a few minutes after the crash.
- The survivors reported that they left the aircraft from the rear fuselage.

The Police and other units involved in the rescue activities found also difficulties in determining the crash site. Although they were equipped with radio, they did not know the frequency used in this operation. They did not know the coordinator or person in charge at the crash site.

1.10.4 Crisis Center

At the time of accident, the airport administration meeting room was used as crisis center. However, many press or media came to the crisis center and disturbed the team.

There was no radio or other communication equipment available at the crisis center which might be used to monitor all activities.

There was no function or person taking care the media and information center. This caused the families or next of kin had difficulties to obtain information related to the accident.

1.11 Flight Recorders

Flight Data Recorder and Cockpit Voice Recorder were recovered from the aircraft wreckage by the rescue team, and then handover to the NTSC.

The Flight Data Recorder and Cockpit Voice Recorder boxes were blackened by the fire but otherwise appeared in good condition.

1.11.1 Flight Data Recorder

The FDR data plate indicated it was dated 8503, TSO C51a and a manufacturer reference code 911.

Manufacturer	:	Sundstrand UFDR
Part Number	:	980-4100-FWUS
Serial Number	:	2488

From the maintenance log for the last six months, there was no pilot complain/ problem recorded.

1.11.2 Cockpit Voice Recorder

The CVR data plate indicated that it was dated Feb. 86.

Manufacturer	:	Fairchild Model A – 100a
Part Number	:	98-A100-80
Serial Number	:	51205

From the maintenance log for the last six months, there was no pilot complain/ problem recorded.

1.12 Wreckage and Impact Information

The airplane overran the departure end of Runway 23, impacted several approach lights, traveled through a grass area and over a river, and impacted several buildings and vehicles before coming to rest on a road. A post crash fire destroyed much of the airplane.

The departure end of runway 23 has a displaced threshold for the landing traffic on runway 05, followed by a 100-meter stop-way and a 60 meter overrun area.

There is a row of lights at the intersection of the stop-way and overrun area and a second row of lights 25 meters from the intersection.

There was a 24 meter long silvery color scrape mark present on the stop-way starting about 7.3 meters right of the centerline and 61 meters prior to the intersection. A second scrape mark began at the second row of lights and ran about 58 meters towards the end of the overrun area.



There were 4 main landing gear (MLG) tire impressions and evidence of jet wash from both engines present in the grass and dirt between the end of the overrun area and the river. There was also a small impression in the grass between the MLG impressions and in line with the scrape mark on the pavement. The airplane also impacted several of the approach lights between the end of the pavement and the river.



Very little fuselage wreckage was evident at the main wreckage site and/or recovered the airport. The recovered wreckage from the forward portion of the fuselage identified the airport only included one vertical gyro (Sperry Mode1311, PIN 2587335-11, 80082064) and the nose landing gear (NLG) lower cylinder and tires.

The first officer's No.2 and No.3 window frames, one NLG door, and several components were identified at the wreckage site.

A section of the aft fuselage was recovered that extended from approximately the aft entry doorframe to the APU. The interior and remaining floor panels in the area were severely fire damage.

The lower 3 feet of the vertical stabilizer remained attached to the fuselage. The upper portion of the vertical stabilizer separated from the lower portion and was found with the upper portion of the rudder still attached, but did not include rudder actuators. The rudder segment swung freely about its hinge line. The rudder actuator was recovered and identified separately. The horizontal stabilizer and elevator were found separated from the empennage. The outboard 1/3 of each stabilizer elevator separated from the

center section. The center section of the stabilizer and attached elevator exhibited leading edge impact damage.

Damage on the aft fuselage was consistent with the stabilizer being pulled from the airplane in an aft direction. A portion of the stabilizer jackscrew remained in the stabilizer gimbals nut. The distance from top of the gimbals nut to the upper stop fitting on the jackscrew was 9 5/16", which equivalent to 6.4 units of stabilizer trim. The lower portion of the stabilizer jackscrew and stabilizer trim motor were found loose in the aft fuselage behind the pressure bulkhead.

The lower portion of the aft fuselage exhibited abrasion damage centered along airplane centerline. At the bottom centerline of the pressure bulkhead, the skin was completely abraded away, the ring chord was cracked and the pressure bulkhead buckled. The airplane tail-cone including APU exhaust was recovered separately. The lower centerline was dented and abraded. Portions of two fuselage entry doors were located one from the right side of the airplane and one from the left. The left portion included the lower gate was in the open position.

A portion of wing center section was found attached to portions of the left-side of body-rib and a portion of the left wing lower skin. The side of body-rib lower chord at wing skins had been folded through approximately 180 degrees. Also attached was fuselage fitting at the intersection of the left wing rear spar and wing center section spar as well as the lower corner of the intersection of the left wing front spar and wing center section front spar.

A large portion of the right wing was recovered that extended from just inboard nacelle rib location at wing station (WS) 191 to the outboard end of spoiler #8 at WS 452. There was considerable burn damage and portions of the upper skin, lower skin, front spar and rear spar were consumed by fire.

The right main landing gear (R/H MLG) separated from the airplane essentially intact. The forward trunnion pulled out of its bushing and the aft trunnion pulled its bushing from the landing gear beam. The side link and retract actuator beam were fractured with overload signs. Both of the R/H MLG tires were cut. The left main landing gear (Left MLG) lower piston, both wheels, lower torque link, and shimmy damper were recovered separated from the cylinder. The lower piston fracture exhibited overload signatures and the cylinder was not recovered. Both of the Left MLG tires were cut. The nose landing gear (NLG) lower piston and both wheels were recovered separated from the cylinder. The piston fracture exhibited overload signs. Both tires of the NLG were cut. The NLG cylinder and drag links were not recovered.

No major portions of the wheel well structure were recovered. The flap drive unit was the only systems component recovered.

1.12.1 Scratch Marks

At the runway, there were aluminum, honeycomb and paint scrap marks.

There are two scratch marks at the end of the runway (see Figure below).

The first mark is at approximately 36 m long (from runway end), 5–7 cm wide, and 7.5 m right of centerline.

The second mark is at 26 m from end of runway 05.

The marks are confirmed as a result of tail strike.

At the grass starting from the asphalt runway end to 12 m from the runway end, main landing gears' marks are clearly found. It continues up to a electrical box at the end of runway, while there is no any mark of the nose wheel. The outer wheel of left and right main landing gear struck the concrete structure of the approach light and the electrical box, respectively.

1.12.2 Aircraft Structures & Systems

Six flap jackscrews (out of eight) were located and measured. One of which indicated to 2 to 2½ threads from the ball nut to the mechanical stop.

The recovered flap jackscrews were identified and the dimension from the forward mechanical stop to the forward end of ball nut (A dimension) was measured. The nominal jackscrew dimension for flap 1, is 4 to 5 inches.

The left outboard flap outboard jackscrew (#1) A dimension measured 0.40 inches.

The left outboard flap inboard jackscrew (#2) dimension measured 1.07 inches. The ball nut was sized to the #2 jackscrew. The P/N 65-50311-3 was cast into the tower.

The left inboard flap inboard jackscrew (#4) dimension measured 1.32 inches.

The right inboard flap inboard jackscrew (#5) a dimension measured 1.02 inches. The screw was free to rotate with some gritty resistance.

The right outboard flap inboard jackscrew (#7) a dimension measured 0.80 inches.

The right, outboard flap outboard jackscrew (#8) the A dimension measured 1.20 inches. The screw was free to rotate but was bent where it exited the aft end of the ball nut.

The left, inboard flap outboard jackscrew (#3) and right, inboard flap out board jackscrew (#6) were not recovered.

It indicated that the left and right flaps were stowed.

Portion of the front spar in the area of slat #4 remained intact including the two slat #4 main tracks, the two auxiliary tracks and a portion of the slat actuator fitting. The slat and actuator were not recovered. The inboard main track was partially extended and could be moved by hand while the inboard auxiliary track, outboard auxiliary track and outboard main track were jammed in the fully retracted position.

The photograph (Figure below) shows that the slat was in retracted position.

1.13 Medical and Pathological Information

Ninety-five (95) passengers and five (5) crew members were killed by the impact forces or post-impact fire. Fifteen (15) passenger were seriously injured, mostly suffering skin burn, broken legs and hands.

1.13.1 Victims Identification

The Adam Malik Hospital in Medan was the only hospital which performed identification to some of the victims, because of the availability of forensic experts at the hospital.

1.14 Fire

There was a post-impact fire destroying most of the aircraft structure and system as well as some houses/buildings and motor-vehicles.

1.15 Survival Aspects

As the airplane came to rest, it fractured into three parts. Most of the survived passengers who sat at the aft section were evacuated through the broken aft fuselage. According to ground-witnesses, there were two survived passengers left the aircraft without any injuries and other survivors were evacuated from the aircraft by the locals.

1.16 Test and Research

1.16.1 Engine Disassembly and Examination

The engines were examined at the accident site followed by the disassembly and examination of both engines performed in the shop facilities at PT. Nusantara Turbine and Propulsion in Bandung. The results of the accident site examination and the shop disassembly and examination are as follows.

1.16.1.1 Engine #1 S/N 702988 On-scene Engine Examination

No fire damage, puncture or un-containment was observed on the engine. All of fan ducts were no longer attached to the engine. The tailpipe and thrust reverser were separated from the engine. All of engine accessories were no longer attached to the engine.

A single unit comprised of the inlet case and the 1st and 2nd stage fan cases was found separated from the core of the engine. This unit was fractured from the exit guide vane case aft. All the Inlet Guide Vanes (IGVs) were present and the outer diameter trailing edges of all the vanes were bent in the direction of rotation (clockwise aft looking forward) and fractured from the outer diameter of the inlet case. Two IGVs were completely fractured from the outer diameter of the inlet case and were displaced in the direction of rotation. The 1st and 2nd stage fan cases

exhibited uniform circumferential scoring on the inner diameter of their respective cases in the normal fan running position. The 2nd stage fan case also exhibited circumferential scoring that moved aft from the normal fan blade running position. This aft moving case scoring was localized around the 5:00 o'clock position. The inlet case and the 1st and 2nd stage cases were intact with no exhibit holes.

Portions of the fan exit guide vane case remained attached to the single unit comprised of the inlet case/fan cases described above. Two sections of the fan exit guide vane case, from approximately 6:00 to 10:30 and 1:30 to 3:30 remained attached and none of the vanes remained attached to case.

The No. 1 bearing remained intact, all the rollers were round, and free to rotated within the cage. A few of the rollers exhibiting some leading edge corner damage. The cage was intact but some of the sockets were distorted. The silver plating remained intact on the cage.

All the fan tie-rods were present and appeared intact and all the nuts were secured to the rods. The stage 1 fan disk was intact and the roots of all the stage 1 fan blades remained installed. Eleven of the stage 1 fan blades were fractured near the blade platform and varied in length from 75-inches to 3.75-inches. Four consecutive stage 1 fan blades were fractured near the platform with blades on either side roughly full length. The remaining stage 1 fan blades were almost full length exhibited and exhibited heavy leading edge and tip damage. Only seven of the stage 1 fan vanes remained installed and they were comprised of two sets of three consecutive vanes plus a lone single vane. One set of three consecutive vanes exhibited light damage while the other set of three consecutive vanes exhibited heavy damage and signs of vane-to-blade clashing. All the 2nd stage fan blades were present and bent in the direction opposite rotation except for a single one that was bent in the direction of rotation. This single blade bent in the direction of rotation was axially in-line with the four consecutive fractured 1st stage fan blades described above. The majorities of the 2nd stage fan blades were full length and exhibited heavy leading edge damage. The 2nd stage low pressure compressor (LPC) vanes were imbedded with dirt form the 6:00 to 12:00 o'clock positions. Some of the 2nd stage vanes exhibited leading edge impact marks and dents while other exhibited no damage.

The compressor intermediate case aft skirt riveted was separated circumferentially 360 degrees from the rest of the intermediate case. The entire case rotated along its centerline approximately 180 degree.

The turbine exhaust case was bent inwards from the 6:00 to the 12:00 o'clock position. The exhaust cone was pushed over, flattened, towards the 3:00 o'clock position (outboard to inboard). Viewing the 4th stage low pressure turbine blades through the turbine exhaust case revealed no damage to any of the blades.

1.16.1.2 Engine #1 S/N 702988 Shop Disassembly Examination

The engine examination confirmed that the approach lights were ingested into the engine at high N1 (low compressor rotor) and N2 (high compressor rotor) RPM. Yellow paint residue consistent with the approach light structure was found on the leading edges of the Inlet Guide vanes (IGV) near the bottom two adjacent vanes. There were several first and second stage fan blades with yellow paint residue on the airfoils. There were also several yellow, light blue, and red paint fragments in the low pressure compressor (LPC) and a light blue electrical wire segment found in the fan section of the engine. These materials were consistent with the approach light structure material.

All of the first stage fan blade airfoil leading edge breakout, tip fractures, and the eleven airfoil fractures above the platform occurred in rapid fracture mode. The damage to the first stage fan was consistent with high RPM impact with the approach lights. All of the damage to the second stage fan blades was consistent with high RPM damage.

Damage on the entrance and exit airfoils of the High Pressure Compressor (HPC) was consistent with the fan airfoil break-up debris ingested during the fan blade impact with the approach lights. The fan blade damage from impact with the approach lights also produced very small dust size particle debris that melted when it contacted the hot burner can domes resulting in metallization splatter in the burner domes. The HPC and burner dome observations are consistent with approach light ingestion prior to ground impact at high fan RPM.

1.16.1.3 Engine #2 S/N 665485 On-scene Engine Examination

The fan ducts from the intermediate case to the exhaust case remained attached to the engine but some were damaged and fracture. Viewing the engine through fractured and missing pieces of the fan ducts revealed no fire damage or punctures and no un-containments were observed on the engine. The majority of the tailpipe remained attached from the engine but was fractured just forward of the thrust reverser attachment flange. The thrust reverser was not recovered from the crash site. All the engine accessories were no longer attached to the engine. The stage 1 and stage 2 fan cases were recovered separately from the engine and both cases were not attached to each other. The fan IGV case was not recovered. Evidence of soot was observed on the majority of the engine and fan ducts.

A single unit comprised of stages 1 and 2 fan disks, plus the 3rd stage low pressure compressor was recovered separate from the engine. The stage 1 fan disk was intact and two blades were missing. All the stage 1 fan blades that remained installed in the disk were fractured just above the platform. All the fan tie-rods were present and appeared intact and all nuts were still secured to the rods. The stage 2 disk was intact and all the fan blades were present and fractured just above the platform except for three consecutive blades with full length and bent towards the direction of rotation. A 90 degree cluster of 2nd stage vanes were bent in the direction

opposite rotation. Thirty-eight stage 3 blades were missing and all the remaining blades were fractured just above the platform except eight blades that were roughly full length. The full length blades were bent in the direction opposite rotation.

The No. 1 bearing remained intact, all the rollers were round, and free to rotated within the cage. The cage was intact but some of the sockets were distorted. The silver plating remained intact on the cage.

The stage 1 fan case was distorted, twisted, and intact. The stage 2 fan cases was twisted, distorted, and intact but exhibited some notable impact damage. The stage 2 fan case front flange was bent aft in some places and ovalized. A small outward-hole (2-inches wide) was located where the vanes are located. There was an 11-inch circumferential tear at the vane outer wall location forward of the case step, and a large impact mark on the trailing edge flange.

The compressor intermediate case aft skirt riveted was separated from the rest of the intermediate case at the 12:00 o'clock position creating an approximately 3-inch gap exposing the stage 7 blades. The front flange of the intermediate case was pushed aft at the 6:00 o'clock position.

The stage 3 vanes were fractured at the 6:00 o'clock position and those vanes located at the 12:00 o'clock position were flattened over in the direction of rotation.

The stage 4 disk was intact and all the blades were missing. The front face of the stage 4 disk exhibited circumferential rub in the vicinity of the tie rod holes and from the disk rim to about 1-inch inboard of the tie-rod bolt circle.

Heavy dirt and debris was found between the stages 4 and 5 of the low pressure compressor.

Viewing the 4th stage low pressure turbine blades through the turbine exhaust case revealed no damage to any of the blades.

1.16.1.4 Engine #2 S/N 665485 Shop Engine Examination

The Low pressure Compressor (LPC) and the High pressure Compressor (HPC) damage are consistent with high RPM damage that occurred during ground impact.

Items Found Loose:

A fuel control unit (FCU) and main fuel pump (MFP) were recovered as a single unit. The FCU, PN 743602-4, SN 78799, model JFC60-2, and the MFP, PN 714810DLH, SN 6153036, experienced impact damage.

The main fuel pump of the left engine was inspected at NTSB. There is no evidence of abnormality.

There was no need for further examination on the FCU, because there was no abnormality found on the engines.

1.16.1.5 Engine Tear-Down Result

The observation of engine tear down could be summarized as follows:

1. Both engines were in operational conditions before impact;
2. Both engines were damaged by impact;
3. Both engine were in high power setting at impact;
4. There was no sign of overheating on both engines;
5. The Number-1 (Left) engine S/N P 702988 hit the approach light structures at high rotational speed causing the fan blades to be at low rotational speed and resulting in low speed impact fan blade damage at the time of final ground impact.
6. The R/H engine S/N P 665485 hit the ground directly, so that the fan blades were at higher rotational speed at impact causing more severe damages.

1.16.2 CVR readout

The read out was performed at the NTSB, Washington, DC, USA.

The CVR found in a good condition; however, the team experienced difficulty reading the Cockpit Area Microphone (CAM). The team also found that the channel from the CAM was mask by hum and noise dominating the signal. There are some voices heard on the CAM track, there are numbers of step changes in background noise level and character that may be consistent with an intermittent electrical connection in the CAM wiring circuit. As a result, the team was not able to conclude that the CAM was providing input to the CVR throughout the entire 30 minutes.

Such a poor quality in CVR record failure makes it impossible to find out whether the flight crews made proper take-off configuration procedures including checklist execution. However several crew words, cockpit switch activations, engine noise, and cabin chime sounds heard on the CAM channel of the CVR are typically at a volume level much lower than the standard take off warning horn of the Boeing 737-200. The typical sound of the take-off configuration warning was not heard in the CVR CAM channel.

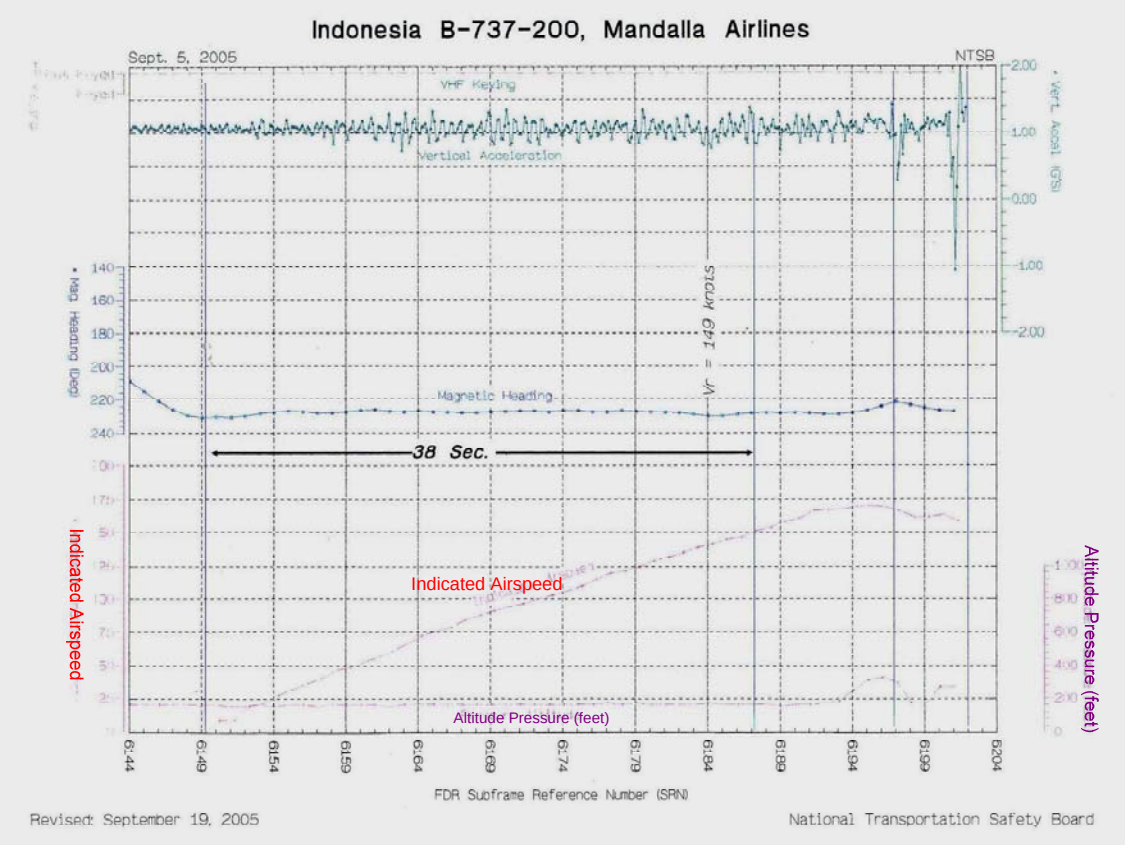
The stick-shaker warning (typically as loud as or louder than the takeoff warning horn) was also not heard on the CVR CAM channel.

