飛航事故調查報告

ASC-AOR-07-03-001

中華民國 94 年 12 月 9 日
美國科捷公司
龐巴迪爾 BD700 型機
國籍註冊編號 N998AM
於高雄國際機場落地時偏出滑行道

行政院飛航安全委員會
AVIATION SAFETY COUNCIL

中華民國 96 **年** 3 **月**

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中華民國飛航事故調查法第五條：

飛安會對飛航事故之調查，旨在避免類似飛航事故之再發生，不以處分或追究責任爲目的。

國際民航公約第十三號附約第三章第 3.1 節規定：

The sole objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability.

因此，依據中華民國飛航事故調查法及國際民航公約第十三號附約，本調查報告專供改善飛航安全之用。

本報告一式兩份，分別以中文及英文繕寫，該兩份報告文字內容有差異則以中文報告爲主。

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摘要報告

民國 94 年 12 月 09 日，一架美國賽列公司（Select Aviation Corp.）所有，科捷公司（Corporate Jets, Inc.,）運作之龐巴迪爾（BOMBARDIER AEROAPACE）BD700 型機，國籍標誌及登記號碼 N998AM[1]，載有駕駛員 2 人，機械員 1 人及客艙組員 1 人，合計 4 人，依據 Title 14, CFR Part 91 美國聯邦航空法執行由桃園國際機場飛往高雄國際機場之空機飛渡任務[2]。

1446：23 時，該機於高雄國際機場 09 跑道落地，鼻輪觸地後左右發動機反推力器施放正常，監控駕駛員（Pilot Monitor，PM）感覺煞車有脈動現象（pulsation of the brake），便問操控駕駛員（Pilot Flying，PF）是否已解除自動煞車，PF 說尚未解除[3]，隨即解除自動煞車。

1446:36 時，駕駛艙內發出警告聲響，EICAS 螢幕上陸續出現多項警示，1446:46 時，PF 復置反推力器控制桿，此時 PM 宣告 2 號、3 號液壓系壓力過低，右發動機反推力器未回收仍在開展位置，鼻輪轉向失效。PF 遂使用差量煞車[4]（differential brake pressure）脫離跑道。1447:17 時，地速 14 浬/時，該機航向開始右偏。1447:28 時，該機地速 10 浬/時，航機右轉進入 D 滑行道，1447:49 時，地速減爲 7 浬/時，PM 道「小心！停！停！」[5]，PF 則道「飛機完全失去控制！完全失控！」[6]，該機繼續向右偏轉，偏出 D 滑行道並停於 D 滑行道右側約 30 公尺處之草地上，人員無傷。

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[1]N998AM 英文字母 N 開頭代表美國籍，餘為登記號碼

[2]目前外籍私人飛機來台按「外籍航空器飛航國境管理規則」申請私人飛航即可，該機來台係依民航法令 03-06A 外籍航空器飛航國境規則辦理

[3]CVR 1446:28 時 PM 道「okay you cut off the autobrake I think」，1446:31 時 PF 道「no」

[4]藉由煞車踏板對左右主輪施以不同之煞車壓力以使航機改變滑行方向之操控方法

[5]CVR 1447:49 PM 道「okay watch it stop stop」

[6]CVR 1447:53 PF 道「I haven’t got anything I got nothing…」

本會在此章中依據調查期間所搜集之事實資料綜合分析，總結以下三類調查結果，分述如下。

調查發現

與可能肇因有關之調查發現

此類調查發現係屬已經顯示或幾乎可以確定爲與本事故發生有關之重要因素。其中包括：不安全作爲、不安全狀況或造成本次事故之安全缺失等。

與風險有關之調查發現

此類調查發現係涉及飛航安全之風險因素，包括未直接導致本次事故發生之不安全作爲、不安全條件及組織和整體性之安全缺失等，以及雖與本次事故無直接關連但對促進飛安有益之事項。

其它調查發現

此類調查發現係屬具有促進飛航安全、解決爭議或澄清疑慮之作用者。其中部分調查發現爲大眾所關切，且見於國際調查報告之標準格式中，以作爲資料分享、安全警示、教育及改善飛航安全之用。

與可能肇因有關之調查發現

1. 因 2 號 BCV 內部橡膠封圈組裝不善，使細微橡膠剝離卡住 2 號煞車控制閥，導致 2 號主輪煞車鎖死。(2.1.1)
2. 2 號主輪煞車鎖死導致輪胎爆裂，爆裂之胎皮撞斷液壓管路造成 2、3 號液壓系統失效。(2.1.1)
3. 2、3 號液壓系統失效使鼻輪轉向及煞車系統亦失去功能，造成該機偏入草坪。(2.1.2)

與風險有關之調查發現

1. 該機係因輪胎爆裂打斷液壓管路，失去液壓及煞車系統以致偏出滑行道，若該機於起飛滾行時發生類似事故，則將於空中增加操控難度，降落時之穩定進場及減速煞車亦無法確保。(2.1.1)
2. 高雄國際機場 09/27 跑道中心線南北兩側具未加蓋之 V 型溝及圍牆，皆屬精確進場跑道地帶需要整平之範圍，不符合「民用機場設計暨運作規範」「精確進場跑道地帶整平」之規定，可能危害偏出跑道航空器之安全。(2.2.2)
3. 檢視高雄國際機場部分滑行道地帶內之未加蓋 V 型溝設計，不符合「民用機場設計暨運作規範」「滑行道地帶排水溝加蓋」之規定，可能危害偏出滑行道航空器之安全。(2.2.3)

其它調查發現

1. 駕駛員之航機操作與飛機系統失效之可能肇因無關。(2.3)
2. 飛航組員持有合格有效證照。(2.3)
3. 該機持有符合民航法規之證件。(2.3)
4. 查閱該機事故前一個月之相關維修紀錄，未發現異常系統故障紀錄。(2.3)

改善建議

致加拿大龐巴迪爾飛機製造廠

1. 改善 BCV 內部橡膠封圈組裝不善之問題。-ASC-ASR-07-03-001
2. 加強主輪上方之液壓管路、電線、扭力管承受外物損害之能力。-ASC-ASR-07-03-002

致交通部民航局

1. 改善高雄國際機場 09/27 跑道中心線南北兩側具未加蓋之 V 型溝及圍牆，使符合「民用機場設計暨運作規範」「精確進場跑道地帶整平」之規定。(2.2.2) -ASC-ASR-07-03-003

2. 改善高雄國際機場部分滑行道地帶內之未加蓋 V 型溝設計，使符合「民用機場設計暨運作規範」「滑行道地帶排水溝加蓋」之規定。（2.2.3）-ASC-ASR-07-03-004

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第一章　事實資料

1.1　飛航經過

民國 94 年 12 月 09 日，一架賽列公司（Select Aviation Corp.）所有，科捷公司（Corporate Jets, Inc.,）運作之龐巴迪爾（BOMBARDIER AEROAPACE）BD700 型機，國籍標誌及登記號碼 N998AM[7]，載有駕駛員 2 人，飛航工程師 1 人及客艙組員 1 人，依據 Title 14, CFR Part 91 美國聯邦航空法，執行由桃園國際機場飛往高雄國際機場之空機飛渡任務[8]。

於台北時間 1442：37 時[9]，該機組員完成落地前檢查程序，將自動煞車設於『medium』，使用全襟翼。1446：23 時，該機於高雄機場 09 跑道落地，速度 110 浬/時。落地時一切正常，鼻輪觸地後左右發動機反推力器施放正常，監控駕駛員（Pilot Monitor，PM）感覺煞車有脈動現象（pulsation of the brake），便問操控駕駛員（Pilot Flying，PF）是否已解除自動煞車，PF 說尚未解除[10]，隨即解除自動煞車。

1446:36 時，該機地速 77 浬/時，駕駛艙內發出警告聲響，EICAS 螢幕上陸續出現多項警示，1446:46 時，該機地速 45 浬/時，PF 復置反推力器控制桿，此時 PM 宣告 2 號、3 號液壓系壓力過低，右發動機反推力器未回收仍在開展位置，鼻輪轉向失效。PF 遂使用差量煞車[11]（differential brake pressure）脫離跑道。

1447:17 時，地速 14 浬/時，該機航向開始右偏。1447:28 時，該機地速 10 浬/時，航機右轉進入 D 滑行道，1447:49 時，地速減爲 7 浬/時，PM 道「小心！停！

[7]N998AM 英文字母 N 開頭代表美國籍，餘為登記號碼
[8]目前外籍私人飛機來台按「外籍航空器飛航國境管理規則」申請私人飛航即可，該機來台係依民航法令 03-06A 外籍航空器飛航國境規則辦理
[9]本報告之時間係以當地時間（台北時間）為準，採 24 小時制
[10]CVR 1446:28 時 PM 道「okay you cut off the autobrake I think」，1446:31 時 PF 道「no」
[11]藉由煞車踏板對左右主輪施以不同之煞車壓力以使航機改變行駛方向

停！」[12]，PF 則道「飛機完全失去控制！完全失控！」[13]，該機繼續向右偏轉，偏出 D 滑行道並停於 D 滑行道右側約 30 公尺處之草地上（詳圖 1.1-1），人員無傷。

圖 1.1-1 航機停於 D 滑行道右側約 30 公尺處之草地上

1.2 飛航組員資料

1.2.1 操控駕駛員（PF）

PF 爲美國籍，執有美國聯邦航空總署（FAA）所核發的 Airline Transport Pilot 執照，總飛時約 5,000 小時，BD700 機種飛時約 200 小時。

事件發生後，PF 酒精濃度測試值為零。

[12]CVR 1447:49 PM 道「okay watch it stop stop」
[13]CVR 1447:53 PF 道「I haven’t got anything I got nothing…」

1.2.2　監控駕駛員（PM）

PM 爲美國籍，執有美國聯邦航空總署（FAA）所核發的 Airline Transport Pilot 執照，總飛時約 21,000 小時，BD700 機種飛時約 1,400 小時。

事件發生後，PM 酒精濃度測試值爲零。

1.3　航空器損壞情況

航空器輕微損壞。

1.4　航空器資料

1.4.1　航空器基本資料

表 1.4-1 航空器基本資料

航　空　器	
國籍標誌及登記號碼	N998AM
國籍	U.S.A.美國
所有人	SELECT AVATION CORP.賽列公司
使用人	CORPORATE JETS, INC.科捷公司
登記證編號	53370147
適航證編號	940035736
適航證書有效期限	2006 年 12 月 09 日
航空器總使用時數	2304 時 48 分
航空器總落地次數	987 次
上次週檢種類	500 小時
上次週檢完成日期	2005 年 08 月 14 日
上次週檢後使用時數	168 時 54 分
上次週檢後落地次數	69 次
機　身	
製造廠	BOMBARDIER AEROAPACE 龐巴迪爾
國籍	加拿大
型號	BD700
序號	9009

製造日期	1999 年
交機日期	1999 年
最大起飛重量	96,000 磅
發　動　機	
製造廠	ROLLS ROYCE 勞斯萊斯
國籍	英國
型別	BR710A2-20
序號	NO.1:12119 NO.2:12120
最大轉速	N1 RPM @ 100% =7,431 N2 RPM @ 100% = 15,898
最大馬力	14,750 lbs X 2
使用總時間	NO.1:2304:48/ 12,903 cycles NO.2:2304:48/ 17,680 cycles
最後週檢種類	500 小時週檢
最後週檢完成日期	2005 年 08 月 16 日
最後週檢後使用時間	168 小時 54 分

1.4.2 維修記錄

查閱該機一個月內之維修紀錄，無異常登錄發現。

1.4.3 載重與平衡

該型機最大起飛重量限制爲 96,000 磅，最大落地重量限制爲 78,600 磅，最大無燃油重量（Max zero fuel weight）限制爲 56,000 磅。

根據該航班之載重平衡表，列表如下：

表 1.4-2 載重平衡表

起飛油量	9,500 磅[14]
起飛總重量	61,450 磅
航行中消耗燃油	2,269 磅
預計落地重量	59,431 磅

[14] PM 於訪談時表示，實際起飛油量為 12,500 磅。

1.5　氣象資料

事故發生前後，高雄機場氣象台之地面天氣觀測紀錄如下：

時間 1400L[15]；風向 320 度，風速 8 浬/時；能見度 4,800 公尺；天氣現象—霾；稀雲 1,400 呎、裂雲 7,000 呎；溫度 23℃，露點 14℃；高度表撥定值 1018 百帕；趨勢預報—無顯著變化。

時間 1430L；風向 340 度，風速 6 浬/時；能見度 4,800 公尺；天氣現象—霾；稀雲 1,400 呎、裂雲 7,000 呎；溫度 23℃，露點 13℃；高度表撥定值 1018 百帕；趨勢預報—無顯著變化。

時間 1435L；風向 320 度，風速 7 浬/時，風向變化範圍自 290 度至 360 度；能見度 6,000 公尺；稀雲 1,400 呎、裂雲 7,000 呎；溫度 23℃，露點 14℃；高度表撥定值 1018 百帕；趨勢預報—無顯著變化。

時間 1500L；風向 330 度，風速 9 浬/時；能見度 7,000 公尺；稀雲 1,400 呎、裂雲 10,000 呎；溫度 23℃，露點 14℃；高度表撥定值 1018 百帕；趨勢預報—無顯著變化。

1.6　場站資料

1.6.1　一般資料

高雄國際機場位於高雄市東南方 4.86 浬，機場參考點位置爲北緯 22 度 34 分 31.6 秒，東經 120 度 21 分 02.4 秒，機場參考代碼 4[16]E[17]，目前使用該機場之最大起降機型爲波音 747-400。

該機場標高 31 呎，具一條 09/27 跑道，長 3,150 公尺，寬 60 公尺，爲水泥混

[15]英文字母 L 表示當地時間
[16]跑道參考長度代號
[17]飛機大小分類代碼

凝土道面。另有一條主滑行道（S）及七條垂直連絡滑行道（A、B、C、D、E、F、G），爲水泥混凝土加鋪瀝青混凝土道面。該機場圖如圖 1.6-1 所示。

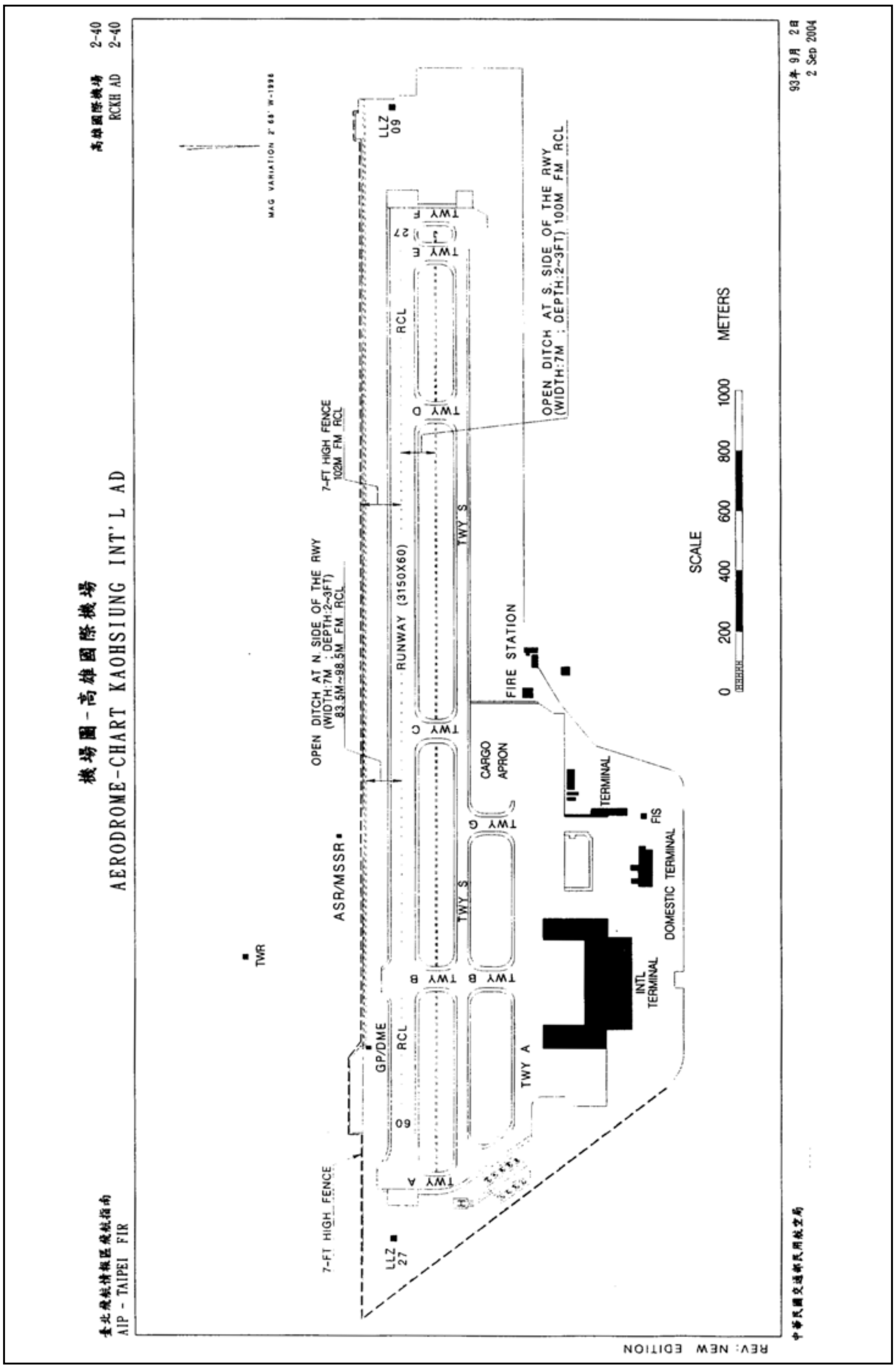

圖 1.6-1　高雄國際機場機場圖

1.6.2　跑/滑道安全地帶

該機場 D 滑行道東、西兩側未加蓋之 V 型溝最大寬度約 5 公尺，最大深度約 1 公尺，距跑道中心線約 97.5 公尺；距跑道邊線約 67.8 公尺。

東側 V 型溝距 D 滑行道中心線約 40 公尺；距 D 滑行道邊線約 22.5 公尺。

西側 V 型溝，距 D 滑行道中心線約 40.2 公尺；距 D 滑行道邊線約 23.1 公尺。

該機場之跑/滑道地帶圖如圖 1.6-2 所示。

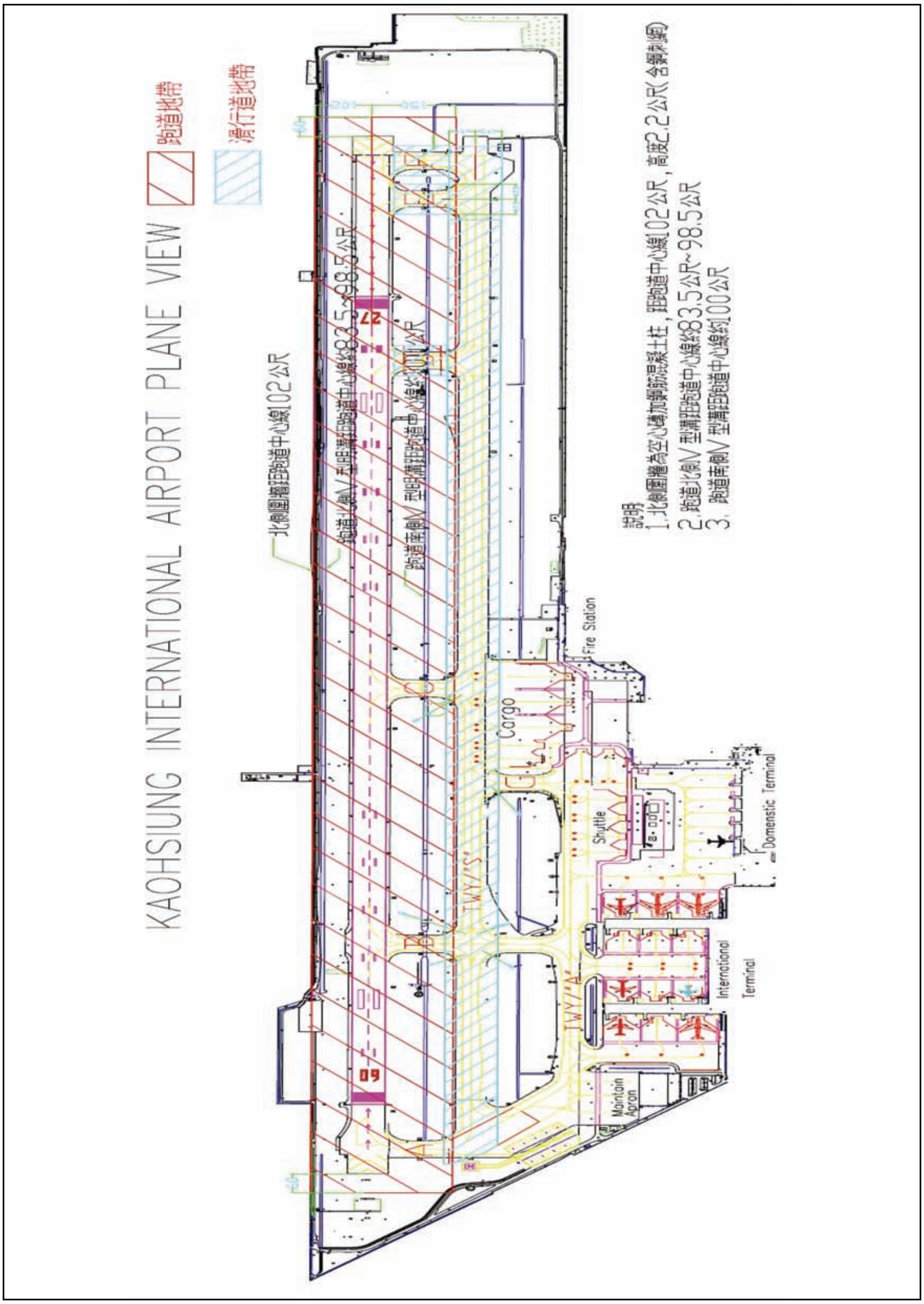
KAOHSIUNG INTERNATIONAL AIRPORT PLANE VIEW
跑道地帶
滑行道地帶
北側圍牆距跑道中心線102公尺
說明
1.北側圍牆為空心磚加鋼筋混凝土柱，距跑道中心線102公尺，高度2.2公尺(含鋼刺網)
2.跑道北側V型溝距跑道中心線約83.5公尺~98.5公尺
3.跑道南側V型溝距跑道中心線約100公尺
Fire Station
Cargo
Shuttle
Domestic Terminal
International Terminal
Maintain Apron
TWY'S'
TWY'A'

圖 1.6-2　跑／滑道地帶圖

1.6.3　目視助航設施之易斷設計

該機滑出 D 滑行道前經過之滑行邊燈為 ADB 公司製造，型號為 44C1081-6511，距滑行道邊線 300 公分，具原廠易斷接頭之設計；跑道警戒燈為 Multi-electric 公司製造，型號為 6804，距滑行道邊線 400 公分，具原廠易斷接頭之設計。

該機滑出 D 滑行道前經過之強制性指示牌為 OCEM 公司製造，全高 1020 公厘，牌面最小值高度 800 公厘，字體高 400 公厘，滑行道鋪面邊緣與指示牌接近側之垂直距離 12 公尺，具原廠易斷接頭之設計，如圖 1.6-3 及圖 1.6-4 所示。

圖 1.6-3　事故地點之目視助航設施

圖 1.6-4　航機與相關目視助航設施

1.6.4 機場設施相關規範

「民用機場設計暨運作規範」跑滑道地帶相關規範摘錄如下：

3.3.3 *精確進場跑道之跑道地帶，其寬度為自跑道中心線及其延長部分中心線每側橫向延伸至少下述距離：*

－兩側各 150m：跑道參考長度分類為 3 或 4 之跑道。

－兩側各 75m：跑道參考長度分類為 1 或 2 之跑道。

3.3.8 **儀器跑道之跑道地帶，自跑道中心線及其延長之部分中心線每側橫向延伸至少下列距離之範圍內，應提供平整區，以備飛機滑出跑道時使用：*

－兩側各 75m：跑道參考長度為 3 或 4。

－兩側各 40m：跑道參考長度為 1 或 2。

註－跑道參考長度分類為 3 或 4 之精確進場跑道之跑道地帶需要較大之平整區之指導內容，詳見附篇 A 第 8 節。

附篇 A 8.3 精確進場跑道地帶之整平

第 3 章 3.3.8 節中述及：跑道參考長度分類爲 3 或 4 之儀器跑道地帶距離跑道中心線至少 75m 之範圍內，應予整平。跑道參考長度分類爲 3 或 4 之精確進場跑道使用較寬之跑道地帶更佳。圖 A-3 顯示精確進場跑道可以考慮之採用較寬跑道地帶之形狀及尺寸，它是根據飛機衝出跑道資料設計，需要整平之範圍擴大到距跑道中心線 105m 處，再從跑道頭 300m 至 150m 處逐漸縮減成距中心線 75m，然後保持 75m 距離直至跑道地帶端點。

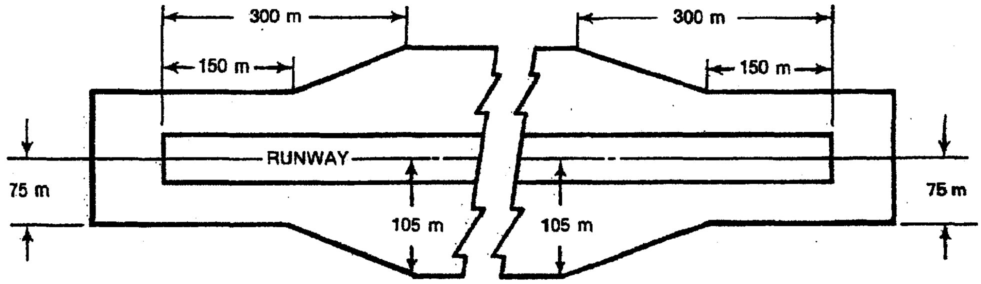

圖 A-3　跑道參考長度分類爲 3 及 4 之精確進場跑道之跑道地帶整平區

8.7.3 *既有之非目視輔助設施，應於2010 年1 月1 日前符合8.7.2 節之要求。*

8.7.4 *任何因助導航需要而設置於跑道地帶未整平區之裝備與裝置，得視為障礙物，得具有易斷性且其設置高度得儘可能地低。*

3.10.2 **沿滑行道全長之滑行道地帶寬度應自滑行道中心線向兩側對稱地延伸至少達表 3-1 第（11）欄中所規定之距離。*

表 3-1 滑行道最小隔離間距

飛機大小分類	滑行道中心線與跑道中心線間之距離(m)								滑行道中心線與滑行道中心線間之距離（m）	除了停機位滑行路徑外之滑行道中心線到物體間之距離(m)	停機位滑行路徑中心線到物體間之距離(m)
	儀器跑道 跑道參考長度分類				非儀器跑道 跑道參考長度分類						
	1	2	3	4	1	2	3	4			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
A	82.5	82.5	--	--	37.5	47.5	--	--	23.75	16.25	12
B	87	87	--	--	42	52	--	--	33.5	21.5	16.5
C	--	--	168	--	--	--	93	--	44	26	24.5
D	--	--	176	176	--	--	101	101	66.5	40.5	36
E	--	--	--	182.5	--	--	--	107.5	80	47.5	42.5
F	--	--	--	190	--	--	--	115	97.5	57.5	50.5

註 1：表中第(2)-(9)欄的間距代表跑道及滑行道之一般組合，制訂這些距離之依據見 *ICAO Aerodrome Design Manual, Part 2*。

註 2：表中第(2)-(9)欄之間距不保證停等之飛機後方有足夠之空間讓平行滑行道上另一架飛機通過，請參考 *ICAO Aerodrome Design Manual, Part 2*。

3.10.3 **滑行道地帶內不應存有可能危及滑行中飛機之物體。*

註－滑行道地帶之排水設施位置及設計可能需要適度考量設計排水溝蓋，以防止飛機意外滑出滑行道時可能造成之損害。

3.10.4 **滑行道地帶沿滑行道中心線之中間部分應為一個平整區域，該區域邊緣與滑行道中心線之距離至少為：*

—11m：飛機大小分類為 A。

—12.5m：飛機大小分類為 B 或 C。

—19m：飛機大小分類為 D。

—22m：飛機大小分類為 E。

—30m：飛機大小分類為 F。

5.4.1.3 *指示牌應是易斷的。靠近跑道與滑行道之指示牌應低到足以與飛機螺旋槳及引擎間保持必要之淨距。其安裝高度應不超過表 5-4 對應欄中所示之尺寸。*

表 5-4 指示牌高度

表 5-4 滑行導引指示牌包括跑道出口指示牌之位置距離

跑道參考長度	指示牌高度(mm) 字 體	牌 面（最小值）	全 高（最大值）	滑行道鋪面邊緣與指示牌接近側之垂直距離(m)	跑道鋪面邊緣與指示牌接近側之垂直距離(m)
1 或 2	200	400	700	5-11	3-10
1 或 2	300	600	900	5-11	3-10
3 或 4	300	600	900	11-21	8-15
3 或 4	400	800	1100	11-21	8-15

1.7 飛航紀錄器

1.7.1 座艙語音紀錄器

該機裝置固態式座艙語音紀錄器（Solid-State Cockpit Voice Recorder, SSCVR），製造商爲 AlliedSignal 公司，件號及序號分別爲 980-6022-001 及 0735。所記錄之語音資料共 120 分鐘 56 秒，下載情形正常，記錄品質良好。

錄音抄件由該機落地前檢查始至打開客艙門止，共計 13 分鐘 49 秒如附錄 1。抄件時間係以座艙語音記錄器所記錄之時間參數爲基準，並轉換爲台北時間，涵蓋範圍包括該機落地前檢查、落地、滾行、滑出跑道、請求地面支援及回報事故狀況等過程。

1.7.2 飛航資料紀錄器

該機裝置固態式飛航資料紀錄器（Solid-State Flight Data Recorder，SSFDR），製造商爲 Honeywell 公司，件號及序號分別爲 980-4700-027 及 2853，紀錄飛航資料之時間共 25 小時。

