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NATIONAL TRANSPORTATION SAFETY COMMITTEE

Runway Excursion Investigation Report

PT. Sriwijaya Air
Boeing 737-200; PK–CJD
Sultan Mahmud Badarudin II Airport, Palembang, Sumatera Selatan, Republic of Indonesia
24 December 2011

NATIONAL TRANSPORTATION SAFETY COMMITTEE
MINISTRY OF TRANSPORTATION
REPUBLIC OF INDONESIA
2014

This Final Report was produced by the National Transportation Safety Committee (NTSC), Transportation Building 3rd Floor, Jalan Medan Merdeka Timur No. 5, Jakarta 10110, INDONESIA.

The report is based upon the initial investigation carried out by the NTSC in accordance with Annex 13 to the Convention on International Civil Aviation, the Indonesian Aviation Act (UU No. 1/2009) and Government Regulation (PP No. 62/2013).

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TABLE OF CONTENTS

TABLE OF FIGURES

GLOSSARY OF ABBREVIATIONS

AD	Airworthiness Directive
AFM	Airplane Flight Manual
AGL	Above Ground Level
ALAR	Approach-and-landing Accident Reduction
AMSL	Above Mean Sea Level
AOC	Air Operator Certificate
ATC	Air Traffic Control
ATPL	Air Transport Pilot License
ATS	Air Traffic Service
Avsec	Aviation Security
BOM	Basic Operation Manual
°C	Degrees Celsius
CAMP	Continuous Airworthiness Maintenance Program
CASO	Civil Aviation Safety Officer
CASR	Civil Aviation Safety Regulation
CPL	Commercial Pilot License
COM	Company Operation Manual
CRM	Cockpit Recourses Management
CSN	Cycles Since New
CVR	Cockpit Voice Recorder
DFDAU	Digital Flight Data Acquisition Unit
DGCA	Directorate General of Civil Aviation
DME	Distance Measuring Equipment
EEPROM	Electrically Erasable Programmable Read Only Memory
EFIS	Electronic Flight Instrument System
EGT	Exhaust Gas Temperature
EIS	Engine Indicating System
FL	Flight Level
F/O	First officer or Copilot
FDR	Flight Data Recorder
FOQA	Flight Operation Quality Assurance
GPWS	Ground Proximity Warning System
hPa	Hectopascals
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
IIC	Investigator in Charge

ILS	Instrument Landing System
ITB	Institut Teknologi Bandung
Kg	Kilogram(s)
Km	Kilometer(s)
Kt	Knots (NM/hour)
Mm	Millimeter(s)
MTOW	Maximum Take-off Weight
NM	Nautical mile(s)
KNKT / NTSC	*Komite Nasional Keselamatan Transportasi* / National Transportation Safety Committee
PIC	Pilot in Command
QFE	Height above aerodrome elevation (or runway threshold elevation) based on local station pressure
QNH	Altitude above mean sea level based on local station pressure
RESA	Runway End Safety Area
RPM	Revolution Per Minute
SCT	Scattered
S/N	Serial Number
SSCVR	Solid State Cockpit Voice Recorder
SSFDR	Solid State Flight Data Recorder
TS/RA	Thunderstorm and rain
TAF	Terminal Aerodrome Forecast
TSN	Time Since New
TT/TD	Ambient Temperature/Dew Point
TTIS	Total Time in Service
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

INTRODUCTION

SYNOPSIS

On 24 December 2011, a Boeing 737-200 aircraft, registered PK-CJD, was being operated by PT. Sriwijaya Air on a schedule passenger flight SJ 041 from Sultan Syarif Kasim II Airport (WIBB) Pekanbaru to Soekarno Hatta international Airport (WIII), Jakarta.

There were 134 persons on board consisted; two pilots, four cabin crews and 128 passengers 114 adult, 4 child and 7 infant.

On 2000 feet after take-off from Pekanbaru, pilot observed that the hydraulic quantity System A was decreasing. The flap indicator pointed between UP and 1 degree and it was observed also that the Trailing Edge Flap Light indicator on AFT Overhead Panel shows green that mean the entire trailing edge flap was still not up position. On 5000 feet, pilot observed that the hydraulic System A totally loss. On FL250, pilot observed that the hydraulic quantity of System B also decreasing followed by autopilot disengage and pilot decided to divert to Sultan Machmud Badarudin II (WIPP) of Palembang.

Initial contact was performed by pilot to APP Palembang on 12:28 UTC. The pilot informed that the aircraft had the hydraulic problem and PIC decided divert to Palembang airport. The Palembang ATC instructed the pilot to descent from FL250 to 2500 feet for VOR/ DME approach. The aircraft holding 4 times to reduce weight to achieved Maximum Landing Weight.

After uneventfully landing, the aircraft was overrun at the stop way of runway 11 at coordinate 02° 54’ 09.5” S 104° 42’ 36.4” E.

The evacuation performed as procedures, crew and passenger were no injured.

The passenger picked up by airport bus to arrival hall.

Engineer checked the aircraft and found the Hydraulic Hose of RH MLG up-lock actuator at the “Lock Port” position was leak.

The factors contributed to this serious incident were as follows:

1. Defective hydraulic hose of RH MLG Actuator at “Lock Port” position was made the hydraulic fluid drawn overboard.
2. The defective hydraulic hose is likely consistent with fatigue mode initiated by fretting damage on the wire mesh as a result of vibration.
3. It likely that loss of hydraulic system A followed by los of system B was due to the defective of EHSV P/N 73016 that led the Main Rudder PCU had excessive internal leak.

Prior to issuing this final report, the NTSC has been informed several safety actions taken by PT. Sriwijaya.

Included in this final report, the NTSC has issued several safety recommendations to the PT. Sriwijaya Directorate General of Civil Aviation to address the safety issues identified in this final report.

1 FACTUAL INFORMATION

1.1 History of the flight

On 24 December 2011, a Boeing 737-200 aircraft, registered PK-CJD, was being operated by PT. Sriwijaya Air on a schedule passenger flight SJ 041 from Sultan Syarif Kasim II Airport (WIBB) Pekanbaru to Soekarno Hatta Airport (WIII), Jakarta.