The Captain’s and First Officer’s channels only recorded when there were radio transmissions. Therefore, most of the recording obtained was conversation between flight crew of MDL 091/PK-RIM and other traffic with ATC Detail of the transcript is as follows:

Mandala 737-200 PK-RIM Medan - 5 Sept 05						
Start	End	Start	End	Source	Track	Transcript (not including VHF transmissions originating outside the airplane e.g. ATC)
CVR min:sec		FDR Subframe				
16:32.6	17:05.4	81744.9	81776.9	CAM	2	*conversation (non-English) and laughter (2 male and 1 female voice)*
20:48.9	20:51.5	81994.7	81997.2	VHF	1	Polonia tower, Mandala zero nine one
20:55.5	21:05.0	82001.1	82010.4	VHF	1	Mandala zero niner one, romeo india mike, stand number two, request push and start bound for ... Jakarta level three one zero, P O B one one seven
21:12.7	21:16.3	82017.9	82021.4	VHF	1	ok to push and start, expect runway two three, Mandala zero nine one
21:14.3	21:15.9	82019.5	82021.0	Ground	4	Salamat pagi *(translation: "Good Morning")*
21:16.1	21:22.7	82021.2	82027.6	Flight Deck	4	Salamat … brake release … pushback *(mixed English/non-English)*
21:36.7	21:37.3	82041.3	82041.9		1	*sound similar to radio key*
22:30.8	21:31.8	82094.0	82036.5	VHF	1	Negative, sir
22:40.3	22:42.7	82103.3	82105.6	VHF	1	Roger two niner zero, Mandala zero niner one
22:55.7	22:57.1	82118.3	82119.6	Flight Deck	4	Yes number two start sir
23:04.1	23:05.1	82126.5	82127.4	Ground	4	N one rotate
23:25.9	23:40.9	82147.7	82162.3		2	*siren tone (15 cycles)*
23:42.2	23:44.3	82163.6	82165.6	Flight Deck	4	Start number one
23:49.2	23:50.3	82170.4	82171.5	Ground	4	N one rotate
24:03.2	24:18.3	82184.1	82198.8		2	*siren tone (15 cycles)*
24:03.7	24:08.3	82184.5	82189.0	Ground	4	?? Number one
24:20.3	24:24.7	82200.7	82205.0	Flight Deck	4	OK normal start disconnect signal left
24:22.1	24:24.6	82202.5	82204.9	VHF	1	Mandala zero niner one, request taxi
24:32.8	24:36.8	82212.9	82216.8	VHF	1	? three via alpha, number three in sequen, clearance go ahead
24:35.2	24:36.3	82215.2	82216.3		2	*sound that may be similar to seat motor*
24:44.2	24:49.2	82224.0	82228.9	VHF	1	Cleared to Jakarta, whiskey one two, level two niner zero, squawk four seven two two mandala zero niner one
27:46.9	27:48.9	82402.1	82404.0	VHF	1	Mandala zero niner one on short alpha
27:56.1	27:58.9	82411.0	82413.7	VHF	1	Roger number two one incoming Mandala zero niner one
30:36.5	30:39.3	82567.3	82570.1	VHF	1	Continue line up runway two three Mandala zero niner one
30:45.1	30:48.2	82575.7	82578.7		2	*hi-lo chime (twice)*
30:53.5	30:58.4	82583.9	82588.7	VHF	1	Maintain the heading one two zero, one thousand feet, Mandala zero niner one
31:01.4	31:03.8	82591.6	82593.9	VHF	1	Roger one thousand five hundred Mandala zero niner one
31:05.6	31:07.5	82595.7	82597.5		2	*two clicks*
31:06.8	31:08.6	82596.9	82598.6	VHF	1	Clear for takeoff Mandala zero niner one
32:05.3	32:08.3	82653.9	82656.8	CAM	2	*possible voices - words not discernable*
32:23.8	32:27.1	82671.9	82675.1	CAM	2	*voices heard - words not discernable*
32:24.1	32:25.3	82672.2	82673.4		3	*distortion of 400hz baseline on OBS track*
32:24.9	32:24.9	82673.0	82673.0			*end of FDR data*
32:26.0	32:26.5	82674.0	82674.5		3	*distortion of 400hz baseline on OBS track*
32:27.4	32:27.4	82675.4	82675.4			*end of CVR recording*
Correlation based on 9 VHF keying events						
1 second of CVR tape = 0.9745 FDR subframes						
CVR tape starts at subframe 80777.7						
End of recording in FDR subframe is a calculated value based on least squares fit to 9 VHF keying events						

Transcript CVR readout at NTSB after filtered.

1.16.3 FDR readout



FDR readout from accident flight at 5 September 2005

1.16.4 Fuel Test

The fuel Millipore test was performed according to ASTM 2776 in Polonia Airport, Medan. The purpose of this test is to identify the possibility of the contamination. There are three different color groups (A, B and G) which used to identify of contamination.

The fuel sampling was taken from refueling truck which had been transferred into other refueling truck (PNA 01). The 5 liters fuel sampling was taped from 2000 liters fuel transferred.

The result of the Millipore test is colored group B with level 4. It indicates a Ferro oxide contamination. The B group indicates a metallic contamination. It shall be noted that the Millipore test is not a requirement to check the fuel quality, but this method may give a good indication of contamination.

The fuel sample from accident aircraft which taken during last refueling in Medan was tested in Migas Laboratory, Cepu. It meets the PT. Pertamina's requirement.

Result of these two fuel tests can be concluded that the fuel is not a factor of the accident.

1.17 Organizational and Management Information

1.17.1 Mandala Airlines

Aircraft Operator	:	PT. Mandala Airlines
Address	:	Jl. Tomang Raya Kav. 33-37 Jakarta Barat 11440
Certificate Number	:	AOC/121-005
Operator Designator	:	Domestic and Flag Operation

PT. Mandala Airlines operates under CASR Part 121. At that time, the company operated a total of 15 aircrafts, including two B737-400s, thirteen B737-200s. At the time of the accident, the company operated scheduled domestic flights.

PT. Mandala Airlines is controlled by a Board of Director, headed by a President Director assists by Director of Operation for the operational aspect and Director of Maintenance for the maintenance aspect.

According to the Operation Specification dated June, 1st 2005, Management Personnel in the Operation Directorate are as follows:

Director of Operation
Manager Operation Development,
Manager Flight Operation Service,
Ass. Manager Safety Standard,
Ass. Manager Crew Training,
Ass. Manager Operation Establishment,
Ass. Manager Flight Service,
Chief Pilot
Chief Flight Attendant,

Meanwhile in the Company Operation Manual dated February 16 2002 sub chapter 1.3 Duty and Responsibility states the duty and responsibility of the following personnel:

Director of Operation
Manager of Flight Operation Services
Manager of Flight Operation
Assistant Manager of Flight Movement Control
Assistant Manager of Crew Management
Assistant Manager Flight Support
Assistant Manager Crew Development
Chief Pilot
Chief Flight Attendant

The company has maintenance contract to GMF (Garuda Maintenance Facility) in Cengkareng, Jakarta and MMF (Merpati Maintenance Facility) in Surabaya. GMF and MMF are certified AMO (Approved Maintenance Organization), performing limited aircraft maintenance.

1.17.2 PT. Angkasa Pura II

Polonia Airport of Medan is managed and operated by PT. Angkasa Pura II, which is also responsible for nine major airports in the western part of Indonesia.

PT. Angkasa Pura II is also responsible for the provision of air traffic services at these nine airports and air traffic service in the whole Jakarta FIR.

1.18 Other Information

1.18.1 Interviews

ATC Operators

The interview with ATC operators was performed on September 6, 2005 at Polonia airport, Medan. The communication between ATC controller and the cockpit crew on 118.1 MHz frequency was done according to the procedure (see tower communication transcript). The aircraft was given a clearance to taxi and take-off to runway 23.

The ATC controller observed that the airplane nose pitched up at the normal position on the runway. The aircraft was observed to roll slightly to the left side, then to the right side and touched the ground. The ATC activated the crash bell.

Fire Brigade

The interview with fire brigade was performed on September 6, 2005 at Polonia airport, Medan. The fire brigade personnel responded to the crash bell immediately. They observed thick black smoke came up from the fuselage.

After they arrived at the crash site, they responded by spraying with foam. And the firemen observed that the most of passengers who sat in front row seat were killed by the impact and post crash fire, while others who survived from the impact were evacuated by local people.

1.18.2 Training

1.18.2.1 Recurrent Training

The operator was unable to provide formal documentation that recurrent training did exist due to the operator did not record such training even though the operator in practice performed it. From the interview with management pilots (chief pilot, chief instructor), there were no structured syllabus or written syllabus for the recurrent training, most of the recurrent training exercises beside from reviewing the flight procedures also served as “warming-up” period before conducting proficiency check. Also from the interview indicated that the operator did not specifically emphasize the utmost importance of adherence to standard operating procedures, crew

coordination and CRM issue despite previous incidents experienced by the operator or other operator.

The interview also indicated that the operator did not perform CRM recurrent training for the flight crew.

1.18.2.2 Pilot Proficiency Check

The operator performed pilot proficiency check and the event was recorded and documented. Pilot in Command receive the check twice a year, while the First Officer once a year. From the record, it was indicated that the flight crews involved in the accident was assessed proficient.

1.18.3 Standard Operating Procedures Manual

The investigation was unable to find the documents onboard the aircraft due the aircraft was destroyed and burned after the crash. Subsequent request was passed through the operator to provide the copies of the document which represent the same document onboard the aircraft.

The operator was using B737-200 OM (Operations Manual) which every page was labeled “do not use for flight”. The QRH was also labeled “do not use for flight”. The last update was April 1, 2005.

The above documents were produced by the Boeing Company and the operator covered the documents with label AOM (Aircraft Operations Manual) Mandala Airlines. No specific or particular unit or department was responsible for issuance and maintaining the update of the OM and AOM.

The above documents were found without DGAC approval stamp.

The normal checklist was developed by the operator but essentially the same with the manufacture with added some operator items. The normal checklist is of A4 size, single page, laminated by plastic. No specific or particular unit or department was responsible for the issuance the normal checklist.

Below is the utmost importance of the communications between Mandala Airlines and Boeing concerning Flight Crew Operating Manuals (FCOM) and Quick Reference Handbooks (QRH):

7 July 2004	:	Email from Mandala Airlines to Boeing Mandala advised Boeing that they had received revision 13 of the 737-300/400/500 FCOM and inquired as to the meaning of the note “DO NOT USE FOR FLIGHT”.
14 July 2004	:	Email from Boeing to Mandala Airlines Boeing advised that Mandala was receiving copies of the non-customized 737 FCOM and QRH as a courtesy. Boeing advised that “The non-customized Flight Crew Operations Manual and QRH are not applicable to Mandala Airlines’ aircraft and are

		provided for your information only. They are not intended for your operational use, but to inform you of the latest Boeing operating procedures and checklists." Boeing offered to provide a budget quote for development of a customized FCOM and QRH.
16 July 2004	:	Email from Mandala Airlines to Boeing Mandala Airlines acknowledged receipt of the 14 July 04 message.
5 September 2005	:	Date of PK-RIM accident at Medan.
19 October 2005	:	Email from Mandala Airlines to Boeing Mandala requested a budget quote for FCOM and QRH in digital format for 14 airplanes.
19 October 2005	:	Email from Boeing to Mandala Airlines Boeing provided a budget quote for existing FCOMs and QRHs applicable to 6 of the 14 airplanes requested by Mandala Airlines. Boeing further advised that a customized FCOM and QRH to cover the remaining 8 airplanes or all 14 identified airplanes could be developed on request.

Another manual the so called Standard Operating Procedures (SOP) was published by operator's Flight Standards dated October 17, 1993 signed by G. Acs. The existing SOP was published in addition to the standard Boeing Operation Manuals. There was no update despite of many changes made by Boeing since 1993.

The company Flight Standard Department as stated in the Operation Specification document as well as Company Operation Manual (COM) was previously the Safety Standard Department. The list of departments mentioned in the COM does not specific mention responsibility for the issuance and updating the SOP manual.

The INTRODUCTION of the Standard Operation Procedure stated that:

"In order to provide Mandala B 737 crew with more detail instruction on specific company procedure and flight techniques, this Flight Standard book has been published. It will kept up to date by Mandala Flight Department.

The structure of this supplement is based on additions to the standard Boeing Operation Manual. After some general subjects, it follows Vol. 1 Chapter 2 (Normal Procedures), covering a flight from start to finish. Thereafter, several non-normal flight procedures are described. These chapters are also meant to support standardization during simulator and / or flight training.

Note:

1. In case of differences with other documentation, especially on procedural matters, this document will have precedence.
2. However, this document can never overrule AFM restrictions Boeing OM bulletins, the DDP, and does not intend to be in-conflict with the air laws of any country where MANDALA flights are operated.
3. Whenever FAA and CAA rules are mentioned in the OM and/or AFM, the FAA rules are to be observed.”

2 ANALYSIS

2.1 Failure to climb

The performance analysis based on the FDR data shows that the take-off profile was normal until rotation. The airplane rotated to a higher than normal attitude, climbed briefly, and stalled before settling back onto the runway. The failure to climb is shown clearly by the scratch marks found at the end of the runway 23 as well as main landing gear tracks on the ground and grass beyond the runway end. The silvery scratch marks on the runway end indicate that the tail portion of the fuselage hit the runway. Moreover on this particular area there was no mark of the nose landing gear. It is solid evidence that the aircraft failed to climb with nose-up attitude of at least 13°.

The following is a description on possible reasons for the failure to climb. The possibilities include issues in:

- Weight and balance
- Engines
- High lift devices : Flap and slat

2.1.1 Weight & Balance

Referring to the load manifest, the actual take-off weight of 51,997 kg was 3 Kg less than the captain requested and 393 kg less than MTOW for particular condition. The load manifest shows also that aircraft weight and the CG position are sufficient to provide stability. Thus the overweight issue can be eliminated.

2.1.2 Engine

The observation of engine disassembly examination is summarized as follows:

a. Both engines were in operational conditions before impact;

b. Both engines were damaged by impact;

c. Both engine were in high power setting at impact;

d. There was no sign of overheating on both engines;

e. The Number-1 (Left) engine S/N P 702988 hit the approach light structures at high RPM before the final ground impact, so that the fan blades were at lower rotational speed at the time of final ground impact causing lesser damage;

f. The Number-2 (Right) engine S/N P 665485 hit the ground directly, so that the fan blades were at higher rotational speed at impact causing more severe damages.

The result of engines tear down shows that the engines operated at normal performance. Therefore engines were not a contributing factor to the accident.

2.1.3 High Lift Devices: Flaps & Slats

The recovered flapjack screws (6 out of 8) were identified. All jack screws showed that the left and right were in retract position

Portion of the front spar in the area of slat #4 remained intact including the two slat #4 main tracks, the two auxiliary tracks and a portion of the slat actuator fitting. The slat and actuator were not recovered. The inboard main track was partially extended and could be moved by hand while the inboard auxiliary track, outboard auxiliary track and outboard main track were jammed in the fully retracted position.

The mechanism of the operation of slats shows that the slat would extend immediately after initial flap selection. Therefore it can be concluded that the slats and the flaps were in retract position.

2.2 Flap position

Field investigation found six screw jacks which indicated flaps were not extended.

There are three possibilities of why the flap did not travel to take-off configuration upon take-off preparation.

The first possibility is flap asymmetry. In the event of asymmetry flap would cause the flap system to stop flap movement. Investigation finding, that 6 screw jacks were in similar position this shows that both left and right flap was found at zero position, however, indicate that flap asymmetry was not the cause of the flap failed to travel to take -off configuration.

The second possibility is the failure of the flap system. There is no available component of the flaps system that can be examined. No single faults were identified that could affect the independent flap actuation, flap position indication and takeoff configuration warning systems. Only limited single faults were identified that could affect two to the three systems simultaneously. In the last six months maintenance record stated that there was no problem reported related to the flap system. Therefore multiple simultaneous faults resulting in failure of the flap actuation, flap position indication, and take off warning system is unlikely. The third possibility is the failure of the flight crew to select the flap to take-off position. Due to the lack of useable CVR recording from the cockpit area microphone, the investigation could not confirm whether the take-off checklist, which includes flap selection, was properly done.

2.3 Take-off configuration recognition

The fact that the flaps and slats were in retracted position. This indicated that the aircraft attempted to take-off without being properly configured. This improper configuration should have activated the take off configuration warning horn to alert the pilots of the improper configuration.

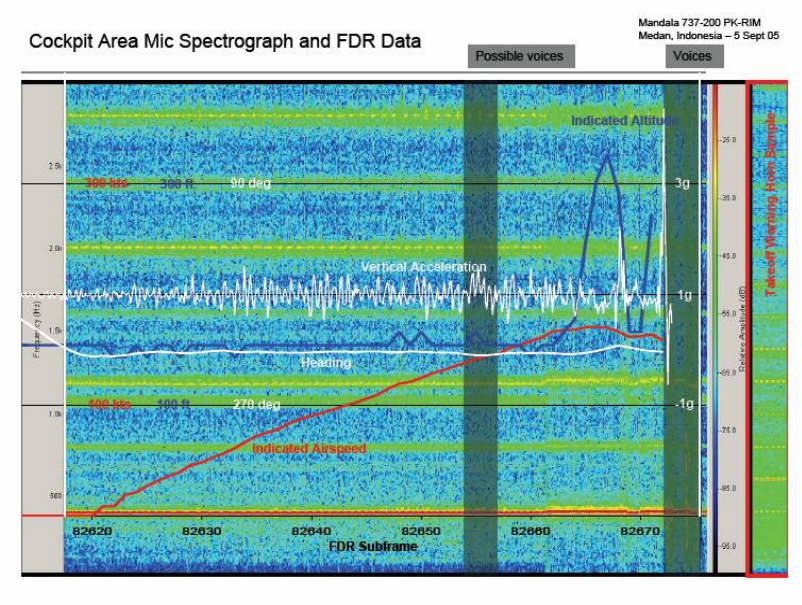
2.4 Cockpit Voice Recorder

The followings are the results of CVR analysis.

1. The CAM channel of the CVR was of very poor quality.
2. The captain's and first officer's audio channels of the CVR appeared to be operating normally. These channels contained only VHF transmissions, indicating that the flight crew was not using headsets to communicate
3. Contributing to the poor CAM channel quality was an excessive amount of electrically induced noise or hum probably due to an open ground in the wiring connecting the cockpit area microphone and the CVR recorder.
4. From the CVR it is not possible to determine which pilot took control during the accident take off. On the same line there is no record/ document that mentioned the pilot flying.
5. Despite the poor quality, some cockpit sounds and information was recorded on the CAM channel of the CVR recording.
6. The aircraft's take off warning horn "could not be heard" on the CAM channel of the CVR, even after extensive filtering of the hum and noise.
7. Several crew words, cockpit switch activations, engine noise, and cabin chime sounds heard on the CAM channel of the CVR are typically at a volume level much lower than the standard take-off warning horn of the Boeing 737-200. The typical sound of the takeoff configuration warning was not heard on the CVR CAM channel. Nor was the stick shaker (typically as loud or louder than the takeoff warning horn) heard on the CVR CAM channel, although it should have been sounding as the aircraft lifted off the runway.Therefore it is possible that both the takeoff configuration warning and the stick shaker were sounding, but not recorded on the CVR CAM channel due to the intermittent electrical connection described in Section 1.16.2. No definite conclusions regarding the takeoff configuration warning could be drawn from the CVR.

The reason for the lack of take off configuration warning horn cannot be determined through sound analysis.

The following picture represents the superposition of sound spectrum taken from the CVR and the FDR data.



2.5 Flight Data Recorder

The followings are the results of FDR analysis.

- FDR readout result suggests that the speed increase of accident aircraft during take-off roll until rotation consistent with previous flight, this indicates that the acceleration was not the factor of the accident. Engine tear down also concluded that the engines were in operation while impacted.

  Wreckage and the FDR confirmed that the engine performance was not the cause of the failure to lift-off.

  The FDR recorded altitude (static pressure), airspeed (pitot pressure), magnetic heading, normal load factor, and VHF mic keying. In addition, the FDR recorded limited internal data (e.g. pressure transducer temperature) used in the conversion of the binary data to engineering units.

  The static and dynamic pressures were measured by transducers installed on the FDR itself. The pitot and static ports used are near the front of the aircraft, and plumbing is installed to convey the pressure to the rear of the aircraft where the FDR is installed.

  Analysis of the data recorded on the FDR revealed that angle-of-attack corrections are required to accurately convert the recorded data to airplane altitude. The recorded altitude parameter shows the airplane initially climbed 170 ft in 5 seconds before settling back onto the runway and then climbing again to just over 100 ft AGL before the recording ended (see Figure 1). The recorded altitude parameter shows an unrealistic climb rate (~2000 ft/min) that is approximately double the typical climb rate for the accident conditions (weight, CG, temperature, winds and field elevation).

Therefore, an examination was made of the recorded altitude.