本會依據取得之解讀文件[18]進行解讀，該機共記錄約 250 項飛航參數。相關參數解讀數據，飛航參數變化情形，及紀錄之飛航軌跡結果，詳附錄 2。

飛航資料記錄器解讀之資料均以世界標準時間參數（Coordinated Universal Time，UTC）爲準，並轉換爲台北時間（UTC+ 8 Hr）。SSFDR 紀錄資料摘錄如下：

1. 1446:22 時，主輪著陸，空速 111 浬/時，地速 121 浬/時，最大垂直加速度爲 1.08g，1、2 及 3 號液壓系統壓力正常。
2. 1446:23 時，主輪著陸後 1 秒，地面擾流板及 1、2、3、4 號擾流板展開。

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[18] 解讀文件為參考 SSFDR DATA INTERPRETATION-FLIGHT DATA RECORDER CONFIGURATION STANDARD，REV:A，DOCUMENT NO:RAE-C700-307，適用於機型 BD-700 Global Express，DAU 之序號：DA-810，件號：10604B1M04，紀錄速率：128 words/sec。

3. 1446:31 時，主輪著陸後 9 秒，鼻輪著陸，地速 95 浬/時，自動煞車解除。
4. 1446:32 時，主輪著陸後 10 秒，左外側地面擾流板收回；1446:48 時，主輪著陸後 26 秒，右外側地面擾流板收回。
5. 1446:39，主輪著陸後 17 秒，至 1446:42 時，3 號液壓系壓力由 2920psi 降至 416psi。
6. 1446:42 至 1446:46 時，主輪著陸後 20 秒，2 號液壓系壓力由 3092psi 降至 520psi。
7. 1447:16 時，主輪著陸後 54 秒，1 號及 4 號擾流板復原。
8. 1447:17 時，主輪著陸後 55 秒，該機航向開始右偏，地速 14 浬/時。
9. 1447:28 時，主輪著陸後 66 秒，該機地速 10 浬/時，航機右轉進入 D 滑行道。
10. 1447:49 時，主輪著陸後 87 秒，地速減爲 7 浬/時，該機繼續向右偏轉，偏出 D 滑行道。
11. 1448:15 時，主輪著陸後 113 秒，飛航資料紀錄器停止記錄，此時航向 249 度，航機停於 D 滑行道右側約 30 公尺處之草地上。

1.8 航空器撞擊資料

1.8.1 航空器損壞情形

右發動機反推力器仍於開展位置（詳圖 1.8-1），左內側主輪爆胎（詳圖 1.8-2），左內側主輪上方機翼次結構破裂，2、3 號液壓系管線斷折，左後襟翼扭力管斷裂，部分電線斷落（詳圖 1.8-3）。

圖 1.8-1　右發動機反推力器仍於開展位置

圖 1.8-2　左內側主輪爆胎

圖 1.8-3　左內側主輪上方機翼次結構破裂

1.8.2　撞擊現場測量

2、3 號液壓系洩漏之液壓油波濺於左側內、外主輪上，遺留左側內、外主輪軌跡及洩漏之液壓油痕跡在跑道及 D 滑行道上，如圖 1.8-4 所示。航機左主輪遺留於跑道及 D 滑行道之胎痕軌跡如圖 1.8-5 所示，鼻輪及右主輪於草地上之軌跡及停止位置無法清楚辨識，左主輪停止位置爲 E120°21’31.37” N22°34’33.21”，離 D 滑行道邊線垂直距離爲 25 公尺。

高雄機場航務組所提供由航機脫落之零件及其分布情形如圖 1.8-6 及圖 1.8-7 所示，觀察強制性指示牌發現上方有機翼擦過之痕跡，如圖 1.8-8 所示。

圖 1.8-4　左側內外主輪軌跡及液壓油洩漏痕跡圖

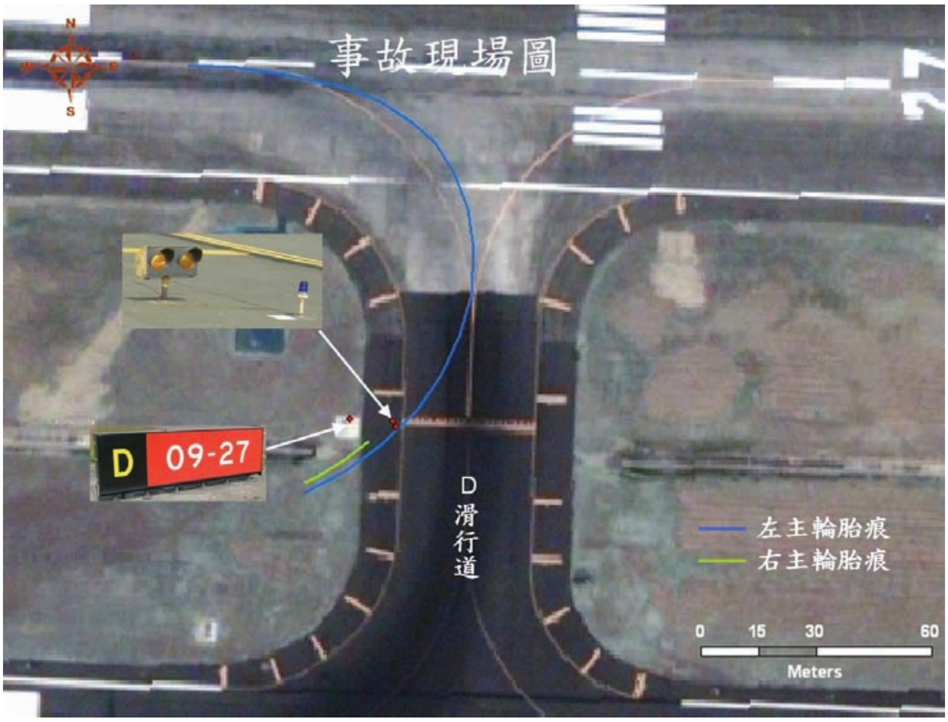

圖 1.8-5　事故現場航機左主輪遺留於跑道及 D 滑行道之胎痕軌跡

圖 1.8-6　由航機脫落之零件

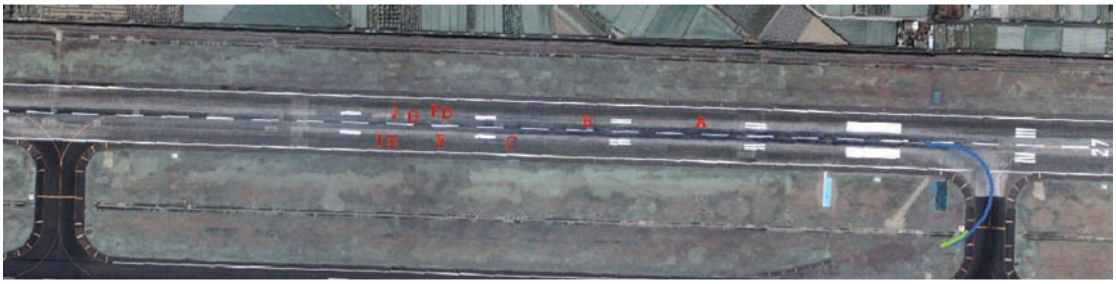

圖 1.8-7　由航機脫落之零件及其分布情形圖

圖 1.8-8　強制性指示牌磨損情形

1.9 測試與研究

專案調查機務分組分別於 2006 年 1 月 3 日及 1 月 5 日與 N998AM 機製造廠進行系統測試及輪胎鑑定。

2006 年 1 月 3 日，該機 2、3 號液壓系統損壞管路修復完成，專案調查小組於現場觀察其系統上電及液壓系統建壓情形，俟液壓系統空氣洩放正常後開始進行煞車系統測試。

煞車控制系統是一有防止打滑和自動煞車功能的電控煞車系統，煞車系統用來停止飛機以及防止主輪打滑之保護，於地面失去鼻輪轉向功能時可利用差壓煞車（differential braking）方式控制航機方向。煞車及防滑控制系統使用兩個控制頻道及兩套液壓系統，任何一個控制頻道或任何一套液壓系統失效時另一個控制頻道或另一套液壓系統仍能提供完整煞車控制。

當自動煞車未使用時，煞車系統的輸入訊號是依據煞車踏板位置轉換器，煞車踏板位置轉換器連接在駕艙的各個煞車踏板，移動煞車踏板的位置即改變轉換器輸出之電訊，此訊號送至煞車控制閥，煞車控制閥用這些電訊找出既定之煞車壓力去致動煞車。當使用自動煞車時，煞車系統的輸入訊號不來自於煞車踏板位置轉換器，而是由自動煞車系統自動提供既定訊號至煞車控制閥。

如果主輪無打滑情況，煞車控制訊號與施加在煞車踏板上的壓力成比例關係，當致動煞車時，煞車控制系統使用輪速轉換器的輸入訊號得知主輪的速度，如果輪速高於預期減速率，則該輪處於打滑狀態，此時煞車控制系統減低煞車壓力紓解主輪滑動現象，當主輪滑動現象解除時，系統增加煞車壓力再次致動煞車，如此操控的狀況發生非常快速，如此才能依據跑道條件讓煞車控制系統藉由調整煞車壓力以持續監控輪速。

煞車控制組件裝置於主電子艙中，其有兩個頻道（頻道 A 及頻道 B），各頻道皆由獨立的電力供電，頻道 A 使用 1 號匯流排之 28 伏直流電，控制內側（inboard）

主輪的煞車系統；頻道 B 使用電池匯流排之 28 伏直流電，控制外側（outboard）主輪的煞車系統。兩個頻道同時工作，如有任一個頻道失效，該側煞車系統就由另一個頻道接替操控，不致影響該機煞車性能。

煞車控制組件有兩個煞車控制卡及一個用於自動煞車及 EICAS/CAIMS 介面之自動煞車卡，一個煞車控制卡控制頻道 A，另一個煞車控制卡控制頻道 B，自動煞車卡透過自動控制選擇鈕與駕艙連結，自動煞車卡失效時會傳送訊號給 EICAS，自動煞車卡及 CAIMS 之間是經由 ARINC429 匯流排傳送資料，自動煞車卡及兩個煞車控制卡之間則是透過高速串列匯流排傳送資料。

煞車系統有六個主要組件爲煞車踏板感知器、煞車控制組件、煞車控制閥、煞車壓力感知器、輪速感知器及煞車組件。爲鑑定這些組件是否正常，於更換組件前後各進行一次煞車測試。更換元件前後之測試結果一致，四個主輪之煞車壓力皆能藉由踩踏煞車踏板將煞車壓力穩定增加至 3,000PSI。

由 N998AM 拆下之五個疑似故障組件除了煞車踏板感知器外，爲煞車控制組件、煞車控制閥、煞車壓力感知器、輪速感知器及煞車組件送至飛機製造廠進行功能測試。

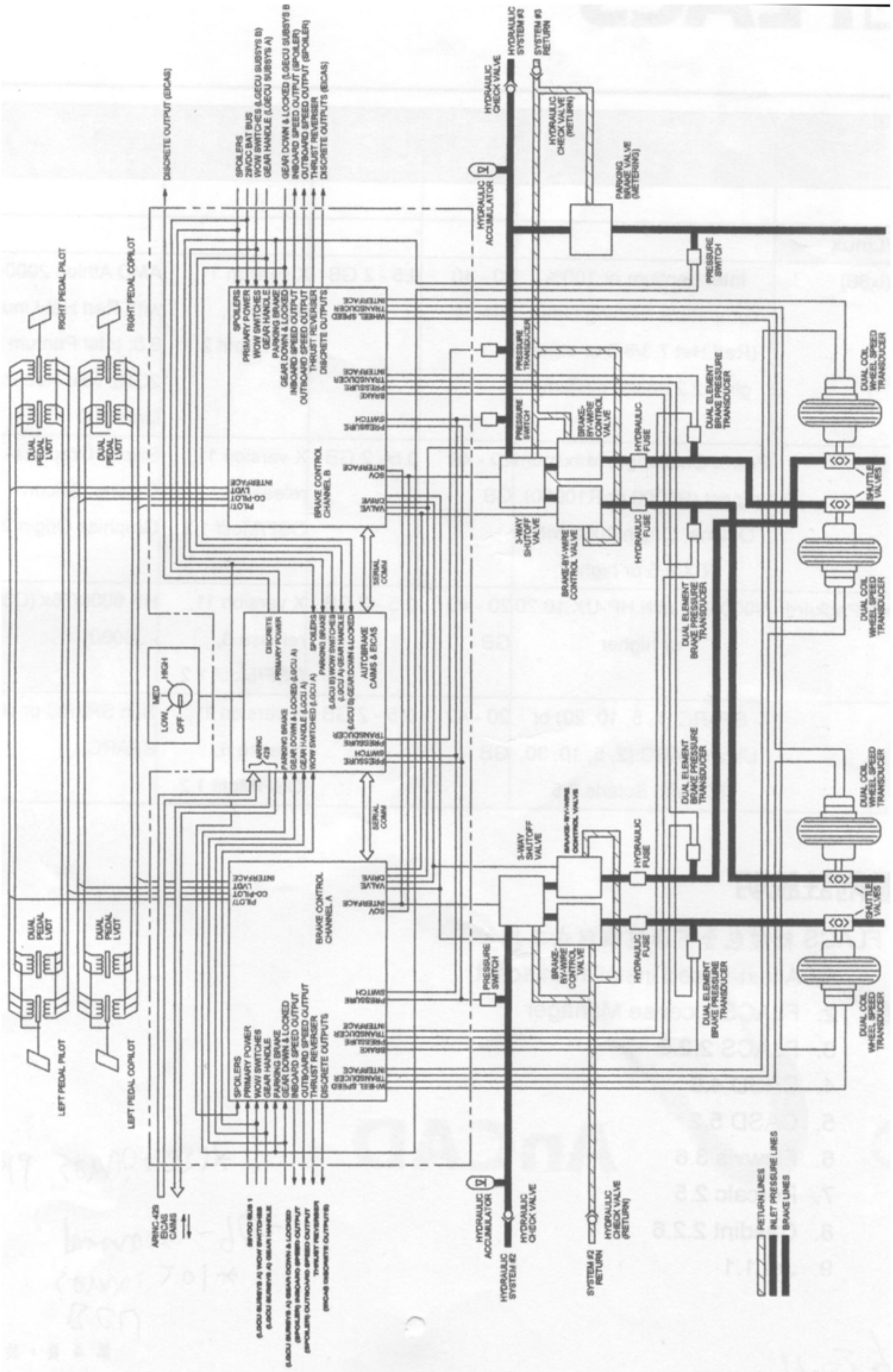

圖 1.9-1　煞車控制系統方塊圖

2006 年 1 月 5 日，固特異輪胎[19]（GOODYEAR TIRE）泰國及新加坡製造廠代表應邀抵達高雄小港機場 N998AM 修護棚場，航空器製造廠及操作人代表與專案調查小組一同參與 2 號輪胎[20]損壞原因鑑定，進行目視檢查，發現如下：

一約 10 英吋×8 英吋大小之胎面碎片，從輪胎的 12 點鐘位置至 3 點鐘位置脫離，留下一菱形缺口約佔胎面[21]面積的四分之一，損壞部位沒有熱生成和外物切割的現象（詳圖 1.9-2,3,4），胎環[22]（bead）和胎壁[23]（side wall）正常，內壁[24]（inner liner）有輕微皺紋。

胎面中間部位有一平面[25]（flat spot），並有一斜向裂紋（diagonal-break）貫穿其上（詳圖 1.9-5）。

圖 1.9-2　2 號輪胎損壞

[19]該機輪胎之設計製造廠商
[20]該型機主輪編號依序由左至右，故 2 號輪即為左內側主輪
[21]輪胎有溝槽設計與地面接觸磨耗之部位
[22]輪胎與輪轂接觸固定且密合之環狀位置
[23]輪胎之兩側，位於胎環與胎面之間
[24]內側胎壁及胎面
[25]該現象有稱削西瓜皮或切洋蔥

圖 1.9-3　損壞部位沒有熱生成和外物切割的現象

圖 1.9-4　胎面碎片自輪胎的 12 點鐘位置至 3 點鐘位置脫離

圖 1.9-5　胎面上有一平面，並有一斜向裂紋貫穿其上

檢查結果，輪胎本身並無熱生成及外物割切現象，胎環及胎壁檢視正常，內部些許皺折應係爆裂所致。觀察損壞情形，輪胎爆裂顯然是切西瓜現象（flat spot）或磨爆現象（skid burn）深入輪胎橡膠疊層，胎內高壓氣體推出輪胎碎片被機輪高速離心力的甩動與撞擊週遭結構的情形下與輪胎分離。

固特異輪胎報告書稱煞車鎖死可能是造成輪胎磨爆現象之原因,但是何原因造成煞車鎖死尚不得知。(報告詳附錄 3)

龐巴迪爾工程報告書稱可能係 2 號煞車控制閥（#2 Brake Control Valve）內部橡膠封圈安裝不良，使橡膠微粒剝離並卡住煞車控制閥，導致後續損壞。(報告詳附錄 4)

1.10　其他資料

1.10.1 訪談資料

1.10.1.1　操控駕駛員（PF）

事故航班爲 PF 當天任務的第二個航班，第一航班爲香港飛往中正機場。

該機自中正機場飛往高雄機場，途中一切正常，於近高雄時使用 ILS DME 09 跑道進場，由於以往只有使用輕度（Low）自動煞車的經驗，便將自動煞車設於『Medium』以體驗中度自動煞車之經驗。航機落地時一切正常，鼻輪觸地後反推力器正常展開，當時因 PM 感覺自動煞車有脈動現象（pulsation of the brake），便問 PF 是否已解除自動煞車，PF 表示並未解除，且未用腳踏板踩煞車。

航機速度漸慢後，PF 復置反推力把手，並解除自動煞車，此時 EICAS 螢幕上出現數個黃色警示及一個紅色警告，當時無暇視讀那些警告，感覺煞車還有些微作用，而航機正順著跑道方向滾行。

等速度更慢後，PM 宣告右發動機反推力器無法復置仍在開展位置，煞車失效，沒有液壓，鼻輪轉向失效。PF 繼續保持航機方向，無偏向現象，感覺煞車還有些微作用。PM 接著發現航機喪失 2 號及 3 號液壓系壓力，便以無線電通知航管並表示無法確定是否能脫離跑道。

PF 表示當航機接近 D 滑行道時，感覺煞車仍有些微作用，遂使用較大量右煞車，使航機右轉滑入 D 滑行道，進入滑行道後 PF 想繼續使用差量煞車控制航機方向，但即使使用全量煞車，PM 亦幫忙煞車，但都沒有任何作用，航機以很慢的速度右偏滑出 D 滑行道，並繼續滑行約 10 公尺後停止。當航機向 D 滑行道右側偏出時，PF 先將右發動機關俥，當航機滑出滑行道時，PF 再將左發動機關俥。

1.10.1.2　監控駕駛員（PM）

該機自中正機場飛往高雄機場，進場時一切正常，自動煞車設於『Medium』。航機落地時皆正常，滾行到某處時 EICAS 螢幕上出現多項警示，包括低液壓警示，而最上方有右反推力器故障（R T/R Failure）之紅色警告。便將警示告知 PF，同時由電腦選擇液壓系統頁面，發現 2 號及 3 號液壓系完全失效，沒有液壓油，沒有液壓壓力，沒有煞車功能，沒有鼻輪轉向功能，無地面擾流板及空中減速板功能

。

航機滾行方向還算正直，PM 將無法運作的系統告知 PF，並通知航管不確定是否能脫離跑道。

稍後，航機開始向右偏轉進入 D 滑行道，再以很慢的速度向右滑出 D 滑行道後停於草地上。在整個落地滑行至事故發生過程中，PM 除了最後飛機滑進草坪時協助踩踏煞車外，未插手任何操控作業。

第二章　分　析

2.1　機械因素

2.1.1　液壓系統失效原因

該機鼻輪轉向及煞車系統失效致使航機失控滑出跑道，係因液壓管路斷裂造成 2、3 號液壓系統失效所致，觀察斷裂液壓管路並非過載或疲勞因素，乃爲外力撞擊所致，撞毀液壓管的外物即是管路下方 2 號主輪爆裂之輪胎。爆裂輪胎上有一類似削洋蔥的 flat spot（平面），flat spot 後方胎面有交叉斜向裂口（diagonal-break）。依據固特異輪胎工程報告書結論，該機左內側主輪爆裂係爲航機於落地後煞車鎖死所導致。龐巴迪爾工程報告書指出煞車鎖死之原因可能爲 2 號 BCV（煞車控制閥）內部橡膠封圈因組裝不善使細微橡膠剝離卡住 2 號煞車控制閥，當 2 號主輪輪速低於航機速度時（主輪滑動之意），BCV 未能正確釋放足夠之煞車壓力，導致車輪鎖死。

綜上所述，該機駕駛艙 EICAM 上顯示 2、3 號液壓系統失效之原因，係因降落時駕駛員設定 BCU 爲中度自動煞車，主輪著陸後液壓系統壓力進入煞車系統，主輪煞車效果正常，當輪速逐漸慢於機速時，BCU 發訊號給 BCV 將煞車壓力釋放，但 2 號 BCV 因故障卡死未能將煞車壓力釋放，使 2 號主輪未能於滑動時被釋放而鎖死車輪，鎖死之 2 號主輪胎面持續摩擦跑道造成疊層漸少，終因強度不足而爆破，此時 2 號 BCV 可能因管路脈衝將橡膠微粒擠出卡住位置，2 號 BCV 液壓獲得釋放使 2 號主輪恢復滾轉，部分因爆破而掀起之胎面因滾動之離心力拍擊其上方空間，此可能爲造成駕駛員感覺脈動之原因。由 FDR 資料得知主輪著陸後 9 秒，自動煞車因駕駛員致動煞車踏板而解除，此時 2、3 號液壓系統壓力亦同時下降（參考附錄二飛航參數繪圖），顯示自動煞車解除前 2、3 號液壓管路已經斷裂，系統已經洩壓，亦表示爆裂輪胎開始轉動並造成結構損壞及 2、3 號液壓管線折斷，液壓油外漏致動警報。

該機係因輪胎爆裂打斷液壓管路，失去液壓及煞車系統以致偏出滑行道，若於起飛滾行時發生類似事故，則將使航機於空中增加操控難度，落地時之穩定進場及減速煞車亦無法確保。若於主輪上方改置防撞能力更強之保護蓋板，使集中於該區之液壓管路、傳輸電線、扭力管等不致於爆胎時損壞，該類事故發生當可避免。

2.1.2 航機轉向原因

PF 訪談資料顯示航機接近 D 滑行道時，感覺煞車仍有些微作用，FDR 資料顯示，航機轉入滑行道前，無煞車失效警告致動，煞車系統至少尚存 1500 PSI 以上之壓力。FDR 資料顯示，駕駛員僅施用及調整部份煞車踏板行程，顯示航機轉入滑行道時，煞車系統提供較實際煞車需要還多之餘裕。無論如何，畢竟當時 PF 使用較大量右煞車，該機向右偏轉滑入 D 滑行道。龐巴迪爾工程報告書 4.1.6 節指出該機有煞車壓力儲存設計，當正常煞車壓力低下，儲備煞車壓力系統會與正常煞車系統隔離，接替並繼續供應煞車壓力之功能，這儲備煞車壓力使該機於最後轉入滑行道。龐巴迪爾工程報告書 4.1.7 節指出該機進入滑行道後儲備煞車壓力亦隨之耗盡，煞車功能完全消失，該機持續先前之右轉弧度進入草坪。

2.2 場站因素

2.2.1 目視助航設施之安全設計

檢視 D 滑行道附近之滑行邊燈、跑道警戒燈及強制性指示牌，其設置位置、牌面高度及其易斷設計，均符合「民用機場設計暨運作規範」之相關規定。

2.2.2 精確進場跑道地帶整平

依據「民用機場設計暨運作規範」附篇 A 8.3「精確進場跑道地帶之整平」敘述：精確進場跑道地帶需要整平之範圍擴大到距跑道中心線 105m 處，再從跑道頭 300m 至 150m 處逐漸縮減成距中心線 75m，然後保持 75m 距離直至跑道地帶端點。

高雄國際機場 09/27 跑道中心線南北兩側具未加蓋之 V 型溝或圍牆，皆屬精確進場跑道地帶需要整平之範圍，不符合「民用機場設計暨運作規範」「精確進場跑道地帶整平」之規定，可能危害偏出跑道航空器之安全。

2.2.3 滑行道地帶排水溝蓋設計

依據「民用機場設計暨運作規範」第 3.10.2 節之表 3.1，飛機大小分類爲 E 之機場其滑行道地帶寬度應自滑行道中心線向兩側對稱地延伸 47.5m。第 3.10.3 節註－滑行道地帶之排水設施位置及設計可能需要適度考量設計排水溝蓋，以防止飛機意外滑出滑行道時可能造成之損害。

檢視高雄國際機場部分滑行道地帶內之未加蓋 V 型溝，不符合「民用機場設計暨運作規範」「滑行道地帶排水溝加蓋」之規定，可能危害偏出滑行道航空器之安全。

2.3 其他

駕駛員之航機操作與系統失效之可能肇因無關；飛航組員持有合格有效證照；該機持有符合民航法規之證件；查閱該機事故前一個月之相關維修紀錄，未發現異常系統故障紀錄。

本頁空白

第三章　結論

本會在此章中依據調查期間所搜集之事實資料綜合分析，總結以下三類調查結果：「**與可能肇因有關之調查發現**」、「**與風險有關之調查發現**」及「**其它調查發現**」，分述如下。

與可能肇因有關之調查發現

此類調查發現係屬已經顯示或幾乎可以確定爲與本事故發生有關之重要因素。其中包括：不安全作爲、不安全狀況或造成本次事故之安全缺失等。

與風險有關之調查發現

此類調查發現係涉及飛航安全之風險因素，包括未直接導致本次事故發生之不安全作爲、不安全條件及組織和整體性之安全缺失等，以及雖與本次事故無直接關連但對促進飛安有益之事項。

其它調查發現

此類調查發現係屬具有促進飛航安全、解決爭議或澄清疑慮之作用者。其中部分調查發現爲大眾所關切，且見於國際調查報告之標準格式中，以作爲資料分享、安全警示、教育及改善飛航安全之用。

3.1　與可能肇因有關之調查發現

1. 因 2 號 BCV 內部橡膠封圈組裝不善，使細微橡膠剝離卡住 2 號煞車控制閥，導致 2 號車輪煞車鎖死。（2.1.1）
2. 2 號主輪煞車鎖死導致輪胎爆裂，爆裂之胎皮撞斷液壓管路造成 2、3 號液壓系統失效。（2.1.1）
3. 2、3 號液壓系統失效使鼻輪轉向及煞車系統亦失去功能，造成該機偏入草坪。（2.1.2）

3.2 與風險有關之調查發現

1. 該機係因輪胎爆裂打斷液壓管路，失去液壓及煞車系統以致偏出滑行道，若該機於起飛滾行時發生類似事故，則將於空中增加操控難度，降落時之穩定進場及減速煞車亦無法確保。（2.1.1）
2. 高雄國際機場 09/27 跑道中心線南北兩側具未加蓋之 V 型溝及圍牆，皆屬精確進場跑道地帶需要整平之範圍，不符合「民用機場設計暨運作規範」「精確進場跑道地帶整平」之規定，可能危害偏出跑道航空器之安全。（2.2.2）
3. 檢視高雄國際機場部分滑行道地帶內之未加蓋 V 型溝設計，不符合「民用機場設計暨運作規範」「滑行道地帶排水溝加蓋」之規定，可能危害偏出滑行道航空器之安全。（2.2.3）

3.3 其它調查發現

1. 駕駛員之航機操作與飛機系統失效之可能肇因無關。（2.3）
2. 飛航組員持有合格有效證照。（2.3）
3. 該機持有符合民航法規之證件。（2.3）
4. 查閱該機事故前一個月之相關維修紀錄，未發現異常系統故障紀錄。（2.3）

第四章　飛安改善建議

4.1　改善建議

致加拿大龐巴迪爾飛機製造廠

1. 改善 BCV 內部橡膠封圈組裝不善之問題。-ASC-ASR-07-03-001
2. 加強主輪上方之液壓管路、電線、扭力管承受外物損害之能力。-ASC-ASR-07-03-002

致交通部民航局

1. 改善高雄國際機場 09/27 跑道中心線南北兩側具未加蓋之 V 型溝及圍牆,使符合「民用機場設計暨運作規範」「精確進場跑道地帶整平」之規定。(2.2.2) -ASC-ASR-07-03-003
2. 改善高雄國際機場部分滑行道地帶內之未加蓋 V 型溝設計,使符合「民用機場設計暨運作規範」「滑行道地帶排水溝加蓋」之規定。(2.2.3) -ASC-ASR-07-03-004

4.2　龐巴迪爾飛機製造廠對飛安會調查報告之意見(原文照列)

基於下列原因,起飛時極不似會發生類似之事故:(It is highly unlikely that this mode of failure would happen during the take off for the following reason.)

- 起飛時襟翼在 0、6 或 16 之位置(相較本案於落地之 30 度位置),系統損壞區域暴露減少。(At take off, the flaps are either at 0, or 6, or 16 Degrees (versus 30 Deg for landing case for this incident), and minimizes exposure area at Aux Spar where system installations are installed.)
- 起飛時,正常狀況下不會使用煞車踏板,故煞車控制閥不致作動肇致煞車鎖死。(At take off , there are normally no expected pedal inputs to cause BCV

to lock up.）

- 起飛時，煞車控制閥之類比（硬體）監控裝置，將略過相關之一個或兩個頻道輸入之信號，指示煞車控制閥將不受控制進入之液壓卸去，並將相關之煞車關閉閥，將受影響之主輪煞車及其對側相應主輪煞車之液壓移除（亦即同時移除兩個內側主輪或兩個外側主輪之煞車壓力）。（At Take off, the BCU analog (hardware) supervisor will over ride either / both channel inputs, and command the valve to dump an un-commanded brake pressure. Additionally the respective Brake Shut Off Valve (BSOV) is commanded closed, removing pressure from the effected brake, and its pair on the other side (i.e. hydraulic pressure removed from either the inboard or outboard pair.)）

同時必須注意的是該型機已完成認證，顯示即使兩套液壓系統失效情形下亦具備殘餘液壓落地之能力。本案顯示當航機依據飛行手冊操作時，煞車儲壓器於失去2、3號液壓系統後仍提供適當煞車壓力。（Also it must be noted that the aircraft has been certified, and shown to be capable of landing with the remaining hydraulic system, even after loss of two other hydraulic systems. The brake accumulators have been shown to provide adequate braking after loss of their respective hydraulic systems 2,3 failures, when the aircraft is operated per appropriate AFM procedures.）

本案之煞車系統對照圖並未說明煞車儲壓器所具備之功能，在液壓系統耗盡後，煞車儲壓器將發揮煞車功能。駕駛員可藉此減速並操控飛機離開跑道進入滑行道。一旦他們有效使用差壓煞車轉向，儲壓器壓力即會隨之耗盡。（The synopsis of the brake system did not explain the role the brake accumulators played in this incident. The accumulators permitted braking after the hydraulic systems depleted. The pilots were able to slow the aircraft enough to attempt a controlled exit from the runway at the taxiway. Only once they got differential braking involved trying to effect the turn, did they deplete the accumulators to zero pressure.）

在瞭解煞車儲壓器提供適當煞車能力之事實下評估若於起飛階段發生類似之事故，我們相信這種情形較本案發生於落地階段更爲嚴重。We believe the assessment of what may happen in the event this were to occur on take-off describes a scenario that may be more severe than the reality considering the brake accumulators do provide the stopping capability needed for the next landing.