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On 5000 feet, pilot observed that the hydraulic System A totally loss.

On FL250, pilot observed that the hydraulic quantity of System B also decreasing followed by autopilot disengage and pilot decided to divert to Sultan Machmud Badarudin II (WIPP) of Palembang.

At 12:28 UTC pilot informed to APP Palembang that the aircraft had the hydraulic problem and PIC decided divert to Palembang airport. The Palembang ATC instructed the pilot to descent from FL250 to 2500 feet for VOR/ DME approach. The aircraft holding 4 times to reduce weight to achieved Maximum Landing Weight.

At 12.50 UTC the aircraft landing, the beginning of aircraft touch down the crew felt that there was a deceleration as result of the brake application; afterward at approximately 60kts they did not feel any deceleration even though the reverser application was increased.

Asymmetry reverser was applied by the pilot to keep align with the runway centre line.

The aircraft main wheels stopped in approximately 20 meters way of end runway 11

The evacuation performed as procedures and the crew and passenger no injured.

The passenger picked up by airport bus to arrival hall.

1.2 Injuries to Persons

Injuries	Flight crew	Passengers	Total in Aircraft
Fatal	-	-	-
Serious	-	-	-
Minor/None	6	131	137
TOTAL	6	131	137

1.3 Damage to Aircraft

There was no substantial damage to the aircraft except the Hydraulic Hose of RH MLG up-lock actuator at the "Lock Port" position was leak.

Figure 1: Hydraulic Hose shows burst at middle position

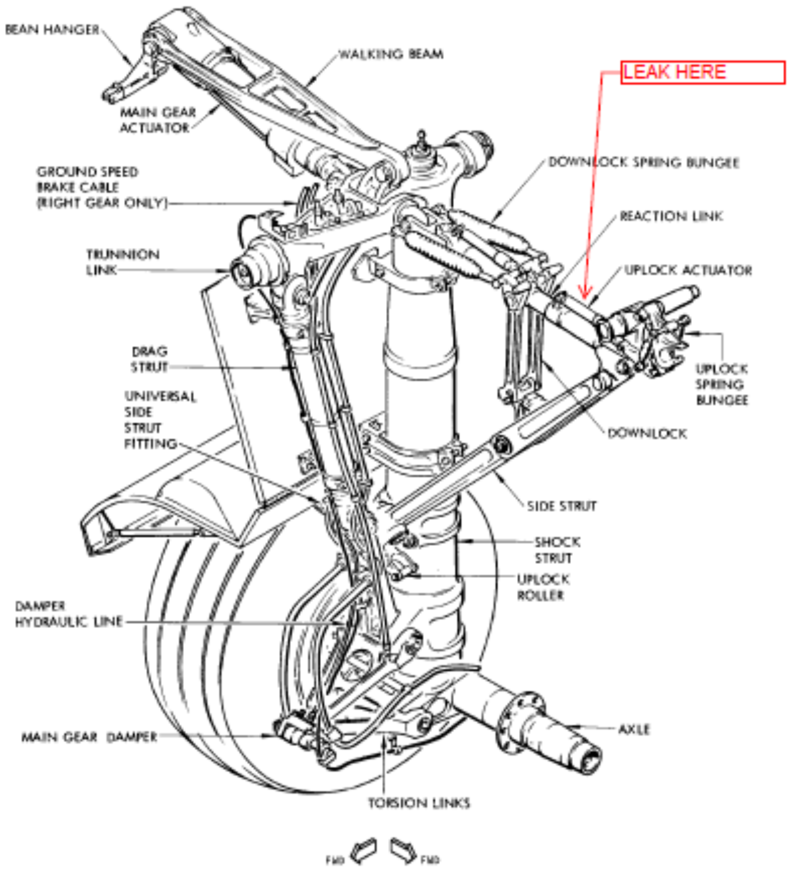

Figure 2: Leak Position on RH MLG

1.4 Other Damage

There was two of right runway light was broken due to impacted with nose gear and one of taxiway signboard light was broken due to impacted with right engine.

1.5 Personnel Information

1.5.1 Pilot in command

Gender	:	Male
Age	:	39 years
Nationality	:	Indonesia
Marital status	:	Married
Date of joining company	:	15 February 2004
License type	:	ATPL
Validity	:	30 November 2012
Aircraft type rating	:	B 737 – 200/300/400/500
Medical certificate	:	First Class
Date of medical examanination	:	21 December 2011
Validity	:	31 May 2012
Flight Time		
Total hours	:	1200 hours
Last 90 days	:	N/A
Last 60 days	:	83 hour 36 minutes
Last 24 hours	:	2 hours 46 minutes

1.5.2 Co-pilot

Gender	:	Male
Age	:	24 years
Nationality	:	Indonesia
Marital status	:	Single
Date of joining company	:	28 Mach 2010
License type	:	CPL
Validity	:	31 January 2012
Aircraft type rating	:	B 737 -200
Medical certificate	:	First Class

Date of medical examanination	:	28 July2011
Validity	:	31 January 2012
Flight Time		
Total hours	:	10,200 hours
Last 90 days	:	226 hour 53 minutes
Last 60 days	:	144 hours 56 minutes
Last 24 hours	:	2 hours 45 minutes

1.6 Aircraft Information

1.6.1 General

Aircraft Registration	:	PK-CJD
Aircraft Manufacturer	:	Boeing Company
Year of Manufacture	:	1996
Type/ Model	:	Boeing 737-200
Serial Number	:	22057
Certificate of Airworthiness		
Valid to	:	22 August 2011
Certificate of Registration		
Valid to	:	22 August 2011
Total flying hours since new	:	88,150 hours 20 minutes (23 December 2011)
Total cycle since new	:	59,581 cycles (23 December 2011)

1.6.2 Engine

Engine type	:	Turbofan
Manufacturer	:	Pratt and Whitney, Canada
Model	:	JT8D-15
L/H Engine		
Serial Number	:	P708930B
Time Since New	:	21,427.21 hours
Cycle Since New	:	19,595 cycles
R/H Engine		
Serial Number	:	P679868B
Time Since New	:	40,623.59 hours
Cycle Since New	:	38,590 cycles

1.6.3 Weight and Balance

The aircraft was being operated within the approved weight and balance limitations.