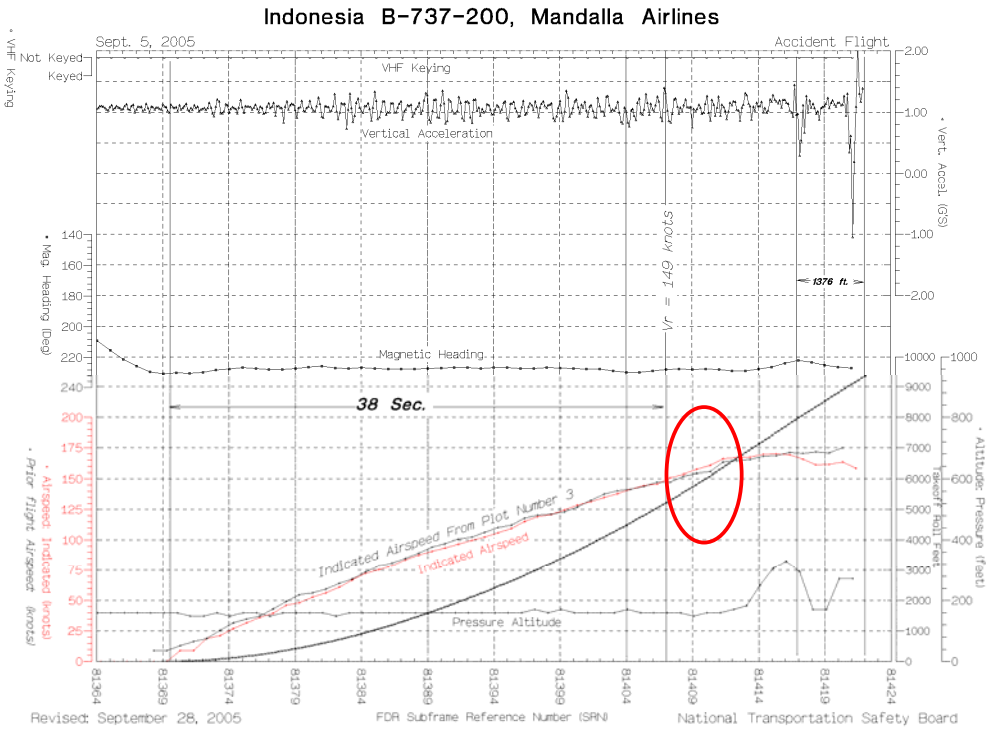
Flight tests of 737-200 aircraft have demonstrated that high angles-of-attack (AOA) beyond approximately 15° (i.e. beyond stick-shaker) result in reduced static pressure at the static ports. Altitude measurements made using the sensed static pressure (indicated altitude) must be corrected to account for the effects of high AOA. The indicated altitude data recorded on the FDR does not make this correction; consequently, it is artificially high.

An aerodynamic simulation of the 737-200 was used to evaluate the accident takeoff and match the parameters recorded by the FDR. The simulation took into account flaps-up ground effect lift and high AOA effect. The simulation calculates both pressure altitude as well as indicated altitude (that does not include the AOA effect) such as would be recorded by an FDR such as the one installed on the accident airplane.

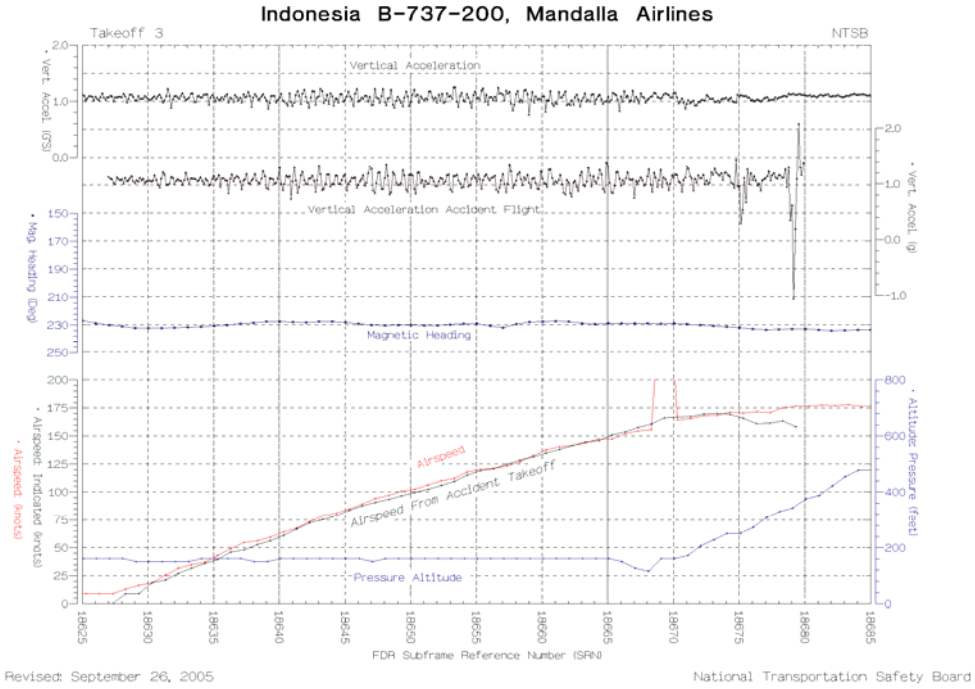
A number of scenarios were investigated in the attempt to match the data recorded on the FDR from the accident takeoff. The best match in the simulator was obtained by using flaps 1 takeoff speeds (V1, Vr, and V2), but with the flaps retracted. The simulator match demonstrated that the airplane lifted off the runway, continued to pitch up through stick shaker to approximately 22° nose up. The resulting high AOA caused the wing to stall. The airplane then descended and struck the runway tail first. It continued along the runway and briefly lifted off a second time before again descending and striking obstacles at and beyond the end of the runway.

Based on the AOA necessary to match the recorded FDR data, the stick-shaker should have been operating continuously during the brief intervals that the airplane was airborne.

The high AOA caused large errors in the static pressure used to determine altitude and airspeed, which in turn caused both recorded altitude and airspeed to read artificially high. The indicated altitude and airspeed modeled in the simulation are in close agreement with the altitude and airspeed recorded on the FDR. The engineering simulator was also used to match a normal flaps one takeoff recorded on the FDR from a previous flight using the same techniques used to match the accident takeoff. Figure 2 shows that the simulation and FDR data for the representative flaps one takeoff (NTSB Takeoff #3) are in close agreement.



FDR plot of accident flight compared to previous flight from Medan in airspeed. Note that the airspeed of both flights are similar. Note also that the accident flight had a failure in lift-off as indicated by the trend in the pressure altitude.



FDR plot of previous flight from Medan compared to accident flight in airspeed and vertical acceleration. Note the successful lift-off as indicated by increasing in pressure altitude.

2.6 Standard Operating Procedure

2.6.1 Manual

The SOP (Standard Operating Procedure) Chapter 3, Crew Coordination – sub chapter Checklist Usage stated as follows:

Normal checklists are used by the crew to ensure that airplane condition is acceptable for flight and to operate the airplane and its system properly during each phase of flight.

The following general rules apply:

- *During normal operation, procedures and action may be performed by recall; thereafter the checklist is used to verify completion of all relevant items.*
- *The Captain shall initiate checklist reading on the ground, the PF in flight.*

At the pointer 6, 7 and 8 states:

- *It is the responsibility of both PF and PNF to ensure that checklist items have been accomplished properly. When a checklist response is given by the PF, <u>both</u> pilots will visually check proper control setting or indication. In other words: don't just give reply, but also look at what you get!*
- *When an improper indication is noticed, the PF will continue to control or monitor aircraft flight path. The PNF will verify that system controls are properly positioned. Then, if necessary, he will check the related circuit breaker (s) and test related system lights.*
- *Completion of each checklist will be announced with the statement: "…….. CHECKLIST COMPLETE".*

Refer to the Quick Reference Handbook, Chapter CI, Section 1 Checklist Introduction – Normal Checklist, states: *Normal checklists are used after doing all respective procedural items.*

Also according this section, the Before Takeoff Checklist shall called by Pilot Flying, read by Pilot Monitoring, verify by both Pilots and respond by Pilot Flying.

The flap selection for take off is in the Before Takeoff Checklist. According to the procedures, the application of the flap item on the Before Takeoff Checklist would be as follows:

- Pilot Flying asked for Flaps selection.

- Pilot Monitoring would select the flap to the desired position and read the checklist, while reaches at the item “Flap”.

- Both pilots should verify by check the flap indication and lights, then Pilot Flying shall respond “five, green light” if he saw the flap indicator showed that flap in 5 position and leading edge lights shows green.

Should pilot selected the flap to take-off configuration and the flap system failed and caused the flap to remain at retracted position, the crew would not see the green lights illuminated and flap indicator would indicated zero position. Therefore, had the procedures been performed, the crew would have identified the flap’s zero position, regardless the failure of the take-off configuration aural warning.

According to the CVR read out, the aircraft arrived on short runway at 02.59 and asked to hold at that position since there were two aircraft about to land. The aircraft received the take off clearance at 03.02 after held on short runway for approximately 3 minutes. This provide enough time for the flight crew to perform checklist.

Since the CAM channel was in poor quality, further analysis of the flight crew activities during this period could not be revealed.

2.6.2 Checklist Philosophy, Concept and Execution

From the interview with the chief pilot, chief instructor, instructors and some of line pilots indicated that there were various understanding on how the checklist should be performed. Some said it should be “read and do”, some said “do and read”, while others said the combination. While being asked whenever the checklist execution is being interrupted, some of the pilots seemed not firmed on how to handle the checklist interruption.

2.7 Airport Emergency Plan

The airport emergency plan as stated in ICAO Annex 14 and KM 47 (Indonesian Minister Decree for Airport) is a requirement for the airport operator as guidance during accident or other emergency event.

The content of the grid map covered only the airport vicinity (inside the perimeter) and the quality of the map was not clear enough and difficult to be interpreted. The Ministry Decree KM 47 states that the airport emergency or rescue shall cover the radius up to five nautical miles from the airport perimeter which covers land, water or city in the vicinity of the airport.

All recipients of the Airport Emergency Plan must read and ensure that they understand. All airport units and related departments outside the airport mentioned in AEP must develop their own procedures to meet their responsibilities under the AEP.

These procedures must be regularly reviewed, updated and tested to ensure that the airport emergency teams including related departments outside the airport are well prepared. In the event of an emergency, an efficient and effective response will only be achieved with careful planning.

The information mentioned showed that the emergency evacuation was not duly performed according to the AEP. The evaluation of the AEP and the execution during the emergency indicate that the AEP was inadequate to conduct properly in the event.

The Polonia Airport, Medan has an Airport Emergency Plan that was published in October 2002 and was distributed to several units within the airport organization and other external related organizations such as Police, Armed Forces, Hospitals and other medical facilities, Local Authority, etc. There was no revision since the manual being published.

The AEP does not mention the accountable unit who maintains the updating of the manual, distributes of the revision, monitors and control copy of the manual, reviews after accident or performs emergency exercises and coordinates in the case of the emergency.

The content of the manual is inadequate to organize an emergency situation, among others: function and responsibility to handle the media, responsibility in managing the crisis center, radio frequency used in the case of an event, etc.

2.7.1 Rescue Operation

As mentioned in the factual, the airport fire brigade had difficulties in conducting the rescue operation at the crash site. It seems that there was no person in charge as the coordinator among the rescue teams. The overly crowded situation caused difficulties to the rescue teams in evacuating the victims. Such a situation could also be due to inadequacy of the rescue teams in training to respond the real situation outside the airport.

As stated by witnesses and several survivors, the fire started some times after the crash. It is important that the rescue teams to arrive to the accident site as early as possible. The absence of access road from the airport perimeter (as required by KM 47) caused the airport rescue teams took a much longer time to arrive on the crash site. In conjunction with lack of coordination among the rescue teams eventually led to a less number of survivors.

As reported in the factual the ATC had difficulty to determine the exact location of the crash site. It was due to the unavailability of the grid map covering the crash area. The airport rescue team shall be familiar with the obstacle and circumstances at the airport and its surrounding. All units or departments involved in emergency operation shall have the grid map in order to conduct the evacuation effectively.

The standard operation procedure for the operation outside the airport was not clearly understood by the rescue teams. It had lead to the decision to dispatch limited fire truck in order to keep the airport operation meet the minimum level of fire fighting.

The lack of understanding of the SOP and practices in the emergency exercise especially outside the airport were also contribute to the ineffectiveness of the emergency operation.

Since the AEP does not state the radio emergency frequency, it caused the related departments outside the airport unable to make a communication for coordination.

2.7.2 Crisis Center

The function of the crisis center as stated in the AEP is to monitor and control all activities and progress of the event. Whereas, at the time of emergency, there was no dedicated crisis center setup (a special room equipped with radio, fax, computer, telephone, etc) during the crisis. The crisis center should be kept isolated from the public, it is important to keep the confidentiality and the security of all data and information. The location of the crisis center is not declared in AEP, it made difficult to other participants to coordinate.

2.7.3 Runway End Safety Area

According to ICAO Annex 14 chapter 3.5.1 and Ministry Decree (KM 47), the RESA (Runway End Safety Area) is mandatory. The RESA shall be provided end each of a runway strip and it shall extended from the end of a runway strip to the distance of at least 90 m (ICAO Annex 14 chapter 3.5.2).

The RESA (Runway End Safety Area) is mandatory according to KM 47 and ICAO Annex 14 chapter 3.5.1, where it shall be provided at each end of a runway strip. It shall extend from the end of a runway strip to a distance of at least 90 m (chapter 3.5.2).

As mentioned in the factual that the extension of runway end 23 has about 60 m, it is 30 m shorter than the minimum requirement.

2.7.4 Victims Identification

Some witnesses stated that one of the pilots and some other victims were still alive some times after the crash. However, they did not survive from the fire.

Should the rescue team arrive earlier to the site, several of them could be survived from the accident.

3 CONCLUSIONS

3.1 Findings

- Both pilots had valid license and are proficient.
- The aircraft had valid Certificate of Registration and Certificate of Airworthiness.
- Wreckage and the FDR confirmed that the engine performance was not the cause of the failure to lift-off.
- The result of engines tear down shows that the engines operated at normal performance. Therefore engines were not a contributing factor to the accident.
- Load manifest data shows that aircraft weight and the CG position are sufficient to provide stability. The aircraft weight and balance is not a contributing factor to the accident.
- Aircraft performance derived from the FDR data conclude that the A/C attempted to take-off with improper take-off configuration (i.e. flaps and slats retracted).
- The aircraft briefly lifted off during the take-off roll, stalled, then settled back onto the ground before overrunning the end of the runway.
- The aircraft's take off warning horn should have been sounding continuously while the airplane was briefly airborne. Neither sound was heard on the CAM channel of the CVR, even after extensive filtering of the hum and noise.
- Several crew words, cockpit switch activations, engine noise, and cabin chime sounds heard on the CAM channel of the CVR are typically at a volume level much lower then the standard take off warning horn.
- The reason that the take-off warning horn was not heard on the CVR could not be conclusively determined. It is possible that the take-off configuration warning horn was not sounding. It is also possible that takeoff configuration horn was sounding, but was not being recorded by the malfunctioning CAM channel.
- Since the CVR recording is of poor quality, the investigator team has no evidence if the check list procedures have been performed properly. Should the crew perform the checklist procedure properly they would have identified the flap's zero position regardless the failure of the take-off configuration aural warning.
- The inadequacy execution of the AEP, lack of coordination and practices among the rescue teams, eventually can be led to a less number of survivors.

3.2 Causes

The National Transportation Safety Committee determines that probable causes of this accident are:

- The aircraft took-off with improper take off configuration namely with retracted flaps and slats causing the aircraft failed to lift off.
- Improper checklist procedure execution had lead to failure to identify the flap in retract position.
- The aircraft's take off warning horn was not heard on the CAM channel of the CVR. It is possible that the take-off configuration warning horn was not sounding.

4 RECOMMENDATIONS

As result of this investigation, National Transportation Safety Committee proposes several recommendations to overcome the safety deficiencies.

4.1 Recommendation to PT. Mandala Airlines

The National Transportation Safety Committee recommends that PT. Mandala Airlines ensure that flight crew correctly perform the checklist execution, in particular ensuring confirmation and verification.

4.2 Recommendation to PT. Mandala Airlines

The National Transportation Safety Committee recommends that Mandala Airlines develop and promulgate an accurate checklist from the approved Operations Manual instead of the “do not use for flight” version.

4.3 Recommendation to PT. Mandala Airlines

The National Transportation Safety Committee recommends that Mandala Airlines should review and update the Standard Operating Procedures in accordance with the approved Operations Manual.

4.4 Recommendation to PT. Mandala Airlines

The National Transportation Safety Committee recommends that Mandala Airlines should conduct a functional test of the take-off warning horn on its Boeing 737 aircraft each day before commencing flight operations. Additionally the warning horn should be functionally checked once in every 200 flight hours in accordance with FAA AD 88-22-09.

4.5 Recommendation to Directorate General Civil Aviation

The National Transportation Safety Committee recommends that Directorate General Civil Aviation should enforce and ensure that the installation and the maintenance of FDR and CVR in accordance with CASR 121.343, 121.359 and Annex 6 Attachment D.

4.6 Recommendation to Directorate General Civil Aviation

The National Transportation Safety Committee recommends that Directorate General Civil Aviation should assess the Mandala Airlines Operations Manual to ensure the adequacy of the Standard Operating Procedures.

4.7 Recommendation to Directorate General Civil Aviation

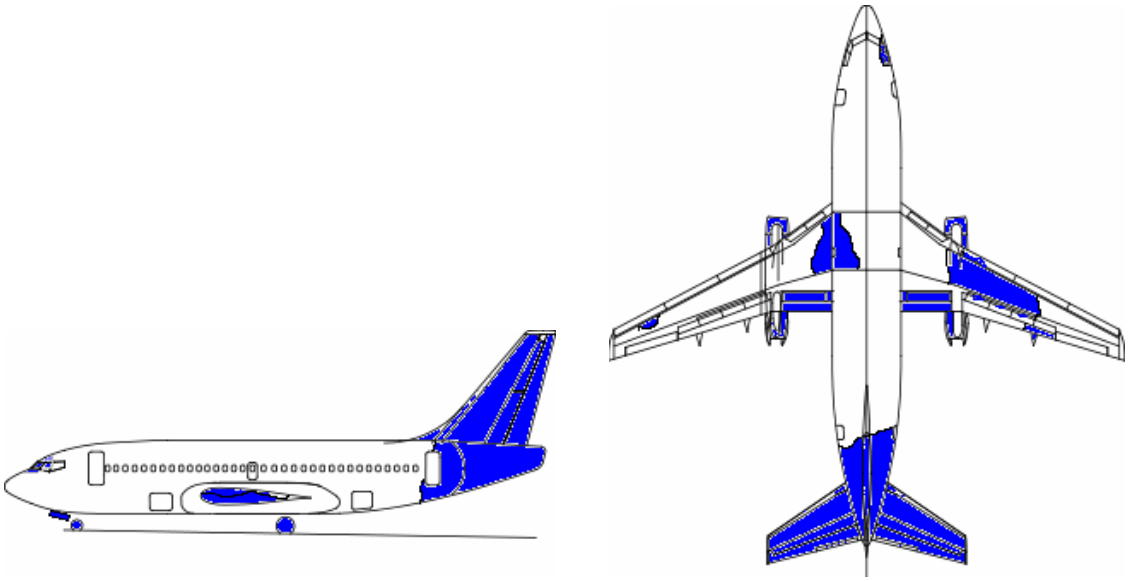
The National Transportation Safety Committee recommends that Directorate General Civil Aviation should review, and improve if necessary, the existing emergency manuals for airlines and airports, in particular with respect to coordination with local authority resources involved during emergencies.

4.8 Recommendation to Directorate General Civil Aviation

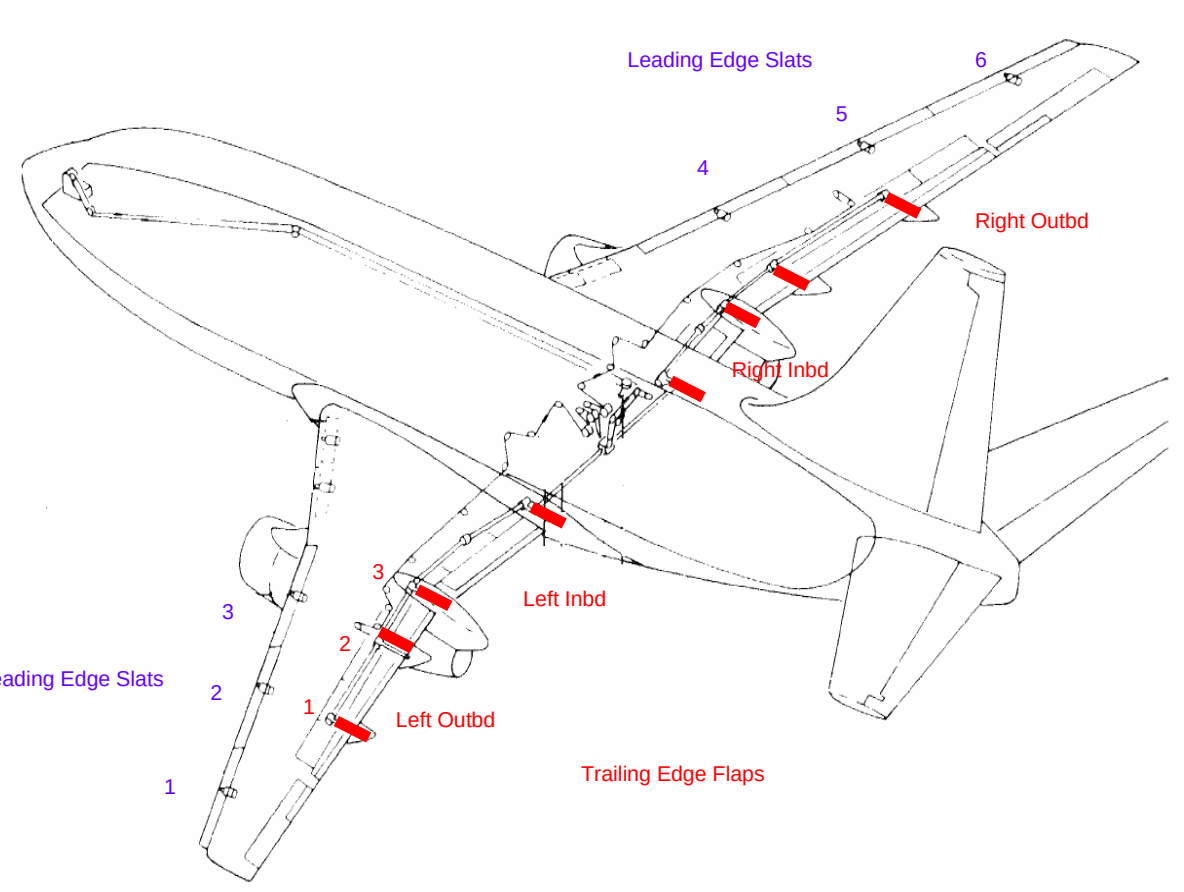
The National Transportation Safety Committee recommends that Directorate General Civil Aviation mandate the requirement for real-time exercise of Airport Emergency Plan to be conducted at least once every year.