4.3　高雄國際機場於事故後已改善之事項

4.3.1　北面圍牆

跑道北面圍牆距跑道中心線最近距離爲 102 公尺，不符合「民用機場設計及運作規範」跑道地帶寬度標準，在高雄機場主計畫中已核定向北面徵購土地至跑道中心線 150 公尺範圍內。若要包含圍牆外移以及北面環場道之建置空間，則需徵收土地至跑道中心線北面 167.5 公尺處，目前已修正徵收土地計劃待行政院經濟建設委員會審核中，俟核定後即辦理都市計畫變更及土地徵收作業。

4.3.2　V 型溝

跑道地帶內位於跑道南北側之 V 型溝，於 95 年 10 月 5 日完成加蓋工程（如下圖），且加蓋區域坡度符合小於 2.5％之規定。

	
北側 V 型溝現況	南側 V 型溝現況

本頁空白

附錄一　N998AM 座艙語音紀錄器英文抄件

符號說明：

PF（Pilot Flying）：操控駕駛員

PM（Pilot Monitoring）：監視駕駛員

FE（Flight Engineer）：飛航工程師

CAM（Cockpit Area Microphone）：駕駛艙區域麥克風

TWR（Kaohsiung Tower Control）：高雄塔台

…：無法辨識之語音

( )：語音之說明或編輯之註解

*：無意義之感嘆語

當地時間	音源	內容
14:42:02	PF	gear down before landing check
14:42:07	CAM	(sound similar to landing gear wheel well door opening)
14:42:24	PM	three green
14:42:25	PF	roger
14:42:26	PM	external light still pulsing passenger sign is on wing … off flight spoilers are retracted slats sixteen
14:42:34	PF	here we go full flaps
14:42:37	PM	landing check complete
14:42:38	PF	thank you
14:42:39	TWR	november niner niner eight alpha mike runway zero niner clear to land wind two four zero at eight
14:42:46	PM	cleared to land and two four at eight niner niner eight alpha mike
14:42:58	PF	uh slight tail wind
14:45:14	CAM	approaching zero nine
14:45:27	PF	lights are insight there is the runway

當地時間	音源	內容
14:45:42	PF	autopilot is going off
14:45:44	CAM	(sound similar to autopilot disengaged)
14:45:57	CAM	minimums minimums
14:46:02	PF	ref plus ten
14:46:10	CAM	Fifty
14:46:12	CAM	Thirty
14:46:16	CAM	Ten
14:46:21	CAM	(sound similar to touch down)
14:46:28	PM	okay you cut off the autobrake I think
14:46:31	PF	No
14:46:33	CAM	five thousand remaining
14:46:36	CAM	(high chime)
14:46:41	PF	what was that for
14:46:41	CAM	four thousand remaining
14:46:43	PM	flap flap failure
14:46:45	PF	yah bunch of things
14:46:47	PM	hydraulic three low hydraulic two low
14:46:49	TWR	november niner niner eight alpha mike vecate delta contact ground one two one point niner
14:46:51	PM	thrust reversers hang on one second
14:46:53	PF	Sure
14:46:59	PM	okay one two one point niner nine nine eight alpha mike
14:47:04	PF	Okay
14:47:06	PF	got brakes still
14:47:07	PM	you got brakes
14:47:11	PM	and okay we're stuck in reverse on one engine
14:47:16	PF	uh huh
14:47:17	PM	hey *
14:47:25	CAM	(high chime)
14:47:27	PM	nose wheel steering fail just just stop it
14:47:30	PF	use the brakes I can get off if you
14:47:32	PM	try it and see if you can get off
14:47:33	PF	yah going slow
14:47:35	PM	and tower november nine nine eight alpha mike just to advise you we get a problem here hydraulic failures and we lost nose wheel steering we are going to try to get off the runway for you here but we might not be able to taxi any further

當地時間	音源	內容
14:47:49	PM	okay watch it stop stop
14:47:50	TWR	november niner niner eight alpha mike confirm still on runway
14:47:52	PF	I am trying
14:47:53	PF	I haven't got anything I got nothing you got anything
14:47:56	PM	god dame it
14:47:58	PF	I got nothing
14:47:58	CAM	(high chime)
14:47:58	TWR	confirm you have vecated runway
14:48:01	PM	affirmative we have lost nose wheel steering
14:48:04	PF	engine is coming off
14:48:05	CAM	(sound similar to master warning)
14:48:06	PF	Up
14:48:07	CAM	right reverser unlock
14:48:07	TWR	november niner niner eight alpha mike roger and please contact ground one two one point niner for further instruction
14:48:13	CAM	(high chime)
14:48:13	PM	nine nine eight alpha mike
14:48:14	CAM	(sound similar to engine spool down)
14:48:16	CAM	(high chime)
		(four minutes and two seconds missing)
14:52:18	PM	we lost everything hydraulically we lost nose wheel steering we lost parking brake we lost emergency brake I mean we we didn't have anything you know
14:52:30	PM	we no we didn't have any brakes we didn't have brakes we didn't have emergency brakes we didn't have nose wheel steering we didn't have anything you know
14:52:40	PM	well the aircraft you know intially had brakes and it started stopping and uh like I said as we got to the point where the aircraft got we we were trying to get off the runway and at that point uh everything went I mean you know we lost everything I mean you know we have lost we have lost everything so
14:53:09	CAM	(high chime)
14:53:11	PM	well I you know * is onboard the next step that I think would be to see how to get the airplane
14:53:18	FE	... we need to tow it with a tug

當地時間	音源	內容
14:53:20	PM	yeh we'll need a tug but you know I'm a little concerned because we're on the grass how firm it is and that sort of stuff so
14:53:26	PM	I I think * would probably have to talk to you know bombardier or what ever you know and will
14:53:32	PM	you know before we proceed any further we'll make sure that we're not doing any misteps or anything like that from this point on but uh
14:53:39	PF	we lost both hydraulic reservoirs
14:53:45	PM	uh well we got people coming out onboard right now and I'm sure I I see a veichle coming and uh you … ya
14:53:58	PM	* is onboard so uh I guess you can call and figure out what they are doing here right now you know
14:54:03	CAM	(high chime)
14:54:05	PM	and I guess our next step is to try to figure out what happened to us here you know so
14:54:13	FE	… status
14:54:14	PM	well we we got it it looks like uh
14:54:17	PF	Normal
14:54:19	PM	it it looks like we lost all the hydraulics and in one and two as of right now you know
14:54:25	PF	Uh
14:54:27	PM	well we getting we we getting that you know we have complete failure you know on number two and three I should say and that obviously one B failed also but I we have number one system but there's no brakes and nose wheel steering on the number one system that's the problem you know
14:54:51	PM	well it's a hydraulic issue in other words nose wheel steering
14:54:59	PM	correct nose wheel steering is on the uh number three system you know and brakes on the number three and number two system so uh okay
14:55:20	PM	well I I don't know what's happening from this stand point I think my next personal call is I need to call *
14:55:27	PM	what time is it there you know
14:55:29	FE	in the morning
14:55:32	FE	no midnight
14:55:33	PF	no midnight

當地時間	音源	內容
14:55:33	PM	midnight
14:55:35	PM	don't you agree you think I should probably call him
14:55:45	FE	I'm open the door is that okay
14:55:47	PM	okay he is gonna go ahead and open the door and we're going to start looking at the main gear and that sort of stuff if we find that we ran over anything or looks like we got any damage
14:55:51	CAM	(sound similar to door opened)

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附錄二　SSFDR 飛航參數列表及繪圖

- 飛航參數列表
- 飛航參數繪圖

飛航參數列表

Time	UTC	WOW			CoPilot	Park/Emer	Master	Ground	IAS
		LMG	NG	RMG	MSK/BM	Brk On	Warning	Speed	
(sec)	(sec)	(discr)	(discrt)	(discrt)	(discrt)	(discrt)	(discrt)	(knots)	(knots)
92605	06:45:59	Air	air	air	-	-	-	134	126
92606		Air	air	air	-	-	-	134	122
92607		Air	air	air	-	-	-	133	123
92608		Air	air	air	-	-	-	133	123
92609	06:46:03	Air	air	air	-	-	-	133	124
92610		Air	air	air	-	-	-	133	122
92611		Air	air	air	-	-	-	133	122
92612		Air	air	air	-	-	-	132	125
92613	06:46:07	Air	air	air	-	-	-	132	122
92614		Air	air	air	-	-	-	132	124
92615		Air	air	air	-	-	-	132	124
92616		Air	air	air	-	-	-	132	126
92617	06:46:11	Air	air	air	-	-	-	131	122
92618		Air	air	air	-	-	-	131	120
92619		Air	air	air	-	-	-	130	118
92620		Air	air	air	-	-	-	129	121
92621	06:46:15	Air	air	air	-	-	-	128	120
92622		Air	air	air	-	-	-	127	118
92623		Air	air	air	-	-	-	126	116
92624		Air	air	air	-	-	-	125	116
92625	06:46:19	Air	air	air	-	-	-	124	117
92626		Air	air	air	-	-	-	123	115
92627		Air	air	air	-	-	-	123	113
92628		Air	air	GND	-	-	-	121	111
92629	06:46:23	GND	air	air	-	-	-	119	110
92630		GND	air	GND	-	-	-	117	108
92631		GND	air	GND	-	-	-	115	107
92632		GND	air	GND	-	-	-	111	104
92633	06:46:27	GND	air	GND	-	-	-	108	100

Time	UTC	WOW			CoPilot	Park/Emer	Master	Ground	IAS
		LMG	NG	RMG	MSK/BM	Brk On	Warning	Speed	
(sec)	(sec)	(discr)	(discrt)	(discrt)	(discrt)	(discrt)	(discrt)	(knots)	(knots)
92634		GND	air	GND	-	-	-	106	98
92635		GND	air	GND	-	-	-	104	96
92636		GND	air	GND	-	-	-	100	94
92637	06:46:31	GND	GND	GND	-	-	WRN	95	90
92638		GND	GND	GND	-	-	-	90	84
92639		GND	GND	GND	-	-	-	86	80
92640		GND	GND	GND	-	-	-	83	78
92641	06:46:35	GND	GND	GND	-	-	-	80	74
92642		GND	GND	GND	-	-	-	77	72
92643		GND	GND	GND	-	-	-	74	68
92644		GND	GND	GND	-	-	-	71	64
92645	06:46:39	GND	GND	GND	-	-	WRN	67	60
92646		GND	GND	GND	-	-	-	64	56
92647		GND	GND	GND	-	-	WRN	60	51
92648		GND	GND	GND	-	-	-	57	48
92649	06:46:43	GND	GND	GND	-	-	-	54	44
92650		GND	GND	GND	-	-	-	51	43
92651		GND	GND	GND	-	-	WRN	48	40
92652		GND	GND	GND	-	-	-	45	36
92653	06:46:47	GND	GND	GND	-	-	WRN	43	34
92654		GND	GND	GND	-	-	-	41	32
92655		GND	GND	GND	-	-	WRN	39	30
92656		GND	GND	GND	-	-	-	37	30
92657	06:46:51	GND	GND	GND	-	-	WRN	35	30
92658		GND	GND	GND	-	-	-	33	30
92659		GND	GND	GND	-	-	WRN	31	30
92660		GND	GND	GND	-	-	-	29	30
92661	06:46:55	GND	GND	GND	-	-	WRN	27	30
92662		GND	GND	GND	-	-	-	25	30
92663		GND	GND	GND	-	-	WRN	24	30
92664		GND	GND	GND	-	-	-	22	30

Time	UTC	WOW			CoPilot	Park/Emer	Master	Ground	IAS
		LMG	NG	RMG	MSK/BM	Brk On	Warning	Speed	
(sec)	(sec)	(discr)	(discrt)	(discrt)	(discrt)	(discrt)	(discrt)	(knots)	(knots)
92665	06:46:59	GND	GND	GND	PTT	-	WRN	20	30
92666		GND	GND	GND	PTT	-	-	19	30
92667		GND	GND	GND	PTT	-	WRN	19	30
92668		GND	GND	GND	-	-	-	18	30
92669	06:47:03	GND	GND	GND	-	-	WRN	18	30
92670		GND	GND	GND	-	-	-	18	30
92671		GND	GND	GND	-	-	WRN	18	30
92672		GND	GND	GND	-	-	-	18	30
92673	06:47:07	GND	GND	GND	-	-	WRN	18	30
92674		GND	GND	GND	-	-	-	17	30
92675		GND	GND	GND	-	-	WRN	16	30
92676		GND	GND	GND	-	-	-	16	30
92677	06:47:11	GND	GND	GND	-	-	WRN	15	30
92678		GND	GND	GND	-	-	-	14	30
92679		GND	GND	GND	-	-	WRN	14	30
92680		GND	GND	GND	-	-	-	14	30
92681	06:47:15	GND	GND	GND	-	-	WRN	14	30
92682		GND	GND	GND	-	-	-	14	30
92683		GND	GND	GND	-	-	WRN	14	30
92684		GND	GND	GND	-	-	-	14	30
92685	06:47:19	GND	GND	GND	-	-	WRN	13	30
92686		GND	GND	GND	-	-	-	13	30
92687		GND	GND	GND	-	-	WRN	13	30
92688		GND	GND	GND	-	-	-	13	30
92689	06:47:23	GND	GND	GND	-	-	WRN	12	30
92690		GND	GND	GND	-	-	-	12	30
92691		GND	GND	GND	-	-	WRN	12	30
92692		GND	GND	GND	-	-	-	12	30
92693	06:47:27	GND	GND	GND	-	-	WRN	11	30
92694		GND	GND	GND	-	-	-	10	30
92695		GND	GND	GND	-	-	WRN	9	30

Time	UTC	WOW			CoPilot	Park/Emer	Master	Ground	IAS
		LMG	NG	RMG	MSK/BM	Brk On	Warning	Speed	
(sec)	(sec)	(discr)	(discrt)	(discrt)	(discrt)	(discrt)	(discrt)	(knots)	(knots)
92696		GND	GND	GND	-	-	-	8	30
92697	06:47:31	GND	GND	GND	-	-	WRN	7	30
92698		GND	GND	GND	-	-	-	6	30
92699		GND	GND	GND	-	-	WRN	6	30
92700		GND	GND	GND	-	-	-	5	30
92701	06:47:35	GND	GND	GND	PTT	-	WRN	5	30
92702		GND	GND	GND	PTT	-	-	5	30
92703		GND	GND	GND	PTT	-	WRN	5	30
92704		GND	GND	GND	PTT	-	-	5	30
92705	06:47:39	GND	GND	GND	PTT	-	WRN	5	30
92706		GND	GND	GND	PTT	-	-	5	30
92707		GND	GND	GND	PTT	-	WRN	5	30
92708		GND	GND	GND	PTT	-	-	5	30
92709	06:47:43	GND	GND	GND	PTT	-	WRN	5	30
92710		GND	GND	GND	PTT	-	-	6	30
92711		GND	GND	GND	PTT	-	WRN	6	30
92712		GND	GND	GND	PTT	-	-	6	30
92713	06:47:47	GND	GND	GND	-	-	WRN	6	30
92714		GND	GND	GND	-	-	-	7	30
92715		GND	GND	GND	-	-	WRN	7	30
92716		GND	GND	GND	-	-	-	7	30
92717	06:47:51	GND	GND	GND	-	-	WRN	7	30
92718		GND	GND	GND	-	-	-	8	30
92719		GND	GND	GND	-	-	WRN	8	30
92720		GND	GND	GND	-	-	-	8	30
92721	06:47:55	GND	GND	GND	-	-	WRN	8	30
92722		GND	GND	GND	-	-	-	9	30
92723		GND	GND	GND	-	-	WRN	9	30
92724		GND	GND	GND	-	-	-	9	30
92725	06:47:59	GND	GND	GND	-	-	-	10	30
92726		GND	GND	GND	-	-	-	10	30

Time	UTC	WOW			CoPilot	Park/Emer	Master	Ground	IAS
		LMG	NG	RMG	MSK/BM	Brk On	Warning	Speed	
(sec)	(sec)	(discr)	(discrt)	(discrt)	(discrt)	(discrt)	(discrt)	(knots)	(knots)
92727		GND	GND	GND	PTT	-	WRN	10	30
92728		GND	GND	GND	PTT	-	-	10	30
92729	06:48:03	GND	GND	GND	PTT	-	WRN	10	30
92730		GND	GND	GND	PTT	-	-	9	30
92731		GND	GND	GND	-	-	WRN	8	30
92732		GND	GND	GND	-	-	WRN	6	30
92733	06:48:07	GND	GND	GND	-	-	WRN	5	30
92734		GND	GND	GND	-	-	WRN	3	30
92735		GND	GND	GND	-	-	WRN	2	30
92736		GND	GND	GND	-	-	WRN	1	30
92737	06:48:11	GND	GND	GND	-	-	WRN	0	30
92738		GND	GND	GND	-	-	WRN	1	30
92739		GND	GND	GND	-	-	-	1	30
92740		GND	GND	GND	PTT	-	WRN	1	30

Time	UTC	RALT	Drift	Roll	Pitch	Pitch	Mag.	Wind	Wind
			Angle	Attitude	Attitude	Trim/stab	Hdg	Direction	Speed
(sec)	(sec)	(feet)	(deg)	(deg)	(deg)	(deg)	(deg)	(deg)	(knots)
92605	06:45:59	212		4.75	0	0	95		10
92606		180		4.75	0.53	0	96	247.5	
92607		171		1.41	1.41	0	97		
92608		146	-2.2	1.93	1.76	-0.1	97		
92609	06:46:03	129		0.88	1.76	0	97		10.2
92610		119		-0.88	1.85	0	97	240.8	
92611		114		1.23	1.67	0.1	98		
92612		100	-2.5	-2.81	1.58	0.1	98		
92613	06:46:07	89		-1.05	1.05	0	97		10.5
92614		83		0	0.79	0.1	97	237.5	
92615		61		-0.53	1.67	0.2	97		
92616		55	-1.6	-4.04	1.85	0.1	96		
92617	06:46:11	40		-0.35	1.67	-0.1	96		10.2
92618		35		0	3.08	-0.2	95	256.3	
92619		26		2.29	3.87	-0.1	96		
92620		17	-1.3	1.58	4.13	-0.1	96		
92621	06:46:15	15		1.58	4.31	-0.1	96		9
92622		10		-2.29	3.87	0.1	96	250.7	
92623		11		-0.35	4.39	0	96		
92624		4	-1.4	1.05	5.01	-0.1	96		
92625	06:46:19	1		0	5.45	-0.1	96		7.5
92626		3		0.18	4.83	-0.1	96	251	
92627		3		1.76	4.75	0	96		
92628		3	-1.4	1.05	5.71	-0.1	97		
92629	06:46:23	1		-1.05	4.83	0.6	96		10.5
92630		1		-1.58	3.69	0.4	96	264.4	
92631		0		-1.41	4.83	0	95		
92632		0	0.3	-0.35	4.48	-0.5	95		
92633	06:46:27	0		0	2.9	-0.2	94		7.5
92634		1		0	2.81	-0.2	94	274.9	
92635		1		0.53	2.2	-0.2	94		

Time	UTC	RALT	Drift Angle	Roll Attitude	Pitch Attitude	Pitch Trim/stab	Mag. Hdg	Wind Direction	Wind Speed
(sec)	(sec)	(feet)	(deg)	(deg)	(deg)	(deg)	(deg)	(deg)	(knots)
92636		1	0.1	0.35	1.32	-0.4	94		
92637	06:46:31	1		0	0.88	0.1	94		6.5
92638		1		-0.18	0.7	0.3	94	261.9	
92639		1		-0.18	0.53	0	95		
92640		1	-0.6	-0.35	0.7	0.3	95		
92641	06:46:35	1		-0.18	0.44	-0.1	95		7.2
92642		1		0	0.44	0	95	264.7	
92643		1		0	0.35	-0.1	95		
92644		1	0.2	0.53	0.18	-0.3	95		
92645	06:46:39	1		0.35	0	-0.3	94		8
92646		2		0.53	-0.09	0.1	94	269.3	
92647		1		0.35	0	-0.4	94		
92648		2	0.2	0.35	0	-0.1	94		
92649	06:46:43	1		0.35	-0.09	-0.2	94		9.5
92650		1		0.18	-0.09	-0.1	94	268.9	
92651		1		0.18	0	0	94		
92652		1	-0.9	0	-0.09	-0.4	94		
92653	06:46:47	1		-0.35	0	0.3	94		9.5
92654		1		-0.53	0	0.1	95	268.9	
92655		2		-0.35	-0.09	0.1	95		
92656		1	-0.8	-0.35	-0.18	0	95		
92657	06:46:51	1		-0.35	0.09	0.2	95		9.5
92658		1		0	0	-0.1	95	268.9	
92659		1		-0.35	-0.09	-0.1	95		
92660		1	-1	0.18	-0.09	-0.1	95		
92661	06:46:55	1		0	-0.09	0	94		9.5
92662		1		-0.18	-0.09	0	94	268.9	
92663		1		-0.18	-0.09	0	94		
92664		1	-1.2	-0.18	-0.09	0	94		
92665	06:46:59	2		-0.18	-0.09	0.1	94		9.5
92666		1		-0.18	-0.09	-0.1	94	359.8	

Time	UTC	RALT	Drift	Roll	Pitch	Pitch	Mag.	Wind	Wind
			Angle	Attitude	Attitude	Trim/stab	Hdg	Direction	Speed
(sec)	(sec)	(feet)	(deg)	(deg)	(deg)	(deg)	(deg)	(deg)	(knots)
92667		1		0	0.09	-0.1	94		
92668		1	-1.2	-0.18	0	0	94		
92669	06:47:03	1		-0.35	0.09	0	94		255.8
92670		1		-0.35	0	0.1	94	359.8	
92671		1		-0.35	-0.09	0.1	94		
92672		1	-1.6	-0.35	0	0	95		
92673	06:47:07	2		-0.53	0.09	0	95		255.8
92674		2		-0.35	0	0	95	359.8	
92675		1		-0.18	0	-0.1	94		
92676		0	-2	-0.18	0	-0.1	94		
92677	06:47:11	1		-0.18	0	-0.1	94		255.8
92678		1		-0.35	0	0	94	359.8	
92679		1		-0.35	0.09	0.1	94		
92680		1	-1.8	-0.35	0.09	0.1	94		
92681	06:47:15	1		-0.35	0.09	0	95		255.8
92682		2		-0.35	0.09	0.1	95	359.8	
92683		1		-0.35	0.09	0.1	95		
92684		2	-2.3	-0.35	0	0.1	96		
92685	06:47:19	1		-0.18	0	-0.1	96		255.8
92686		0		0	0	0	96	359.8	
92687		1		0	-0.09	-0.1	96		
92688		2	-2.4	0.18	0	-0.1	96		
92689	06:47:23	1		0.35	0	0	96		255.8
92690		1		0.18	-0.09	0.1	96	359.8	
92691		1		0.35	-0.18	-0.1	97		
92692		1	0	0.35	-0.18	0	97		
92693	06:47:27	1		0.35	-0.18	0.1	97		255.8
92694		2		0.53	-0.18	0.1	98	359.8	
92695		2		0.53	-0.18	0.1	99		
92696		1	0	0.53	-0.26	0	100		
92697	06:47:31	1		0.35	-0.18	0.1	102		255.8

Time	UTC	RALT	Drift	Roll	Pitch	Pitch	Mag.	Wind	Wind
			Angle	Attitude	Attitude	Trim/stab	Hdg	Direction	Speed
(sec)	(sec)	(feet)	(deg)	(deg)	(deg)	(deg)	(deg)	(deg)	(knots)
92698		1		0.53	-0.18	0.1	104	359.8	
92699		1		0.53	-0.26	0	107		
92700		1	0	0.53	-0.35	0.1	109		
92701	06:47:35	1		0.35	-0.35	0.1	112		255.8
92702		1		0.35	-0.44	0.1	116	359.8	
92703		1		0.35	-0.44	0.2	119		
92704		1	0	0.35	-0.53	0.1	123		
92705	06:47:39	1		0.35	-0.62	0.2	127		255.8
92706		1		0.18	-0.62	0.2	131	359.8	
92707		1		0.35	-0.7	0.1	135		
92708		1	0	0.18	-0.7	0.1	139		
92709	06:47:43	1		0.18	-0.79	0.2	143		255.8
92710		1		0	-0.88	0.1	148	359.8	
92711		1		0	-1.05	0.2	153		
92712		2	0	0	-1.05	0.2	157		
92713	06:47:47	1		0.53	-0.97	0	162		255.8
92714		1		0.18	-0.88	0.2	166	359.8	
92715		1		0.18	-0.88	0.2	171		
92716		1	0	0.18	-0.88	0.3	175		
92717	06:47:51	1		0.18	-0.7	0.2	180		255.8
92718		1		0.18	-0.7	0.2	185	359.8	
92719		1		0.18	-0.62	0.2	189		
92720		1	0	0.18	-0.88	0.3	194		
92721	06:47:55	1		0.18	-0.97	0.2	199		255.8
92722		1		0	-0.88	0.3	203	359.8	
92723		2		0	-0.79	0.3	208		
92724		1	0	-0.18	-0.88	0.3	213		
92725	06:47:59	1		-0.18	-0.88	0.3	217		255.8
92726		2		1.05	-0.88	-0.1	221	359.8	
92727		1		0.18	-1.67	0.4	226		
92728		1	0	0.35	-1.76	0.2	230		

Time	UTC	RALT	Drift	Roll	Pitch	Pitch	Mag.	Wind	Wind
			Angle	Attitude	Attitude	Trim/stab	Hdg	Direction	Speed
(sec)	(sec)	(feet)	(deg)	(deg)	(deg)	(deg)	(deg)	(deg)	(knots)
92729	06:48:03	1		2.29	-0.44	0.2	234		255.8
92730		1		0.35	0.7	0.8	237	359.8	
92731		2		1.23	1.14	0.1	240		
92732		1	0	1.58	0.97	-0.3	242		
92733	06:48:07	1		1.76	0.62	-0.3	245		255.8
92734		1		1.41	0.35	-0.1	247	359.8	
92735		2		1.23	0.26	-0.3	248		
92736		2	0	0.88	0.26	-0.3	249		
92737	06:48:11	2		1.05	0.35	-0.1	249		255.8
92738		2		0.88	0.44	-0.2	249	359.8	
92739		2		0.88	0.44	-0.2	249		
92740		2	0	0.88	0.44	-0.2	249		

Time	UTC	Aileron		Column Pos		Elev Pos		Flap	Grd Spoiler	
		L	R	FO	Capt	L	R	Pos	LO	RO
(sec)	(sec)	[deg)	[deg)	(deg)	(deg)	(deg)	(deg)	(deg)	(discrt)	(discrt)
92605	06:45:59	-3	-2	-0.06	0	-3.19	-2.58		-	-
92606		-8	-6	0	0	-3.31	-3.12	30.3	-	-
92607		0	0	-0.06	0	-3.94	-3.59		-	-
92608		-1	-1	-0.06	0	-3.75	-3.83	30.3	-	-
92609	06:46:03	-6	-5	-0.06	0	-3.38	-3.75		-	-
92610		2	1	-0.06	0	-2.94	-2.58	30.3	-	-
92611		-7	-7	0	0	-2.75	-2.5		-	-
92612		-1	-1	0	0	-2.75	-2.42	30.3	-	-
92613	06:46:07	0	0	-0.06	0	-2.56	-2.11		-	-
92614		-5	-4	0	0	-3.69	-3.83	30.3	-	-
92615		-7	-5	0	0	-3.5	-2.81		-	-
92616		6	7	-0.06	0	-2.81	-2.5	30.3	-	-
92617	06:46:11	4	5	0	0	-5.19	-5.39		-	-
92618		5	5	0	0	-4.31	-3.91	30.3	-	-
92619		3	1	0	0	-4.5	-3.98		-	-
92620		0	0	0	0	-4.81	-4.45	30.3	-	-
92621	06:46:15	-2	-5	0	0	-3.75	-3.44		-	-
92622		4	5	0	0	-5.81	-5.62	30.3	-	-
92623		3	3	0	0	-6.94	-6.09		-	-
92624		1	1	-0.06	0	-7.19	-5.86	30.3	-	-
92625	06:46:19	1	1	0	0	-6.56	-4.77		-	-
92626		4	3	0	0	-5.12	-5.23	30.3	-	-
92627		-1	0	0	0	-7.69	-7.81		-	-
92628		-8	-8	0	0	-6.81	-6.25	30.3	-	-
92629	06:46:23	-2	-3	0	0	-8.81	-8.52		DEP	DEP
92630		-2	-2	0	0	-15.06	-12.27	30.3	DEP	DEP
92631		-4	-3	0	0	-6.31	-6.17		DEP	DEP
92632		-3	-2	0	0	-5.5	-5.47	30.3	DEP	DEP
92633	06:46:27	-3	-3	0	0	-22.5	-21.25		DEP	DEP
92634		-1	-1	-0.06	0	-9.81	-9.92	30.4	DEP	DEP
92635		5	4	0	0	-8.62	-7.73		DEP	DEP