1.7 Meteorological Information

Wind	:	340/05 kts
Visibility	:	Above 10 Km/ Rw 11
Weather	:	Clear
Cloud	:	Few 2000
TT/TD	:	26/23
QNH	:	1007/29.75
QFE	:	1005/ 29.70

1.8 Aids to Navigation

There were no aids to navigation considered to be relevant to this serious incident.

1.9 Communications

All communication between ATS and the crew were recorded by ground-based automatic voice recording equipment for the duration of the flight. The quality of the ground-base automatic voice recording and the aircraft transmission was good. There was no radio communication considered to be relevant to this serious incident.

1.10 Aerodrome Information

Airport Name	:	Sultan Mahmud Badarudin II Airport, Palembang
Airport Identification	:	WIPP / PLM
Airport Operator	:	PT. Angkasa Pura II (Persero)
Elevation	:	49 feet
Runway Direction	:	11 /28
Runway length	:	3,000 M
Runway width	:	45 M
Surface	:	Asphalt

1.11 Flight Recorders

The aircraft was equipped with a Solid State Flight Data Recorder (SSFDR) and a Cockpit Voice Recorder (CVR). The recorders are being downloaded at NTSC facility for further analysis.

Solid State Flight Data Recorder (SSFDR)

Manufacturer	:	Fairchild
Model	:	SSFDR
Serial Number	:	01044
Part Number	:	S703-1000-00

Figure 3: Flight Data Recorder

Cockpit Voice Recorder (CVR)

Manufacturer	:	Fairchild
Model	:	CVR
Serial Number	:	61998
Part Number	:	93-A100-80

Figure 4: Cockpit voice recorder

1.12 Wreckage and Impact Information

The aircraft main wheels went out at approximately 20 meter from the end of runway 11.

Figure 5: Aircraft last position at over run area 11

Image courtesy of Jeppesen

Figure 6: The relative aircraft last position in red triangle

1.13 Medical and Pathological Information

Not relevant to this serious incident.

1.14 Fire

There was no indication of pre or post impact fire.

1.15 Survival Aspects

The pilot and passengers were not injured and left the aircraft unaided.

1.16 Tests and Research

The damaged hose was send to Metallurgic Department of Institute Technology Bandung (ITB) for more detail inspection and study under the scanning electron microscope equipment.

1.16.1 Hydraulic Hose P/N AE2464163E0192

Metallurgical inspection of the hydraulic hose ex Boeing B737-200 Sriwijaya Air registered PK-CJD issued by Metallurgical Department of ITB, the result of the detail inspection is as follows:

Component

The damage component is Hydraulic Hose P/N AE2464163E0192 taken from PK-CJD on 24 December 2011 was part of hydraulic system A. The operating pressure is 3000 psi.

Figure 7: The hose shows damage in the middle

Observation

The hose was constructed as follows:

a. The external cover is hydrocarbon rubber (nitrile butyl rubber) that used for ester phosphate (skydrol).

b. The internal part as per label wrapped at the hose is teflon hose covered by wire mesh.

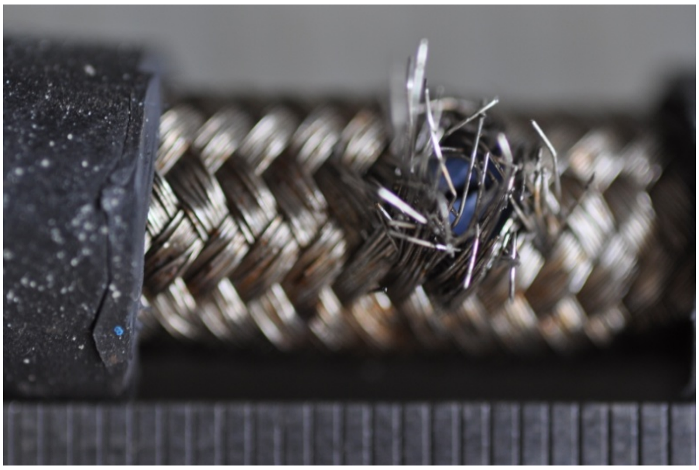

Figure 8: The external rubber was peeled to expose the wire mesh and internal hose

The failure mode of the wire mesh can be determined based on detail observation of the wires tip fracture. The fracture wires observed with macro lens and a scanning electron microscope.

Observation Data

The following observation was made with scanning electron microscope at different magnification (see the scale bar)