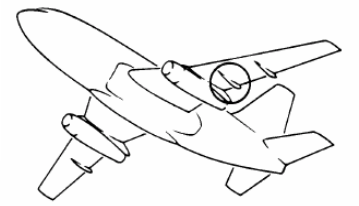
APPENDICES

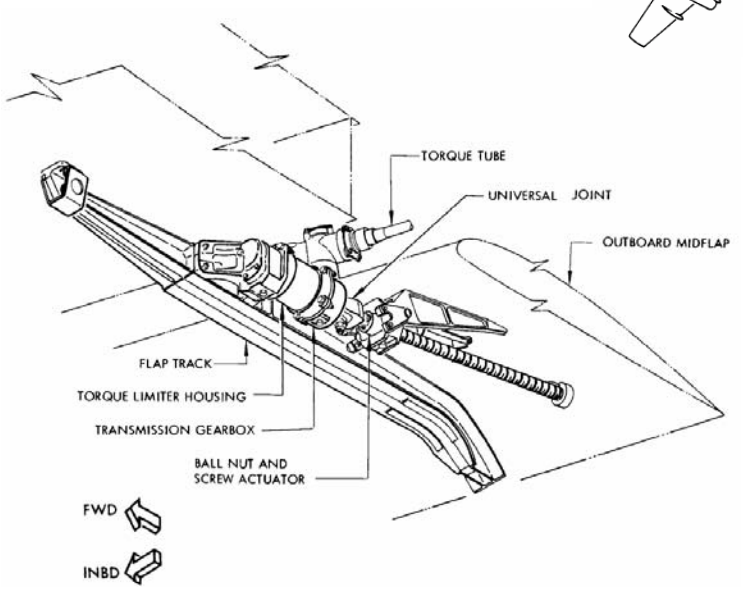
Appendix A Recovered and identified portions of the wreckage

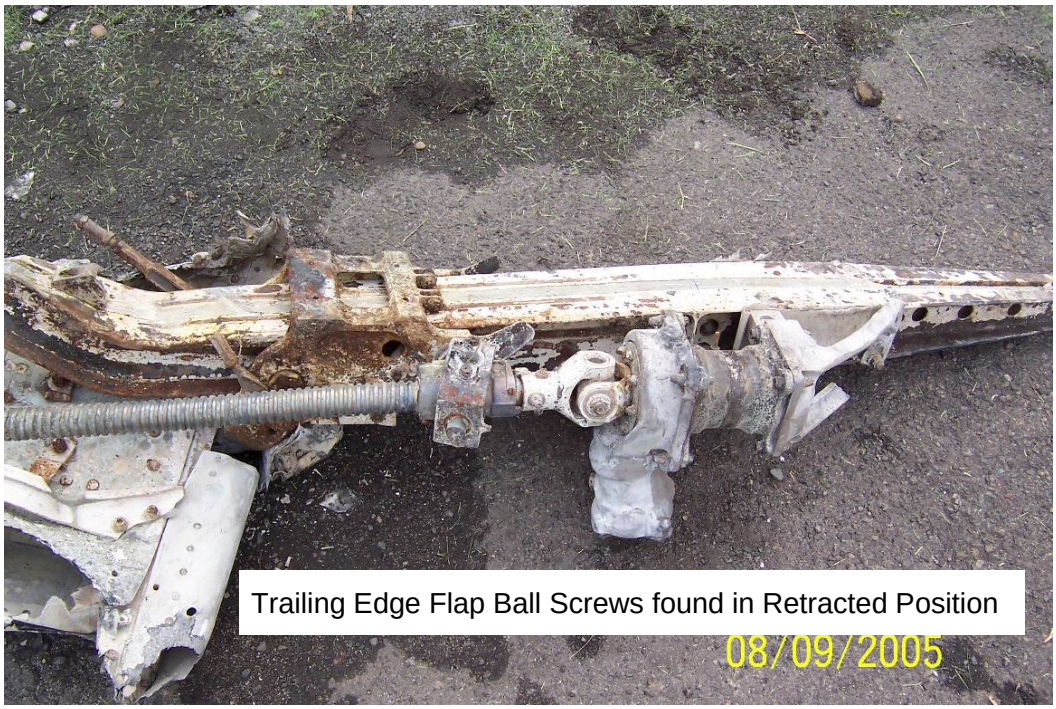


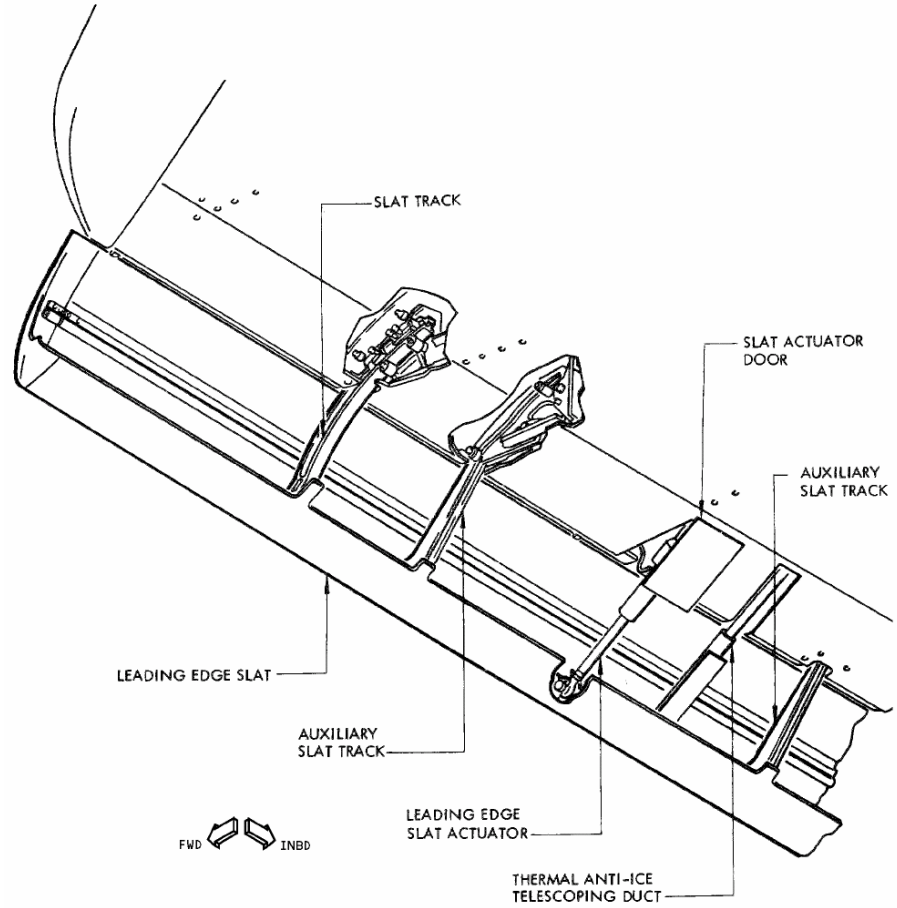
Appendix B Picture of Flap Jackscrews

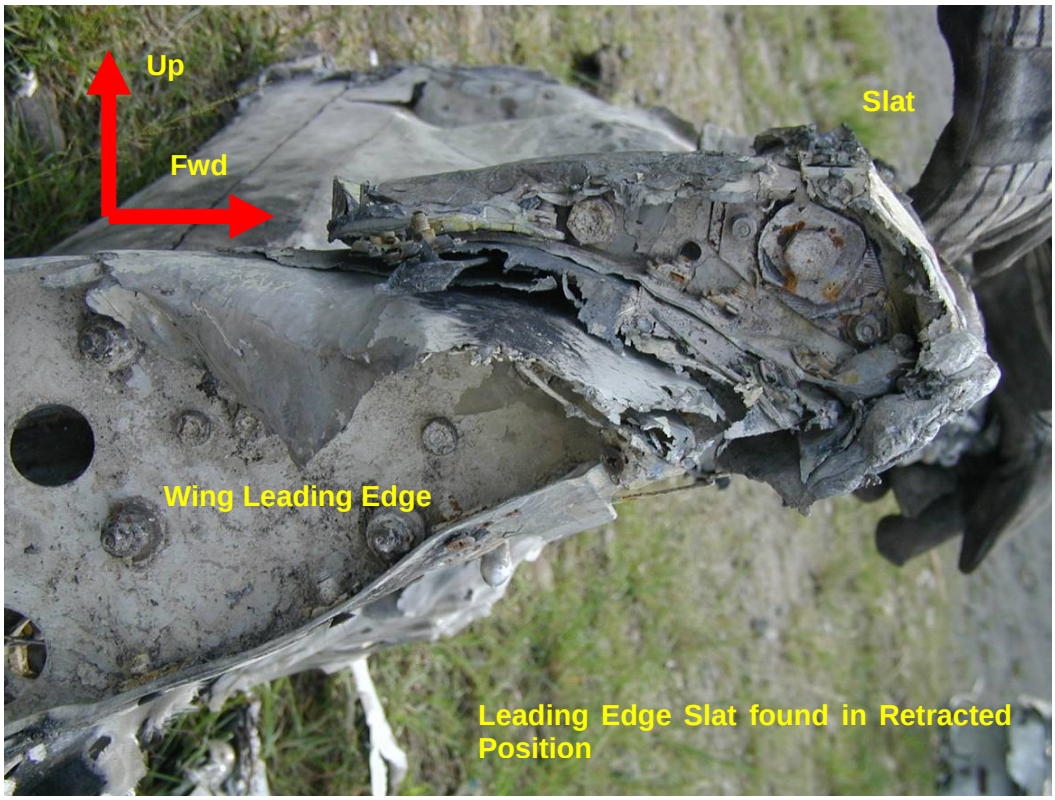


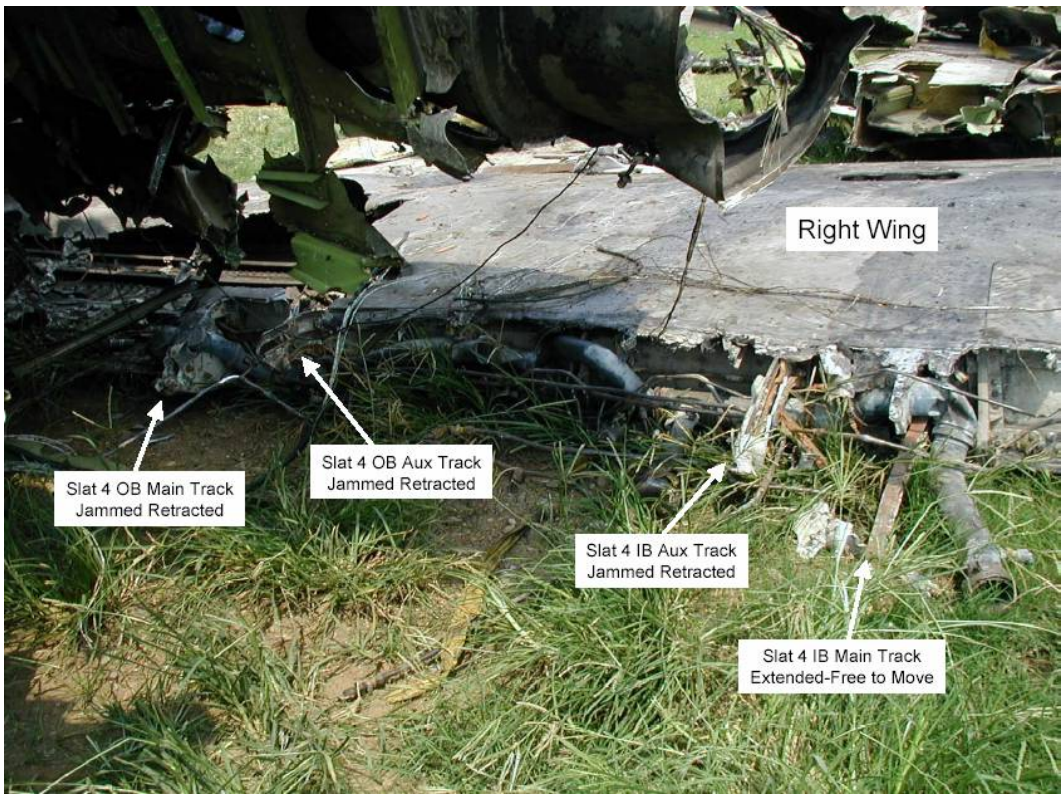





Trailing Edge Flap Ball Screws found in Retracted Position
08/09/2005


SLAT TRACK
SLAT ACTUATOR DOOR
AUXILIARY SLAT TRACK
LEADING EDGE SLAT
AUXILIARY SLAT TRACK
LEADING EDGE SLAT ACTUATOR
THERMAL ANTI-ICE TELESCOPING DUCT
FWD
INBD


Up
Fwd
Slat
Wing Leading Edge
Leading Edge Slat found in Retracted Position


Right Wing
Slat 4 OB Main Track Jammed Retracted
Slat 4 OB Aux Track Jammed Retracted
Slat 4 IB Aux Track Jammed Retracted
Slat 4 IB Main Track Extended-Free to Move