Time	UTC	Aileron		Column Pos		Elev Pos		Flap	Grd Spoiler	
		L	R	FO	Capt	L	R	Pos	LO	RO
(sec)	(sec)	[deg]	[deg]	(deg)	(deg)	(deg)	(deg)	(deg)	(discrt)	(discrt)
92636		6	6	0	0	-17.31	-11.88	30.4	DEP	DEP
92637	06:46:31	5	4	-0.06	0	-9.81	-8.91		DEP	DEP
92638		4	4	0	0	-7.75	-6.8	30.4	DEP	DEP
92639		2	2	-0.06	0	-6.56	-6.02		-	DEP
92640		0	0	0	0	-6.62	-6.02	30.4	-	DEP
92641	06:46:35	-1	0	0	0	-6.31	-5.78		-	DEP
92642		-2	-1	-0.06	0	-6.31	-5.62	30.4	-	DEP
92643		-2	-1	0	0	-5.5	-4.77		-	DEP
92644		-1	-1	0	0	-4.94	-4.3	30.3	-	DEP
92645	06:46:39	-1	-1	-0.06	0	-4.56	-3.98		-	DEP
92646		0	-1	0	0	-4	-3.59	0	-	DEP
92647		-1	-1	0	0	-3.94	-3.52		-	DEP
92648		-1	-1	0	0	-3.81	-3.44	0	-	DEP
92649	06:46:43	-1	-1	0	0	-3.56	-3.2		-	DEP
92650		-1	-1	0	0	-3.44	-3.12	0	-	DEP
92651		-1	-1	0	0	-3.44	-3.12		-	DEP
92652		-1	-1	0	0	-3.5	-3.12	0	-	DEP
92653	06:46:47	-1	-1	-0.06	0	-3.5	-3.12		-	DEP
92654		-1	-1	0	0	-3.75	-3.28	0	-	-
92655		-1	-1	0	0	-3.69	-3.28		-	-
92656		-1	-1	-0.06	0	-3.69	-3.28	0	-	-
92657	06:46:51	-1	-1	-0.06	0	-3.62	-3.28		-	-
92658		-1	-1	-0.06	0	-3.62	-3.2	0	-	-
92659		-1	-1	0	0	-3.69	-3.2		-	-
92660		-1	-1	0	0	-3.62	-3.12	0	-	-
92661	06:46:55	-1	-1	-0.06	0	-3.44	-2.97		-	-
92662		-1	-1	-0.06	0	-3.31	-2.89	0	-	-
92663		-1	-1	0	0	-3.31	-2.81		-	-
92664		-1	-1	-0.06	0	-3.31	-2.81	0	-	-
92665	06:46:59	-1	-1	0	0	-3.31	-2.81		-	-
92666		-1	-1	0	0	-2.88	-2.58	0	-	-

Time	UTC	Aileron		Column Pos		Elev Pos		Flap	Grd Spoiler	
		L	R	FO	Capt	L	R	Pos	LO	RO
(sec)	(sec)	[deg)	[deg)	(deg)	(deg)	(deg)	(deg)	(deg)	(discrt)	(discrt)
92667		0	-1	0	0	-2.75	-2.34		-	-
92668		0	-1	0	0	-2.75	-2.34	0	-	-
92669	06:47:03	0	-1	0	0	-2.75	-2.34		-	-
92670		0	-1	0	0	-2.75	-2.27	0	-	-
92671		0	-1	0	0	-2.75	-2.27		-	-
92672		0	-1	0	0	-2.75	-2.27	0	-	-
92673	06:47:07	0	-1	0	0	-2.75	-2.27		-	-
92674		0	-1	0	0	-2.75	-2.19	0	-	-
92675		0	-1	0	0	-2.75	-2.19		-	-
92676		0	-1	0	0	-2.75	-2.19	0	-	-
92677	06:47:11	0	-1	-0.06	0	-2.69	-2.19		-	-
92678		0	-1	0	0	-2.75	-2.19	0	-	-
92679		0	-1	0	0	-2.75	-2.19		-	-
92680		0	-1	-0.06	0	-2.75	-2.11	0	-	-
92681	06:47:15	0	-1	0	0	-2.75	-2.11		-	-
92682		0	-1	0	0	-2.75	-2.11	0	-	-
92683		0	-1	-0.06	0	-2.75	-2.11		-	-
92684		0	-1	0	0	-2.75	-2.11	0	-	-
92685	06:47:19	0	-1	-0.06	0	-2.75	-2.03		-	-
92686		0	-1	-0.06	0	-2.75	-2.03	0	-	-
92687		0	-1	0	0	-2.75	-2.03		-	-
92688		0	-1	0	0	-2.75	-2.03	0	-	-
92689	06:47:23	0	-1	-0.06	0	-2.75	-2.03		-	-
92690		0	-1	0	0	-2.75	-2.03	0	-	-
92691		0	-1	0	0	-2.75	-2.03		-	-
92692		0	-1	0	0	-2.69	-2.03	0	-	-
92693	06:47:27	0	-1	-0.06	0	-2.75	-2.03		-	-
92694		0	-1	-0.06	0	-2.75	-2.03	0	-	-
92695		0	-1	-0.06	0	-2.75	-2.03		-	-
92696		0	-1	-0.06	0	-2.75	-2.03	0	-	-
92697	06:47:31	0	-1	0	0	-2.75	-2.03		-	-

Time	UTC	Aileron		Column Pos		Elev Pos		Flap	Grd Spoiler	
		L	R	FO	Capt	L	R	Pos	LO	RO
(sec)	(sec)	[deg)	[deg)	(deg)	(deg)	(deg)	(deg)	(deg)	(discrt)	(discrt)
92698		0	-1	0	0	-2.75	-2.03	0	-	-
92699		0	-1	0	0	-2.75	-1.95		-	-
92700		0	-1	-0.06	0	-2.75	-1.95	0	-	-
92701	06:47:35	0	-1	-0.06	0	-2.75	-1.95		-	-
92702		0	-1	-0.06	0	-2.69	-1.95	0	-	-
92703		0	-1	0	0	-2.75	-1.95		-	-
92704		0	-1	0	0	-2.69	-1.95	0	-	-
92705	06:47:39	0	-1	0	0	-2.75	-1.95		-	-
92706		0	-1	0	0	-2.69	-1.95	0	-	-
92707		0	-1	0	0	-2.75	-1.95		-	-
92708		0	-1	-0.06	0	-2.75	-1.88	0	-	-
92709	06:47:43	0	-1	-0.06	0	-2.69	-1.88		-	-
92710		0	-1	-0.06	0	-2.75	-1.88	0	-	-
92711		0	-1	0	0	-2.75	-1.88		-	-
92712		0	-1	0	0	-2.69	-1.88	0	-	-
92713	06:47:47	0	-1	-0.06	0	-2.69	-1.88		-	-
92714		0	-1	0	0	-2.75	-1.88	0	-	-
92715		0	-1	0	0	-2.75	-1.88		-	-
92716		0	-1	0	0	-2.69	-1.88	0	-	-
92717	06:47:51	0	-1	0	0	-2.75	-1.88		-	-
92718		0	-1	0	0	-2.69	-1.88	0	-	-
92719		0	-1	-0.06	0	-3	-1.88		-	-
92720		0	-1	0	0	-3.81	-1.88	0	-	-
92721	06:47:55	1	-1	-0.06	0	-4.5	-1.8		-	-
92722		0	-1	0	0	-7.56	-1.8	0	-	-
92723		-1	-1	0	0	-7.94	-1.8		-	-
92724		-1	-1	0	0	-8.75	-1.8	0	-	-
92725	06:47:59	-8	-1	0	0	-8.06	-1.8		-	-
92726		-8	-1	0	0	-8.44	-1.8	0	-	-
92727		-8	-1	-0.06	0	-8.19	-1.8		-	-
92728		-7	-1	0	0	-7.19	-1.8	0	-	-

Time	UTC	Aileron		Column Pos		Elev Pos		Flap	Grd Spoiler	
		L	R	FO	Capt	L	R	Pos	LO	RO
(sec)	(sec)	[deg)	[deg)	(deg)	(deg)	(deg)	(deg)	(deg)	(discrt)	(discrt)
92729	06:48:03	-8	-1	-0.06	0	-6.81	-1.8		-	-
92730		-8	-1	0	0	-6.62	-1.8	0	-	-
92731		-8	-1	0	0	-5.62	-1.8		-	-
92732		-8	-1	0	0	-5.5	-1.8	0	-	-
92733	06:48:07	-8	-1	0	0	-5.12	-1.8		-	-
92734		-8	-1	-0.06	0	-4.62	-1.8	0	-	-
92735		-8	-1	0	0	-4.31	-1.8		-	-
92736		-8	-1	-0.06	0	-3.94	-1.8	0	-	-
92737	06:48:11	-6	-1	0	0	-3.31	-1.8		-	-
92738		-2	-1	0	0	-3.06	-1.8	0	-	-
92739		-1	-1	0	0	-3	-1.8		-	-
92740		-1	-1	0	0	-2.94	-1.8	0	-	-

Time	UTC	Hand	Hand	Horz	Rudder	Rudder	Rudder	Slip Skid	Spoiler			
		Whl	Whl	Stab	Pedal		Trim		1L	1R	2L	2R
		Pos-C	Pos-P	Trim	Pos	Pos	Pos					
(sec)	(sec)	(deg)	(deg)	(deg)	(deg)	(deg)	(deg)	(ft/sec^2)	(deg)	(deg)	(deg)	(deg)
92605	06:45:59	12.7	8.6	-32.0	-0.1	1.6		-0.1	0.0	0.0	0.0	0.0
92606		0.4	9.7	-32.0	-0.1	0.5	0.2	-0.1	2.6	0.0	3.5	0.0
92607		3.2	-0.7	-32.0	-0.1	-3.2		-0.1	0.9	0.0	0.0	0.0
92608		19.0	6.2	-32.0	-0.1	1.2	0.2	-0.1	0.0	0.0	0.0	0.0
92609	06:46:03	12.1	13.2	-32.0	-0.1	0.2		-0.1	1.8	0.0	1.8	0.0
92610		1.6	-5.1	-32.0	-0.1	-1.4	0.2	-0.1	0.0	0.0	0.0	0.0
92611		28.8	27.1	-32.0	-0.1	1.6		-0.1	0.9	0.0	1.8	0.0
92612		-5.8	-1.2	-32.0	-0.1	-2.0	0.2	0.1	1.8	0.0	0.9	0.0
92613	06:46:07	15.1	0.4	-32.0	-0.1	0.8		0.1	0.0	0.9	0.0	0.0
92614		9.8	9.1	-32.0	-0.1	0.2	0.2	0.2	1.8	0.0	1.8	0.0
92615		15.5	14.9	-32.0	-0.1	1.1		0.2	1.8	0.0	1.8	0.0
92616		-15.8	-27.2	-32.0	-0.1	-0.1	0.2	0.3	0.9	0.0	0.0	1.8
92617	06:46:11	-12.1	-17.9	-32.0	-0.1	6.1		0.1	0.0	1.8	0.0	1.8
92618		-25.0	-24.8	-32.0	-0.1	-1.6	0.2	-0.2	0.0	1.8	0.0	1.8
92619		1.9	0.5	-32.0	-0.1	-0.7		-0.4	0.0	3.5	0.0	1.8
92620		-14.2	-7.2	-32.0	-0.1	-0.6	0.2	-0.4	0.0	0.0	0.0	0.0
92621	06:46:15	17.4	20.2	-32.0	-0.1	-0.6		-0.3	0.0	0.0	0.0	0.0
92622		-19.0	-22.7	-32.0	-0.1	-3.5	0.2	-0.3	0.9	0.0	0.0	0.9
92623		-7.2	-10.4	-32.0	0.0	1.5		-0.3	0.0	1.8	0.0	0.9
92624		-2.5	-4.4	-32.0	-0.1	0.5	0.2	-0.2	0.0	0.0	0.0	0.0
92625	06:46:19	-8.3	-8.1	-32.0	0.0	-0.9		-0.2	0.0	0.0	0.0	0.0
92626		-9.3	-12.7	-32.0	-0.1	-0.5	0.2	-0.2	0.0	0.9	0.0	0.9
92627		3.5	-0.2	-32.0	-0.1	0.9		-0.2	0.0	0.0	0.0	0.0
92628		-2.5	24.1	-32.0	-0.1	0.5	0.2	0.0	1.8	0.0	2.6	0.0
92629	06:46:23	9.3	13.9	-32.0	-0.1	1.2		0.4	0.9	0.0	0.9	0.0
92630		19.0	6.9	-32.0	-0.1	0.0	0.2	0.8	22.0	22.0	30.8	33.4
92631		25.7	9.1	-32.0	-0.1	1.3		0.8	39.6	36.9	39.6	37.8
92632		19.0	9.3	-32.0	-0.1	-0.9	0.2	0.2	39.6	36.9	39.6	38.7
92633	06:46:27	12.8	6.2	-32.0	-0.1	-4.7		-0.4	39.6	38.7	39.6	38.7
92634		-6.7	-3.5	-32.0	-0.1	-3.1	0.2	-0.8	39.6	39.6	39.6	39.6

Time	UTC	Hand	Hand	Horz	Rudder	Rudder	Rudder	Slip Skid	Spoiler			
		Whl	Whl	Stab	Pedal		Trim		1L	1R	2L	2R
		Pos-C	Pos-P	Trim	Pos	Pos	Pos					
(sec)	(sec)	(deg)	(deg)	(deg)	(deg)	(deg)	(deg)	(ft/sec^2)	(deg)	(deg)	(deg)	(deg)
92635		-18.1	-19.0	-32.0	-0.1	-1.3		-1.0	38.7	39.6	38.7	39.6
92636		-21.1	-24.1	-32.0	-0.1	-3.9	0.2	-1.0	37.8	39.6	37.8	39.6
92637	06:46:31	-10.5	-13.7	-32.0	-0.1	-3.1		-0.6	37.8	39.6	37.8	39.6
92638		-11.8	-14.6	-32.0	-0.1	-1.9	0.2	-0.1	38.7	39.6	38.7	39.6
92639		-1.1	-5.8	-32.0	-0.1	-2.2		0.4	39.6	39.6	36.9	39.6
92640		0.4	-1.2	-32.0	-0.1	1.4	0.2	0.7	39.6	39.6	55.4	39.6
92641	06:46:35	1.6	0.7	-32.0	-0.1	1.0		0.7	39.6	39.6	55.4	39.6
92642		5.6	4.4	-32.0	-0.1	1.3	0.2	0.3	39.6	39.6	55.4	39.6
92643		1.4	1.9	-32.0	-0.1	4.3		-0.2	39.6	39.6	55.4	39.6
92644		2.5	0.7	-32.0	-0.1	-0.5	0.2	-0.5	39.6	39.6	55.4	39.6
92645	06:46:39	2.8	1.2	-32.0	-0.1	-4.6		-0.6	39.6	39.6	55.4	39.6
92646		0.9	0.0	-32.0	-0.1	-0.5	0.2	-0.6	39.6	39.6	55.4	39.6
92647		1.6	0.4	-32.0	-0.1	-3.1		-0.6	39.6	39.6	55.4	39.6
92648		1.4	0.4	-32.0	-0.1	0.9	0.2	-0.6	39.6	39.6	55.4	39.6
92649	06:46:43	1.4	0.2	-32.0	-0.1	-0.2		-0.4	39.6	39.6	55.4	39.6
92650		1.2	0.0	-32.0	-0.1	0.4	0.2	-0.4	39.6	39.6	55.4	39.6
92651		1.2	0.0	-32.0	-0.1	-0.9		-0.4	39.6	39.6	55.4	39.6
92652		1.6	0.4	-32.0	-0.1	-2.5	0.2	-0.2	39.6	39.6	55.4	39.6
92653	06:46:47	2.1	0.5	-32.0	-0.1	-2.3		0.2	39.6	39.6	55.4	39.6
92654		2.5	1.2	-32.0	-0.1	-4.3	0.2	0.4	39.6	39.6	55.4	39.6
92655		2.5	1.4	-32.0	-0.1	-1.7		0.5	39.6	39.6	55.4	39.6
92656		2.3	0.7	-32.0	-0.1	-0.5	0.2	0.3	39.6	39.6	55.4	39.6
92657	06:46:51	1.9	0.9	-32.0	-0.1	-0.7		0.1	39.6	39.6	55.4	39.6
92658		2.5	1.1	-32.0	-0.1	-1.2	0.2	0.1	39.6	39.6	55.4	39.6
92659		3.2	1.8	-32.0	-0.1	-2.0		0.0	39.6	39.6	55.4	39.6
92660		2.8	1.6	-32.0	-0.1	-0.2	0.2	-0.1	39.6	39.6	55.4	37.8
92661	06:46:55	2.6	1.1	-32.0	-0.1	0.2		-0.1	39.6	39.6	55.4	37.8
92662		2.1	0.7	-32.0	-0.1	-0.1	0.1	-0.2	39.6	39.6	55.4	37.8
92663		2.5	1.2	-32.0	-0.1	-2.0		-0.1	39.6	39.6	55.4	37.8
92664		2.1	1.1	-32.0	-0.1	-0.7	0.2	0.0	39.6	39.6	55.4	37.8

Time	UTC	Hand	Hand	Horz	Rudder	Rudder	Rudder	Slip Skid	Spoiler			
		Whl	Whl	Stab	Pedal		Trim		1L	1R	2L	2R
		Pos-C	Pos-P	Trim	Pos	Pos	Pos					
(sec)	(sec)	(deg)	(deg)	(deg)	(deg)	(deg)	(deg)	(ft/sec^2)	(deg)	(deg)	(deg)	(deg)
92665	06:46:59	1.8	0.7	-32.0	-0.1	-0.7		0.0	39.6	39.6	55.4	37.8
92666		0.7	-0.4	-32.0	-0.1	-0.1	0.2	0.0	39.6	39.6	55.4	37.8
92667		0.7	-0.7	-32.0	-0.1	0.9		-0.1	39.6	39.6	55.4	37.8
92668		0.5	-0.7	-32.0	-0.1	0.3	0.2	-0.1	39.6	39.6	55.4	37.8
92669	06:47:03	0.4	-0.9	-32.0	-0.1	0.2		0.0	39.6	39.6	55.4	37.8
92670		0.5	-0.9	-32.0	-0.1	-0.6	0.2	0.1	39.6	39.6	55.4	37.8
92671		0.5	-0.9	-32.0	-0.1	0.0		0.3	39.6	39.6	55.4	37.8
92672		0.4	-1.1	-32.0	-0.1	-0.9	0.2	0.3	39.6	39.6	55.4	37.8
92673	06:47:07	0.5	-0.9	-32.0	-0.1	-0.2		0.3	39.6	39.6	55.4	37.8
92674		0.4	-0.9	-32.0	-0.1	1.6	0.2	0.1	39.6	39.6	55.4	37.8
92675		0.4	-0.9	-32.0	-0.1	2.3		-0.1	39.6	39.6	55.4	37.8
92676		0.4	-1.1	-32.0	-0.1	0.9	0.2	-0.1	39.6	39.6	55.4	37.8
92677	06:47:11	0.5	-1.1	-32.0	-0.1	-1.2		0.0	39.6	39.6	55.4	37.8
92678		0.4	-0.9	-32.0	-0.1	-1.0	0.2	0.1	39.6	39.6	55.4	37.8
92679		0.4	-1.1	-32.0	-0.1	-0.7		0.1	39.6	39.6	55.4	37.8
92680		0.4	-0.9	-32.0	-0.1	-0.9	0.2	0.2	39.6	39.6	55.4	37.8
92681	06:47:15	0.4	-0.9	-32.0	-0.1	-1.1		0.3	39.6	39.6	55.4	37.8
92682		0.4	-1.1	-32.0	-0.1	-0.9	0.2	0.3	7.0	7.0	55.4	37.8
92683		0.4	-0.9	-32.0	-0.1	-0.9		0.3	0.0	0.0	55.4	37.8
92684		0.4	-0.9	-32.0	-0.1	-0.7	0.2	0.3	0.0	0.0	55.4	37.8
92685	06:47:19	0.4	-0.9	-32.0	-0.1	-0.1		0.2	0.0	0.0	55.4	37.8
92686		0.4	-0.9	-32.0	-0.1	0.2	0.2	0.1	0.0	0.0	55.4	37.8
92687		0.4	-1.1	-32.0	-0.1	0.5		0.0	0.0	0.0	55.4	37.8
92688		0.4	-1.1	-32.0	-0.1	0.5	0.2	-0.1	0.0	0.0	55.4	37.8
92689	06:47:23	0.4	-1.1	-32.0	-0.1	0.5		-0.2	0.0	0.0	55.4	37.8
92690		0.4	-1.1	-32.0	-0.1	0.2	0.2	-0.2	0.0	0.0	55.4	37.8
92691		0.4	-1.1	-32.0	-0.1	-0.1		-0.2	0.0	0.0	55.4	37.8
92692		0.4	-1.1	-32.0	-0.1	0.2	0.4	-0.2	0.0	0.0	55.4	37.8
92693	06:47:27	0.4	-1.1	-32.0	-0.1	-0.1		-0.1	0.0	0.0	55.4	37.8
92694		0.4	-1.1	-32.0	-0.1	-0.7	0.2	-0.1	0.0	0.0	55.4	37.8

Time	UTC	Hand	Hand	Horz	Rudder	Rudder	Rudder	Slip Skid	Spoiler			
		Whl	Whl	Stab	Pedal		Trim		1L	1R	2L	2R
		Pos-C	Pos-P	Trim	Pos	Pos	Pos					
(sec)	(sec)	(deg)	(deg)	(deg)	(deg)	(deg)	(deg)	(ft/sec^2)	(deg)	(deg)	(deg)	(deg)
92695		0.4	-1.1	-32.0	-0.1	-1.8		0.1	0.0	0.0	55.4	37.8
92696		0.4	-1.1	-32.0	-0.1	-1.6	0.2	0.1	0.0	0.0	55.4	37.8
92697	06:47:31	0.4	-1.1	-32.0	-0.1	0.9		0.2	0.0	0.0	55.4	37.8
92698		0.4	-0.9	-32.0	-0.1	1.2	0.2	0.2	0.0	0.0	55.4	37.8
92699		0.4	-1.1	-32.0	-0.1	1.6		0.3	0.0	0.0	55.4	37.8
92700		0.5	-0.9	-32.0	-0.1	3.1	0.2	0.3	0.0	0.0	55.4	37.8
92701	06:47:35	0.5	-1.1	-32.0	-0.1	3.0		0.4	0.0	0.0	55.4	37.8
92702		0.4	-1.1	-32.0	-0.1	4.3	0.2	0.3	0.0	0.0	55.4	37.8
92703		0.4	-1.1	-32.0	-0.1	7.6		0.4	0.0	0.0	55.4	37.8
92704		0.4	-1.2	-32.0	-0.1	8.3	0.2	0.4	0.0	0.0	55.4	37.8
92705	06:47:39	0.4	-0.9	-32.0	-0.1	8.4		0.4	0.0	0.0	55.4	37.8
92706		0.4	-0.9	-32.0	-0.1	8.9	0.2	0.5	0.0	0.0	55.4	37.8
92707		0.4	-1.1	-32.0	-0.1	9.4		0.6	0.0	0.0	55.4	37.8
92708		0.4	-1.1	-32.0	-0.1	9.1	0.2	0.6	0.0	0.0	55.4	37.8
92709	06:47:43	0.4	-1.1	-32.0	-0.1	7.5		0.6	0.0	0.0	55.4	37.8
92710		0.4	-1.1	-32.0	-0.1	5.9	0.2	0.8	0.0	0.0	55.4	37.8
92711		0.4	-0.9	-32.0	-0.1	4.8		0.8	0.0	0.0	55.4	37.8
92712		0.4	-1.1	-32.0	-0.1	0.5	0.2	1.0	0.0	0.0	55.4	37.8
92713	06:47:47	0.4	-1.1	-32.0	-0.1	-0.6		0.8	0.0	0.0	55.4	37.8
92714		0.4	-0.9	-32.0	-0.1	-4.5	0.4	0.8	0.0	0.0	55.4	37.8
92715		0.4	-1.1	-32.0	-0.1	-9.3		0.7	0.0	0.0	55.4	37.8
92716		0.4	-0.9	-32.0	-0.1	-14.6	0.2	0.8	0.0	0.0	55.4	37.8
92717	06:47:51	0.4	-1.1	-32.0	-0.1	-11.5		0.9	0.0	0.0	55.4	37.8
92718		0.4	-1.1	-32.0	-0.1	-10.8	0.2	1.0	0.0	0.0	55.4	37.8
92719		0.4	-1.1	-32.0	-0.1	-10.6		1.0	0.0	0.0	55.4	37.8
92720		-0.2	-1.8	-32.0	-0.1	-1.6	0.2	1.0	0.0	0.0	55.4	37.8
92721	06:47:55	-3.3	-5.4	-32.0	-0.1	-6.8		1.0	0.0	0.0	55.4	37.8
92722		0.2	-1.2	-32.0	-0.1	-4.8	0.2	1.1	0.0	0.0	55.4	37.8
92723		2.3	0.9	-32.0	-0.1	-7.0		1.1	0.0	0.0	55.4	37.8
92724		1.6	-0.4	-32.0	-0.1	-7.0	0.2	1.2	0.0	0.0	55.4	37.8

Time	UTC	Hand	Hand	Horz	Rudder	Rudder	Rudder	Slip Skid	Spoiler			
		Whl	Whl	Stab	Pedal		Trim		1L	1R	2L	2R
		Pos-C	Pos-P	Trim	Pos	Pos	Pos					
(sec)	(sec)	(deg)	(deg)	(deg)	(deg)	(deg)	(deg)	(ft/sec^2)	(deg)	(deg)	(deg)	(deg)
92725	06:47:59	26.4	24.8	-32.0	-0.1	-8.5		1.2	2.6	0.0	55.4	37.8
92726		25.5	23.9	-32.0	-0.1	-9.5	0.2	1.1	7.0	0.0	55.4	37.8
92727		23.0	21.3	-32.0	-0.1	-10.2		0.9	6.2	0.0	55.4	37.8
92728		24.6	23.0	-32.0	-0.1	-11.2	0.4	0.9	6.2	0.0	55.4	37.8
92729	06:48:03	25.3	23.4	-32.0	-0.1	-7.2		0.8	6.2	0.0	55.4	37.8
92730		24.8	23.6	-32.0	-0.1	-4.8	0.2	0.5	6.2	0.0	55.4	36.9
92731		24.6	23.2	-32.0	-0.1	-4.9		0.1	6.2	0.0	55.4	36.9
92732		24.6	23.7	-32.0	0.0	-5.9	0.4	-0.3	6.2	0.0	55.4	36.9
92733	06:48:07	24.6	23.4	-32.0	-0.1	-5.8		-0.4	6.2	0.0	55.4	36.9
92734		24.4	23.2	-32.0	-0.1	-6.5	0.2	-0.7	6.2	0.0	55.4	36.9
92735		24.1	23.0	-32.0	-0.1	-4.8		-0.8	6.2	0.0	55.4	36.9
92736		21.6	20.6	-32.0	-0.1	-4.3	0.2	-1.0	6.2	0.0	55.4	36.9
92737	06:48:11	9.0	12.3	-32.0	-0.1	-3.2		-0.9	4.4	0.0	55.4	36.9
92738		3.9	2.6	-32.0	-0.1	-3.4	0.2	-0.8	0.9	0.0	55.4	36.9
92739		3.5	2.1	-32.0	0.0	-4.7		-0.6	0.0	0.0	55.4	36.9
92740		3.5	1.9	-32.0	-0.1	-5.7	0.2	-0.6	0.0	0.0	55.4	36.9

Time	UTC	Spoiler				HydPres			Revsr Unlk	
		-3L	-3R	-4L	-4R	-1	-2	-3	L	R
(sec)	(sec)	(deg)	(deg)	(deg)	(deg)	(PSI)	(PSI)	(PSI)	(discrt)	(discrt)
92605	06:45:59	0	0	0	0		3148	3072	-	-
92606		3.516	0	1.758	0	3116			-	-
92607		0	0	0	0		3152	3068	-	-
92608		0	0	0	0	3120			-	-
92609	06:46:03	1.758	0	0.879	0		3152	3076	-	-
92610		0	0	0	0	3112			-	-
92611		1.758	0	1.758	0		3140	3068	-	-
92612		0.879	0	0.879	0	3120			-	-
92613	06:46:07	0	0	0	0		3148	3068	-	-
92614		1.758	0	0.879	0	3116			-	-
92615		1.758	0	0.879	0		3148	3060	-	-
92616		0.879	0	0	2.637	3124			-	-
92617	06:46:11	0	1.758	0	1.758		3156	3072	-	-
92618		0	0.879	0	1.758	3120			-	-
92619		0	2.637	0	0.879		3156	3072	-	-
92620		0	0	0	0	3124			-	-
92621	06:46:15	0	0	0.879	0		3156	3076	-	-
92622		0	0	0	1.758	3116			-	-
92623		0	0.879	0	0.879		3156	3072	-	-
92624		0	0	0	0	3116			-	-
92625	06:46:19	0	0	0	0		3156	3076	-	-
92626		0	0.879	0	0.879	3112			-	-
92627		0	0	0	0		3156	3072	-	-
92628		1.758	0	2.637	0	3108			-	-
92629	06:46:23	0	0	0	0		3132	3056	-	-
92630		35.156	34.277	36.914	37.793	3108			-	-
92631		45.703	43.945	44.824	44.824		3152	3064	-	-
92632		45.703	43.945	45.703	44.824	3108			-	-
92633	06:46:27	45.703	44.824	45.703	45.703		3160	3064	-	-
92634		45.703	45.703	45.703	45.703	3112			-	-
92635		44.824	45.703	43.945	45.703		3136	3068	-	-