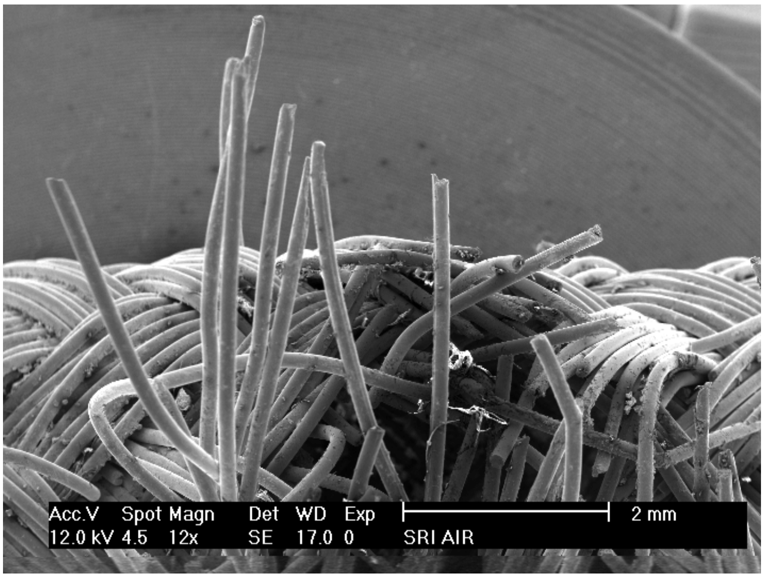

Figure 9: Fracture wire mesh at the burst area

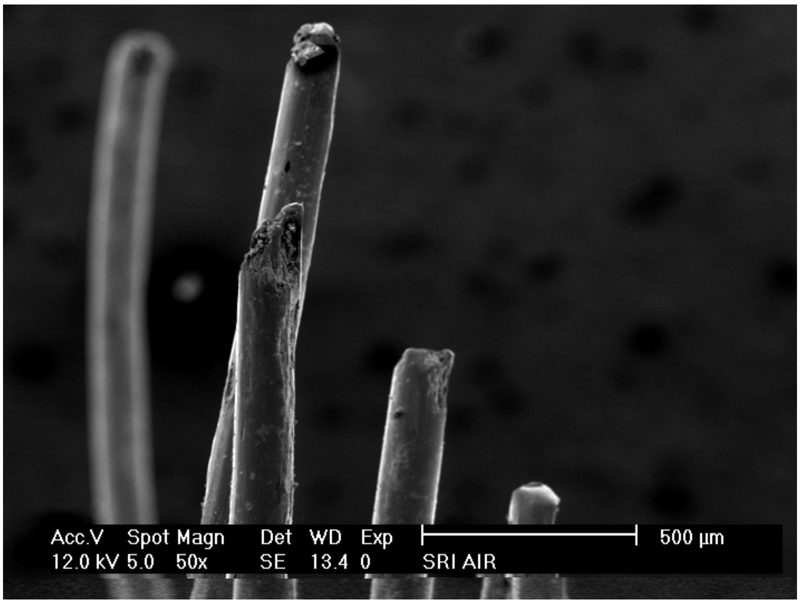

Figure 10: Detail fractures tip

Static fracture characteristics due to tensile load: deformation and an angle of 45 º.

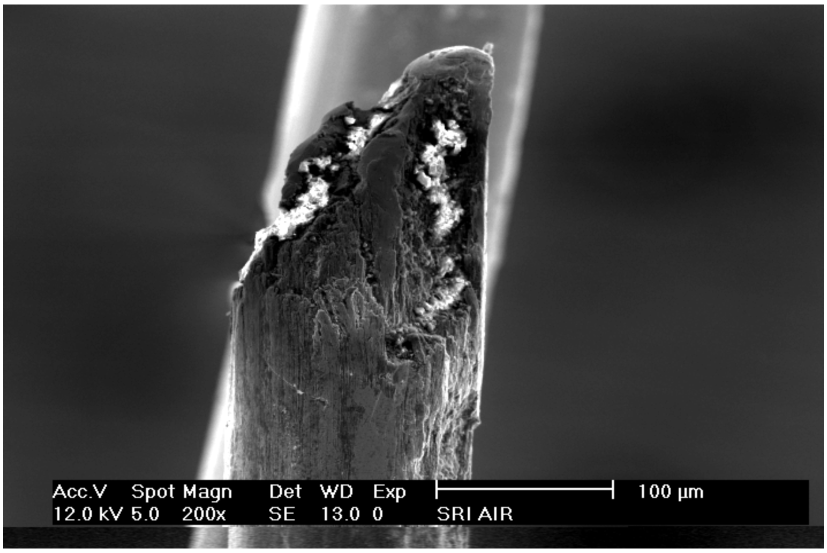

Figure 11: Static fracture characteristics due to tensile load (the deformation with an angle of 45º)

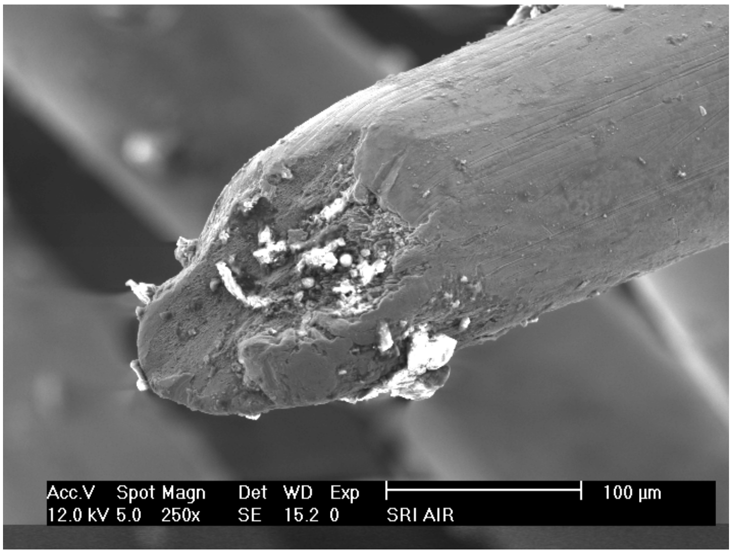

Figure 12: Static fracture characteristics due to tensile load (the deformation with an angle of 45º)

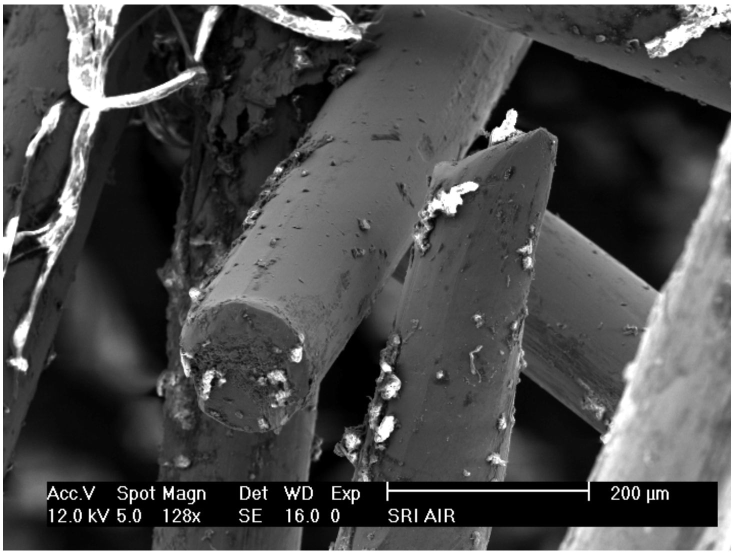

Figure 13: Fatigue fracture characteristic (no deformation and the 90º fracture)