Appendix C Load Sheet

```
DVC-47474 0234 OSSEPOS
0444
MANDALA AIRLINES PT

 L O A D S H E E T              CHECKED BY                APPROVED          EDNO
 ALL WEIGHTS IN KG          RUDY                                          01

 FROM/TO FLIGHT          A/C REG VERSION          CREW      DATE        TIME
 MES CGK R10091/05       PK-RIM  CRYTOC           2/3       OSSEP05     0234
                         DEPART                DISTRIBUTION
 LOAD IN COMPARTMENTS          3692 1/2292 4/1400 0/0
 PASSENGER/CABIN BAG           7730 110/0/3          TTL 113 CBN 0
                                    DRY 8/102
 TOTAL TRAFFIC LOAD           11422
 DRY OPERATION WEIGHT         30175
 ZERO FUEL WEIGHT ACTUAL      41597 MAX   47000       ADJ
 ------------------------------------------------------
 TAKE OFF FUEL                10400
 TAKE OFF WEIGHT  ACTUAL      51997 MAX   52000  L    ADJ
 ------------------------------------------------------
 TRIP FUEL                     6200
 LANDING WEIGHT   ACTUAL      45797 MAX   46720       ADJ
 ------------------------------------------------------
 BALANCE AND SEATING CONDITIONS          LAST MINUTE CHANGES
 TOI      31.83 DLI            4.37   DEST  SPEC    CI/CPT + - WEIGHT
 LIZFW     6.76 MAC%FW        20.68
 LITOW     3.41 MACTOW        18.57
 LILDW     3.60

 STAB TO  05.3 MID
 SEATING
 MA/20 00/66 OC/24

 UNDERLOAD BEFORE LMC          3              LMC TOTAL + - :

 LOADMESSAGE AND CPTAINS INFORMATION BEFORE LMC

 *** CONNECTED TO CHECK-IN APPLICATION ***

 THIS AIRCRAFT HAS BEEN LOADED IN ACCORDANCE WITH THE
 LOADING INSTRUCTIONS INCLUDING THE DEVIATIONS RECORDED.
 THE LOAD HAS BEEN SECURED IN ACCORDANCE WITH COMPANY
 REGULATIONS

 SIGNED .....

    NOTOC - NIL

.LDM
R10091/05.PK-RIM.CRY102.2/3
-CGK.110/0/3.0.T3692.1/2292.4/1400.0343.02749.PNIL.ENIL
.PAX/8/102.PAD/0/0
SI PIC DEPT.ABKAR T.*****ATPL NO.4634
 LOADSHEET BY RUDY ****,PIC LIC 1069
 NOTOC + 02 PERSL + 20 BELLMU TO CGK

:DVC-47474 0234 OSSEPOS
LPM
R10091/05.PK-RIM.CRY102
-MES.PAX/8/102.0343.02749
.2D\041597.LI[illegible]
.1/CGK/[illegible]
.1/CGK/C1349
.4/CGK/C1400
SI
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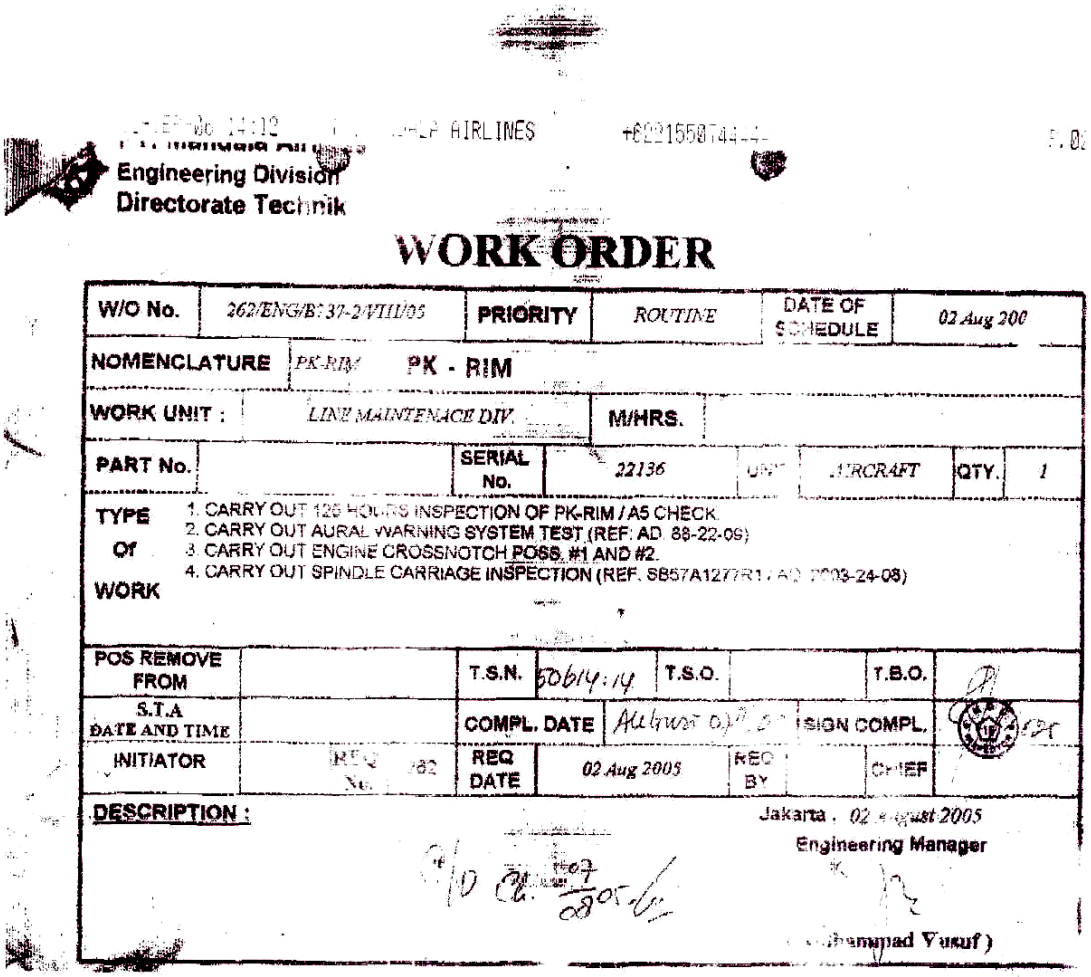
Appendix D FAA AD 88-22-09 Take-off Configuration Aural Warning Horn Test



Engineering Division
Directorate Technik

WORK ORDER

W/O No.	262/ENG/B737-2/VIII/05	PRIORITY	ROUTINE	DATE OF SCHEDULE	02 Aug 200
NOMENCLATURE	PK-RIM PK - RIM				
WORK UNIT :	LINE MAINTENACE DIV.	M/HRS.			
PART No.		SERIAL No.	22136	UNIT AIRCRAFT	QTY. 1

TYPE Of WORK
1. CARRY OUT 125 HOURS INSPECTION OF PK-RIM / A5 CHECK.
2. CARRY OUT AURAL WARNING SYSTEM TEST (REF. AD 88-22-09)
3. CARRY OUT ENGINE CROSSNOTCH POSS. #1 AND #2.
4. CARRY OUT SPINDLE CARRIAGE INSPECTION (REF. SB57A1277R1 / AD 2003-24-08)

POS REMOVE FROM		T.S.N.	30614:14	T.S.O.		T.B.O.	
S.T.A DATE AND TIME		COMPL. DATE	August 02, 05			SION COMPL.	
INITIATOR	REQ No. /82	REQ DATE	02 Aug 2005	REQ BY		CHIEF	

DESCRIPTION :

Jakarta, 02 August 2005
Engineering Manager

(Muhammad Yusuf)

Appendix E Preflight Check List

Mandala Airlines

MAINTENANCE PROGRAM

BOEING 737 - 200

PRE FLIGHT CHECK

A/C REG :..... DATE :...../...../..... STATION :.....

TASK. NO.	DESCRIPTION	SIGNATURE MECH.	SIGNATURE R.I.I
	FUSELAGE EXTERIOR		
01.	Complete a " Walk around check" for obvious damage and evidance or fluid leaks.	.....	X
02.	Ensure all access panels and cowling are secure, particulary check FWD/AFT entry and Galley service doors for abvious damage	.....	X
03.	All movable flight control surface(Rudder ; Elevator; Ailerons ; Horinzontal Stab.; T/E Flaps and spoiler) clear of all obstructio.	.....	X
04.	Ensure all external doors are closed and secured.	.....	X
05.	Ensure Ram air inlets and outlets are free from obstruction.	.....	X
06.	Check all pitot head covers removed and correct stowed.	.....	X
07.	Check cargo compartments for cleanliness and free from foreign mater.	.....	X
08.	After Toilet & water servicing, inspect the servicing cavities for sign of leakage and ensure that charge pipe has been drained.	.....	X
09.	Electronic and lower nose compartment for proper Installation and security.	.....	X
	APU		
10.	Check APU and Engine fire extinguisher bottle pressure correct and APU discharge are intact.	.....	X
11.	APU inlet and exhaust for damage and free from obstruction.	.....	X
12.	APU operation, check APU low oil quantity (light).	.....	X
	WING'S & FUEL SYSTEM		
13.	Ensure all fuel to be uplift has been check for contamination. Uplift remaining fuels are recorded in the Aircraft Tech. Log.	.....	X
	Rem: / Add: / Total:		
14.	Fuel Tank's carry out water check(drained). minimum setting time 30 minutes after servicing/ engine shot down.	.....	X

TASK. NO.	DESCRIPTION	SIGNATURE	
		MECH.	R.I.I
15.	Check for condition of landing; Taxi; Runway Turn off light ; Rotatiing Becon; Wing Tip light.	.....	X
	UNDER CARRIAGE & HYDRAULIC SYSTEM		
16.	Check Main & Nose undercarriage assemblies for obvious damage, Cleanlinees and evidence of fluid leaks; strut extention appear normal . Check downfock marking and viewing window for condition and cleanliness	.....	X
17.	Check Tyre condition for uneven wear / cut / flat spot and Tyre pressure appear normal	.....	X
	NOSE: 1 .....Psi; 2 .....Psi MAIN LH: 1 .....Psi; 2 .....Psi MAIN RH: 1 .....Psi; 2 .....Psi		
18.	Check Brake Unif for condition, with parking brakes applied check brake wear. Replace when indicator pin 1/16 inch or less.		
19.	Check Hydraulic system component in the wheel well areas for condition for and sigh of fluid leaks or damage		
20.	Undercarriage ground lock removed and stowed.	.....	X
21.	Engine fire bottle for correct pressure and security.	.....	X
	POWER PLANT		
22.	Check engine air intakes are free from foreign matter (FOC) and check for condition of first stage compressor (Fan blades) free from obstruction. inspect iniet cowl and Nose dome for securty and cleanliness.	.....	X
23.	Check Tail pipe for evidence of metal/oil accumulation or Turbine blades damage and Trusht reverser fair whith engine cowling when closed	.....	X
24.	Check Red and Green warning stripes on AFT over board of LH & RH nacelle fairing to ensure no mismatch.	.....	X

TASK. NO.	DESCRIPTION	SIGNATURE	
		MECH.	R.I.I
25.	Check engine oil level with dipstick and oil tank cap for proper installation Check decal for fluid spec. Engine # 1. | Engine # 2.	.....	X
26.	Check engine CSD's for oil level, over servisinng wil cause over heating. Check access panels, drain holes and masts for fuel or hydraulic leakage and proper installation.	.....	X
	COCKPIT		
27.	Check circuit breakers are locking intact and spare bulbs in box.	.....	X
28.	Inspected crew seats, safety belts and harneses Check areas for cleanliness, ash trays ampties; visors etc... stowed.	.....	X
29.	Safety check competed → Power "ON" check exterior light and heaters for opertion: - Landing; Taxi and Runaway turn off (ono person out side) max. ops. 5 minutes. - Pitot and stall warning heaters. - Navigation, Beacon, Wing illumination and wheel weil lights.	.....	X
30.	Check Hydraulic brake precharge pressure(hydraulic pumps must be "OFF") - Operate the brake pedals Until brake pressure stops falling (pross, stabllize 1000 Psl.) - Operate the parking brake and check warning light.	.....	X
31.	Check Hydraulic fluid and cross check gages reading with visual on reservoir. - Turn "ON" electric hydraulic pumps, check "B" system press. - Open GRD interconect switch and check "A" system press. - Turn "ON" fuel boots pump for each Tank. - Extend Flaps, check clearance.	.....	X

TASK. NO.	DESCRIPTION	SIGNATURE	
		MECH.	R.I.I
32.	Check flight deck, sliding windows for cleanliness and free or foreign object.	.....	X
33.	CSD's disconect switch chick and fuse wirings locking intact.		
34.	Check oxygen perssure for Crews & Passengers above minimum for dispatch: Crew : Pass :	.....	X
35.	Check instrunent panel for condition : - Fuel Qty. (gage) - Hydr. Oil Qty. (gage) - Eng. Oil Qty. (gage) - Hydr. "B" sys press(light). - APU low oil Qty. (light) - Leading edge devace - Crew & Pax oxygen (gage) - Annuciator panel (light)	.....	X