Time	UTC	Spoiler				HydPres			Revsr Unlk	
		-3L	-3R	-4L	-4R	-1	-2	-3	L	R
(sec)	(sec)	(deg)	(deg)	(deg)	(deg)	(PSI)	(PSI)	(PSI)	(discrt)	(discrt)
92636		43.945	45.703	43.066	45.703	3088			-	-
92637	06:46:31	41.308	45.703	43.945	45.703		3152	2928	-	-
92638		55.371	45.703	44.824	45.703	3104			-	-
92639		55.371	45.703	45.703	45.703		3148	2892	-	-
92640		55.371	45.703	45.703	45.703	3108			-	-
92641	06:46:35	55.371	45.703	45.703	45.703		3152	2920	-	-
92642		55.371	45.703	45.703	45.703	3112			-	-
92643		55.371	45.703	45.703	45.703		3152	2916	-	-
92644		55.371	45.703	45.703	45.703	3116			-	-
92645	06:46:39	55.371	45.703	45.703	45.703		3160	2920	-	-
92646		55.371	45.703	45.703	45.703	3120			-	-
92647		55.371	45.703	45.703	45.703		3132	2064	-	-
92648		55.371	45.703	45.703	45.703	3116			-	-
92649	06:46:43	55.371	45.703	45.703	45.703		3092	416	-	-
92650		55.371	45.703	45.703	45.703	3120			-	-
92651		55.371	45.703	45.703	45.703		1356	384	-	-
92652		55.371	45.703	45.703	45.703	3100			-	-
92653	06:46:47	55.371	45.703	45.703	45.703		520	376	-	-
92654		55.371	45.703	45.703	45.703	3112			-	-
92655		55.371	45.703	45.703	45.703		440	376	-	-
92656		55.371	45.703	45.703	45.703	3112			-	-
92657	06:46:51	55.371	45.703	45.703	45.703		448	380	-	-
92658		55.371	45.703	45.703	45.703	3112			-	-
92659		55.371	45.703	45.703	45.703		320	372	-	-
92660		55.371	44.824	45.703	45.703	3112			-	-
92661	06:46:55	55.371	44.824	45.703	45.703		24	372	-	-
92662		55.371	44.824	45.703	45.703	3112			-	-
92663		55.371	44.824	45.703	45.703		20	372	-	-
92664		55.371	44.824	45.703	45.703	3112			-	-
92665	06:46:59	55.371	44.824	45.703	45.703		16	372	-	-
92666		55.371	44.824	45.703	45.703	3112			-	-

Time	UTC	Spoiler				HydPres			Revsr Unlk	
		-3L	-3R	-4L	-4R	-1	-2	-3	L	R
(sec)	(sec)	(deg)	(deg)	(deg)	(deg)	(PSI)	(PSI)	(PSI)	(discrt)	(discrt)
92667		55.371	44.824	45.703	45.703		20	372	-	-
92668		55.371	44.824	45.703	45.703	3116			-	-
92669	06:47:03	55.371	44.824	45.703	45.703		16	364	-	-
92670		55.371	44.824	45.703	45.703	3116			-	-
92671		55.371	44.824	45.703	45.703		16	352	-	-
92672		55.371	44.824	45.703	45.703	3116			-	-
92673	06:47:07	55.371	44.824	45.703	45.703		16	28	-	-
92674		55.371	44.824	45.703	45.703	3116			-	-
92675		55.371	44.824	45.703	45.703		16	16	-	-
92676		55.371	44.824	45.703	45.703	3116			-	-
92677	06:47:11	55.371	44.824	45.703	45.703		16	16	-	-
92678		55.371	44.824	45.703	45.703	3116			-	-
92679		55.371	44.824	45.703	45.703		16	16	-	-
92680		55.371	44.824	45.703	45.703	3116			-	-
92681	06:47:15	55.371	44.824	39.55	39.55		16	12	-	-
92682		55.371	44.824	1.758	1.758	3112			-	-
92683		55.371	44.824	0	0		16	16	-	-
92684		55.371	44.824	0	0	3112			-	-
92685	06:47:19	55.371	44.824	0	0		16	12	-	-
92686		55.371	44.824	0	0	3112			-	-
92687		55.371	44.824	0	0		16	12	-	-
92688		55.371	44.824	0	0	3112			-	-
92689	06:47:23	55.371	44.824	0	0		16	12	-	-
92690		55.371	44.824	0	0	3112			-	-
92691		55.371	44.824	0	0		12	12	-	-
92692		55.371	44.824	0	0	3112			-	-
92693	06:47:27	55.371	44.824	0	0		16	12	-	-
92694		55.371	44.824	0	0	3112			-	-
92695		55.371	44.824	0	0		16	12	-	-
92696		55.371	44.824	0	0	3112			-	-
92697	06:47:31	55.371	44.824	0	0		12	12	-	-

Time	UTC	Spoiler				HydPres			Revsr Unlk	
		-3L	-3R	-4L	-4R	-1	-2	-3	L	R
(sec)	(sec)	(deg)	(deg)	(deg)	(deg)	(PSI)	(PSI)	(PSI)	(discrt)	(discrt)
92698		55.371	44.824	0	0	3112			-	-
92699		55.371	44.824	0	0		16	12	-	-
92700		55.371	44.824	0	0	3112			-	-
92701	06:47:35	55.371	44.824	0	0		12	12	-	-
92702		55.371	44.824	0	0	3112			-	-
92703		55.371	44.824	0	0		12	12	-	-
92704		55.371	44.824	0	0	3112			-	-
92705	06:47:39	55.371	44.824	0	0		12	12	-	-
92706		55.371	44.824	0	0	3112			-	-
92707		55.371	44.824	0	0		12	12	-	-
92708		55.371	44.824	0	0	3112			-	-
92709	06:47:43	55.371	44.824	0	0		12	12	-	-
92710		55.371	44.824	0	0	3112			-	-
92711		55.371	44.824	0	0		12	12	-	-
92712		55.371	44.824	0	0	3112			-	-
92713	06:47:47	55.371	44.824	0	0		12	12	-	-
92714		55.371	44.824	0	0	3112			-	-
92715		55.371	44.824	0	0		12	12	-	-
92716		55.371	44.824	0	0	3112			-	-
92717	06:47:51	55.371	44.824	0	0		12	12	-	-
92718		55.371	44.824	0	0	3112			-	-
92719		55.371	44.824	0	0		12	12	-	-
92720		55.371	44.824	0	0	3108			-	-
92721	06:47:55	55.371	44.824	0	0		12	12	-	-
92722		55.371	44.824	0	0	3112			-	-
92723		55.371	44.824	0	0		12	12	-	-
92724		55.371	44.824	0	0	3112			-	-
92725	06:47:59	55.371	44.824	5.273	0		12	12	-	-
92726		55.371	44.824	6.152	0	3108			-	-
92727		55.371	44.824	5.273	0		12	12	-	-
92728		55.371	44.824	5.273	0	3104			-	-

Time	UTC	Spoiler				HydPres			Revsr Unlk	
		-3L	-3R	-4L	-4R	-1	-2	-3	L	R
(sec)	(sec)	(deg)	(deg)	(deg)	(deg)	(PSI)	(PSI)	(PSI)	(discrt)	(discrt)
92729	06:48:03	55.371	44.824	6.152	0		12	12	-	-
92730		55.371	44.824	6.152	0	3108			-	-
92731		55.371	44.824	6.152	0		12	12	-	unlk
92732		55.371	44.824	6.152	0	3104			-	unlk
92733	06:48:07	55.371	44.824	6.152	0		12	12	-	unlk
92734		55.371	44.824	6.152	0	3108			-	unlk
92735		55.371	44.824	6.152	0		12	12	-	unlk
92736		55.371	44.824	5.273	0	3108			-	unlk
92737	06:48:11	55.371	44.824	2.637	0		12	12	-	unlk
92738		55.371	44.824	0	0	3112			-	unlk
92739		55.371	44.824	0	0		12	12	-	unlk
92740		55.371	44.824	0	0	3112			-	unlk

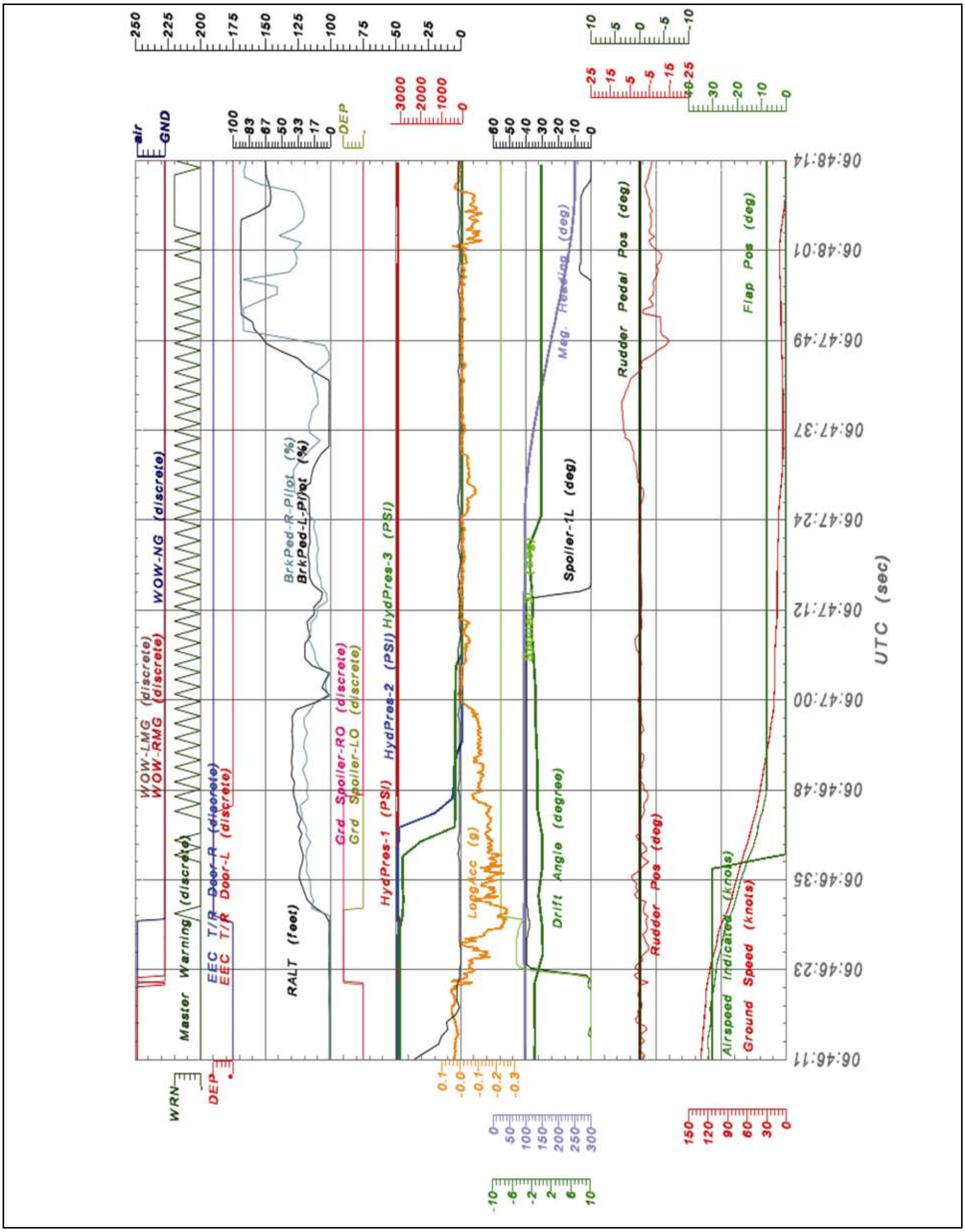
Time	UTC	BRAKE		BrkPed				EEC T/R		ENG	
		OVHT	SYS Inbd	L-CP	R-P	R-CP	R-P	Door-L	Door-R	EPR-L	EPR-R
(sec)	(sec)	(1-Active)	(1-Active)	(%)	(%)	(%)	(%)	(discrt)	(discrt)	(%)	(%)
92605	06:45:59	-	-	1.5	1.5	1.1	0.8	*	*	1.02	1.02
92606		-	-	1.5	1.5	1.1	0.8	*	*	1.02	1.02
92607		-	-	1.5	1.5	1.3	0.8	*	*	1.03	1.03
92608		-	-	1.5	1.5	1.3	0.8	*	*	1.03	1.03
92609	06:46:03	-	-	1.5	1.3	1.3	0.8	*	*	1.05	1.05
92610		-	-	1.5	1.3	1.4	0.8	*	*	1.06	1.06
92611		-	-	1.5	1.3	1.4	1	*	*	1.06	1.06
92612		-	-	1.5	1.3	1.2	1	*	*	1.05	1.05
92613	06:46:07	-	-	1.4	1.4	1.3	1.1	*	*	1.05	1.05
92614		-	-	1.4	1.3	1.2	1	*	*	1.05	1.05
92615		-	-	1.4	1.4	1.2	0.9	*	*	1.05	1.05
92616		-	-	1.4	1.2	1.2	1	*	*	1.04	1.04
92617	06:46:11	-	-	1.4	1.2	1.2	0.9	*	*	1.04	1.04
92618		-	-	1.4	1.2	1.2	0.9	*	*	1.04	1.04
92619		-	-	1.4	1.2	1.2	0.9	*	*	1.03	1.03
92620		-	-	1.4	1.2	1.1	0.9	*	*	1.02	1.02
92621	06:46:15	-	-	1.4	1.2	1.1	0.9	*	*	1.02	1.02
92622		-	-	1.6	1.2	1.1	0.9	*	*	1.02	1.02
92623		-	-	1.6	1.2	1.1	0.9	*	*	1.02	1.02
92624		-	-	1.5	1.3	1.1	0.8	*	*	1.02	1.02
92625	06:46:19	-	-	1.6	1.4	1.1	0.9	*	*	1.02	1.02
92626		-	-	1.5	1.4	1.1	0.8	*	*	1.02	1.02
92627		-	-	1.5	1.3	1.1	0.8	*	*	1.02	1.02
92628		-	-	1.4	1.3	1.3	0.9	*	*	1.02	1.02
92629	06:46:23	-	-	1.4	1.5	1.2	0.9	*	*	1.02	1.02
92630		-	-	1.4	1.5	1.2	0.8	*	*	1.02	1.02
92631		-	-	1.4	1.4	1.2	0.9	*	*	1.02	1.02
92632		-	-	1.4	1.3	1.2	0.9	*	*	1.02	1.02
92633	06:46:27	-	-	1.4	1.5	1.2	0.9	*	*	1.02	1.02
92634		-	-	1.4	1.5	1.2	0.9	*	*	1.03	1.03

Time	UTC	BRAKE		BrkPed				EEC T/R		ENG	
		OVHT	SYS Inbd	L-CP	R-P	R-CP	R-P	Door-L	Door-R	EPR-L	EPR-R
(sec)	(sec)	(1-Active)	(1-Active)	(%)	(%)	(%)	(%)	(discrt)	(discrt)	(%)	(%)
92635		-	-	1.5	1.3	1.3	0.9	*	*	1.02	1.02
92636		-	-	1.4	1.5	1.1	0.9	*	*	1.02	1.02
92637	06:46:31	-	-	1.6	5.9	1.3	1.1	DEP	DEP	1.03	1.03
92638		-	-	1.7	16.8	1.2	19.4	DEP	DEP	1.03	1.03
92639		-	-	1.7	24	1.3	17.5	DEP	DEP	1.03	1.03
92640		-	-	1.6	26.7	1.2	20.3	DEP	DEP	1.03	1.03
92641	06:46:35	-	-	1.6	29.7	1.4	20.5	DEP	DEP	1.03	1.03
92642		-	-	1.6	32	1.4	21.2	DEP	DEP	1.04	1.04
92643		-	-	1.6	31.4	1.4	24.8	DEP	DEP	1.05	1.05
92644		-	-	1.6	29.1	1.4	24.1	DEP	DEP	1.08	1.08
92645	06:46:39	-	-	1.5	27.8	1.5	25.3	DEP	DEP	1.16	1.16
92646		-	-	1.6	30.1	1.4	24.3	DEP	DEP	1.16	1.16
92647		-	-	1.5	32	1.4	20.4	DEP	DEP	1.14	1.14
92648		-	-	1.6	29.4	1.4	25	DEP	DEP	1.11	1.11
92649	06:46:43	-	-	1.5	33.2	1.4	24.6	DEP	DEP	1.1	1.1
92650		-	-	1.5	30.2	1.3	28.5	DEP	DEP	1.1	1.1
92651		-	-	1.7	33.8	1.3	29.4	DEP	DEP	1.08	1.08
92652		-	-	1.7	34.6	1.4	31.5	*	DEP	1.06	1.06
92653	06:46:47	-	-	1.7	37.4	1.3	23	*	DEP	1.04	1.04
92654		-	-	1.7	38.1	1.3	24.3	*	DEP	1.03	1.03
92655		-	-	1.7	37	1.3	23.3	*	DEP	1.03	1.03
92656		-	-	1.7	40.2	1.3	25.8	*	DEP	1.02	1.02
92657	06:46:51	-	-	1.7	39.1	1.3	28.8	*	DEP	1.02	1.02
92658		-	-	1.6	40.1	1.5	24.5	*	DEP	1.02	1.02
92659		-	-	1.6	39.2	1.5	24.6	*	DEP	1.02	1.02
92660		-	-	1.6	38.5	1.5	27.4	*	DEP	1.02	1.02
92661	06:46:55	-	-	1.6	38.9	1.4	26.5	*	DEP	1.02	1.02
92662		-	-	1.6	39.6	1.4	23.8	*	DEP	1.02	1.02
92663		-	-	1.6	38.6	1.4	26.9	*	DEP	1.02	1.02
92664		-	-	1.6	39.5	1.4	27.1	*	DEP	1.02	1.02

Time	UTC	BRAKE		BrkPed				EEC T/R		ENG	
		OVHT	SYS Inbd	L-CP	R-P	R-CP	R-P	Door-L	Door-R	EPR-L	EPR-R
(sec)	(sec)	(1-Active)	(1-Active)	(%)	(%)	(%)	(%)	(discrt)	(discrt)	(%)	(%)
92665	06:46:59	-	-	1.6	34.9	1.4	21.1	*	DEP	1.02	1.02
92666		-	-	1.4	14.9	1.4	16.5	*	DEP	1.02	1.02
92667		-	-	1.4	1.3	1.2	1.2	*	DEP	1.02	1.02
92668		-	-	1.4	8.6	1.4	4.7	*	DEP	1.02	1.02
92669	06:47:03	-	-	1.4	5.5	1.2	4.8	*	DEP	1.02	1.02
92670		-	-	1.4	1.3	1.2	1	*	DEP	1.02	1.02
92671		-	-	1.5	18.9	1.2	11.1	*	DEP	1.02	1.02
92672		-	-	1.7	26.2	1.2	15.5	*	DEP	1.02	1.02
92673	06:47:07	-	-	1.7	26.4	1.3	16.2	*	DEP	1.02	1.02
92674		-	-	1.7	26.2	1.1	19.4	*	DEP	1.02	1.02
92675		-	-	1.7	20.6	1.3	23.1	*	DEP	1.02	1.02
92676		-	-	1.7	22.9	1.3	20	*	DEP	1.02	1.02
92677	06:47:11	-	-	1.7	24.1	1.2	20.1	*	DEP	1.02	1.02
92678		-	-	1.6	16.8	1.3	13.9	*	DEP	1.02	1.02
92679		-	-	1.6	17.1	1.4	14.1	*	DEP	1.02	1.02
92680		-	-	1.5	9.9	1.3	3.3	*	DEP	1.02	1.02
92681	06:47:15	-	-	1.5	8.2	1.3	4.2	*	DEP	1.02	1.02
92682		-	-	1.5	17.7	1.4	9.4	*	DEP	1.02	1.02
92683		-	-	1.6	21.4	1.4	10.2	*	DEP	1.02	1.02
92684		-	-	1.6	21.9	1.4	13.4	*	DEP	1.02	1.02
92685	06:47:19	-	-	1.5	21.7	1.4	13.7	*	DEP	1.02	1.02
92686		-	-	1.5	22.9	1.4	14.3	*	DEP	1.02	1.02
92687		-	-	1.5	22.5	1.4	12.6	*	DEP	1.02	1.02
92688		-	-	1.4	20.8	1.2	13.7	*	DEP	1.02	1.02
92689	06:47:23	-	-	1.4	21.7	1.3	14.6	*	DEP	1.02	1.02
92690		-	-	1.5	21.6	1.4	17.2	*	DEP	1.02	1.02
92691		-	-	1.5	21	1.2	16.6	*	DEP	1.02	1.02
92692		-	-	1.6	21.7	1.3	23.8	*	DEP	1.02	1.02
92693	06:47:27	-	-	1.7	21.9	1.3	27.2	*	DEP	1.02	1.02
92694		-	-	1.7	22.1	1.3	30.3	*	DEP	1.02	1.02

Time	UTC	BRAKE		BrkPed				EEC T/R		ENG	
		OVHT	SYS Inbd	L-CP	R-P	R-CP	R-P	Door-L	Door-R	EPR-L	EPR-R
(sec)	(sec)	(1-Active)	(1-Active)	(%)	(%)	(%)	(%)	(discrt)	(discrt)	(%)	(%)
92695		-	-	1.7	31.6	1.4	36.9	*	DEP	1.02	1.02
92696		-	-	1.6	20.6	1.3	37	*	DEP	1.02	1.02
92697	06:47:31	-	-	1.7	19.6	1.5	37.8	*	DEP	1.02	1.02
92698		-	-	1.6	17.7	1.3	37.8	*	DEP	1.02	1.02
92699		-	-	1.5	14.1	1.5	32.6	*	DEP	1.02	1.02
92700		-	-	1.5	9.5	1.5	26	*	DEP	1.02	1.02
92701	06:47:35	-	-	1.5	1.5	1.4	18.8	*	DEP	1.02	1.02
92702		-	-	1.5	1.5	1.4	10.7	*	DEP	1.02	1.02
92703		-	-	1.5	1.5	1.5	21	*	DEP	1.02	1.02
92704		-	-	1.5	1.5	1.4	22.5	*	DEP	1.02	1.02
92705	06:47:39	-	-	1.5	1.5	1.4	20.3	*	DEP	1.02	1.02
92706		-	-	1.5	1.4	1.4	18.9	*	DEP	1.02	1.02
92707		-	-	1.5	1.4	1.4	12.8	*	DEP	1.02	1.02
92708		-	-	1.4	1.4	1.4	13.2	*	DEP	1.02	1.02
92709	06:47:43	-	-	1.4	1.3	1.4	14.4	*	DEP	1.02	1.02
92710		-	-	1.4	1.4	1.4	17	*	DEP	1.02	1.02
92711		-	-	1.5	14.2	1.3	18.9	*	DEP	1.02	1.02
92712		-	-	1.5	25.4	1.2	8.7	*	DEP	1.02	1.02
92713	06:47:47	-	-	1.6	33.3	1.2	1.4	*	DEP	1.02	1.02
92714		-	-	1.6	50.8	1.2	1.7	*	DEP	1.02	1.02
92715		-	-	1.7	65.4	1.4	6.1	*	DEP	1.02	1.02
92716		-	-	1.7	70.8	1.5	45.5	*	DEP	1.02	1.02
92717	06:47:51	-	-	2	78.1	1.7	89.2	*	DEP	1.02	1.02
92718		-	-	2	80	1.7	89.4	*	DEP	1.02	1.02
92719		-	-	2	91.5	1.7	89.4	*	DEP	1.02	1.02
92720		-	-	2	91.5	1.8	89.2	*	DEP	1.02	1.02
92721	06:47:55	-	-	90.9	91.9	89.1	73	*	DEP	1.02	1.02
92722		-	-	90.8	92.3	91	54.8	*	DEP	1.02	1.02
92723		-	-	90.9	91.9	87.5	54.6	*	DEP	1.02	1.02
92724		-	-	90.9	91.9	77.7	89.4	*	DEP	1.02	1.02

Time	UTC	BRAKE		BrkPed				EEC T/R		ENG	
		OVHT	SYS Inbd	L-CP	R-P	R-CP	R-P	Door-L	Door-R	EPR-L	EPR-R
(sec)	(sec)	(1-Active)	(1-Active)	(%)	(%)	(%)	(%)	(discrt)	(discrt)	(%)	(%)
92725	06:47:59	-	-	91.1	92.3	32.2	42.4	*	DEP	1.02	1.02
92726		-	-	91.2	92.2	23.8	35.3	*	DEP	1.02	1.02
92727		-	-	91.1	92.2	22.4	34.5	*	DEP	1.02	1.02
92728		-	-	88.3	92.2	16	37.3	*	DEP	1.02	1.02
92729	06:48:03	-	-	91.3	92	25.1	29.6	*	DEP	1.02	1.02
92730		-	-	85.5	92	19	52.6	*	DEP	1.02	1.02
92731		-	-	80.3	91.8	21	36.5	*	DEP	1.02	1.02
92732		-	-	78.9	91.5	26.9	28.6	*	DEP	1.02	1.02
92733	06:48:07	-	-	77.2	74.3	26.1	26.7	*	DEP	1.02	1.02
92734		-	-	76.9	62.4	24.1	28.7	*	DEP	1.02	1.02
92735		-	-	75.9	61	26.4	31.6	*	DEP	1.02	1.02
92736		-	-	66.8	61.7	22.8	37.4	*	DEP	1.02	1.02
92737	06:48:11	-	-	56.9	63.3	19.8	71.3	*	DEP	1.02	1.02
92738		-	-	55.8	66	19.7	88.1	*	DEP	1.02	1.02
92739		-	-	55.9	66.3	19.2	88.6	*	DEP	1.02	1.02


WRN
DEP
air
GND
Master Warning (discrete)
WOW-LMG (discrete)
WOW-RMG (discrete)
WOW-NG (discrete)
EEC T/R Door-R (discrete)
EEC T/R Door-L (discrete)
RALT (feet)
BrkPed-R-Pilot (%)
BrkPed-L-Pilot (%)
Grd Spoiler-RO (discrete)
Grd Spoiler-LO (discrete)
HydPres-1 (PSI)
HydPres-2 (PSI)
HydPres-3 (PSI)
LogAcc (g)
Drift Angle (degree)
Mag. Heading (deg)
Spoiler-1L (deg)
Rudder Pos (deg)
Rudder Pedal Pos (deg)
Airspeed Indicated (knots)
Ground Speed (knots)
Flap Pos (deg)
UTC (sec)
06:46:11
06:46:23
06:46:35
06:46:48
06:47:00
06:47:12
06:47:24
06:47:37
06:47:49
06:48:01
06:48:14

飛航參數繪圖

附錄三　固特異輪胎工程報告書

GOODYEAR
AVIATION

23rd Floor, Q-House Building
66 Sukhumvit 21, Bangkok 10110, Thailand
Phone: 66-2-2642716, -2717, Fax: 66-2-264-2709
E-mail: pollathorn_srisuk@goodyear.com

FIELD REPORT

CUSTOMER:	Corporate Jets, Inc.	REPORT DATE:	05/01/2006
TIRE SIZE:	H38x12.0-19	PLY/SPEED RATING:	20/210
SERIAL NO:	41281600	NEW/R-LEVEL:	New
PLANT CODE & DATE:	Goodyear Thailand	CASING MFG:	Goodyear
REQUESTED BY:	Mark Hudson	PART NO.:	382K03-2
LOC. OF INCIDENT:	Kaohsiung, Taiwan	INCIDENT DATE:	09/12/05
LOC. OF REMOVAL:	Kaohsiung, Taiwan	FLIGHT NO:	N/A
AIRCRAFT NO/TYPE:	N998AM/BD700(Global Express)	REM. SKID:	4 mm.
POSITION:	2	NO. LANDINGS:	121
A/C DAMAGE:	Yes	REPORT NO:	AS 051201

REASON FOR CUSTOMER REMOVAL: Tire burst on landing.

AIRLINE COMMENTS ON TIRE/WHEEL ASSEMBLY:

	Incident Tire	Mate Tire
Wheel Serial Number	N/A	0168
Tire Serial Number	41281600	41291601
Retread Revel	New	New
No. Of Landing(cycle)	121	121
Remaining skid depth (mm.)	4 mm.	4 mm.
Wheel Position	MLG # 2	MLG # 1
Record Tire Inflation Pressure (Before incident)	N/A (operating pressure=175 psi)	N/A
Record Tire Inflation Pressure (After incident)	0 psi	N/A

Damage sustained:
A piece of tire (approx 10"x18") departed the tire and contacted the aircraft near the aft spar of the wing directly above the #2 wheel. This contact severed hydraulic lines on #2 and #3 hydraulic systems, severed four wire harnesses, and did structural damage.

Pilot Report:
" AUTO BRAKE' landing using the "MEDIUM" setting. Normal approach, landing, deceleration, and TR deployment. Pilot felt a slight pulsing during this period, starting at time of the initial touchdown.

Additional comments:
The tire did not come off the rim and the tire bead area looked like it remained seated. During towing the tire did not appear to be spinning on the rim.

GOODYEAR INSPECTION & OBSERVATIONS OF TIRE:

Upon visual inspection of the casings at Kaohsiung Airport in Taiwan on Jan 5, 2006, the following was observed:

There is a portion of the incident tire (approx 10"x8") completely detached down to lower sidewall area from 12 o'clock to 3 o'clock (See photo 1 & 2), as viewed from the tire serial number, it almost 100% can be recovered to aid in this analysis.

There are no sign of heat generated and cut marks shown on the remaining of the casing. Bead and sidewall areas found normal while innerliner shows slightly wrinkles possibly occurred after the tire burst.

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Photo 1: Incident Tire - As Received

Photo 2

Photo 3: Reassemble the returned pieces on the casing

There is a large flat spot at 12 o'clock (in relation to the tire serial number, as viewed from the tire serial number) along with a diagonal-break (see photo 4).

Photo 4: Flat spot along with a diagonal-break

<u>CONCLUSIONS BASED ON INSPECTION & OBSERVATIONS</u>:

From the appearance of the tire, it is obvious that the tire failed due to flat spot or skid burn in the tread rubber down to casing plies causing the tire blew out then the aforementioned piece was detached due to high inflation pressure of the tire and combined with the high centifical force.

Brake lock might be the cause of skid burn but could not be determined what was the root cause of brake lock at this time.

<u>PREVENTATIVE / CORRECTIVE ACTIONS</u>:
Not required by Goodyear.

<u>TIRE DISPOSITION</u>:
The tire and its mate will be sent to Goodyear Technical center, Akron, USA for further analysis.

<u>ANALYSIS PERFORMED BY:</u>

Kho Kok Thye and Pollathorn S.