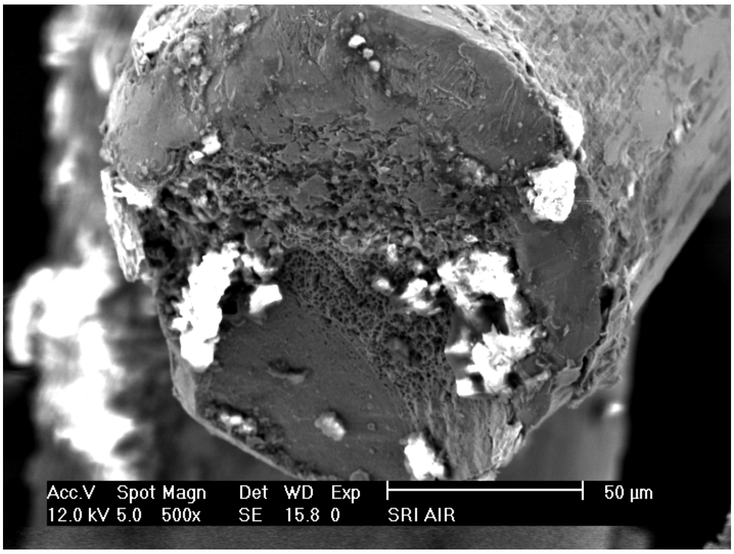

Figure 14: Fatigue fracture characteristic (no deformation and the 90º fracture). The initial fatigue crack is at the bottom part of the wire

As a result of repetitive load of hydraulic operation at the hose and the present of fretting defects due to hose vibration, some wires mesh were fracture because of fatigue. Since there were wires mesh fractures at that location, the integrity of the hose become weak and finally burst. The sudden burst indicated by the presence of deformation on the wires and fractures tip angle about 45º.

The hose vibration also led wire broken despite the broken wire was not in burst location.

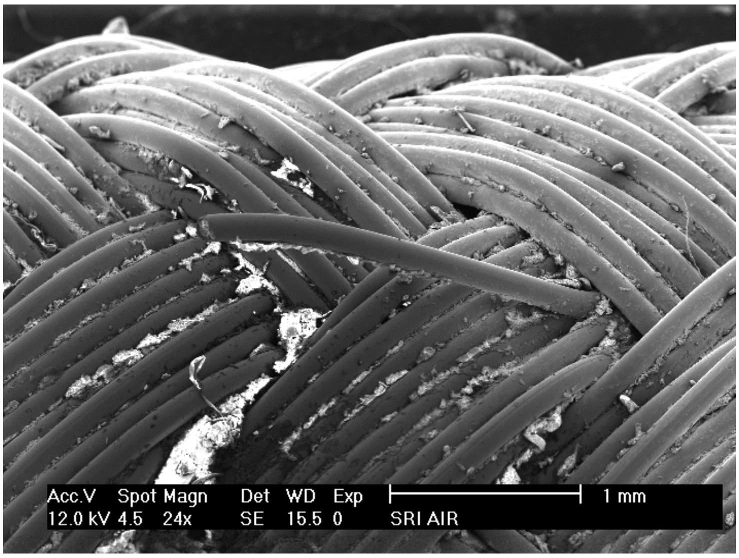

Figure 15: One wire was fatigue fracture at other location near the burst area

1.17 Organisational and Management Information

Aircraft Owner	:	Aero North International
Address	:	Flat/Rm 1503, Cameron Comm., Centre Causeway Bay Hongkong.
Aircraft Operator	:	PT. Sriwijaya Air
Address	:	Jalan Pangeran Jayakarta No. 68 C 15-16, Mangga Dua Selatan, Jakarta Republic of Indonesia
Operator Certificate Number	:	AOC 121/035

1.18 Additional Information

1.18.1 Hydraulic System Boeing B737-200

The hydraulic system of Boeing B737-200 consist of System A, System B and Standby System. These 3 (three) system using separate hydraulic reservoir with the capacity as follows:

a. System A is 4.1 US gallons or 15.5 liters

b. System B is 1.3 US gallons or 4.9 liters

c. Standby System is 1.9 US gallons or 7.2 liters

Hydraulic System A will cover Ailerons, Elevators, Rudder, Ground Spoiler, Inboard Flight Spoiler, Thrust Reverser, Landing Gear, Nose Gear Steering, Trailing Edge Flap, Inboard Brakes and Krueger Flap (Leading Edge Flap).

Hydraulic System B will cover Ailerons, Elevators, Rudder and Outboard Flight Spoiler.

Hydraulic Standby System will cover Standby Rudder, Krueger Flap (Leading Edge Flap) and Thrust Reverser.

The aileron and elevator is identical actuator and controlled by system A and B, but they were using a separate actuator (LH Aileron controlled by system A and RH Aileron controlled by system B). This method also applied to the elevator. The main rudder control unit is controlled by system A and B in 1 (one) actuator.

The schematic diagram for the hydraulic system is as follows:

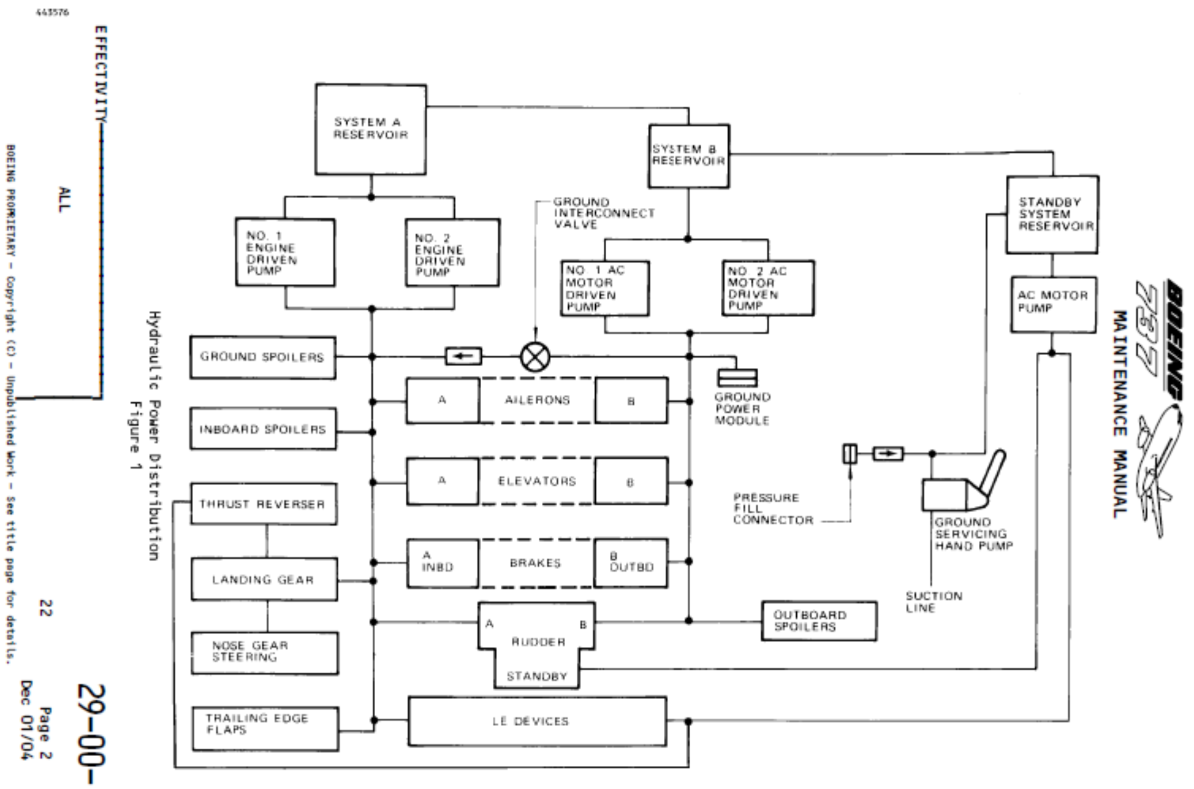

Diagram courtesy of Boeing Company

Figure 16: Schematic Diagram of Hydraulic System B737-200

1.18.2 Rudder PCU Strip Report

In the course of investigation, NTSC observe the maintenance inspection and check of PK-CJD regarding the serious incident and revealed that the Main Rudder Power Control Unit (PCU) was detective. The rudder PCU was replaced and sent to repair station.

Refer to the strip report it was reported that the Electro-Hydraulic Servo Valve (EHSV) P/N 73016 was replaced due to defective and excessive internal leak.

1.19 Useful or Effective Investigation Techniques

The investigation is being conducted in accordance with the NTSC approved policies and procedures, and in accordance with the standards and recommended practices of Annex 13 to the Chicago Convention.

2 ANALYSIS

The analysis part of this Final Report will discuss the relevant issues resulting in the runway excursion on runway 11 involving a Boeing 737-200 aircraft, registered PK-CJD, and operated by PT. Sriwijaya Air at Sultan Mahmud Badarudin II Airport, Palembang on 24 December 2011

The investigation determined that there were issues with the hydraulic systems, therefore the analysis focus on the following issues:

- Hydraulic Hose P/N AE2464163E0192 damage component.
- Situations of the Flight during Hydraulic Loss
- Maintenance Action
- Defective Hydraulic Hose
- Deceleration with total Hydraulic failure

2.1 Hydraulic Hose P/N AE2464163E0192 damage component

The investigation at Metallurgical Department of ITB studied on the damage of hydraulic hose and the results of the studied were as follows:

The damage component Hydraulic Hose P/N AE2464163E0192 taken from PK-CJD on 24 December 2011 was part of hydraulic system A and the operating pressure inside the hose was 3000 psi.

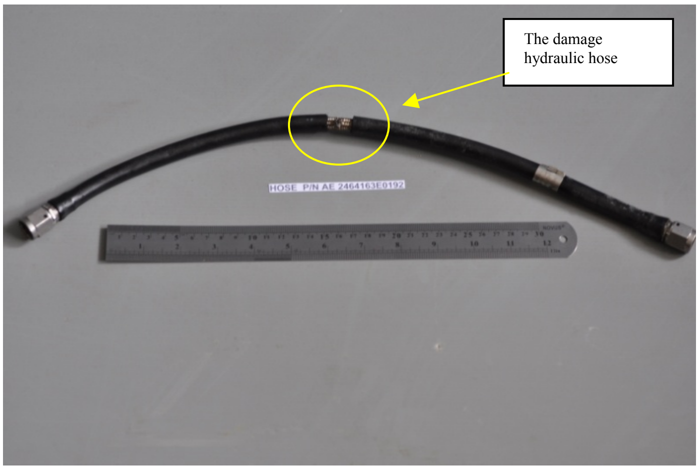

Figure 17: The damage hydraulic hose

Inspection and studied on static fracture characteristics due to tensile load: found deformation and an angle of 45 º.

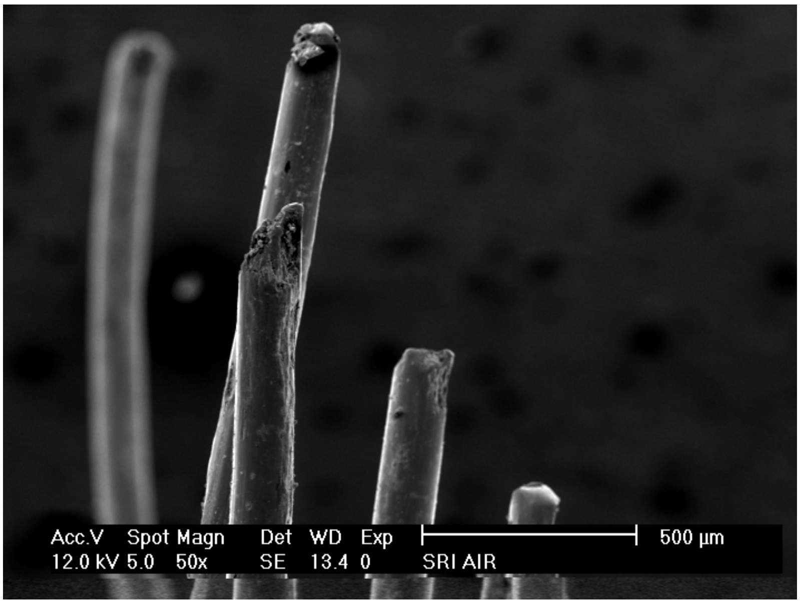

Figure 18: Shows static fracture due to tensile load

Fatigue fracture characteristic (no deformation and the 90º fracture). The initial fatigue crack is at the bottom part of the wire as shown on the figure bellow.