36.	Instrument panels check for operation : - Wind and clock sets. - Fuel Qty. test switch (each tank decrease, total will increase and release switch → indicator. Should return to original)	.....	X
37.	Check Engine instruments and oil quantity: - Oil press → Zero. - Oil temp. → Ambient temp. - Oil Qty. → Service as required. - Oil Qty. test awitch → ON = decrease ; release = return to original.	.....	X
38.	Check that APU low oil quantity light is out and service as	.....	X
39.	Inducator lights and APD (Approach Progress Display) and press. to test lights Checked : - Pleace Master Test and Diming Switch to → TEST LIGHT Position. - Press - to - Test all warning and indicator lights.	.....	X
40.	Check all instuments to see if any FAILURE flags are in view, check applicable circuit breaker if any appears	.....	X
41.	Check 'Equipment Cooling Off' light, if this light is ON there is danger of equipment → take immediate corrrection	.....	X

TASK. NO.	DESCRIPTION	SIGNATURE	
		MECH.	R.I.I
42.	Flight Recorder check hours remaining, and also Voice recorder operationally checked.		
43.	Check all caution and Warning lights if any sign, and takes immediates corrective action.	.....	X
44.	Test overspeed warning system.	.....	X
45.	Check compass slaving and synchronization	.....	X
46.	Test windshield heating system.	.....	X
47.	Check engine anti ice valves.	.....	X
48.	Test stall warning system.	.....	X
49.	Test fire warning and oberheat warning of engine and APU for serviceability	.....	X
50.	Test wing body overheat for serviceability.	.....	X
51.	Check for seviceability of : - VHF Comm.; HF Comm.; FLT / Service Int.; - FLT / GRD Crew call; P.A. system.	.....	X
52.	Check for serviceability of: - VHF NAV; DME; ADF; ATC; GPWS and WX Radar.	.....	X
53.	Check altimeter for barometeric correction.	.....	X
54.	Check for serviceability of Automatic Pilot.	.....	X
55.	Reset Auto Ground Spoiler Actuator.	.....	X
56.	Ensure aircraft interior (Windows; Seats; Safety Belts; Doors; Emergency Exit) are clean and proper intallation. Also lavatories cleaned and serviced.	.....	X
57.	Turn "ON" light switches passenger sign (Fasten Seat Belt; No. Smoking) for chime works and replace any defective light bulb.	.....	X
58.	Turn "ON" Emergency Exit light, Check that 8 external exit lights / Doors for chime works and conserve battery power.	.....	X
59.	Check all emergency self - illuminating signs and markings for legibility and damage.		

TASK. NO.	DESCRIPTION	SIGNATURE	
		MECH.	R.I.I
60.	Checks that the following emergency equipment is on board and is in proper condition - Portable CO2 - Portable oxy. Bottle (press.<1800 psig. At 70°F - Crash axe and smoke goggles, masks. - First Aid Kit and Megaphone in piece. - Escapo straps or Ropes stowed properly. - Life vests are stowed properly. - Escape chute / slides stowed.	.....	X
61.	Check condition and serviceability of protective breathing equipment.	.....	X
62.	Check serviceability of emergency locator transmitter.	.....	X
63.	Check serviceability of : - Smoke detector. - Flash light. - Extention seat belt. - Demonstration equipment.	.....	X

ABOVE ITEMS COMPLETED AND DEFECT FOUND HAVE BEEN ACTIONED

SIGNATURE : ....

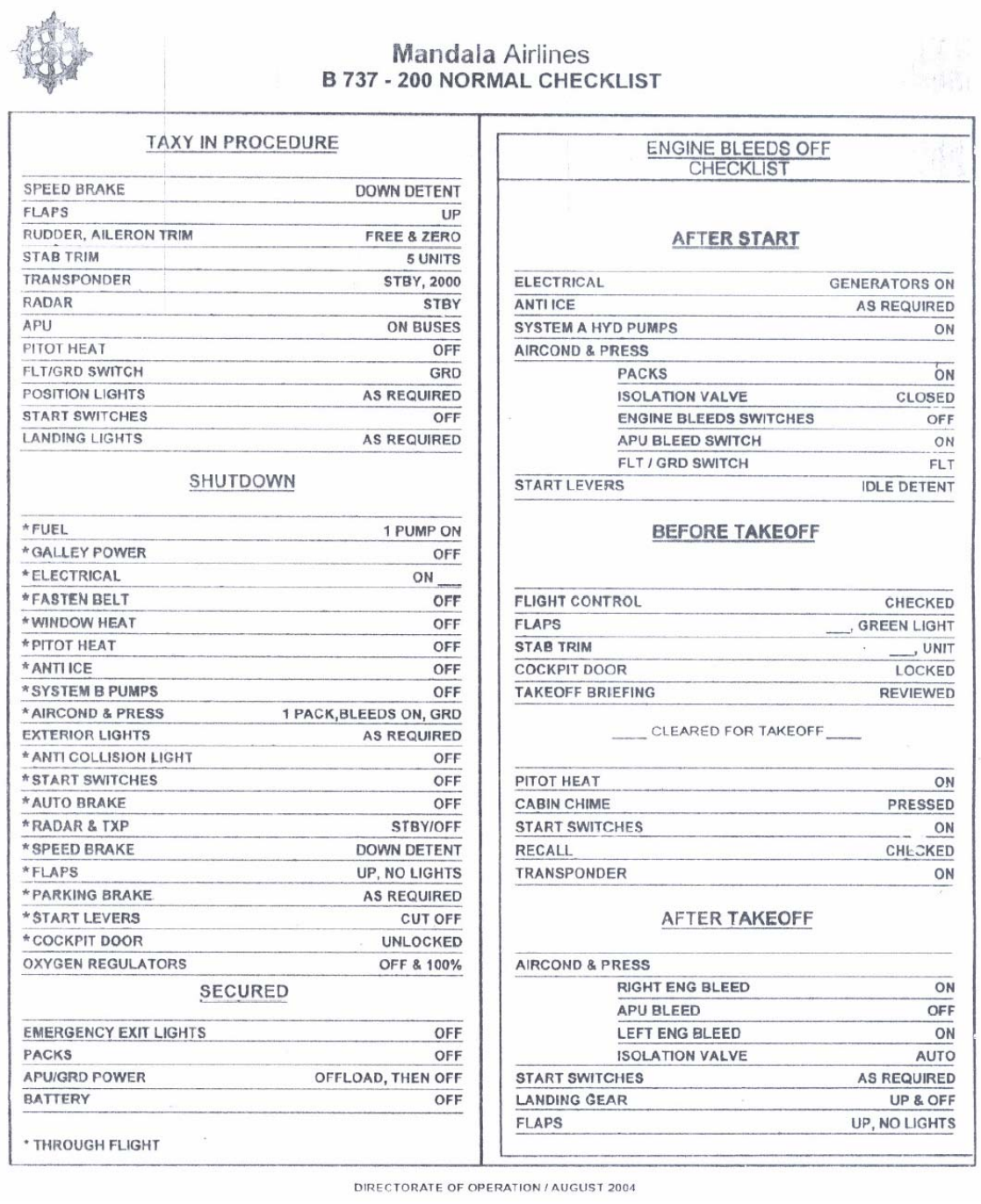
NAME : .....

LIC /OTR No. : .....

ACRF TSN / CSN : .....Hours /.....Cycles

BASE : .....

Appendix F Check List



Mandala Airlines
B 737 - 200 NORMAL CHECKLIST

TAXY IN PROCEDURE

SPEED BRAKE	DOWN DETENT
FLAPS	UP
RUDDER, AILERON TRIM	FREE & ZERO
STAB TRIM	5 UNITS
TRANSPONDER	STBY, 2000
RADAR	STBY
APU	ON BUSES
PITOT HEAT	OFF
FLT/GRD SWITCH	GRD
POSITION LIGHTS	AS REQUIRED
START SWITCHES	OFF
LANDING LIGHTS	AS REQUIRED

SHUTDOWN

*FUEL	1 PUMP ON
*GALLEY POWER	OFF
*ELECTRICAL	ON ___
*FASTEN BELT	OFF
*WINDOW HEAT	OFF
*PITOT HEAT	OFF
*ANTI ICE	OFF
*SYSTEM B PUMPS	OFF
*AIRCOND & PRESS	1 PACK,BLEEDS ON, GRD
EXTERIOR LIGHTS	AS REQUIRED
*ANTI COLLISION LIGHT	OFF
*START SWITCHES	OFF
*AUTO BRAKE	OFF
*RADAR & TXP	STBY/OFF
*SPEED BRAKE	DOWN DETENT
*FLAPS	UP, NO LIGHTS
*PARKING BRAKE	AS REQUIRED
*START LEVERS	CUT OFF
*COCKPIT DOOR	UNLOCKED
OXYGEN REGULATORS	OFF & 100%

SECURED

EMERGENCY EXIT LIGHTS	OFF
PACKS	OFF
APU/GRD POWER	OFFLOAD, THEN OFF
BATTERY	OFF

* THROUGH FLIGHT

ENGINE BLEEDS OFF CHECKLIST

AFTER START

ELECTRICAL		GENERATORS ON
ANTI ICE		AS REQUIRED
SYSTEM A HYD PUMPS		ON
AIRCOND & PRESS		
	PACKS	ON
	ISOLATION VALVE	CLOSED
	ENGINE BLEEDS SWITCHES	OFF
	APU BLEED SWITCH	ON
	FLT / GRD SWITCH	FLT
START LEVERS		IDLE DETENT

BEFORE TAKEOFF

FLIGHT CONTROL	CHECKED
FLAPS	___, GREEN LIGHT
STAB TRIM	___, UNIT
COCKPIT DOOR	LOCKED
TAKEOFF BRIEFING	REVIEWED

____ CLEARED FOR TAKEOFF ____

PITOT HEAT	ON
CABIN CHIME	PRESSED
START SWITCHES	ON
RECALL	CHECKED
TRANSPONDER	ON

AFTER TAKEOFF

AIRCOND & PRESS		
	RIGHT ENG BLEED	ON
	APU BLEED	OFF
	LEFT ENG BLEED	ON
	ISOLATION VALVE	AUTO
START SWITCHES		AS REQUIRED
LANDING GEAR		UP & OFF
FLAPS		UP, NO LIGHTS

DIRECTORATE OF OPERATION / AUGUST 2004

Appendix G Ramp Activity Check List

RAMP ACTIVITIES CHECK LIST B. 737-200 01.54

Date	Reg	Flt No	Route	ETD	ATD
05.09.05	PK RIM	RI 091	Mbe-Jkt	09.40	09.54

Activity	SOP Time		Actual Time		Remarks
	Start	Finish	Start	Finish	
Block-ON	09.15				LATE ON ARR/05 mnt
Crew On Board					
Refueling	+0	+10	09.28	09.50	
Loading Cargo + Bagage	+0	+25	09.17	09.45	
A/C Cleaning	+5	+15	09.19	09.30	0/13 2 pintu
Catering	+5	+15	09.19	09.30	1 MG2
Maintenance Release	+15	+15	09.18	09.21	20. PE lum
Pax Boarding	+15	+25	09.30	09.51	.1 [illegible]
Load Sheet Sign	+20	+25	09.35	09.40	([illegible]).
Door Closed	+29	+29	09.53	09.53	
Block-OFF	+30	+30	09.54	09.54	PH/9 mnt
Push Back			09.54	09.55	
Taxi			09.58	10.01	

Note :

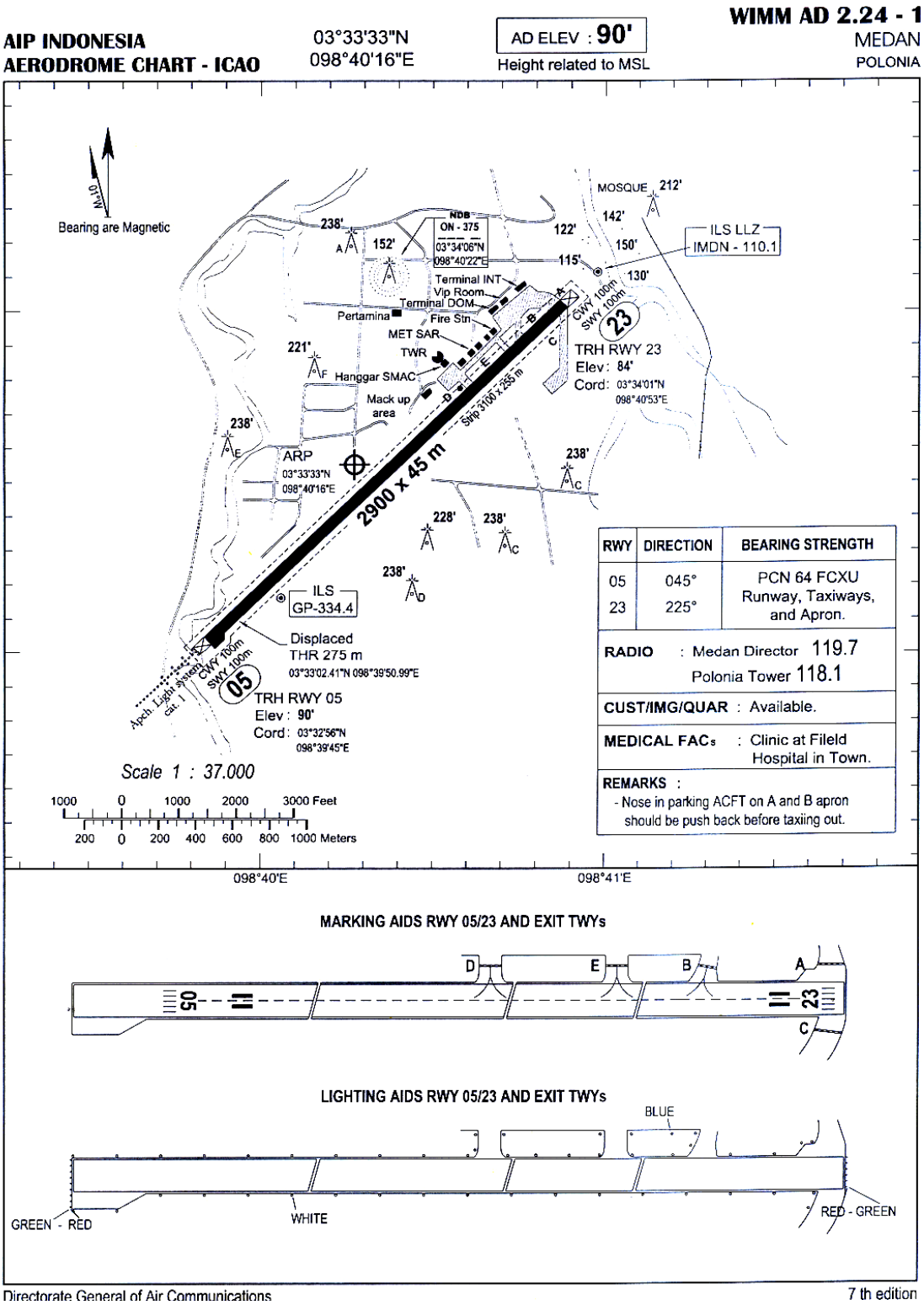
In Coming		Out Going		Fuel	
Pax		Pax	113	Block Fuel (Kgs/Lbs)	10.600
Baggage		Baggage	943	Remaining (Kgs/Lbs)	4000
Cargo		Cargo	2749	Uplift (Ltr)	6 600

8300 Ltr–

Station Manager — (ASHART) | FOO — (Rubiyanto.) | Ramp Officer, — (M. Syaiful A)

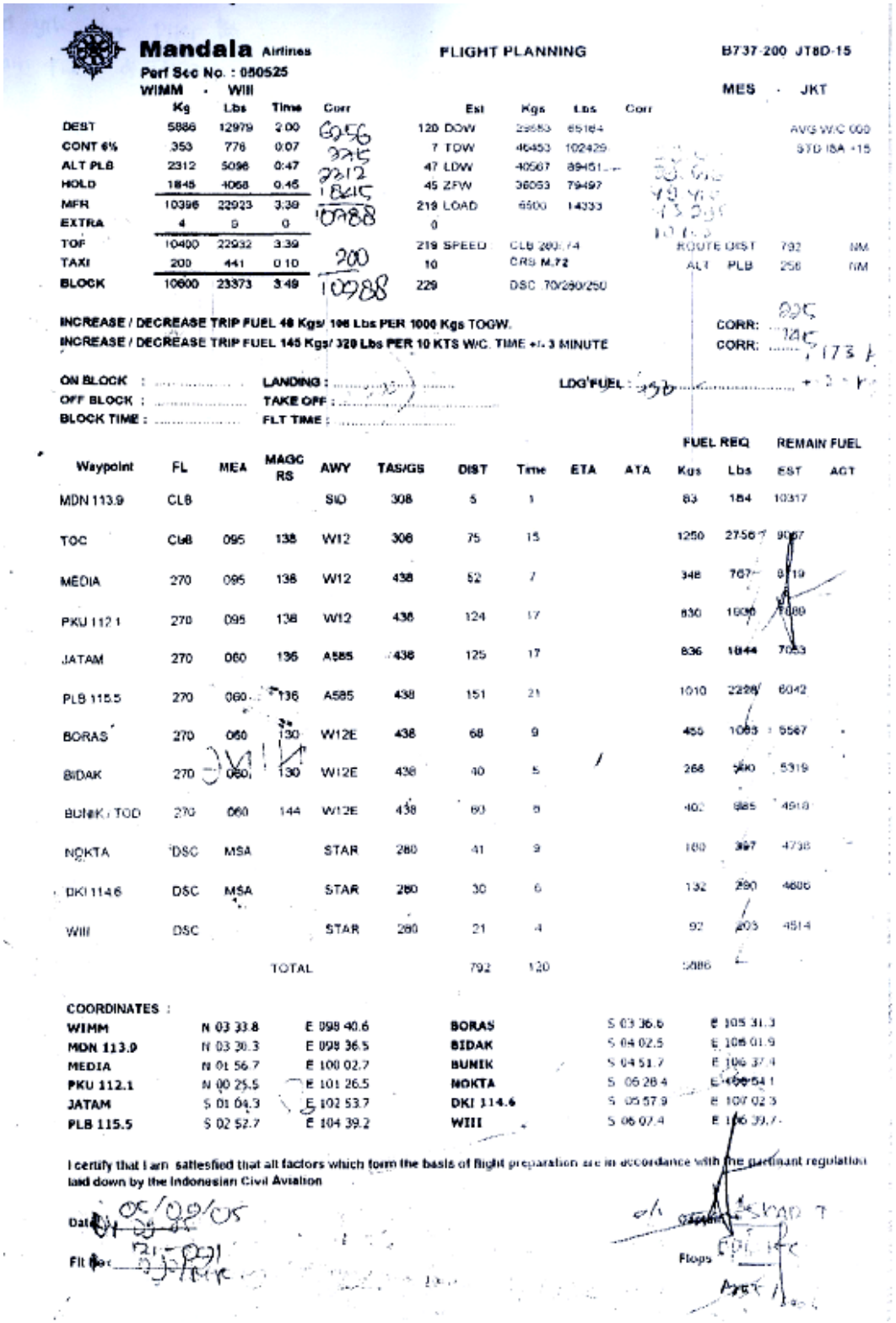
Note : 1. Original send to : "Team Fuel"
2. Copy : file

Appendix H Airport



Directorate General of Air Communications 7 th edition

Appendix I Flight Plan



Mandala Airlines

FLIGHT PLANNING

B737-200 JT8D-15

Perf Sec No. : 050525

WIMM - WIII

MES - JKT

	Kg	Lbs	Time	Corr
DEST	5886	12979	2:00	
CONT 6%	353	776	0:07	
ALT PLB	2312	5098	0:47	
HOLD	1848	4068	0:45	
MFR	10396	22923	3:39	
EXTRA	4	9	0	
TOF	10400	22932	3:39	
TAXI	200	441	0:10	
BLOCK	10600	23373	3:49	

	Est	Kgs	Lbs	Corr
120	DOW	29883	65864	
7	TOW	46453	102429	
47	LDW	40567	89451	
45	ZFW	36053	79497	
219	LOAD	6500	14333	
0				
219	SPEED	CLB 280/.74		
10		CRS M.72		
229		DSC 270/280/250		

AVG W/C 000

STD ISA +15

ROUTE DIST 792 NM

ALT PLB 258 NM

INCREASE / DECREASE TRIP FUEL 48 Kgs/ 106 Lbs PER 1000 Kgs TOGW.

INCREASE / DECREASE TRIP FUEL 145 Kgs/ 320 Lbs PER 10 KTS W/C. TIME +/- 3 MINUTE

CORR:

CORR:

ON BLOCK :

OFF BLOCK :

BLOCK TIME :

LANDING :

TAKE OFF :

FLT TIME :

LDG FUEL :

Waypoint	FL	MEA	MAGC RS	AWY	TAS/GS	DIST	Time	ETA	ATA	FUEL REQ Kgs	FUEL REQ Lbs	REMAIN FUEL EST	REMAIN FUEL ACT
MDN 113.9	CLB			SID	308	5	1			83	184	10317	
TOC	Clb	095	138	W12	306	75	15			1250	2756	9067	
MEDIA	270	095	138	W12	438	52	7			348	767	8719	
PKU 112.1	270	095	138	W12	438	124	17			830	1830	7889	
JATAM	270	060	136	A585	438	125	17			836	1844	7053	
PLB 115.5	270	060	136	A585	438	151	21			1010	2228	6042	
BORAS	270	060	130	W12E	438	68	9			455	1003	5587	
BIDAK	270	060	130	W12E	438	40	5			268	590	5319	
BUNIK / TOD	270	060	144	W12E	438	60	8			402	885	4918	
NOKTA	DSC	MSA		STAR	280	41	9			180	397	4738	
DKI 114.6	DSC	MSA		STAR	280	30	6			132	290	4606	
WIII	DSC			STAR	280	21	4			92	203	4514	
			TOTAL			792	120			5886			

COORDINATES :

WIMM	N 03 33.8	E 098 40.6	BORAS	S 03 36.6	E 105 31.3
MDN 113.9	N 03 30.3	E 099 36.5	BIDAK	S 04 02.5	E 106 01.9
MEDIA	N 01 56.7	E 100 02.7	BUNIK	S 04 51.7	E 106 37.4
PKU 112.1	N 00 25.5	E 101 26.5	NOKTA	S 05 28.4	E 106 54.1
JATAM	S 01 04.3	E 102 53.7	DKI 114.6	S 05 57.9	E 107 02.3
PLB 115.5	S 02 52.7	E 104 39.2	WIII	S 06 07.4	E 106 39.7

I certify that I am satisfied that all factors which form the basis of flight preparation are in accordance with the pertinent regulation laid down by the Indonesian Civil Aviation