Pollathorn Srisuk
Product Support Manager

Aviation Tire - Asia
Phone: +661-815-0280
E-mail: pollathorn_srisuk@goodyear.com

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附錄 4　龐巴迪爾工程報告書

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Bombardier Inc.
Downsview, Canada
CAGE CODE 71867

DOCUMENT NO.: **RBS-C700-108**

REV: **NC**

TITLE: **GLOBAL EXPRESS AIRCRAFT 9009 SYSTEMS REPORT - KAOHSIUNG AIRPORT LANDING INCIDENT**

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DATE: 8 June 2006
DOCUMENT NUMBER: **RBS-C700-108** REVISION: **NC**

TITLE: **GLOBAL EXPRESS AIRCRAFT 9009 SYSTEMS REPORT - KAOHSIUNG AIRPORT LANDING INCIDENT**

SUMMARY

NAME	DEPARTMENT	BUILDING	SITE	REMARKS
B. Dunn				
D. Field				
S. Goobie				
J. Petzke				

COMPLETE DOCUMENT

NAME	DEPARTMENT	BUILDING	SITE	REMARKS
J. Coll				
A. Constable				
Dave Gieb				
H. Jedeman				
Foly Lau				
Harry Sayan				
A. Tousignant				

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SUMMARY

Bombardier Inc.
CAGE CODE 3AB48

PAGE: iii
DATE: **8 JUNE 2006**

DOCUMENT NUMBER: **RBS-C700-108** REVISION: **NC**

TITLE: GLOBAL EXPRESS AIRCRAFT 9009 SYSTEMS REPORT - KAOHSIUNG AIRPORT LANDING INCIDENT

Author(s): HARRY H. SAYAN

This report provides a summary of the investigation into the landing incident of the Global Express Aircraft Serial Number 9009 at Kaohsiung airport on Dec 9, 2005. The report documents findings relevant to the aircraft systems behavior during the incident based on the flight crew reports, FDR & CVR data, plus testing completed on aircraft systems or components.

On Dec 9th, 2005, Global Express Aircraft S/N 9009 landed in Taiwan Kaohsiung airport (RCKH) after an uneventful departure and short flight from Taipei (RCTP).

The flight crew reported a normal approach and touchdown at RCKH, in good weather conditions, with Auto Brake selected to Medium setting. Slight pulsing was noted during the landing roll.

Shortly after touchdown and deployment of the Thrust Reverses (TR), the crew noted multiple EICAS messages, and failure indications related to T/R, hydraulics No. 2 and 3, and brakes.

The crew also noted loss of nose wheel steering, and stated that the aircraft continued to slow down along the centerline of the runway, with the reported loss of normal and emergency braking. The aircraft drifted to the right as it was slowing, then exited into a taxiway, and came to a safe stop at the adjacent grass area.

After deplaning, the crew noted failure of No. 2 tire (Left Inboard), and damage to aircraft system installations at the left wing Aft Auxiliary Spar area.

There were no injuries to the aircraft crew, or others on ground. The event was classified as an " Incident " by Taiwan Aviation Safety Council authorities.

The results of this investigation concludes that a condition of temporary deep skid of No.2 wheel, after touchdown resulted in tire failure, which in turn caused flailing tire damage to Hydraulic system No.2 and 3 tubing, flap actuation, and flap and spoiler system harnesses in the aft auxiliary spar area.

The investigation also concludes that the most probable cause of the noted deep skid condition was internal contamination of the No.2 wheel Brake Control Valve, most likely caused by small rubber particles, from an improperly installed valve seal.

Note: Contact E.T.D.S. (Montréal) for a copy of the Complete Document.

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INITIAL APPROVAL

GLOBAL EXPRESS AIRCRAFT 9009 SYSTEMS REPORT - KAOHSIUNG AIRPORT LANDING INCIDENT

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Further revisions shall be documented on the Revision / Approval Log page.

(Major Supplier name here) Initial Approval

Major Supplier Use Only

		DATE
PREPARED	Harry H. Sayan	Jan/09/2006
CHECKED	Dave Gieb, Foley Lau	June/12/2006
APPROVED	Scott Goobie	June/12/2006

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REFERENCES

1) Flight Crew Debrief Notes - Landing Incident BBD700 Kaohsiung, Wayne P. Patin 12/09/05

2) E-Mail – Lester Ingram to Dave George: Global Express Tire Blow-Out Status dated 12/10/2005

3) FDR Down Load - SSFDR BD 700 N998AM

4) VCR Transcripts - N998 AM Kaohsiung Tower

5) Hydro-Aire report # R100-109-42 Hardware Test & Evaluation Report of Antiskid Components Removed from the Bombardier Global Express BD-700 Aircraft 9009--

6) Response to SRPSA Aircraft 9009 Brake Accumulator Depletion Test Results. E-mail Mark Hudson to Alan Constable – Dated 01/04/2006

7) Flight Test Engineering – Aircraft 9127 Brake Accumulator Depletion Test- FTE Log Sheet. Flt 236 dated 12/22/2005

8) Goodrich Engineering Report Number ER-9012 Brake and Wheel Investigation on Global Express (BD-700) Aircraft 9009 Dated March 10, 2006

9) Airport Traces - E-Mail David Lee to Mark Hudson : Meeting with ASC 12/29/2005 (photos 10 and 11)

10) Goodyear Aviation Field Report AS 051201, Dated 05/01/2006

11) Goodyear Tire Incident Investigation Summary Dated Dec/29/2005

12) Meteorological Reports - Internet Site, http://www.wunderground.com/history/airport/rctp/2005/12/9/DailyHistory.html

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GLOBAL EXPRESS AIRCRAFT 9009 SYSTEMS REPORT - KAOHSIUNG AIRPORT LANDING INCIDENT

1.0 INTRODUCTION

On Friday Dec 9th, 2005, Global Express Aircraft S/N 9009 departed Hong Kong for a flight to Taiwan Kaohsiung airport (RCKH), with a stop at Taipei Chiang Kai- Shek airport (RCTP).

First leg of the flight was completed normally, with take off and landing taking place in good weather conditions, and no standing water or contamination on either airport ramps or runways (Ref.2, 12).

Following an uneventful departure and short flight from RCTP, the crew reported a normal approach and touch down at RCKH, with Auto Brake (A/B) selected to Medium setting.

Slight pulsing was noted during the landing roll, starting at touch down (Ref.1). The aircraft weight and speed at touch down were calculated to be approximately 60,000 Lbs, 111.0 Kias respectively (Ref.1, Ref .3).

Shortly after touch down and deployment of spoilers, and Thrust Reverses (TR), the crew noted multiple EICAS and failure indications related to T/R, hydraulics # 2 and 3, and brakes (Ref.1 and 3).

The crew also identified loss of nose wheel steering, and stated that the aircraft continued to slow down along the centerline of the runway, with reported loss of normal and emergency braking. The crew reported that the aircraft drifted to the right side of the runway, at a speed of 5 to10 MPH, then exited onto a taxiway with no brakes, or steering, finally coming to a stop at the adjacent grass area (Ref.1 and 3). (Photos 1, 11)

An inspection of the aircraft after it had come to stop, revealed failure of # 2 tire (Left Inboard), and damage to aircraft system installations in the left wing Aft Auxiliary Spar area. The damage was limited to hydraulic systems #2, #3 tubing, flap actuation components, harnesses installation for the spoiler and flap system, and structural and bracket components in the spar area, and slight damage to right inboard flap was also reported. (Photos 2,3,4)

During a runway walk back, pieces of tire, and small metal brackets that had departed the aircraft were collected, and identified with the respect to their relative location on the runway (Photo 10)

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FDR and CVR data were retrieved and made available for the relevant authorities for investigation and documentation of the incident.

The event was classified as an "Incident" by the Taiwan Aviation Safety Council authorities. (ASC). There were no injuries to the aircraft crew, or others on ground.

Bombardier Product Support and Engineering team produced a plan to investigate the cause of failure, and to provide repair and testing of the aircraft. Subsequent to the repairs and successful testing of the aircraft systems, a ferry plan with appropriate limitations was defined for flight approval of the aircraft's return back to the main base. Final repairs and return to service were completed at aircraft's main base.

A list of aircraft system components required for investigation was identified. The components were removed from aircraft, quarantined, and sent to appropriate testing facilities for investigation. The testing of the relevant components were witnessed by Bombardier, Engineering specialists.

This report, documents the results, and conclusions of the Bombardier investigation completed for Global Express Aircraft 9009 landing incident at Taiwan Kaohsiung airport. On Dec 9th, 2005

2.0 AIRCRAFT INFORMATION

Global Express BD 700-1A10 aircraft, Serial Number 9009, US registered number N998AM, operated by Corporate Jets Inc., was manufactured in year 1999, with Transport Canada Type approved Maximum Take Off Weight of 96,000 Lbs.

At the time of the incident, the aircraft had accumulated approximately 2304 flight hours, and 987 landings, with no reported accident or incident history.

At the time of incident, the aircraft had accumulated approximately 168 flight hours and 69 landings the since last 500 HRS check.

3.0 FLIGHT INFORMATION

The aircraft had departed Taipei (RCTP) airport, en route from Hong Kong, for a short positioning flight to Kaohsiung (RCKH) airport in Taiwan.

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Reported and calculated aircraft weight and attitude for takeoff and landing were reviewed, and found to be within normal limits. Touchdown speed, vertical and lateral accelerations were also normal (Ref 1, and Ref 3).

Reported meteorological, and airport information, do not indicate any relevant weather, runway, taxiway, or ramp conditions at Taipei, or Taiwan airport, that could be considered to have had any impact on the aircraft system's operation. (Ref. 2. and 12)

Review of the flight FDR, CVR transcripts, and flight crews debrief, indicate no aircraft system failure, or abnormal condition, prior touchdown that could have had any significant effect on this landing incident (Ref.1, 3 ,4).

Based on the above noted flight information, the main focus of this investigation was directed to events related to landing and taxi portion of flight.

4.0 AIRCRAFT DATA

A review of the aircraft, and relevant systems behavior during the Dec 9th landing is provided here. The information for this review was collected mainly from FDR and CVR data. (Ref 3, 4)

The above information was supplemented by crew's post flight de-brief statement, Flight crew telephone interview, site landing and taxi traces provided by ASC (Ref 9), and tire pieces collected from the runway. Bombardier Field Service Representative (FSR) e-mail (Ref. 2), and aircraft and site photos attached, plus results of testing and examination of components removed from the aircraft have been also included.

For the purpose of this review, FDR Sample Record number (SR) 92629 will be used as the touchdown time, and reference datum (TD + 0.00 Sec). SR 92629 is referenced against UTC time stamp 06:46:22, and local time 14:46:22.

It should be noted that Sample Record is incremented in one second intervals, while FDR data is recorded at varying sampling rates. The sampling rate can range from UTC time at one sample every Four seconds, to acceleration data, at Eight samples per second. This variation in sampling rates may occasionally cause various FDR data stream to be out of alignment by one frame due to round off. The potential effects of this alignment shift are considered to be negligible for the purpose of this investigation .

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4.1 TOUCHDOWN AND TAXI –AIRCRAFT SYSTEMS

The FDR data for this section were extracted from FDR data run results directly or from plots 1-6 included in Appendix A of this report. Some plots are duplicated in lager view for better resolution.

4.1.1 The review indicates that, after a typical ILS approach, the aircraft had a normal touchdown, with all systems operating, flaps 30, slats out. The aircraft speed was 111 Kias, and vertical acceleration (Nz) 0.96 -1.1 g . Prevailing winds were recorded to be approximately 10 knots, and from 260 degrees direction. (Ref.3)

4.1.2 FDR data (Plot 2) indicate a transitory Right MLG (Main Landing Gear), WOW (Weight On Wheel) at SR 92629, followed by steady WOW transition for Left MLG, at SR 92630(TD + 1 Sec). The Right MLG steady WOW transition, and start of spoilers deployment are shown to be at SR 92631 (TD + 2 Sec). At this point, the recording indicates a longitudinal deceleration (Nx) of less than -0.10 g, typical and expected value prior to application of brakes, similar to recordings for previous flights

4.1.3 At SR 92636 (TD + 7 Sec), the Left, and Right Thrust Reversers (T/R) start deployment, and are fully deployed by SR 92638 (TD + 9 Sec.). This time coincides with Nose Landing Gear (NLG) WOW transition to ground at approximate aircraft speed of 90 Kias. It is also noted that by this time, the rapid increase of deceleration Nx had reached –0.24 g, which is in line with brake system design ramp up target for Medium A/B setting of 8 Ft/Sec **2.

4.1.4 At SR 92639 (TD + 10 Sec), where pilot brake pedals are applied, releasing A/B, the aircraft had reached an Nx of –0.26g, and speed of approximately 85 kts. Next, the aircraft deceleration is initially reduced to less than 0.1 g, but rapidly increases, in response to pilot pedals input, to 0.24 g at (TD+15 Sec). From touchdown, to this point there were no FDR or system EICAS indications of abnormal system functionality or performance, and the A/B function had remained engaged.

It is noted that the crew de-brief also indicates that the aircraft had started to decelerate normally, as the nose was gradually lowered to the runway, and T/R s deployed, all normal. The Pilot Monitoring (PM) however, indicated that he felt a slight pulsing during this period, starting at the time of the initial touch down, and questioned if the Pilot Flying (PF) had released the A/B.

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During a subsequent review discussion, (telecon on the 16th of March 200), the crew stated that the pulsation was considered to have been above levels normally observed in previous flights.

4.1.5 At SR 92645 (TD + 16 Sec) the aircraft deceleration indicates a distinct reduction from 0.24 g, to between 0.15 g & 0.18 g , in three seconds ,This reduction in deceleration is contrary to effects expected, since the pilot pedal displacement was increasing. It is also noted that at this time, Nz, the aircraft vertical acceleration shows a minor but distinct increase in level of oscillation (Plots 2 and 6).

4.1.6 At SR 92648 (TD + 19 Sec), the FDR indicates a rapid drop of Hydraulic #3 pressure (Plots 2 and 5). Similar pressure drop is recorded for Hydraulic #2, at time 92652 (TD + 23 Sec) . These events are also noted in the flight crew de brief statement, are indicative of rupture of the aircraft's Hydraulic #2, #3 tubing, in the aft spar area , which supply the left wing flight controls. Site Photos confirm rupture and separation of hydraulic lines. (Photo 2)

It is recognized that rupture of hydraulic lines resulted in loss of functions powered by Hydraulic #2 and #3, including the steering system, which is supplied by Hydraulic #3. However, the inboard and outboard brakes, while gradually depleting by pilot brake application, remained pressurized above 1400 PSI, until after the aircraft exited the runway. (as indicated by first low brake pressure caution message that occurred later, at SR 92741 (TD + 113 Sec).

Brakes remained available after loss of main hydraulics, due to a design feature which isolates the brake lines, from a depleting main system, via respective in line check valves, and dedicated brake accumulators.

A review of brake pedal position (Plot 3) indicates that the pilot controlled and modulated left and right brakes between 0 % - 40 % of pedal travel, symmetrically and differentially, during SR 92638 (TD + 10 Sec) to SR 92714 (TD + 85 Sec).

The plots show that only past this time, higher pedal inputs were required by the pilot to control the aircraft speed and direction. In fact, pilot right brake pedal gradually increased from almost zero at SR 92680(TD+51 Sec), to 38%, at SR 92695 (TD+66 Sec). The 38% right pedal input is maintained for another five seconds, while the left brake pedal is reducing. This clearly is an indication of pilot differential braking, for a controlled right turn.

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FDR records of the aircraft heading (Plot 3) indicate a sharp change of direction to the right, around SR 92685 (TD + 57 Sec), with aircraft IRS ground speed of about 13 kts. This data is in agreement with time projected reference, deducted from landing and taxi traces (Ref 9 - Photo 10 and 11) and confirms aircrafts controlled differential braking turn into the taxiway D (Delta).

Comparing timing of (TD + 113 Sec) for low brake pressure caution indication, versus time of (Td + 57 Sec) for aircraft turn into taxiway Delta, and considering pilot activity modulating brakes, up to (TD + 87 Sec.), it is concluded that braking, although possibly at reduced levels, remained available to the crew for control of aircraft speed, and differential brake steering into the taxi way.

Results of the brake pressure depletion testing are provided later in section 6.1 of this report

4.1.7 Loss of Hydraulic #3 pressure at SR 92647 (TD + 19 Sec), resulted in the sudden loss of powered steering. However nose gear shimmy control, and steering caster mode allowed some level of un-powered steering of the aircraft, via available differential braking.

Based on remaining differential braking available at the time, as discussed in Para. 4.1.6 above, it is clear that the pilot was left with adequate level of control, to steer the aircraft into taxiway Delta, It is also noted that once the nose wheel was castered to steer, the aircraft would continue to turn, unless effective differential braking was used to straighten the castered nose wheel.

It is believed, that once the aircraft turned into the taxiway, the availability of differential braking was reducing rapidly by brake accumulators depletion. This condition, combined with a decreasing aircraft forward speed, caused differential braking to become ineffective in straightening the castered nose wheel, and the aircraft continued turn to the right, and then exited into the adjacent grass area.

The effect of differential thrust from right engine T/R having ' failed' in the extended position was analyzed by simulation, for this part of landing roll and taxi power setting. The results show minimal effect on directional control with a minor bias for aiding right turn steering.

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4.2 SITE INFORMATION

4.2.1 AIRPORT SITE AND RUNWAY

Recorded Longitudinal and Latitude coordinates, and integrated aircraft speeds were reviewed against landing traces provided by ASC. They were also checked against Sept 05 issue Jeppesen charts. The result indicates that the aircraft exited the runway onto taxiway Delta, approximately 5000 feet past the point of touchdown. This provides an approximate touchdown location of 2300-2400 foot point on the runway, close to 1500-2500 foot point mentioned in the crew's debrief.

This data indicates that the first piece of component separated from the aircraft (shield H), was located at approximately 2800 feet past the touchdown point. The last piece, which is identified as the largest piece of the tire (piece A), was found at around 3850 feet location from touchdown. (Photo 9 and 10)

4.2.2 AIRCRAFT DAMAGE

As was indicated in section 1.0 above, damage to the aircraft was limited to hydraulics and flight controls installations in the left wing aft auxiliary spar, directly above left MLG inboard wheel (#2). There was also minor damage to wing brackets and supporting structures. The system installations affected were Hydraulic #2, and #3 tubing, flap drive components, harnesses and wiring installation for the spoiler and flap system The left inboard flap had some black (tire) rubbing marks and right inboard slight surface skin damage.

There was no damage to NLG, and MLG or their installations, except for the failed # 2 tire ,and slight damage to #2 wheel .

There was hydraulic fluid leakage in the aircraft damaged are, runway, and the taxiway. There was also taxiway light damaged, as a result of a low speed flap contact.

5.0 HARDWARE EXAMINATION AND TESTING

Relevant brake control system components were removed from the aircraft for investigation. The components were identified based on preliminary assessment of the incident FDR, FSR submitted reports and site photos, indicating tire #2 blowout failure as the cause of the incident.

See below simplified brake system diagram, and hydraulics schematics.

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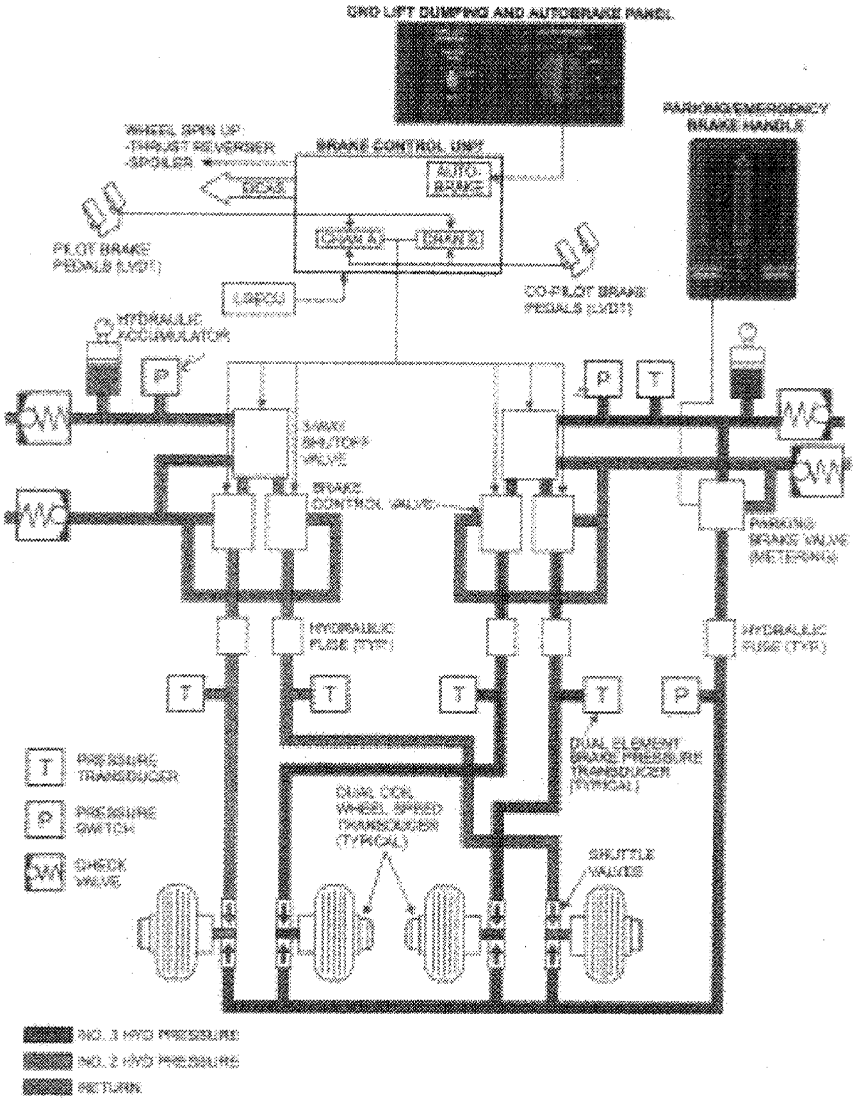

FIGURE 1 - BRAKE SYSTEM DIAGRAM

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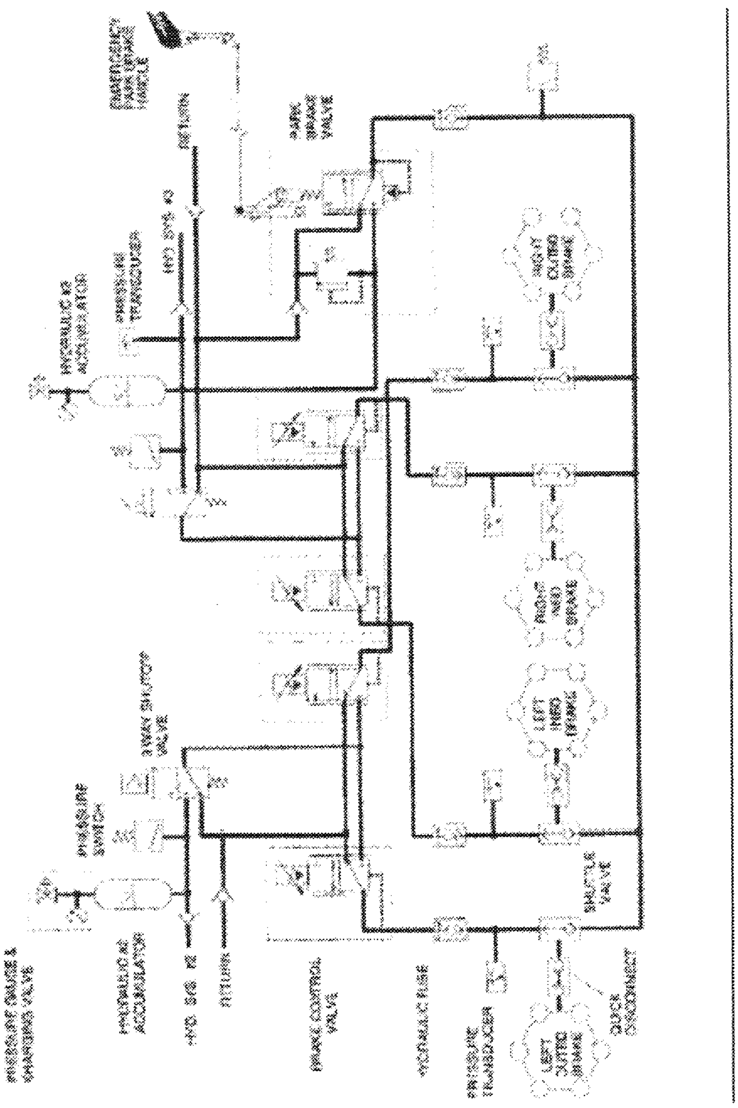

FIGURE 2 - BRAKE SYSTEM HYDRAULIC SCHEMATIC

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The following components were quarantined after removal from the aircraft, and sent to appropriate testing facilities for investigation. Examination, and testing of components removed from aircraft, were witnessed by Bombardier Engineering system specialists.

5.1 TIRE

Main Landing Gear tire Part Number 382K03-2, is a 20 Ply Rating, 210 MPH rated H38 X 12-19 tire made by Goodyear Tire Co. of Akron, Ohio.

The failed tire, S/N 41281600 with reported 121 landings prior to failure, was removed from the aircraft left MLG inboard wheel, and visually examined at location by ASC and Goodyear Tire Company representative (Ref.10) , (Photo 5, 6, 7)

The tire, the mating wheel, plus tire pieces collected from the runway, were then sent to Goodyear Tire Engineering facility in Akron Ohio for examination. (Photo 8 and 9)

The examination took place on Feb 27th, 2006, with Bombardier landing gear and brake system specialists present. The Goodyear Tire product support and engineering team were assisted by the company's accident investigation specialists.

The main body of the tire, the wheel, and smaller tire pieces collected from the runway, were subject to detail visual and lab examination. Manufacturing and product airworthiness records, TSO approval documents, in service history, and removal rate of the tire, were also examined.

The examination did not indicate any manufacturing flaw, rib failure, shoulder/casing separation, ply separation, blisters or tire bulge that could be considered as the cause of its failure.

There were also no evidence of maintenance negligence, heat damage, tire slippage on rim, runway or FOD damage. There was some minor signs of inner liner wrinkling that could suggest low inflation pressure, but this was clearly not the cause of tire failure due to its relative location on the tire. The wrinkling could have resulted during tire rotation after failure.

The result of the tire examination indicated that the cause of #2 tire failure was an induced transient deep skid, and blow out. The condition, clearly evident by a typical flat spot, concentric ply ring marks, and cross tear pattern around 11:00 clock from serial number

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markings, when viewed from inboard. Examination indicated that the initial event, was followed by wheel & tire rotation, which in turn resulted in tire flailing, and separation of tire pieces.

Examination of tire pieces, and their respective locations on the runway clearly indicate that the deep skid condition took place after the touch down, past the initial part of the landing roll.

5.1.1 Examination of tire piece "F" which was found upstream of pieces "C", and "A", exhibited gouges, heavy rubbing and tearing marks under microscope. The piece (approximately 1.5 x 3.0 inches) was most likely separated from the 'skid patch' area by dragging, and tearing.

5.1.2 Tire pieces "I", and "H" showed signs of tearing and indication of early separation from the main body soon after tire blow out, as there were no signs of repeated damaged marks.

5.1.3 Examination of tire piece "C", which was from the area of the tire away from the 'skid patch', showed 'clean' tearing separation marks on edges, no major gouges or damage on the crown surface, and no wear on the shoulder decorative rib "GG grooves". This indicates that the piece most likely separated, after the initial skid and tire blow out, and when the tire and wheel started rotation again. This tire piece was found downstream of "F", and upstream of tire pieces "A".

5.1.4 Examination of the largest piece "A", (approximately 22.0 x 17.0 inches flat), separated from the crown area, and provided valuable information. The piece, was from crown area of the tire between 11:00 to 3:00 o'clock, and adjacent to the skid patch. (Photo 7, 8, and 9)

The piece on one end, and the sides, had clear signs of 'clean' separation cuts. However the other end (adjacent to the skid patch), had a collection of uneven, frayed and stretched cords.

The stretched and frayed nylon cords, are a clear indication of piece "A" remaining attached to the main body of tire, during initial blow out, and later separating due to centrifugal loads during rotation. The location of the piece on the runway supports this conclusion.

Evidence of tire skid and subsequent rotation of tire can be found in the photos of the tire taken where aircraft had come to rest. The photo clearly shows, the skid

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patch had rotated away from the ground contact position. The wheel & tire examination earlier, revealed that there was no tire rotation on the wheel. (Photo 1)

The piece, also had shallow marks across the crown cord, indicating repeated strikes against some aircraft structural member / component.

It was noted that piece "A" was from the crown part of tire, located clockwise downstream of the skid patch (when viewed from inboard side). The piece therefore was not facing the runway surface during the skid, and could not have been separated without post skid wheel rotation, and high centrifugal forces.

Based on collective evidence observed for piece "A", its size, its adjacent location to the skid patch, and indications to the mechanism of its final separation, it is concluded that piece "A" was the flailing section rotating with the remaining main part of the tire, striking the wing aft spar area.

5.1.5 A review of the tire failure, and projected shedding of radial trajectories, excludes direct impact striking of components nestled in the rear spar area. It also strongly suggests that a rotation of a flailing tire is required for the level, and type of damage observed on system installations in that area.

The evidence indicating that some of the components (flap torque tube, wiring, hydraulic lines, and sheet metal shield) were 'pulled down and out' by a rotating tire piece, as opposed to being 'pushed in' by trajectory impact, is noted here for reference (Photo 2). Additionally, the black rubbing mark on the inboard flap, suggesting flailing tire contact must be mentioned.

Finally, location of piece "A", as the furthest component found on the runway from touchdown point, is noted as confirmation of above failure scenario. Photos of tire debris at the location where the aircraft had come to rest, shows the location of missing piece "A" relative to the skid patch location (See Photo 1, 8, 9)

Details of tire examination are documented in Goodyear investigation summary (Ref. 11).

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5.2 WHEEL ASSEMBLY

Left inboard MLG wheel was initially included in tire investigation. Tire to rim interfaces were examined for flaws, damage, tire slippage, or other potential abnormalities, No tire to wheel anomalies, or conditions that could cause, or be a contributor to tire failure were found.

At the conclusion of the tire inspection, the wheel was sent to Goodrich Corporation in Troy Ohio, as part of the wheel / brake assembly investigation witnessed by Bombardier brake specialists.

Wheel P/N GW 313-1100-5, S/N 147 was visually inspected for proper structural, bearing surfaces, and heat shield condition. The over pressure valve, and fuse plug integrity were also verified. Radial and drive lug alignment, in addition to proper interface with the brake assembly were examined. The inflation valve was pressurized to 170 PSI, and checked for leakage.