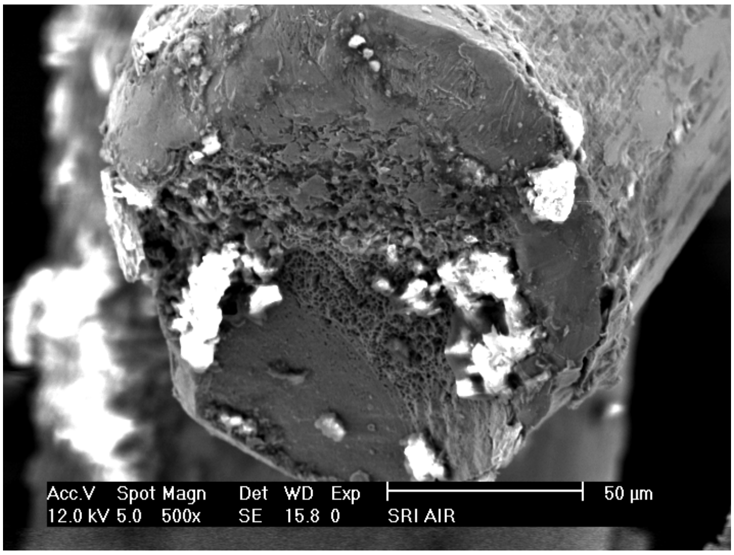

Figure 19: Shows the initial crack

Fatigue fracture characteristic (no deformation and the 90º fracture). The initial fatigue crack is at the bottom part of the wire.

As a result of repetitive load of hydraulic operation at the hose and the present of fretting defects were due to;

- Most probably frequent Hose vibration.
- Some wires mesh were fracture because of fatigue. Since there were wires mesh fractures at that location, the integrity of the hose become weak and finally burst. The sudden burst indicated by the presence of deformation on the wires and fractures tip angle about 45º.
- The hose vibration also led wire broken despite the broken wire was not in burst location.

2.2 Situations of the Flight during Hydraulic Loss

On 2000 feet after take-off from Pekanbaru, pilot observed that the hydraulic quantity System A was decreasing. The flap indicator pointed between UP and 1 degree and it was observed also that the Trailing Edge Flap Light indicator on AFT Overhead Panel showed green that mean the entire trailing edge flap was still not up position.

On 5000 feet, pilot observed that the hydraulic System A totally loss. Pilot also try to attempt to use the alternate flap to move the flap to up position but no change. Refer to B737-200 Aircraft Maintenance Manual the alternate flap can be used to operate the trailing edge up and down but especially for leading edge flap, the alternate flap operation is applicable to down (extend) only.

On FL250, pilot observed that the hydraulic quantity of System B also decreasing followed by autopilot disengage and pilot decided to divert to PLM.

At 12:28 UTC pilot informed to APP Palembang that the aircraft had the hydraulic problem and PIC decided divert to Palembang airport. The Palembang ATC instructed the pilot to descent from FL250 to 2500 feet for VOR/ DME approach. The aircraft holding 4 times to reduce weight to achieved Maximum Landing Weight and finally overrun at the stop way of run way 11.

Reviewing the evident after serious incident, it showed that the thrust reversers were in stowed position, trailing edge flap were not in "UP" position and the leading edge flap were down. The switch of Flight Control in P5 panel (cockpit overhead panel) shows the Flight Control A and B were selected in "STBY RUD" position and the "ALTERNATE FLAPS" switch in "ARM" position.

It means that pilot used the standby hydraulic system to cover the limited system i.e. trailing edge flap, Leading Edge Flap and Thrust Reverser. It seemed that the standby hydraulic system was working normally without any leak (the standby hydraulic reservoir still enough to support the system). The braking systems in this serious incident were supported by accumulators.

2.3 Maintenance Action

The aircraft was checked by the engineer and found that the Hydraulic Hose of RH MLG up-lock actuator at the "Lock Port" was leak.

After this serious incident, the maintenance action had been performed by replacing the defective hydraulic hose on RH MLG up-lock actuator. The leak test as per manual chapter 29-00 “Hydraulic Power – Inspection/Check” on sub chapter Hydraulic System External leakage Check and Internal Leakage Check had been performed and there was no leak found at that time.

Since the maintenance action does not resolve the question why both hydraulic systems were loss in flight, NTSC compile a discussion and it was revealed that the only point where the hydraulic system A and system B were intersected was in the Rudder PCU. Therefore, NTSC involved in a detail inspection of the hydraulic system including the operational check of the Main Rudder PCU and finally the Main Rudder PCU was replaced due to suspected defective.

The Main Rudder PCU was sent to repair station and refer to the strip report it was reported that the Electro-Hydraulic Servo Valve (EHSV) P/N 73016 was replaced due to defective. In the Main Rudder PCU Component Maintenance Manual (CMM) 27-20-01 in the sub chapter of trouble shooting, it was stated that the EHSV is one of the contributing factor of excessive internal leak. It means that there was a possibility of both systems may transfer its hydraulic fluid.

2.4 Defective Hydraulic Hose

As a result of repetitive load of hydraulic operation at the hose and the present of fretting defects due to hose vibration, some wires mesh were fracture because of fatigue. Since there were wires mesh fractures at that location, the integrity of the hose become weak and finally burst. The sudden burst indicated by the presence of deformation on the wires and fractures tip angle about 45º.

The burst of the hydraulic hose is likely due to fatigue mode initiated by fretting damage on the wire mesh as a result of vibration.

2.5 Deceleration with total Hydraulic failure

Reviewing the evident after serious incident, it showed that the thrust reversers were in stowed position, trailing edge flap were not in “UP” position and the leading edge flap were down. The switch of Flight Control in P5 panel (cockpit overhead panel) showed the Flight Control A and B were selected in “STBY RUD” position and the “ALTERNATE FLAPS” switch in “ARM” position.