Date :

Flt No :

Flops :

Appendix J CVR Transcript

TIME	STATION	TRANSCRIPTION
02:48[30]	PK-JTR	Polonia Tower, PK-JTR
	ATC	PK-JTR, Polonia Tower go ahead
	PK-JTR	Four FOB, Destination is Belawan, taxi clearance
	ATC	PK-JTR, Take off direction zero five, taxi to Delta APR
02:49	PK-JTR	Roger, zero five via Delta, PTR.
	ATC	PK-JTR, transponder four seven two one
	PK-JTR	Four seven two one, coming up
		PTR short delta
	ATC	Roger confirm PK-JTR altitude one zero feet.
		Correction one thousand feet?
	PK-JTR	Affirmative
	ATC	Roger, take off direction zero further climb to five, climb to five hundred feet, cleared for take off
02:50	ATC	PK-JTR, maintain one thousand feet, airborne time five two. Report Belawan area.
02:51	PK-JTR	Air borne five two, report Belawan area climb to one thousand PTR
	ATC	N four six six SP, Polonia
	N 466 SP	Polonia, SP go ahead
	ATC	N four six six SP, confirmed you start and ready for taxi now?
	N 466 SP	Ah, sorry not ready for taxi, not ready for taxi, we're waiting for phone call, I have to wait for phone call, we call you departure
	ATC	A.. Roger, report when ready
	N 466 SP	I'll call you when ready
02:52[30]	MDL 091	Polonia Tower, Mandala zero nine one
	ATC	Mandala zero nine one, Polonia Tower, go ahead
	MDL 091	Mandala zero nine one, RIM, stand number two, request push and start bound for Jakarta, level three one zero, POB one one seven
	ATC	Mandala zero nine one, start and pushback approved, expect runway two three
02:53	MDL 091	
	Int (3)	Ok, Selamat pagi
	Int (1)	Selamat siang Pak, kita clear pushback brake release Pak, silahkan Pak.
	Int (2)	Pushback and start, expect runway two three Mandala zero nine one
	Int (3)	Ok, brake release Capt
02:54	ATC	Mandala zero nine one confirmed RVSM approved?
	MDL 091,	
	Int (2)	Negative Sir
	ATC	A.. Roger, Level two nine zero Sir
	MDL 091,	
	Int (2)	Roger, two nine zero Mandala zero nine one

TIME	STATION	TRANSCRIPTION
02:54[15]	MDL 091	
	Int (3)	Pushback finish brake set
	Int (1)	Brake set removed tow bar and pin
	Int (3)	Tow bar pin removed
	Int (1)	Yes Number two start Sir
	Int (3)	Tow bar, right clear
	Int (3)	N one rotate sir
	Int (1)	"Check"
02:54[30]	N 466 SP	Polonia Tower November four six six SP
	ATC	N four six six SP Polonia Tower, go ahead
	N 466 SP	A. Roger I've got to shut down, call you back ready for taxi
	ATC	N four six six SP confirmed ready for taxi?
	N 466 SP	Sierra Papa, negative, I'm going to shut down. I will call you back when I'm ready to go
	ATC	A..Roger
	Adam 881	Polonia morning Adam eight eight one localizer zero five
	ATC	Adam eight eight one, Polonia Tower surface wind calm QNH zero zero eight, clear to land. Runway zero five
	MDL 091	
	Int (3)	Light up Sir
	Int (1)	"Check"
	Adam 881	Clear to land zero five, wind is calm. One zero zero eight Adam eight eight one, PK-KKC
	ATC	A.. Roger
02:55	SLK 233	Polonia Tower, Silk Air two three three ready for pushback and start up
	ATC	Silk Air two three three standby
	SLK 233	Standby Silk Air two three three
	MDL 091	
	Int (1)	Start number one
	Int (3)	One area clear Capt
	Int (3)	"N one" rotate
	Int (1)	"Check"
	ATC	Silk Air two three three start approved standby for pushback
	SLK 233	Start approved, we are start Silk Air
	PK-JTR	Polonia, PK-JTR reaching Belawan, established contact with company
	ATC	PK-JTR contact your company
	MDL 091	Light up one
	Int (3)	
	Int (1)	"Check"
	PK-JTR	Roger see you departure, thank you
	ATC	See you departure
02:56	MDL 091	
	Int (1)	Ok normal start disconnect signal left, terima kasih Pak

TIME	STATION	TRANSCRIPTION
	Int (2)	Mandala zero nine one request taxi
	Int (1)	Ok selamat siang Pak
	ATC	Mandala zero nine one taxi runway two three via alpha, hold on short sequence number three after two traffic incoming, ATC clearance available
	MDL 091	Two three via alpha number three in sequence clearance go ahead
	ATC	Mandala zero nine one clear to Jakarta via Wiskey one two, flight level two niner zero, squawk four seven two two
	MDL 091	Clear to Jakarta, Wiskey one two, level two niner zero, squawk four seven two two Mandala zero nine one
	ATC	Roger
02:57 [30]	ATC	Silk Air two three three, after traffic passing behind you Mandala zero nine one, push back approved expect runway two three.
	SLK 233	After Mandala, cleared to push back expect runway two three, Silk Air.
	GIA 198	Polonia morning Indonesia one nine eight
02:58	ATC	Good morning Indonesia one nine eight Polonia tower go ahead.
	GIA 198	Indonesia one nine eight parking stand number six, POB one two eight. Information x-ray request push back and start to Banda Aceh flight level two four zero.
	ATC	Indonesia one nine eight start first stand by for push back.
	GIA 198	Cleared for start stand by push back, Indonesia one nine eight.
	ATC	Adam eight eight one landed on the hour, proceed to apron via taxi bravo parking stand number four.
02:58 [30]	ADAM 881	Via bravo, parking stand number four Adam eight eight one PK-KKC.
	ATC	Roger. Thank you.
	PK-TVL	Polonia Tower, PK-TVL
	ATC	PK-TVL, Polonia Tower go ahead.
	PK-TVL	On delta apron. Request start bound for Lhoksukon level one four five, we have POB one eight.
	ATC	Roger, PK-TVL start approved expect runway two three report ready for taxi
	PK-TVL	Cleared start for runway two three, call when ready for taxi PK-TVL.
02:59 [20]	MDL 091	Mandala zero nine one on short Alpha.
	ATC	Mandala zero nine one hold on short, sequence number two after one traffic incoming.
	MDL 091	Roger, number two, one traffic coming Mandala zero nine one
	ATC	Polonia Tower.
	ATC	Indonesia one nine eight push back approved expect for runway two three.
	GIA 198	Cleared for push back runway two three Indonesia one nine eight.

TIME	STATION	TRANSCRIPTION
	MNA 5425	Polonia Tower, Merpati five four two five on final.
	ATC	Merpati five four two five, Polonia Tower, surface wind calm, QNH one zero zero eight cleared to land runway zero five.
	MNA 5425	Cleared to land runway zero five, Merpati five four two five.
	ATC	Polonia Tower.
03:00 [20]	LNI 288	Polonia Tower, Lion Air two eight eight Selamat siang
	ATC	Selamat siang, Lion Air two eight eight Polonia Tower go ahead.
	LNI 288	Lion two eight eight stand number niner, LMW, POB one five six request push and start in sequence, destination to Penang, stand by level one niner zero.
03:01	ATC	Roger. Standby.
	LNI 288	Standby Lion two eight eight.
	ATC	Lion two eight eight, Start approved, standby for push back sequence number seven after two traffic incoming and four traffic departure.
	LNI 288	Start approved standby push back, sequence number seven, copied, Lion two eight eight.
	ATC	Polonia Tower.
	ATC	Merpati five four two five, landed time zero three, to apron via Delta and Echo
	MNA 5425	Delta and Echo, number one, Merpati five four two five
	ATC	Polonia Tower
03:02	ATC	Mandala zero nine one, continue line up runway two three.
	MDL 091	Continue line up runway two three, Mandala zero nine one.
	ATC	Polonia Tower.
03:02 [10]	ATC	Mandala zero nine one, additional clearance, departure turn left heading one two zero maintain one thousand five hundred feet.
	MDL 091	Heading one two zero maintain one thousand feet, Mandala zero nine one.
	ATC	One thousand five hundred feet, sir.
03:02 [50]	MDL 091	Roger, one thousand and five hundred, Mandala zero nine one.
03:03	ATC	Mandala zero nine one, cleared for take off.
	MDL 091	Cleared for take off, Mandala zero nine one.
	SLK 233	Silk Air two three three, request taxi.
	ATC	Silk Air two three three, taxi runway two three via alpha, ATC clearance available
	SLK 233	Taxi for runway two three via alpha, ATC clearance go ahead, sir.
	ATC	Silk Air two three three, cleared to Singapore via N563 flight level three seven zero squawk six seven one two.
	SLK 233	Cleared to flight plan route, flight level three seven zero squawk six seven one two, Silk Air two three three.

TIME	STATION	TRANSCRIPTION
	GIA 198	Indonesia one nine eight request taxi.
	ATC	Indonesia one nine eight, taxi for runway two three via alpha.
	GIA 198	Runway two three via alpha, Indonesia one nine eight.
	ATC	Polonia Tower.
03:04	ATC	Silk Air two three three, continue line up runway two three and wait, say your POB, Sir.