It was noted that the out side face of the wheel showed sign of non standard paint over spray and minor contamination which are both considered immaterial in the context of this investigation, There was also black marking, indicating tire rub in one location on the face of the wheel.

In summary, the results of this examination and testing do not identify the wheel or wheel/brake interface to be the cause or a contributing factor to the tire failure. There were no sign of internal markings, nicks or gouges that could point to FOD or brake parts binding against the wheel, restraining its rotation.

Full result of the wheel assembly investigation is documented in Goodrich investigation report (Ref.8).

5.3 BRAKE ASSEMBLY

Brake assembly P/N GW313-2001-3, S/N 103 was the subject of extensive visual inspections, functional and cold chamber testing.

Extensive Brakes ON / Brakes OFF pressure, hysteresis, and brake drag, and brake release testing were conducted in room and extreme cold temperatures down to –85 Deg F.

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Additionally, after completion of the testing, during tear down, all rotors and stators were subject to detailed dimensional checks, surface measurement for flatness, rough spots, de-lamination.

The brake assembly testing and inspections results show minor hydraulic leakage at a piston rod during pressure and cold soak tests, and minor rotor /stator surface imperfections. Some minor surface contamination was also noted.

The leakage at the piston rod seal area, and the minor surface anomalies, were assessed in details and are concluded not to have had any effect or contribution that would result in any significant brake drag, or a brake jammed condition.

Full and detailed results of the wheel assembly investigation, are documented in Goodrich investigation report (Ref.11).

5.4 BRAKE CONTROL UNIT

5.4.1 Brake Control Unit (BCU), Part Number GW415-7125-5 is a two channel Active/Active brake control, and anti-skid digital controller. The unit also incorporates an analog supervisor for the most critical failure mode of un-commanded brake during take off. The unit provides for appropriate communication of normal or failed brake system status, for cockpit indication, and can provide full (100 %) braking after the loss of one channel.

The unit also provides for selectable Auto Braking with three settings of High, Medium, and Low. It also provides for Touch Down and Locked Wheel Cross Over protection.

In case of loss of total BCU function (loss of normal braking), the crew can use emergency braking from a cockpit lever, which bypasses the BCU, and anti-skid protection.

5.4.2 BCU, S/N 333 was removed from the aircraft, its NVM downloaded, and the unit then subjected to checks, and extensive Acceptance Test Procedures (ATP).

The visual check indicated that the unit was in good condition, and all pins and connectors looked normal. The NVM downloaded records showed that the only anomaly recorded the day of incident, was an A/B bus communication fault.

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Analysis of the data indicated that the time of the fault recording was 6: 48 AM (aircraft time), and at zero wheel speed, which was not related to the landing incident event. The fault was identified to be a nuisance indication caused by different power up times from two separate aircraft 28 V DC buses feeding the BCU.

Additional testing and simulation of various scenarios were also completed to verify BCU's response to input parameter failures. The checks and testing took place at Crane Hydro-Aire engineering laboratory, with Bombardier brake system specialist participation.

The laboratory simulation rig incorporates production equivalent aircraft brake system hardware, except for the wheel spin up signal which is simulated. The rig is a high fidelity integration and certification engineering rig, and therefore representative of the aircraft brake system performance, and functionality.

Below a summary of relevant simulations testing completed, are noted for reference. Full and detailed results of BCU investigation is documented in Ref.5, Hydro-Aire Test and Evaluation Report.

The result of checks, testing, and NVM review of the BCU, indicated that the unit was not the cause of #2 tire failure.

Below are block diagrams of the BCU and its interface with the brake system, provided for reference.

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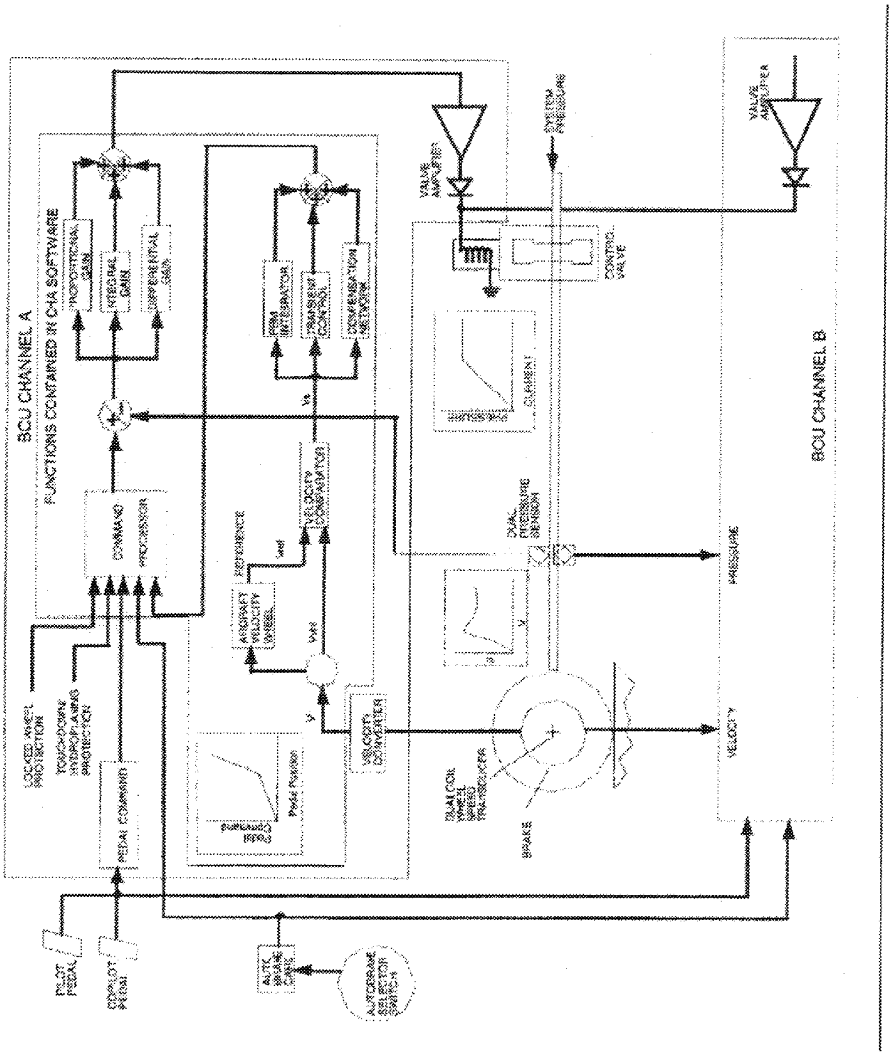

FIGURE 3 - BRAKE CONTROL SYSTEM BLOCK DIAGRAM

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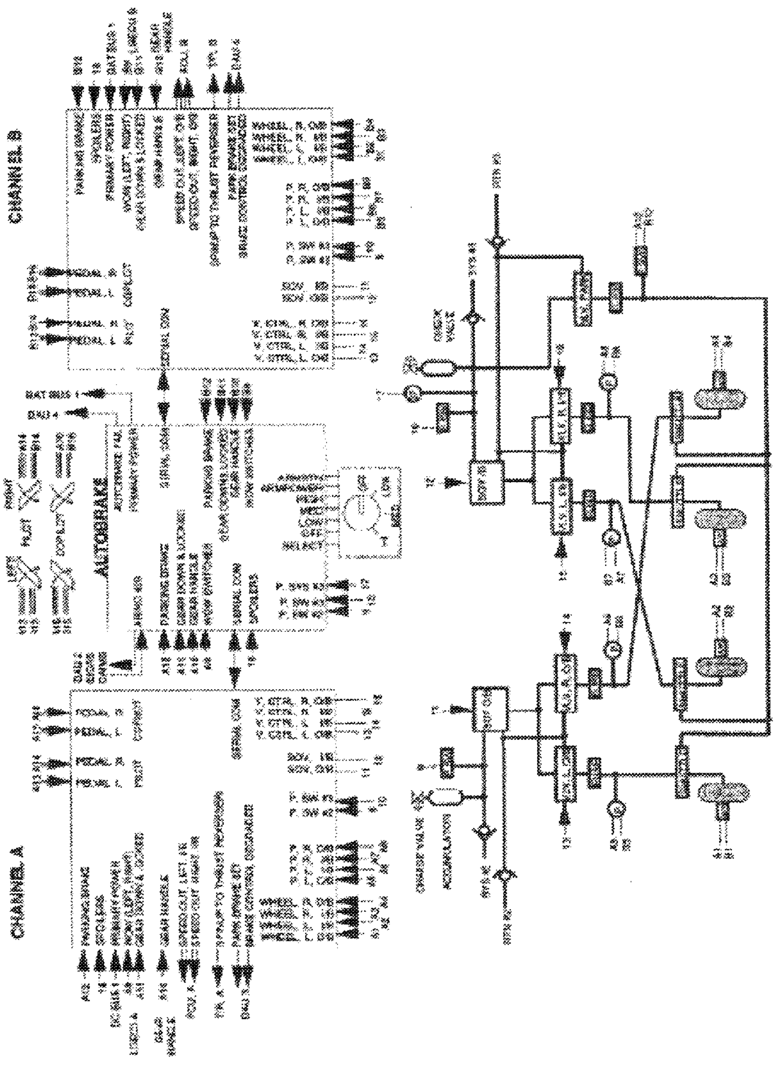

FIGURE 4 - BRAKE CONTROL SYSTEM INTERFACE DIAGRAM

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5.5 BCU SIMULATION TESTING

The following simulation rig testing was conducted to verify proper BCU unit A/B ARM, and ENGAGE functionality during normal operation, as well as simulated failure conditions.

For ease of reference A/B ARM, and ENGAGE logic is referenced below :

Auto Brake ARM

- A/B Cockpit Switch Selected to HIGH, or MED, or LOW
- Aircraft in Air Mode
- Pilot and Co-pilot Pedals at Less Than 20% Deflection
- Wheel Speeds at Zero
- No Brake System Fault

Auto Brake ENGAGE

- A/B Armed
- Ground Spoilers (GS) Deployed
- Wheel Speed Above Zero (latched after 3 seconds)

5.5.1 Normal landing with A/B selected to MED was conducted, simulating all wheels spin up, then GS deployed, followed by WOW.

The result was normal expected deceleration and no EICAS Fault / Failure indication.

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5.5.2 Same as above (5.5.1) except WOW was NOT selected (no WOW).

The results for ARM , ENGAGE, and deceleration function was the same as (5.5.1), down to the 10 kts antiskid drop out threshold.

5.5.3 Same as above (5.5.1) except with ONE wheel (left inboard wheel) locked, (no spin up) at touch down, and landing roll.

The results for ARM , ENGAGE, function was the same as (5.5.1) with no EICAS fault indication.

5.5.4 Same as above (5.5.1) except with ALL wheels locked (no spin up) at touch down, and landing roll.

The A/B remained Armed, but the A/B did not Engage, and there was no A/B deceleration.

5.5.5 Same as above (5.5.1) except introduce one wheel locked (no spin up) after A/B had been engaged post touch down.

The result indicated that the A/B remained engaged and commanded according to the A/B schedule, but was dropped to 'zero' by the Anti-Skid logic, thus reducing the pressure commanded to the locked wheel.

5.5.6 Same as above (5.5.1), except introduce an un-commanded pressure (300 PSI) to left inboard brake prior to touch down.

The result was an immediate loss of Armed status, inboard brake shut off valve closure, with appropriate 50 % brake degrade EICAS indication.

5.5.7 Same as above (5.5.1) except introduce pressures higher than commanded of 300 PSI to left inboard brake, after A/B engagement. Repeat result with 700, and then 1000 PSI higher than commanded.

The A/B remained engaged for the 300,and the700 PSI higher pressure cases, as the BCU reduced the current to the valve attempting to compensate for un commanded higher pressure.

When the test was repeated for the 1000 PSI case, on channel A of the BCU, the A/B disengaged after 3 Seconds, with normal pedal braking, remaining available.

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5.5.8 Additional testing to confirm proper functionality of the BCU unit was completed, including; Touchdown Protection feature, Locked Wheel Cross Over protection, A/B to normal brake transition, and finally BCU ability to compensate for a typical max Brake Control Valve (BCV) null bias shift.

The results did not identify any BCU anomaly that would have result in # 2 tire failure during landing. As a confirmatory validation, BCV null bias test was repeated during aircraft testing, with a pair of BCVs, intentionally mal adjusted null bias. Aircraft testing confirmed simulation findings that the effect of such a shift is minimal , and has no appreciable effect on brake systems over all response or performance.

Details of BCU testing, and results are documented in Hydro-Aire report (Ref. 5)

5.6 WHEEL SPIN UP TRANSDUCER

Wheel Spin up Transducer (WST), P/N GW415-1050-5, S/N 206 was removed from left MLG inboard axel. The unit was visually inspected, and functionally tested at Crane Hydro-Aire engineering test lab with Bombardier brake system specialist participation.

Based on the results of testing, and inspections completed, the WST was found to be in good physical and operating condition, and to pass all required mechanical and electrical characteristics for both channels. The WST is not considered to be the cause or a contributing factor in the tire failure.

The results of testing are documented in Hydro-Aire report (Ref. 5)

5.7 BRAKE PRESSURE TRANSDUCER

Brake Pressure Transducer (BPT), P/N GW415-1350-3, S/N 6037-6AB-209 was removed from the aircraft and sent to its manufacture (Kulite) for testing. The unit was visually inspected, and functionally tested per the applicable ATP.

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The results indicates that the unit was in good physical and operating condition, and both channels of the BPS met the required functional requirements. The BPT is not considered to be the cause or a contributing factor in the tire failure.

The results of testing are documented in Hydro-Aire report (Ref. 5)

5.8 BRAKE CONTROL VALVE

Brake Control Valve (BCV) P/N GW415-6150-1 is a single channel, two stage flapper nozzle, Electro Hydraulic Servo Valve, which controls brake system pressure, proportional to current command inputs from the BCU.

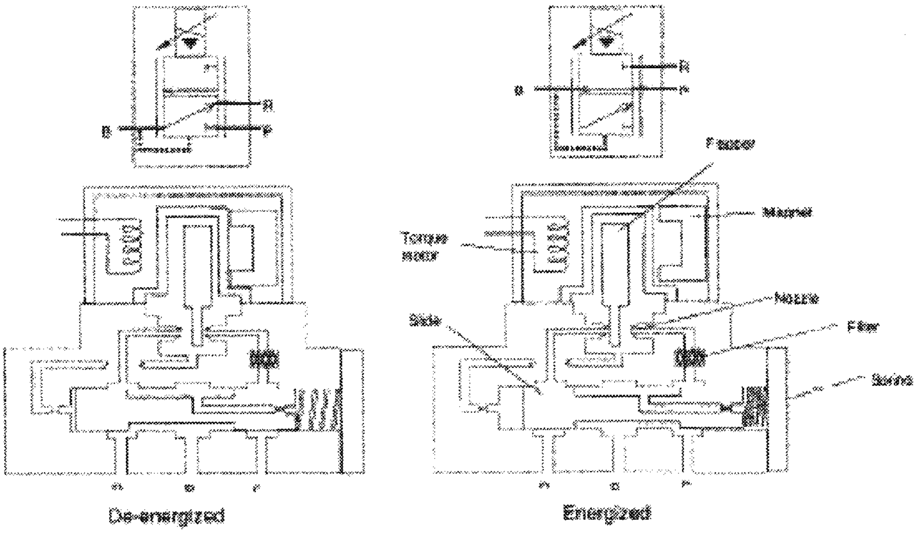

FIGURE 5 - BRAKE CONTROL VALVE SCHEMATIC

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5.8.1 BCV S/N 218, which was installed as part of #2 wheel brake control circuit, was removed from the aircraft, and subjected to functional testing, visual inspection, and detailed tear down.

Records of the valve at Hydro-Aire indicated that it had successfully completed all its functional ATP tests prior to shipment. The records also showed that it had never been returned to Hydro-Aire, due to removal or for repair.

5.8.2 After a visual inspection, which confirmed no external or connection damage, the unit was tested per relevant ATP. The results indicated that the valve operated normally, without hesitation or jamming, but did not meet functional requirement for internal leakage at 5 ma Quiescent current flow. Also results for blocked port pressure, verses current schedule, was slightly out of the required tolerances.

The above anomalies were analyzed, and the cause determined to be as follows:

- The higher than allowable internal valve leakage at 5 ma, was caused by abnormal wear out (erosion) of the 2nd stage slide /sleeve metering edges.
- The current versus pressure shift, was determined to have been caused by reduction of magnetic flux of the torque motor, resulting from minor backing out of flux adjusting screw.

The effects of the above two non compliances to the ATP, separately or combined, and at levels observed, would most likely be an erosion of performance and functionality margins, but would not cause the loss of brake control. This was demonstrated when the BCV was installed in the simulation rig facility, and shown to operate 'properly' during various takeoff and landing simulations.

To confirm the above findings, additional testing was conducted on a Flight Test Aircraft, equipped with a pair of degraded valves (intentionally mal adjusted for null bias). The results did not show any tangible abnormal behavior. (See Section 6.2 below)

The BCV, ATP results, while out of Spec, did not show a jammed or 'sticky' valve, during testing, which could explain deep skid, and blown tire.

However, based on the collective evidence of the incident at the time, the BCV remained a potential candidate, and therefore a tear down of the valve was

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requested. This rationale was supported by the result of aircraft checks, and investigation of other brake system components, indicating no significant or relevant anomalies.

5.8.3 The tear down of the BCV, witnessed by a Bombardier brake system specialist, revealed presence of rubber debris in the area of 2nd stage slide and sleeve of the valve. The debris was determined to be bits of "O" ring, from the sleeve assembly.

Removal of the slide from the sleeve revealed that the "O" ring, and its back up ring had been erroneously installed in reverse order, in the area of the pressure, and control ports.

The incorrect installation, subject to many cycles of valve modulation, had led to nibbling, and pinching of the "O" ring and release of small rubber particles in the area.

The contamination of the hydraulic fluid by rubber particles or pieces separated from the "O" ring, increases the probability of a slide jam or slow response of the 2nd stage.

The 2nd stage controls output pressure of the valve to its dedicated brake. A jammed, or slow responding sleeve impairs proper brake control, and anti skid modulation, resulting in brake pressures being higher than commanded.

This condition, if not relieved by corrective command from the BCU, may lead to a valve 'runaway'. The condition in turn could result in a deep skid of the corresponding wheel, and failure of the tire during the braking.

Tests completed at Hydro-Aire indicated that for MED setting of A/B, where typical dry runway modulated pressures are about 1500-1700 PSI, the pressure has to reach a value of approximately 2300 PSI, before the monitoring logic would provide a 'pressure higher than commanded ' indication to release the A/B function.

It must be noted that the brake system incorporates additional provisions to protect against occurrence of this mode of failure during the Take Off. Any pressure higher than the nominal zero brake pedal input during takeoff, is detected by BCU, and is immediately shut off via the Brake Shut Off Valve.

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5.8.4 The Hydro-Aire report (Ref 5.) recognizes and confirms the probability of this mode of failure, and incipient escalation to a skid condition. However it considers it an unlikely scenario for this case, based on consideration of the likely resulting particle size.

The report states that particles or slivers of "O" ring must have a cross section of under 0.0002 inch thickness to fit between the slide and sleeve, and have a length long enough to cause a binding force that could not be overcome by sleeve end chamber forces of 130 pounds.

5.8.5 Design review of the valve indicates that pressure increase from the first stage, shuttles the slide against its internal return spring to increase brake pressure. However, the valve depends on the spring return force, combined with brake back pressure, to return the slide, for modulation and control of fast increasing brake pressure.

In case of a jam, or sticking of the slide, the return spring, the brake back pressure forces, and reduction of the sleeve end chamber pressure combined, must 'un-jam' the slide, to allow pressure modulation, and prevent valve 'runaway '. Failure to release a sticky, or jammed slide, could lead to brake pulsing, skidding or tire failure.

The valve is more vulnerable to a jam of its slide, at the onset of a brake 'fill function', on initial, or max rate, brake pressure demand.

During this period, the chamber pressure is still high, and the brake back pressure is still low, to help the return spring over come jam.

In majority of cases, the build up of brake back pressure, combined with first stage attempt to reduce it by lowing sleeve chamber pressure, will help to release sticky or jammed slide before any damage is done to the tire.

However, if the jam condition persists, first stage attempt to reduce brake pressure will not succeed, and brake pressure build up will escalate.

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5.8.6 Aerospace industry experience, including Bombardier, indicate that probability of EHSV valve sticking increases in a contaminated fluid environment. Also, Global Express FRACAS reports, and in service Failure Analysis Reports (FAR) for BCV GW415-6150-1, identifies contamination as the cause of removal for several valves in service.

The Global Express service record however, does not show any report of similar aft spar damage to any Global Express aircraft in service to date, related to or caused by the failure of the BCV.

In summary; the following is concluded for the investigation of the BCV, based on the examination, testing, tear down and analysis of the results :

- The ATP test results for the valve did not identify a jammed, runaway or sticky valve.
- The results of testing and analysis indicated that the null bias anomaly, and the current versus pressure schedule shift, are not considered to have caused or had significant contribution to tire failure
- The tear down of the valve revealed the incorrect installation of "O" rings in the 2nd stage slide and sleeve assembly. The incorrect assembly had resulted in contamination of the valve by scattered rubber particles, nibbled and pinched from extrusion of the "O" ring.
- Contamination of the sleeve and slide assembly could lead to a jammed or sticky slide, which unless cleared, would result in a slow acting or a runaway valve. The valve is more likely vulnerable to this mode of failure during brake 'fill function' or rapid / max pressure demand inputs.
- A sticky or runaway valve could result in a deep skid and tire failure.
- Brake pressure increase, and corrective command to first stage, could help release a jammed valve.

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6.0 AIRCRAFT TESTING

Two categories of aircraft tests, related to the incident were conducted.

The first category tests were intended to check and ensure health of aircraft systems prior to ferry flight from Taiwan Kaohsiung airport. In general these test were in line with aircraft AMM, to ensure that the repaired and effected systems met all functional requirements. The second category of tests simulated certain failure conditions, to verify that the results are per expected design requirements.

For the purpose of this report, only those aircraft tests that are relevant to this investigation will be documented here.

6.1 BRAKE ACCUMULATOR DEPLETION TESTS

Crew debrief (Ref. 1), noted loss of all braking, and both brake systems indication of zero pressure, just after the appearance of EICAS messages, but prior to aircraft exit to taxiway Delta.

System design requirements are for capability of at least six full brake applications powered by brake accumulator(s), after loss of main hydraulic systems(s).

FDR recordings show that loss of all braking, took place after multiple brake applications, and only after the aircraft had departed the runway. See Para. 4.1.6, and 4.1.7 of this report

It is understood that flight crew's debrief statements, although extremely helpful, and generally accurate, could occasionally be influenced by fast moving events during landing, especially when combined with multiple failure events.

To verify that A/C 9009, and others in Global Express fleet, are free from unintended product faults that could cause premature bleed down of brakes, the following tests were completed on A/C 9009, and Bombardier Flight Test aircraft S/N 9127.

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6.1.1 Testing on A/C 9127 consisted of recording inboard brake accumulator depletion rate, and low brake press caution indication, versus number of brake applications. This after simulated loss of main hydraulic pressure.

Tests were conducted with aircraft stationary (no anti skid activity), and repeated during runway high peed accelerated stops for Low, Medium, and Max braking.

Runway brake tests took place in Dec /22 / 2005 in Wichita Kansas, during flight F236, per TDS131-32-MD-006-1 NC. Results are document in Ref, 7) Flight FTE Log Sheet of same date

6.1.2 Depletion tests, with aircraft stationary were repeated on A/C 9009 in Taiwan, prior to Ferry Flight, The results of A/C 9009 tests are recorded in A/C 9009 SRPSA response dated 12/22/2005 of Ref.6). Similar tests were conducted on production aircraft in Toronto Canada

In all cases tested, the results met and exceeded the design requirements. For all accelerated stops, the aircraft was brought to rest on the runway, prior to complete depletion of the accumulators.

The lowest brake accumulator pressure recorded after full stop on runway was 700 PSI. also INBD BRK LO PRESS was reported as expected.

It must be noted that accelerated stop RTO tests procedure on A/C 9127, are considered to have been more conservative. The procedure was adopted to simplify simulation of hydraulic system failure. During the tests, the system pressure was completely depleted, prior to start of the accelerated run, rather than at the start of braking .

For this procedure, in addition to the main system being fully depleted, before start of simulated RTO, the accumulator would also start to deplete by pilot holding the brakes during engine power increase, prior to start of the run. Never the less as was mentioned earlier, for all conditions tested, the aircraft came to full stop on the runway, with brake accumulators still holding partial charge.

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6.2 DEGRADED NULL BIAS - BRAKE CONTROL VALVE TESTING

During investigation of the Brake Control Valve removed from the aircraft, some degradation of valve's performance was detected at Hydro-Aire (Section 5.6.2 above). Testing of the valve on high fidelity simulator rig, excluded the condition as the cause of the tire skid during the incident.

To confirm these findings on actual aircraft operational environment, a pair of valves intentionally mal adjusted for null bias, were installed on Bombardier Flight Test Aircraft 9127.

During various taxi, and brake runs, valves response, performance and sign of skid activities were monitored. The observed data, flight crew comments, and tire inspection post testing did not indicate any tangible abnormal brake activities. The results confirmed that levels of null bias shift tested , can easily be compensated within the pressure control loop limits.

7.0 <u>REVIEW AND ANALYSIS OF THE RESULTS</u>.

Sections 1.0 to 6.0 of this report provide relevant flight, aircraft, site, and aircraft system information relevant to this incident. Although there have been additional information, made available, or collected via e-mails, telephone conferences, etc, only those relevant to determining the cause of the incident have been documented here. It is believed that no information, or evidences that could alter the findings, or conclusion of this report has been excluded from this report.

7.1 FLIGHT FROM KAOHSIUNG AIRPORT TO TOUCH DOWN

From the results provide in sections 1.0 to 5.0 of this report, it is concluded that the flight until touchdown, was uneventful, and for this portion of the flight, there were no abnormal aircraft, system, or airport conditions that contributed to this incident.

Supporting this conclusion are results of tire, wheel, and brake assembly investigation, which revealed no sign of pre touch down failure, or A/B arming anomalies.

Additionally FDR, CVR, and crew's debrief indicate no anomaly for this portion of flight, including gear extension event, where brake system pulse check is completed..

These results, plus evidence that take off and landing took place in good weather conditions, with no standing water or contamination on either runway, and duration and altitude of flight (less than

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¾ of an hour, at FL 160) rules out the case for a jammed or frozen brake landing. (See Plot 4 and Ref 2 & 12).

This argument is also supported by the separated tires found on the runway, and their respected position from point of touchdown.

7.2 LANDING ROLL AND TIRE FAILURE

7.2.1 SUMMATION OF RESULTS

Results and data presented in section 4.1 of this report, indicate that; the touchdown, main wheels spin up, deployment of spoilers, aircraft deceleration (Nx) in A/B mode, and lowering of the nose wheel on to the runway, were all normal . The PM however noted some pulsation, which was considered to be abnormal.

The results also show, by the time NLG WOW was made (TD + 9 Sec), the aircraft had achieved Nx of 0.24 g, which is in line with the crew selected MED setting of A/B deceleration of 8 ft/sec^2 .

By this time the T/R had fully deployed, and the aircraft speed was reducing through 90 kts.

It is about this time that the PM asked if the PF had released the A/B, and within one second, the pilot starts to apply brake pedals.

Results noted in section 4.1.4 indicated an Nx of 0.26, just prior to time of initial pilot pedal application (TD+10 Sec).

The pilot action to press the brake pedals, released the A/B. The aircraft Nx initially reduces to less than 0.1 g, but within the next second, it starts to increase, in response to pilot pedal inputs and reaches 0.24 g at (TD+15 Sec), with aircraft speeds of around 68 kts.

However, at (TD+16 SEC), Six seconds after initial pilot input, the aircraft deceleration is reduced, in contrast to increasing pilot pedal input. Also, there is a minor but distinguishable increase in Nz. Oscillation, continuing through HYD #3 line rupture At (TD+19Sec), and HYD#2 rupture 4.0 seconds later. From here on, the EICAS was flooded with various hydraulics, T/R, and other system failure messages.

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7.2.2 ANALYSIS OF RESULTS

The analysis of the events from touchdown, to HYD #3 failure, leads to the following conclusions. The conclusions are supported by evaluation of tire pieces found on the runway itemized in section 5.1, and the results of BCV tear down, and discussions included in Section 5.6. Only relevant events to failures are highlighted.

- At, or shortly after a normal touchdown, with A/B ARMED, plus ground spoilers deployed, the wheel spin up signals, ENGAGE the A/B function. The four BCV(s) start the 'fill function' of brakes, for ramp up to MED deceleration.
- Contamination in sleeve of BCV #2 effects the valve's modulation .
- The degraded modulation of the BCV results in brake grabbing / chattering, noticed by PM as Pulsing.
- The A/B remains engaged since all requirements are met, as evident by MED level aircraft deceleration. Any reduced braking of #2 wheel, is compensated by the other three brakes, maintaining the selected deceleration rate. Potential pressure transients higher than commanded in # 2 brake, does not exceed the required threshold to cause an A/B disable. (Testing at Hydro-Aire indicated that 600-700 PSI pressure, over typical modulated pressure of 1500-1700 PSI for MED braking is required to disable the A/ B function.) Aircraft deceleration reaches 0.26g.
- Initial pilot brake pedal contact releases A/B, resulting in dumping of brake pressure, as evident by a rapid change of deceleration from 0.26 g to 0.07g in less than 2 Seconds. (TD + 12 Sec)
- Pilot pedal application demands a rapid brake pressure increase from all BCV(s) including #2 brake BCV. Rapid shuttling of #2 BCV slide, to the high pressure side, (high first stage sleeve chamber pressure, and low brake back pressure) in contaminated sleeve, results in slide sticking / jam in high pressure position.
- The aircraft deceleration increases from 0.07 back to 0.24 g within the next 3 Seconds, while #2 wheel is pushed into a deep skid condition by lack of modulation from the jammed BCV. The BCU by design, does not close the Brake Shut Off Valve since there is a valid pedal input above zero. The BCU logic, however continues it's attempts to minimize the brake pressure by reducing sleeve chamber pressure, but remains ineffective against the jammed sleeve.