It means that pilot used the standby hydraulic system to cover the limited system i.e. trailing edge flap, Leading Edge Flap and Thrust Reverser. It seemed that the standby hydraulic system was working normally without any leak (the standby hydraulic reservoir still enough to support the system). The braking systems in this serious incident were supported by accumulators.

As those particulars, there was a consistency between the facts with the pilot report which were;

- At 12.50 UTC when the aircraft landed and at the beginning of aircraft touch down the crew felt that there was a deceleration as result of the brake application; afterward at approximately 60kts they did not feel any deceleration even though the reverser application was increased.

- Asymmetry reverser was applied by the pilot to keep align with the runway center line.

  As such, when on the landing roll the aircraft break system and reversers were still available at low deceleration ability until the speed 60kts, then inactive till rest into stopped. Hence worsen condition was avoided.

3 CONCLUSIONS

3.1 Finding

1. The aircraft was airworthy prior the serious incident, but both hydraulic loss during flight.
2. The crew had valid flight license and medical certificate. There was no evidence of crew incapacitation.
3. The Pilot in Command (PIC) was the pilot flying and Second in Command was the pilot monitoring.
4. At 12:28 UTC pilot informed to APP Palembang that the aircraft had the hydraulic problem and PIC decided divert to Palembang airport
5. The thrust reversers were in stowed position, trailing edge flap were not in "UP" position and the leading edge flap were down.
6. The switch of Flight Control in P5 panel (cockpit overhead panel) showed the Flight Control A and B were selected in "STBY RUD" position and the "ALTERNATE FLAPS" switch in "ARM" position.
7. It seemed that the standby hydraulic system was working normally without any leak.
8. The standby hydraulic reservoir stills enough to support the system.
9. The trailing edge flap was down position and thrust reversers were stowed position.
10. The braking systems were provided by accumulators.
11. The maintenance action that observed by NTSC revealed that Main Rudder PCU was defective and sent to repair station.
12. The EHSV is one of the contributing factors of excessive internal leak.
13. The defective hydraulic hose is likely consistent with fatigue mode initiated by fretting damage on the wire mesh as a result of vibration.
14. The aircraft break system and reversers were still available at low deceleration ability until the speed 60 kts.

3.2 Contributing Factors

The factors contributed to this serious incident are as follows:

1. Defective hydraulic hose of RH MLG Actuator at "Lock Port" position was made the hydraulic fluid drawn overboard.
2. The defective hydraulic hose is likely consistent with fatigue mode initiated by fretting damage on the wire mesh as a result of vibration.

3. It likely that loss of hydraulic system A followed by the lossing of system B was due to the defective of EHSV P/N 73016 that led the Main Rudder PCU had excessive internal leak.

4 SAFETY ACTIONS

At the time of issuing this Accident Investigation Report, the National Transportation Safety Committee had been informed of the safety actions resulting from this serious incident by PT Sriwijaya Air.

SAFETY RECOMMENDATIONS

(Incident report, page 10 to 11) it part of the PT Sriwijaya Air internal investigation conducted by QSS (Quality Safety and Security) Directorate after this serious Incident.

Maintenance:

1. To determine conclusively and without delay, the reason for the serious mechanical failure causing total loss of the hydraulic power and inform Sriwijaya QA and QSS.
2. To inspect all other B737-200 aircraft hoses to ensure a systematic hazardous condition does not exist.
3. To develop a predictive analysis for such a condition to be detectable before the condition can be experienced.
4. To investigate further the reason for the subsequent hydraulic related issues that existed in the subsequent flight in the same aircraft (repetitive issue).

QA:

1. To investigate the reason for a total failure in the hydraulic system.
2. To develop a more rigorous and participative oversight of external maintenance contractors.
3. To report to QSS regarding any failure for such oversight and corrections and mitigations for the future for active accident prevention.

Operation Directorate:

Increase affectivity particularly to training in:

1. Standard Operating Procedures:
    - ➢ Crew Resources Management;
    - ➢ New Boeing Procedures;
    - ➢ Standard Callouts especially during approach and landing;
    - ➢ Proper selection and use of Normal + Non-normal checklist including:
        A. Human factor concepts of use checklist
        B. Proper identification of non-normal condition
        C. Appropriate selection of QRH Sections of each non-normal condition
2. Approach and Landing Accident Reduction → Stabilized approach and CANPA.
3. LOFT and PPC HIGHLIGHT related to seasons, factual environment and Safety Recommendation.

→ CONDUCT MANDATORY TRAINING

For the specific crew involved in the incident:

- Re-enactment of event
- At least 3 day Ground recurrent including Systems, CRM concepts, QRH usage
- Line check

5 SAFETY RECOMMENDATIONS

Base on the examination of the factual data and the findings that contributed to this serious incident such as,

1. Defective hydraulic hose of RH MLG Actuator at "Lock Port"
2. The defective hydraulic hose is likely consistent with fatigue mode initiated by fretting damage on the wire mesh as a result of vibration.
3. It likely that loss of hydraulic system A followed by los of system B was due to the defective of EHSV P/N 73016 that led the Main Rudder PCU had excessive internal leak.

The National Transportation Safety Committee issued several safety recommendations addressed to:

5.1 PT Sriwijaya Air

a) In the course of investigation, NTSC issue immediate recommendation to perform the leak test as per Boeing B737-200 Maintenance Manual chapter 29-00 "Hydraulic Power – Inspection/Check" in sub chapter "Hydraulic System External leakage Check and Internal Leakage Check" regularly.

b) The internal leak of Main Rudder PCU is not easily to detect, therefore NTSC recommend that the maintenance item to perform the operational test of Main Rudder PCU using the isolated hydraulic system is preferable.

c) The QSS had issued several recommendations as result from internal investigation. Aligning with those aforesaid internal recommendations, the NTCS recommends the QSS department shall also refer to the subpar 2 of this final report.

5.2 Directorate General of Civil Aviation (DGCA)

The defective hydraulic hose was most likely consistent with fatigue mode initiated by fretting damage on the wire mesh as a result of vibration, and it could be happen again to the other similar aircrafts as such, The NTSC recommends that the DGCA has to oversight this recommendation implementation.