	SLK 233	Line up and wait runway two three, Silk Air two three three.
	ATC	Silk Air two three three, say again, Sir.
	SLK 233	Confirm, we're line up and wait runway two three … (Not clear).
	SLK 233	Yes, Silk Air two three three, confirm we cleared to line up and wait
	ATC	Silk Air two three three, standby, Sir.
	SLK 233	Standby.
		… (not clear) …
		… papa victor lima …
		… (not clear) …

Int 1: Captain's voice
Int 2: First Officer's voice
Int 3: Ground engineer's voice

Appendix K FDR Plot

NATIONAL TRANSPORTATION SAFETY BOARD

OFFICE OF RESEARCH AND ENGINEERING

Vehicle Recorder Division

Washington, D.C.

September 27, 2005

FLIGHT DATA RECORDER

Dennis R. Grossi

ACCIDENT

Operator: Mandalla Airlines

Location: Medan, Indonesia

Date: September 5, 2005

Aircraft: Boeing 737-200, PK-RIM

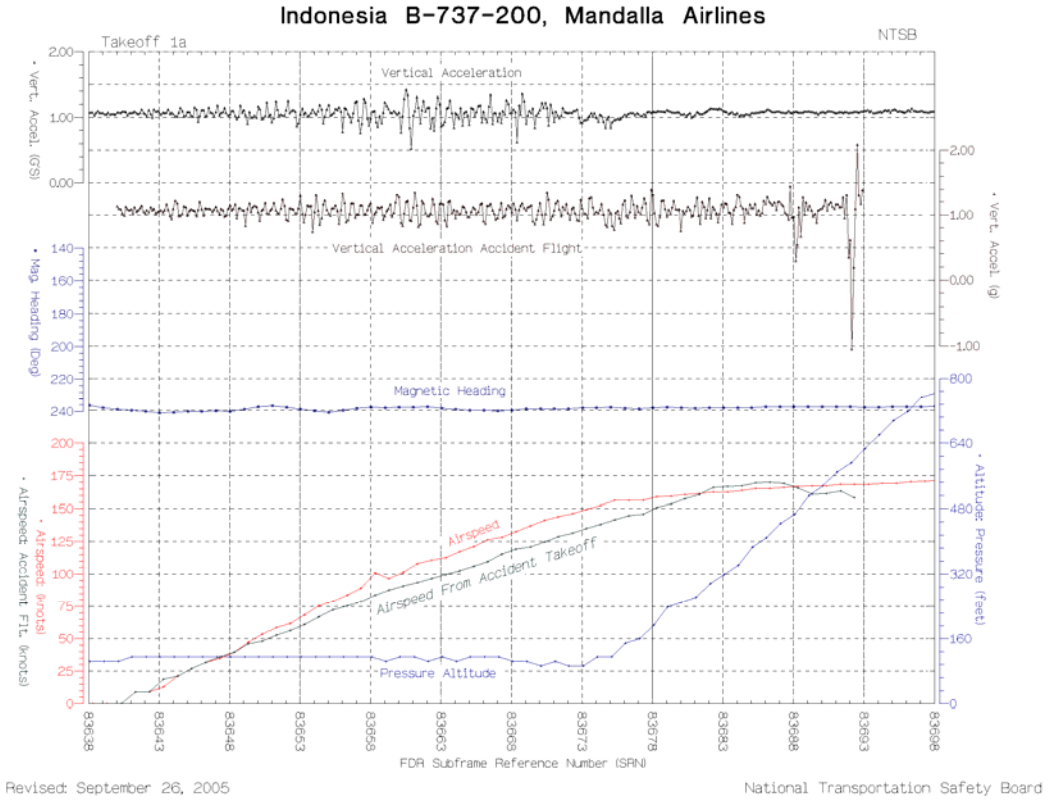
The flight data recorder (FDR) removed from Mandalla Airlines, Boeing 737-200 following the September 5, 2005 accident at Medan, Indonesia contained data from 13 prior takeoffs. All 13 takeoffs have been plotted in the order recorded starting with 1a, through 12. The airspeed and vertical acceleration values recorded during the takeoff roll of the accident flight were overlaid on each plot for comparison (see attached plots).

The following table lists the takeoffs in order recorded, along with runway elevation and heading to help identify the departure airport. The runway pressure altitude values have not been corrected for barometric pressure and therefore may not reflect actual runway elevation. The runway heading values generally reflect the heading values recorded during the takeoff roll when the heading appeared steady, and therefore may not precise match the actual runway heading.

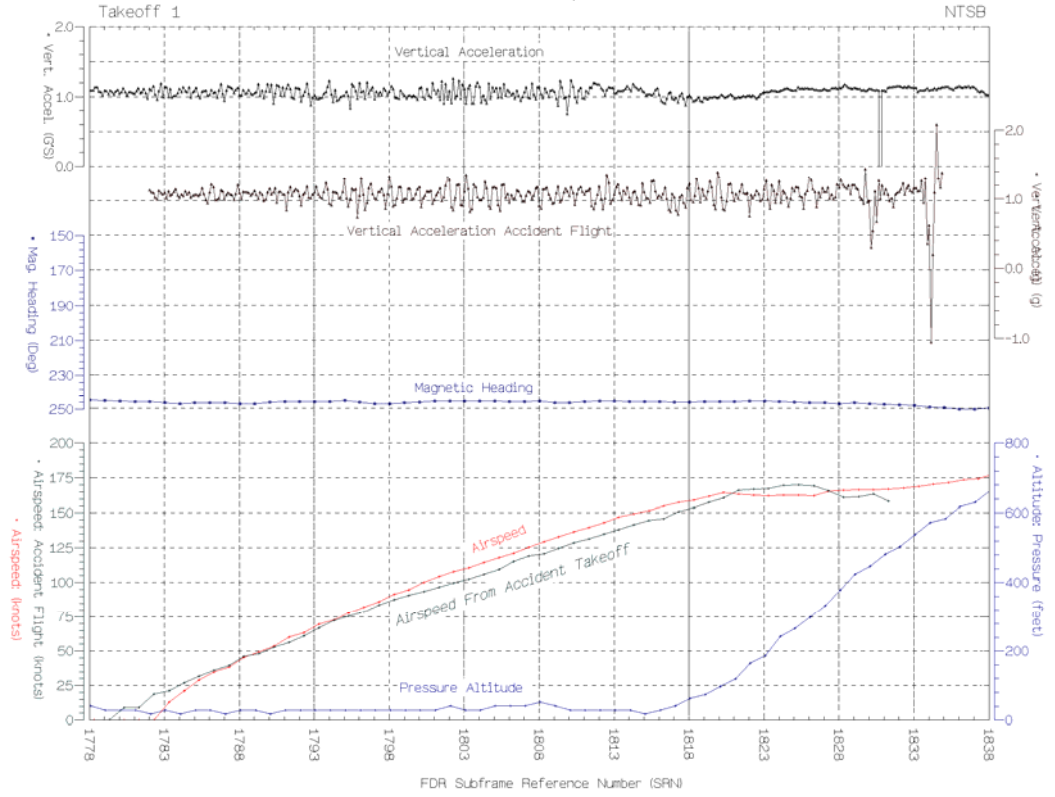
Plot Number	Runway Pressure Alt.	Runway Heading	Remarks
1a	115 ft	238°	Recorded on track 5[1]; same track on which accident was recorded.
1	23 ft	245°	Altitude data indicates liftoff occurred at approximately 149 to 150 knots
2	Sea Level	247°	Airspeed trace closely matches accident flight, rotation occurs at approximately 148 to 149 knots
3	149 ft	230°	Airspeed trace closely matches accident flight, rotation occurs at approximately 148 to 149 knots
4	118 ft	249°	Rolling takeoff, comparison not applicable. Note heading change as airspeed increases for takeoff.
5	295 ft	181°	Altitude dip associated with rotation occurs at approx. 135 knot

[1] This model FDR records digital data sequentially on 8-separate tracks of a ¼inch magnetic tape. The accident flight was recorded on track 5, which also contained the transition to the oldest portion of the 25 hrs recording.

6	17 ft	247°	Altitude dip associated with rotation occurs at approx. 137 knots.
7	114 ft	129°	Altitude dip associated with rotation occurs at approx. 136 knots.
8	70 ft	68°	Significant dropouts occurred during transcription.
9	150 ft	335°	Altitude dip associated with rotation occurs at approx. 150 knots.
10	115 ft	68°	Altitude dip associated with rotation occurs at approx. 138 knots.
11	58 ft	98°	Significant data dropout occurred during transcription. Altitude dip associated with rotation occurs at approx. 148 knots. Closely matches accident airspeed.
12	26 ft	247°	Significant data dropout occurred during transcription. Altitude dip associated with rotation occurs at approx. 146 knots. Closely matches accident airspeed.



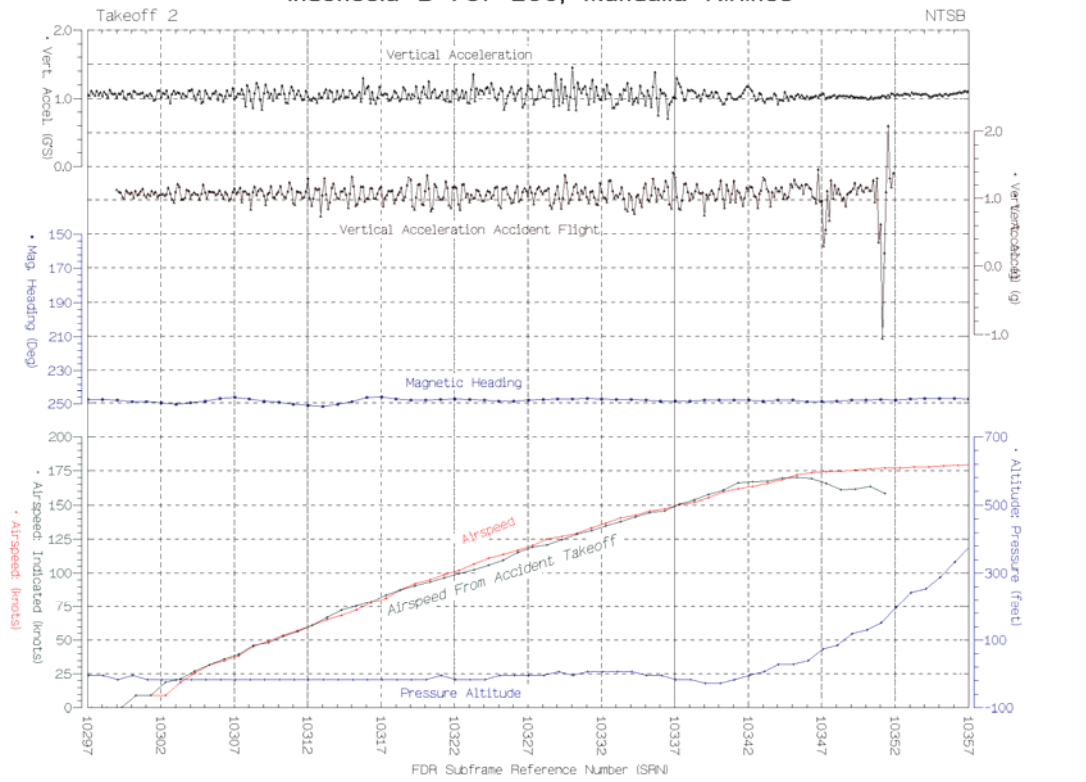
Indonesia B-737-200, Mandalla Airlines



Revised: September 26, 2005

National Transportation Safety Board

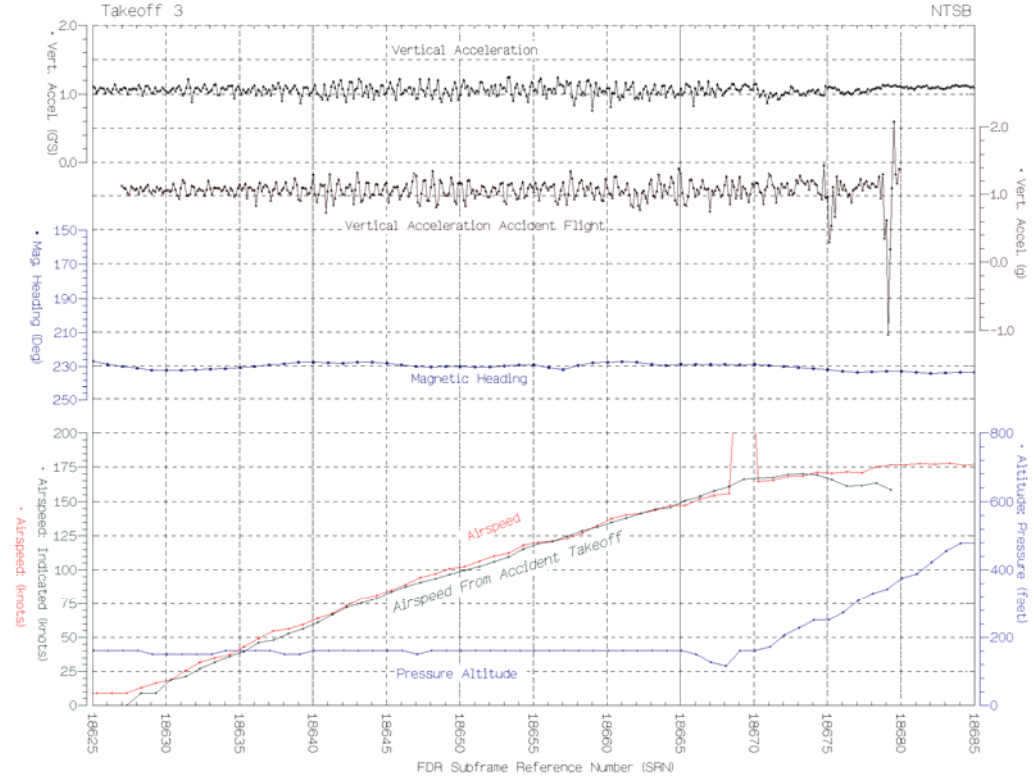
Indonesia B-737-200, Mandalla Airlines



Revised: September 26, 2005

National Transportation Safety Board

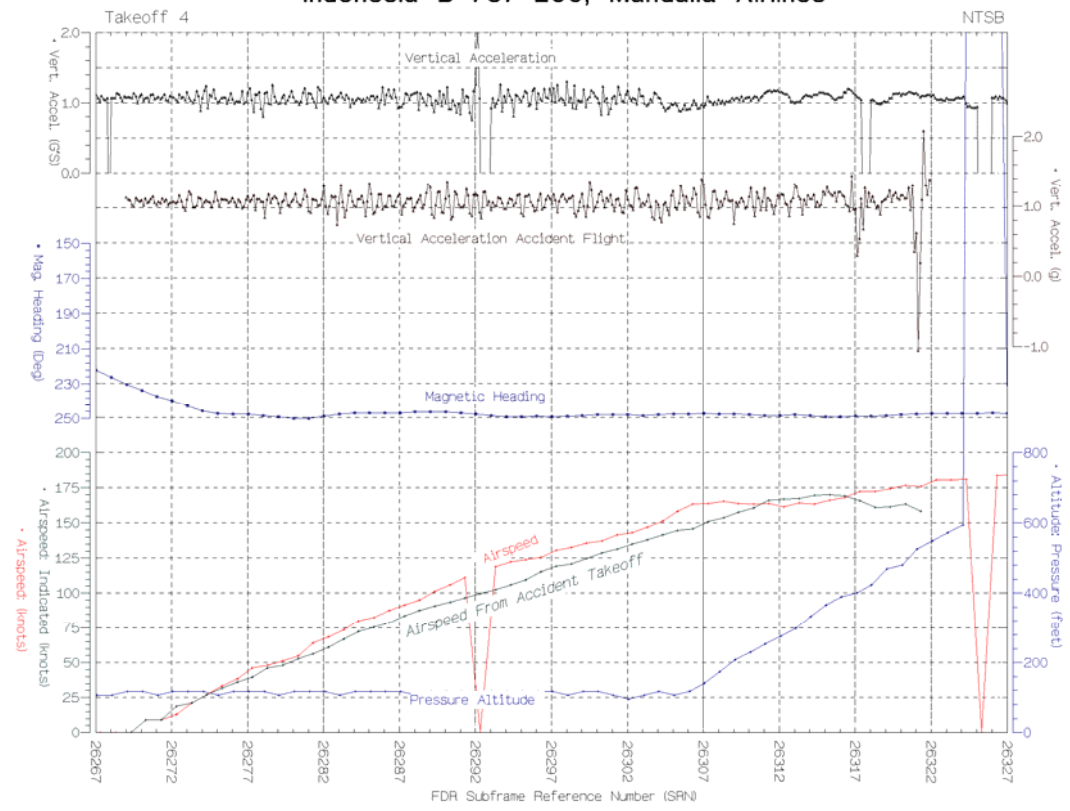
Indonesia B-737-200, Mandalla Airlines



Revised: September 26, 2005

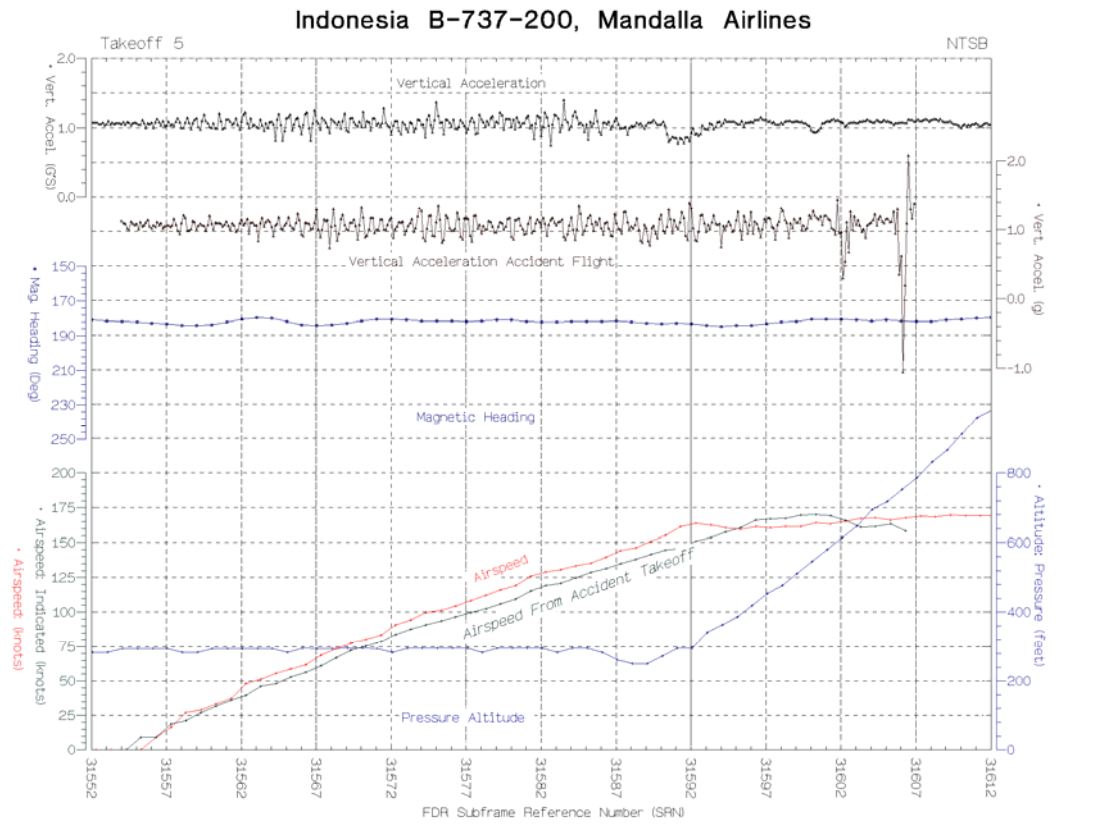
National Transportation Safety Board

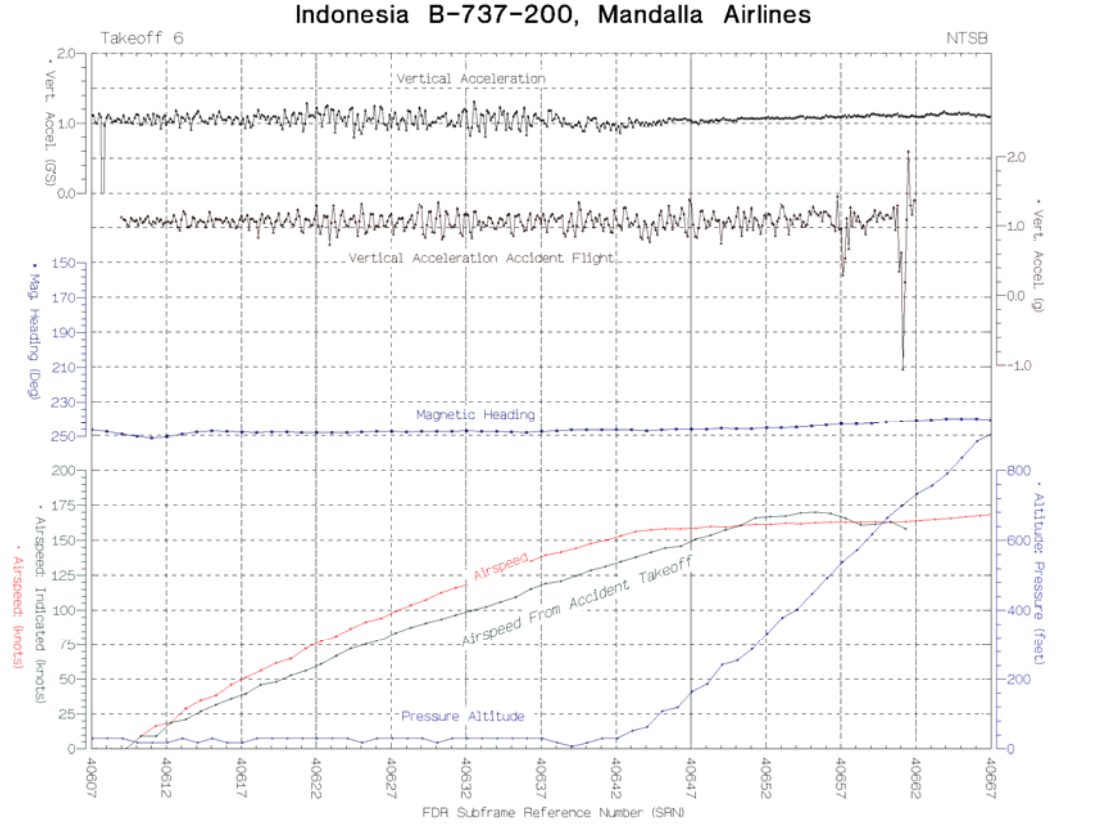
Indonesia B-737-200, Mandalla Airlines

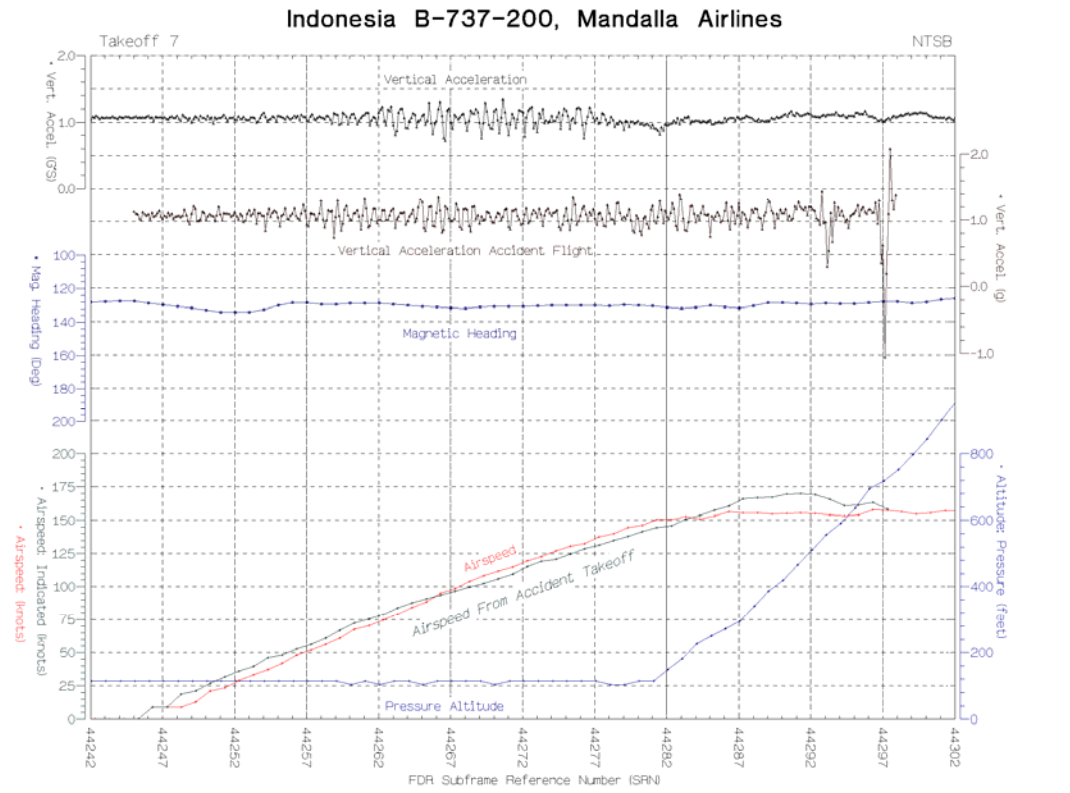


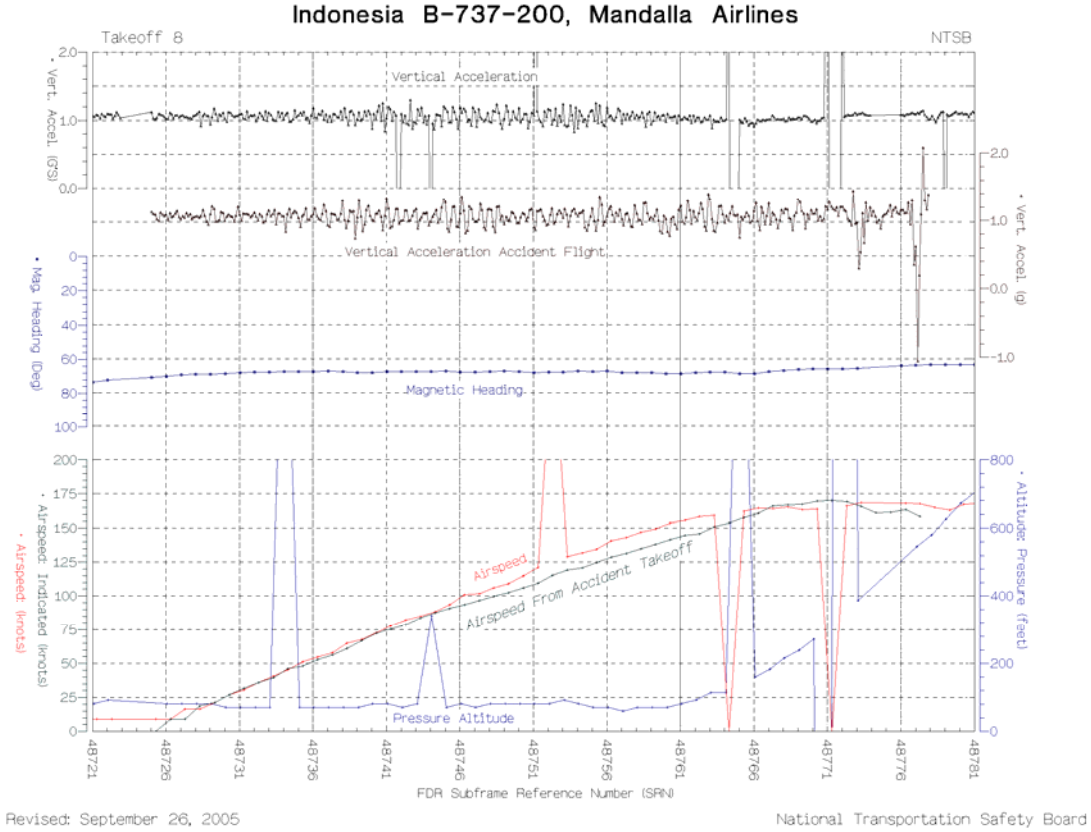
Revised: September 26, 2005

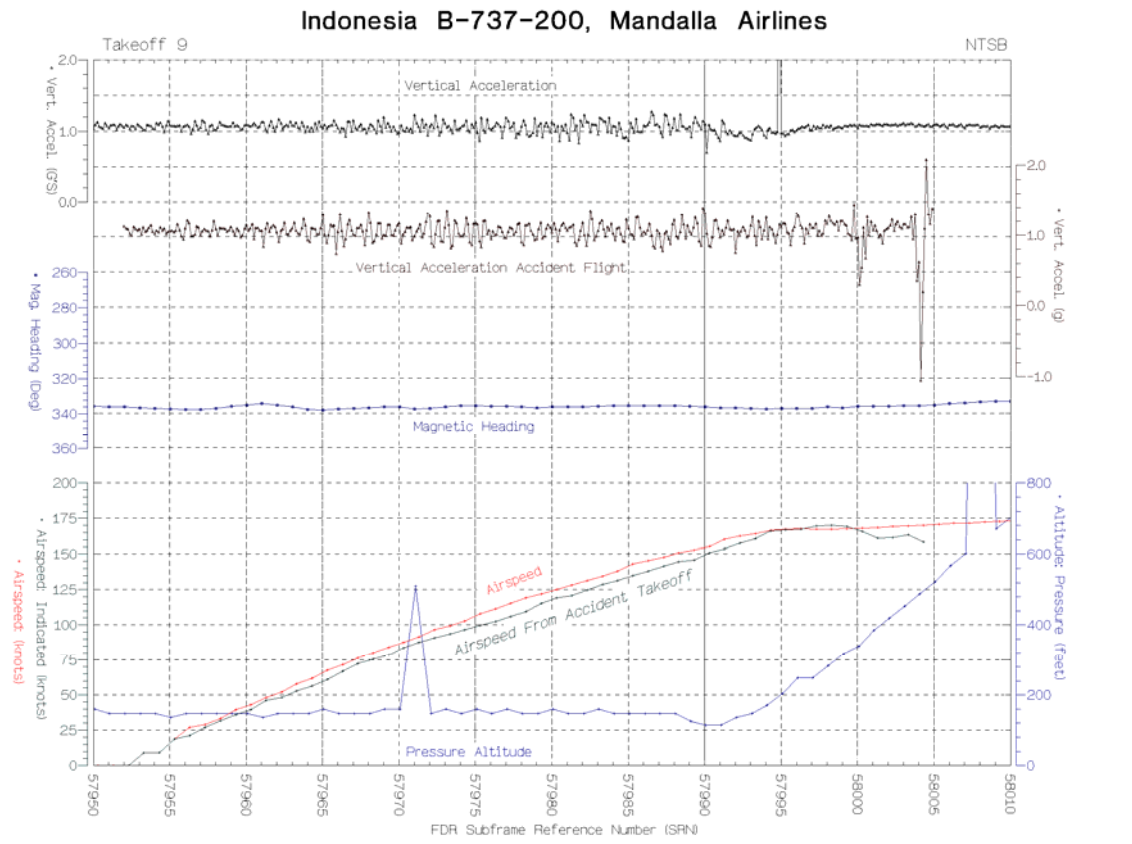
National Transportation Safety Board

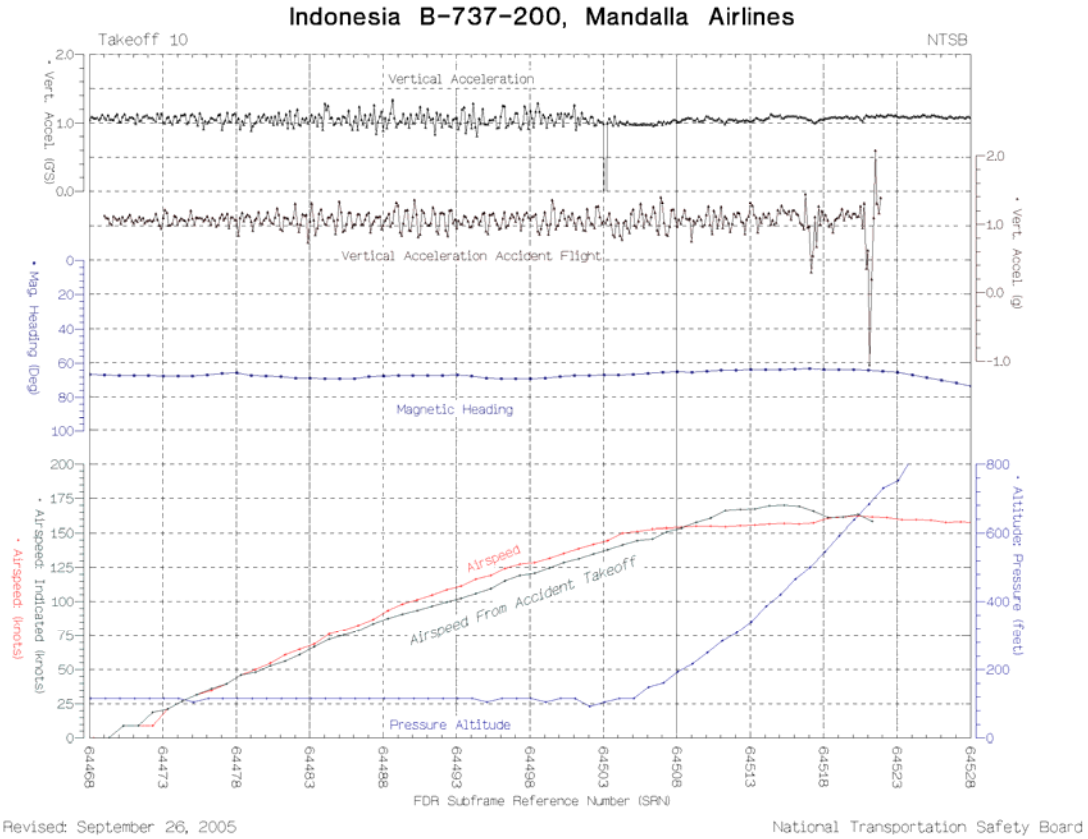

Indonesia B-737-200, Mandalla Airlines
Takeoff 5
NTSB
Vertical Acceleration
Vertical Acceleration Accident Flight
Magnetic Heading
Airspeed
Airspeed From Accident Takeoff
Pressure Altitude
• Vert. Accel (G's)
• Vert. Accel (g)
• Mag. Heading (Deg)
• Airspeed: Indicated (knots)
• Altitude: Pressure (feet)
FDR Subframe Reference Number (SRN)
Revised: September 26, 2005
National Transportation Safety Board

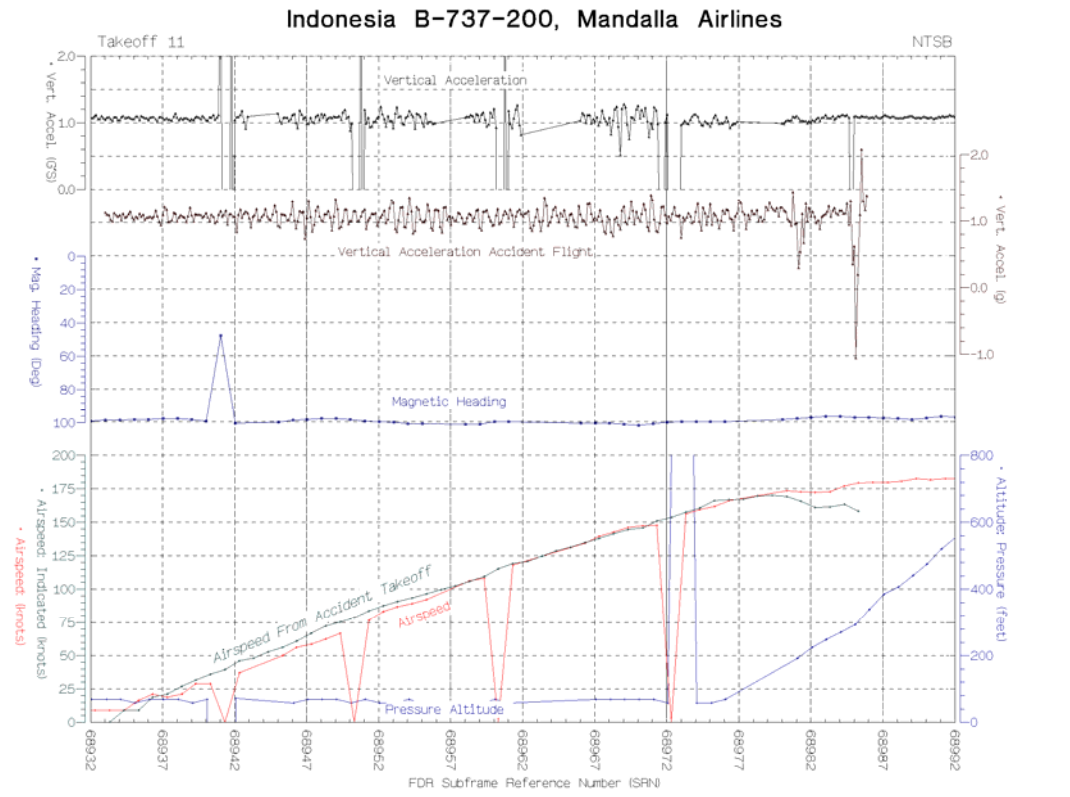

Indonesia B-737-200, Mandalla Airlines
Takeoff 6
NTSB
Vertical Acceleration
Vertical Acceleration Accident Flight
Magnetic Heading
Airspeed
Airspeed From Accident Takeoff
Pressure Altitude
• Vert. Accel (G's)
• Vert. Accel (g)
• Mag. Heading (Deg)
• Airspeed: Indicated (knots)
• Altitude: Pressure (feet)
FDR Subframe Reference Number (SRN)
Revised: September 26, 2005
National Transportation Safety Board

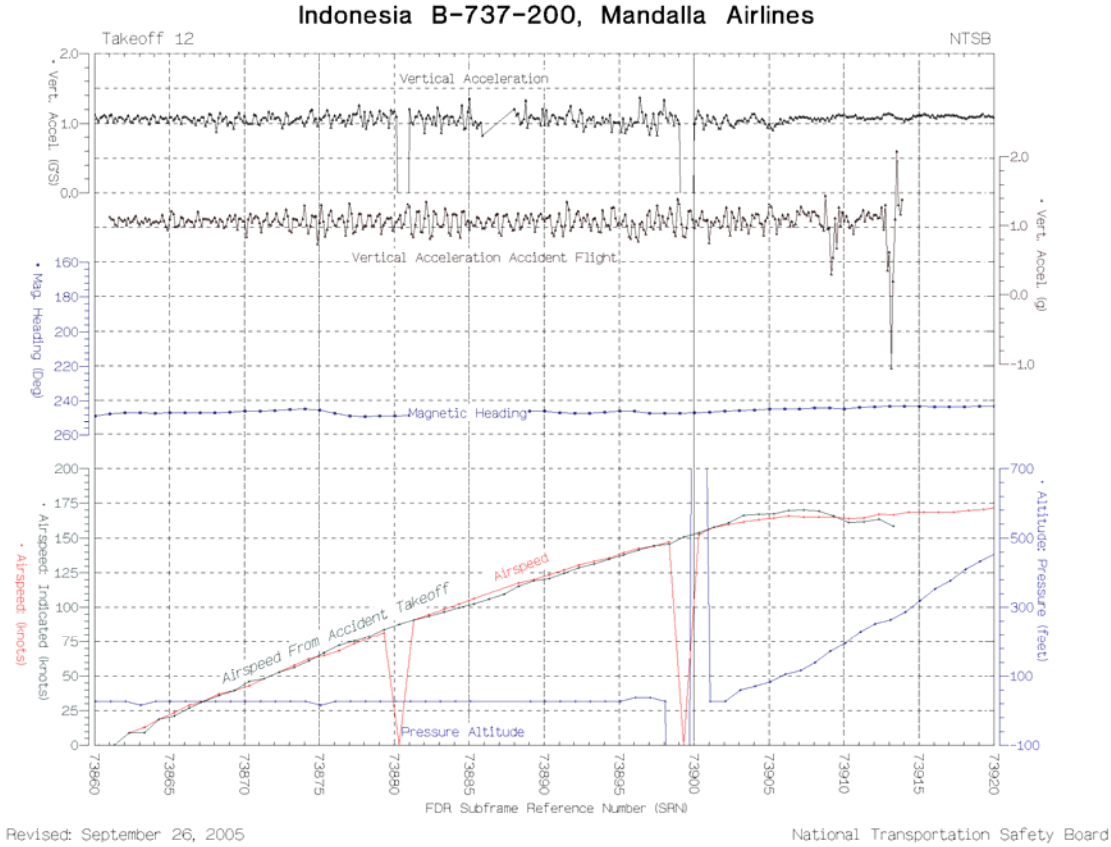

Indonesia B-737-200, Mandalla Airlines
Takeoff 7
NTSB
Vertical Acceleration
Vert. Accel (G's)
Vertical Acceleration Accident Flight
Vert. Accel (g)
Magnetic Heading
Mag. Heading (Deg)
Airspeed
Airspeed From Accident Takeoff
Airspeed Indicated (knots)
Airspeed (knots)
Pressure Altitude
Altitude Pressure (feet)
FDR Subframe Reference Number (SRN)
Revised: September 26, 2005
National Transportation Safety Board

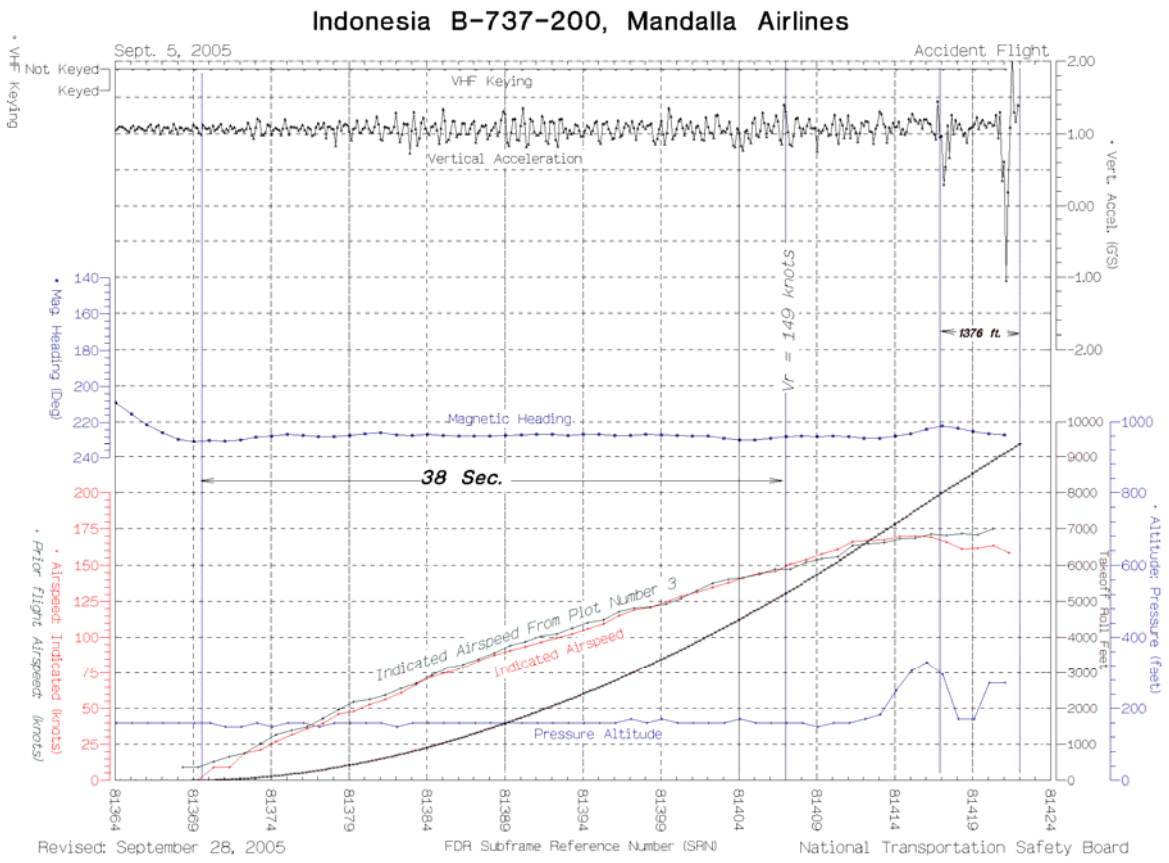

Indonesia B-737-200, Mandalla Airlines
Takeoff 8
NTSB
Vertical Acceleration
Vert. Accel (G's)
Vertical Acceleration Accident Flight
Vert. Accel (g)
Magnetic Heading
Mag. Heading (Deg)
Airspeed
Airspeed From Accident Takeoff
Airspeed Indicated (knots)
Airspeed (knots)
Pressure Altitude
Altitude Pressure (feet)
FDR Subframe Reference Number (SRN)
Revised: September 26, 2005
National Transportation Safety Board


Indonesia B-737-200, Mandalla Airlines
Takeoff 9
NTSB
Vertical Acceleration
Vertical Acceleration Accident Flight
Magnetic Heading
Airspeed
Airspeed From Accident Takeoff
Pressure Altitude
• Vert. Accel. (GS)
• Vert. Accel. (g)
• Mag. Heading (Deg)
• Airspeed: Indicated (knots)
• Altitude: Pressure (feet)
FDR Subframe Reference Number (SRN)
Revised: September 26, 2005
National Transportation Safety Board


Indonesia B-737-200, Mandalla Airlines
Takeoff 10
NTSB
Vertical Acceleration
Vertical Acceleration Accident Flight
Magnetic Heading
Airspeed
Airspeed From Accident Takeoff
Pressure Altitude
• Vert. Accel. (GS)
• Vert. Accel. (g)
• Mag. Heading (Deg)
• Airspeed: Indicated (knots)
• Altitude: Pressure (feet)
FDR Subframe Reference Number (SRN)
Revised: September 26, 2005
National Transportation Safety Board


Indonesia B-737-200, Mandalla Airlines
Takeoff 11
NTSB
Vertical Acceleration
Vert. Accel (G's)
Vertical Acceleration Accident Flight
Vert. Accel (g)
Mag. Heading (Deg)
Magnetic Heading
Airspeed From Accident Takeoff
Airspeed
Pressure Altitude
Airspeed Indicated (knots)
Altitude Pressure (feet)
FDR Subframe Reference Number (SRN)
Revised: September 26, 2005
National Transportation Safety Board


Indonesia B-737-200, Mandalla Airlines
Takeoff 12
NTSB
Vertical Acceleration
Vert. Accel (G's)
Vertical Acceleration Accident Flight
Vert. Accel (g)
Mag. Heading (Deg)
Magnetic Heading
Airspeed From Accident Takeoff
Airspeed
Pressure Altitude
Airspeed Indicated (knots)
Altitude Pressure (feet)
FDR Subframe Reference Number (SRN)
Revised: September 26, 2005
National Transportation Safety Board


Indonesia B-737-200, Mandalla Airlines
Sept. 5, 2005
Accident Flight
VHF Keying
Not Keyed
Keyed
Vertical Acceleration
Vert. Accel. (G's)
Mag. Heading (Deg)
Magnetic Heading
149 Knots = V1
1376 ft.
38 Sec.
Airspeed Indicated (knots)
Prior flight Airspeed (knots)
Indicated Airspeed From Plot Number 3
Indicated Airspeed
Pressure Altitude
Takeoff Roll Feet
Altitude: Pressure (feet)
81364
81369
81374
81379
81384
81389
81394
81399
81404
81409
81414
81419
81424
Revised: September 28, 2005
FDR Subframe Reference Number (SRN)
National Transportation Safety Board