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- Within the next two seconds (TD +15 Sec to TD + 17Sec) the # 2 tire fails, as evident by a sudden reduction of deceleration, in contrast to increasing pilot pedal input. The increase of recorded aircraft Nz volatility is another evidence of the time of tire failure and erratic dragging on the runway.
- Separation of tire pieces "I", "H", and "F" (section 5.1) is viewed to have taken place in this period.
- Shortly after tire failure, the jam of BCV sleeve is expected to have been released. This based on evidence of tire piece "C" indicating start of rotation of the blown tire, and FDR timing for HYD #3 line rupture at by flailing tire (TD + 19 Sec) .
- Although no clear explanation for un-jamming of the BCV can be offered, the effect of already high back pressure, in combination with anti skid command to dump the pressure , and pilot's modulation of brake pedal seems reasonable.
- Higher vibration levels after tire burst due to dragging of blown tire, (as evident by higher Nx, and Nz oscillations), plus close proximity of the location of BCV in the MLG may have also been a factor

It must be emphasized that the above constructed scenario is a statement of most probable cause, based on explicit and deduced collective investigation results documented in sections 2 to 6 of this report.

No other scenario, including landing with frozen brakes, Mechanical jam of wheel / brake, or failure of BCU, Wheel Speed Transducer, Brake Pressure Transducer, or other aircraft system failure can be considered credible. This again based on collective result of investigations noted in section 2 to 6.

7.3 AIRCRAFT SYSTEMS DAMAGE POST TIRE FAILURE

Results of examination of tire piece "A", and its location on the runway were discussed in details, in Para 5.1. The results, concluded that piece "A" while still attached to the main body of the tire and rotating, severed system installations in the wing auxiliary aft spar.

Below, the ensuing events after tire failure, and effects on aircraft systems are documented

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- Rupture of HYD # 2 line by flailing tire, caused rapid loss of function of the right hand T/R , #2 & #3 multifunction spoilers, and MLG retract actuator. The failure also made availability of outboard brakes, dependent on capacity of brake accumulator. (see Hydraulic System #2 distribution below)

- Rupture of HYD #3 line caused rapid loss of function of steering, ground spoilers, plus MLG and NLG actuator, doors and related locks,. Nose gear shimmy damping, and caster mode remained functional. The failure also made availability of inboard brakes, dependent on capacity of brake accumulator. (see Hydraulic System #3 distribution below, Figure 6)

- Damage to the system installations and harnesses, resulted in loss of flap system, and spoiler control. These damages in combination with effects of loss of HYD #2 & # 3 caused flood of EICAS CAUTION, and WARNING messages.

- Loss of all braking was discussed in Para. 4.1.5, and section 6.1, aircraft brake accumulator testing.

  The results and analysis indicate that the inboard and outboard brake accumulators, as part of the brake system, provided appropriate braking after loss of main hydraulics, until aircraft exited the runway.

  The level of braking was in line with the aircraft AFM instruction for Non- Normal, HYD 2 LO PRESS and HYD 3 LO PRESS.

- After loss of powered steering, NLG wheel shimmy protection, and nose wheel caster mode, for differential brake steering remained available. Although degraded, the level was adequate to allow PF control of the aircraft on the runway.

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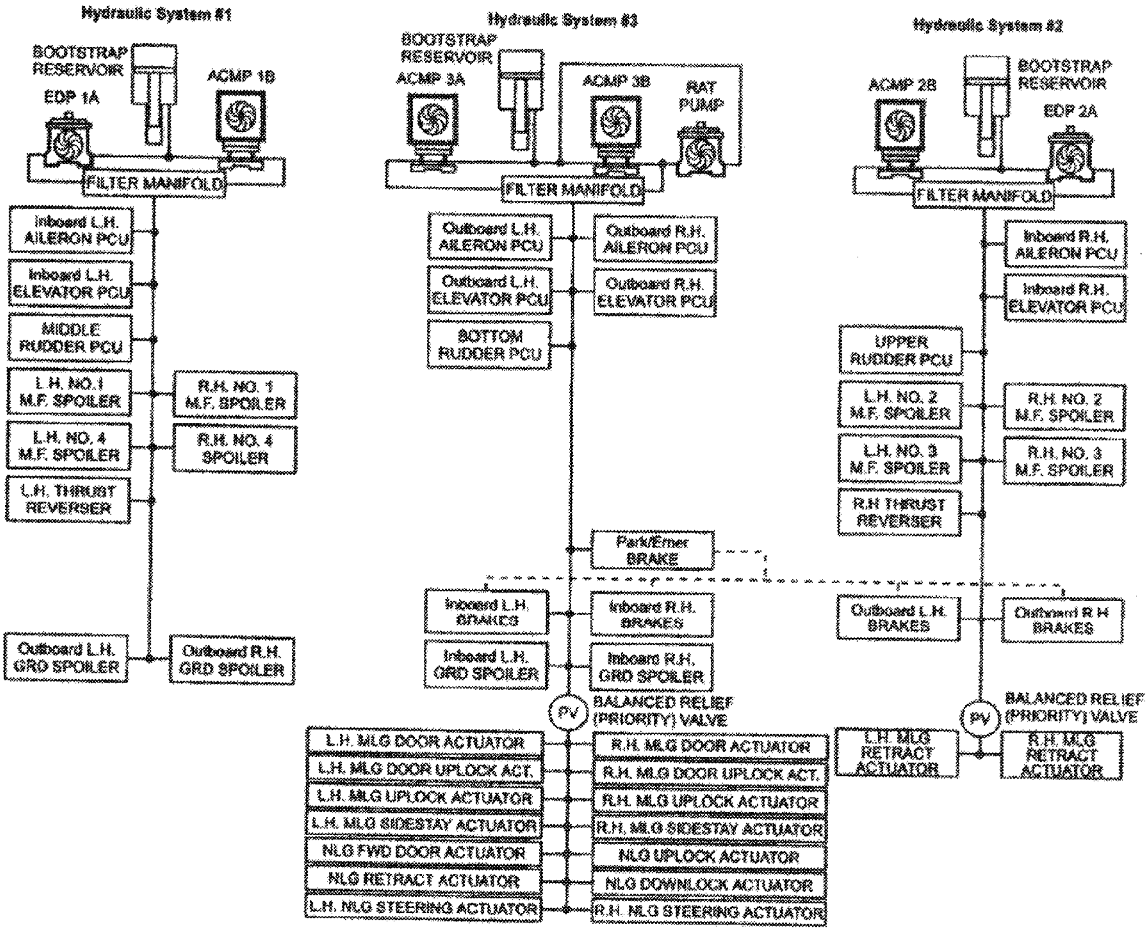

FIGURE 6 - AIRCRAFT HYDRAULIC SYSTEM DISTRIBUTION

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8.0 CONCLUSIONS

The following conclusions are based on the results of the review and analysis documented in section 7 of this report:

1. The cause of the Aircraft 9009 landing incident on Dec 9th, 2005 at Taiwan Kaohsiung airport, was the failure of #2 MLG tire after touch down, causing flailing tire damage to the aircraft hydraulics and flight control systems.

2. The tire failure was a direct result of a transient lockup of #2 MLG wheel. There were no other aircraft system or site related factors causing failure of the tire.

3. The most probable cause of #2 MLG wheel transient lockup was an induced deep skid condition, likely resulting from jamming of #2 Brake Control Valve by rubber particles separating from an improperly installed BCV internal seal.

4. The damage to the hydraulic systems #2 and #3, disabled steering, spoilers, right hand T/R, and landing gear related actuation systems. The damage also made braking availability dependent on capacity of inboard and outboard brake accumulators, and braking activity.

5. After touchdown, The Auto Brake had remained engaged, and provided expected level of deceleration, until released by pilot brake pedal application.

6. Braking, while reduced by depleting accumulators, remained available for aircraft directional and speed control until after aircraft departure from the main runway.

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APPENDIX A - INCIDENT PHOTOS

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PHOTO 1 - AIRCRAFT FINAL POSITION - TIRE SKID PATCH AND MISSING PART

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PHOTO 2 - DAMAGE TO SYSTEMS IN THE AFT AUXILIARY SPAR

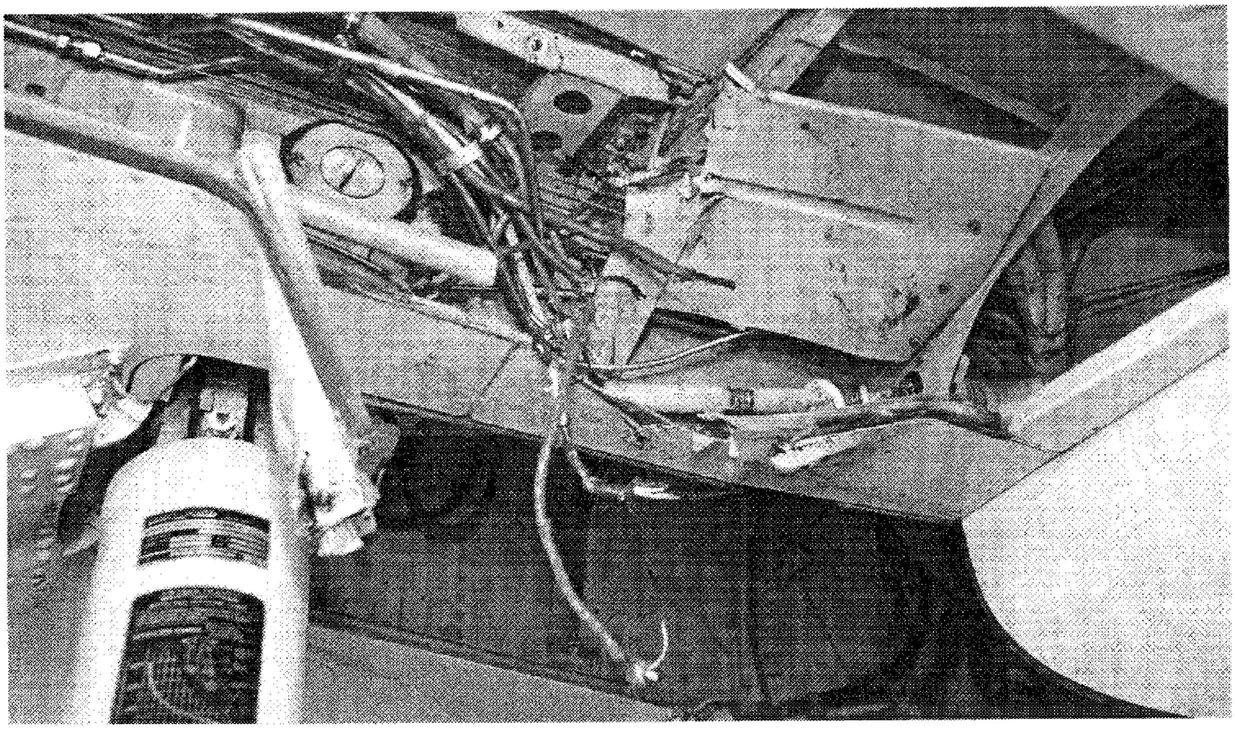

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PHOTO 3 - VIEW OF TIRE DAMAGE AND LEFT MAIN LANGING GEAR

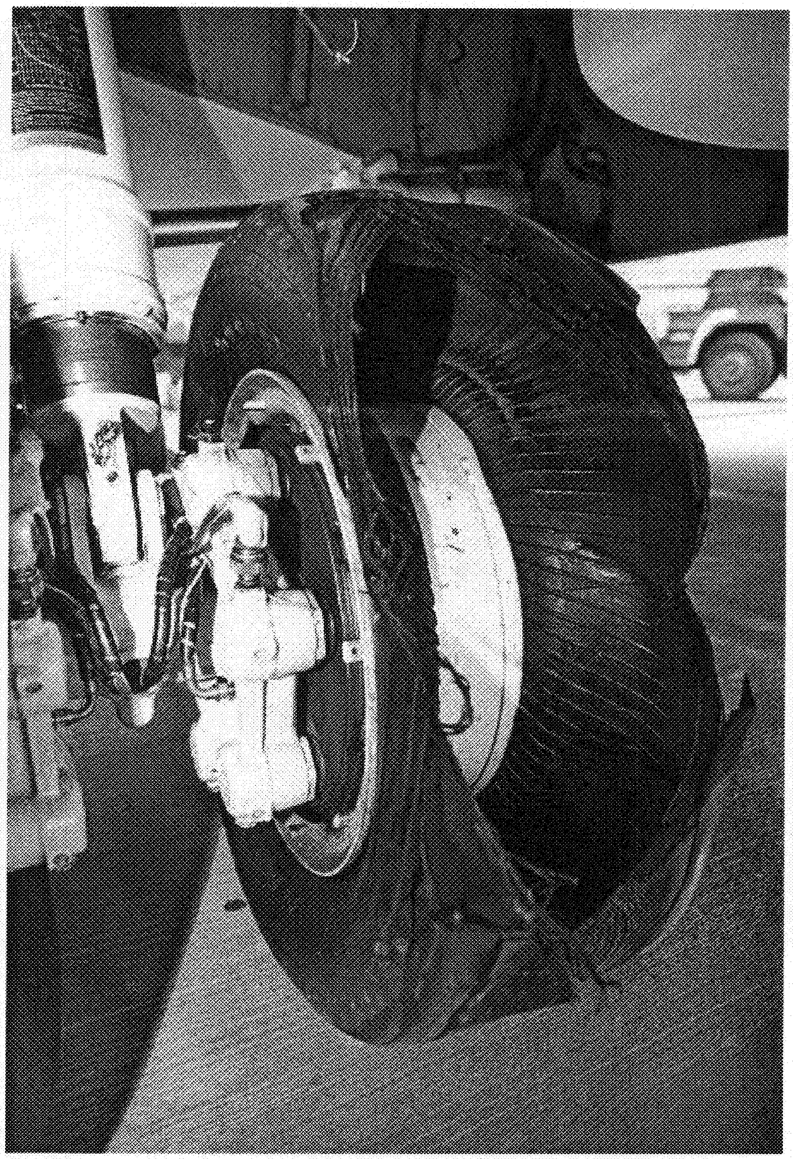

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PHOTO 4 - *RIGHT INBOARD FLAP DAMAGE*

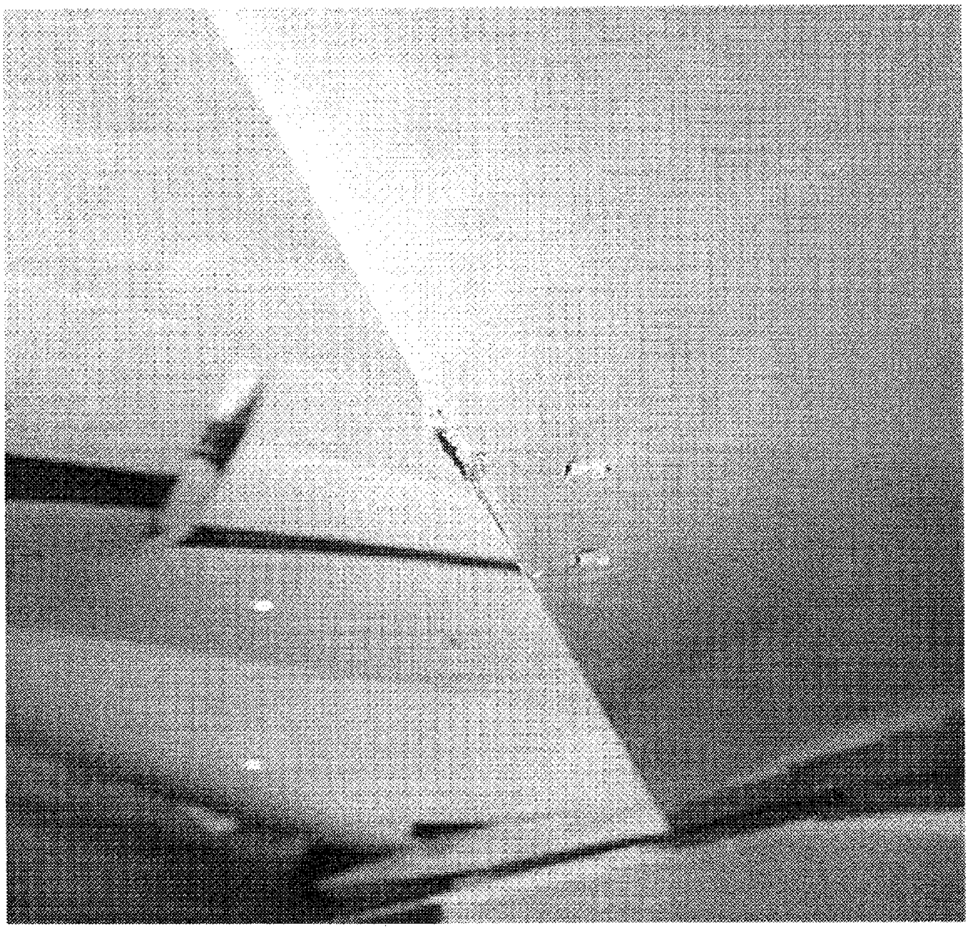

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PHOTO 5 - TIRE FAILURE

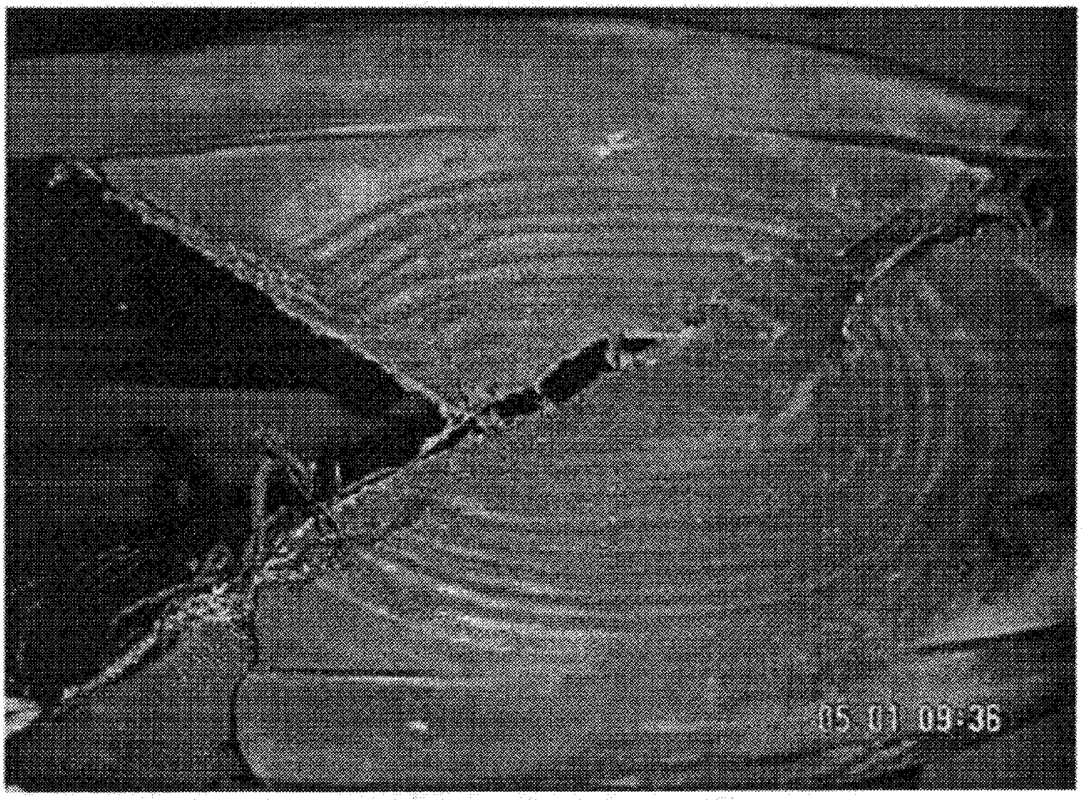

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PHOTO 6 - TIRE FAILURE

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PHOTO 7 - TIRE FAILURE - RECONSTRUCTED TIRE

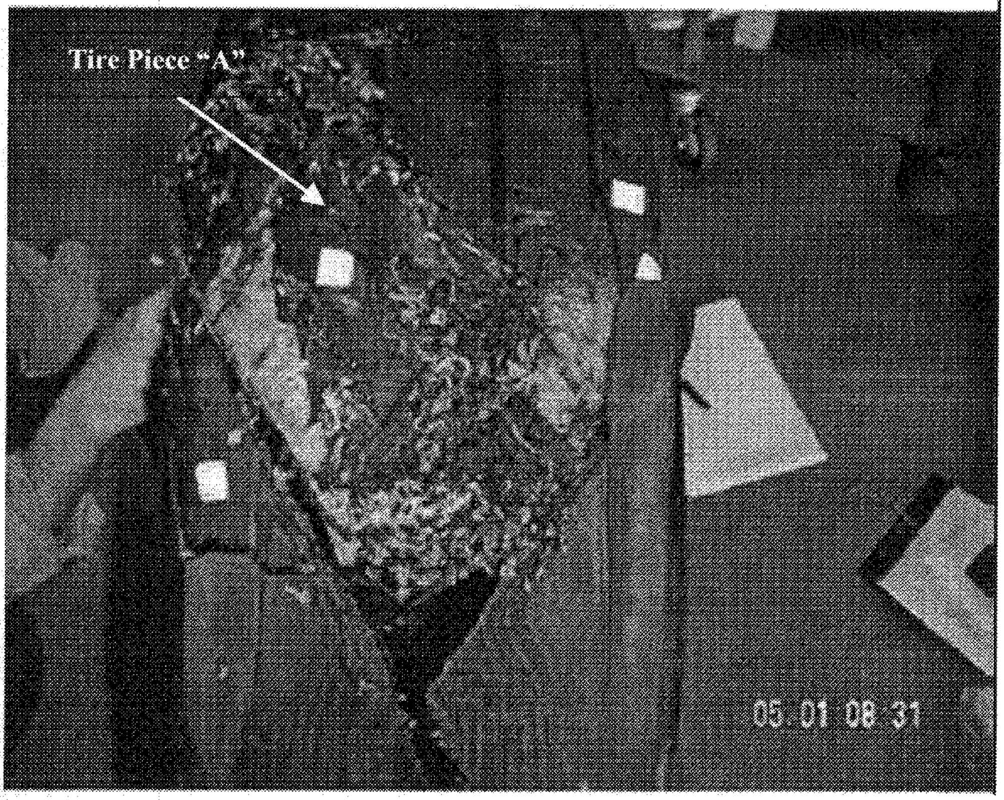

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PHOTO 8 - TIRE PIECE "A"

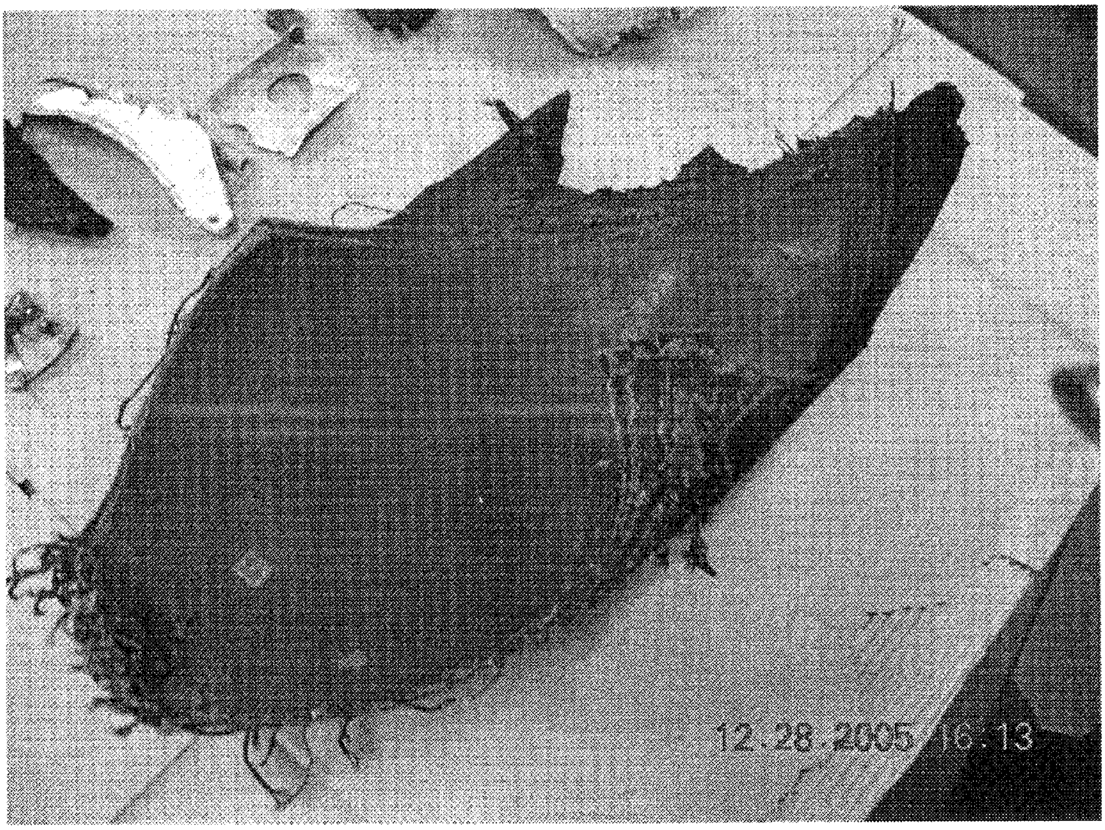

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PHOTO 9 - SEPERATED AIRCRAFT PIECES COLLECTED FROM RUNWAY

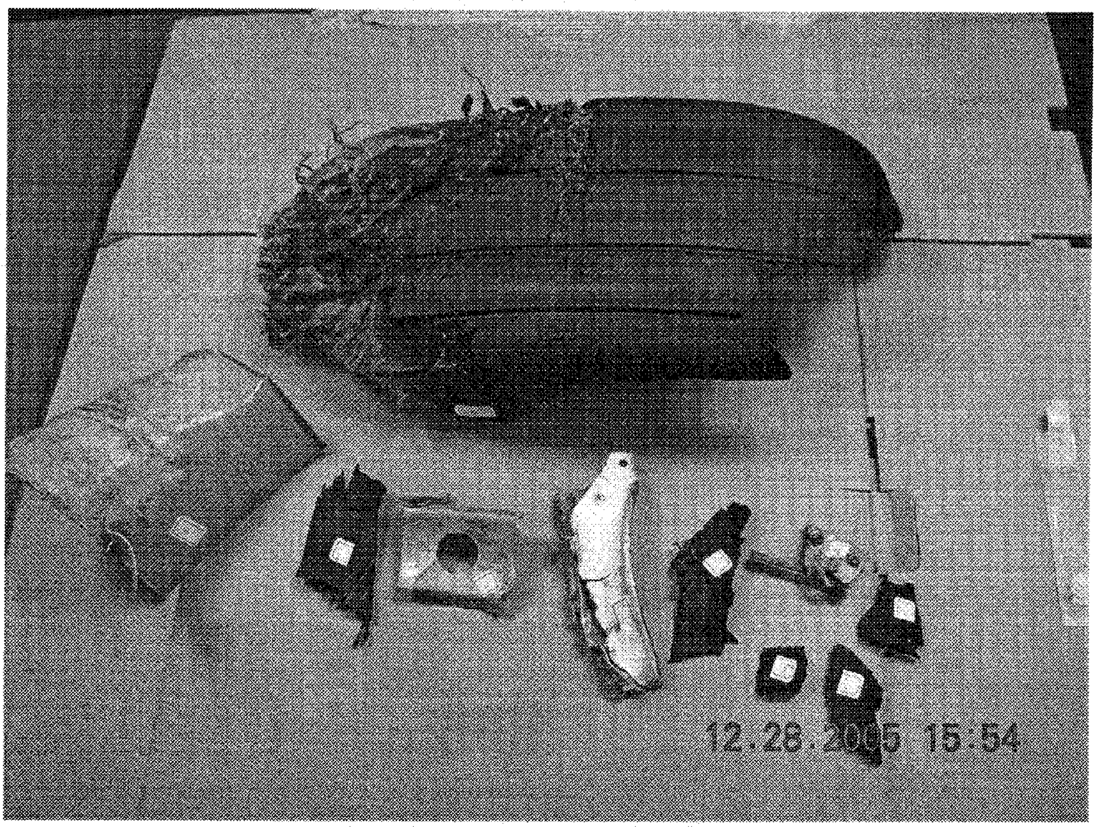

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PHOTO 10 - LOCATION OF TIRE PIECES ON THE RUNWAY

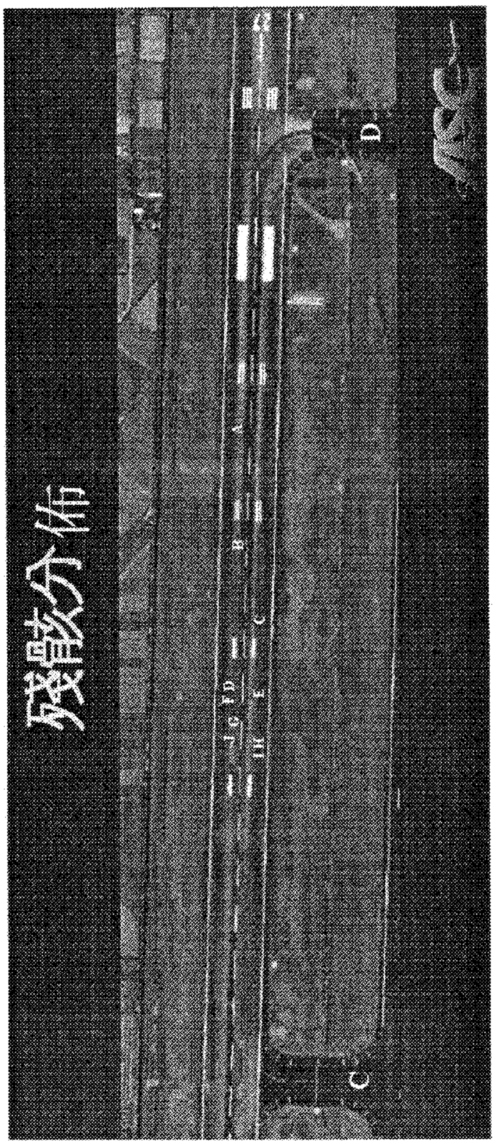

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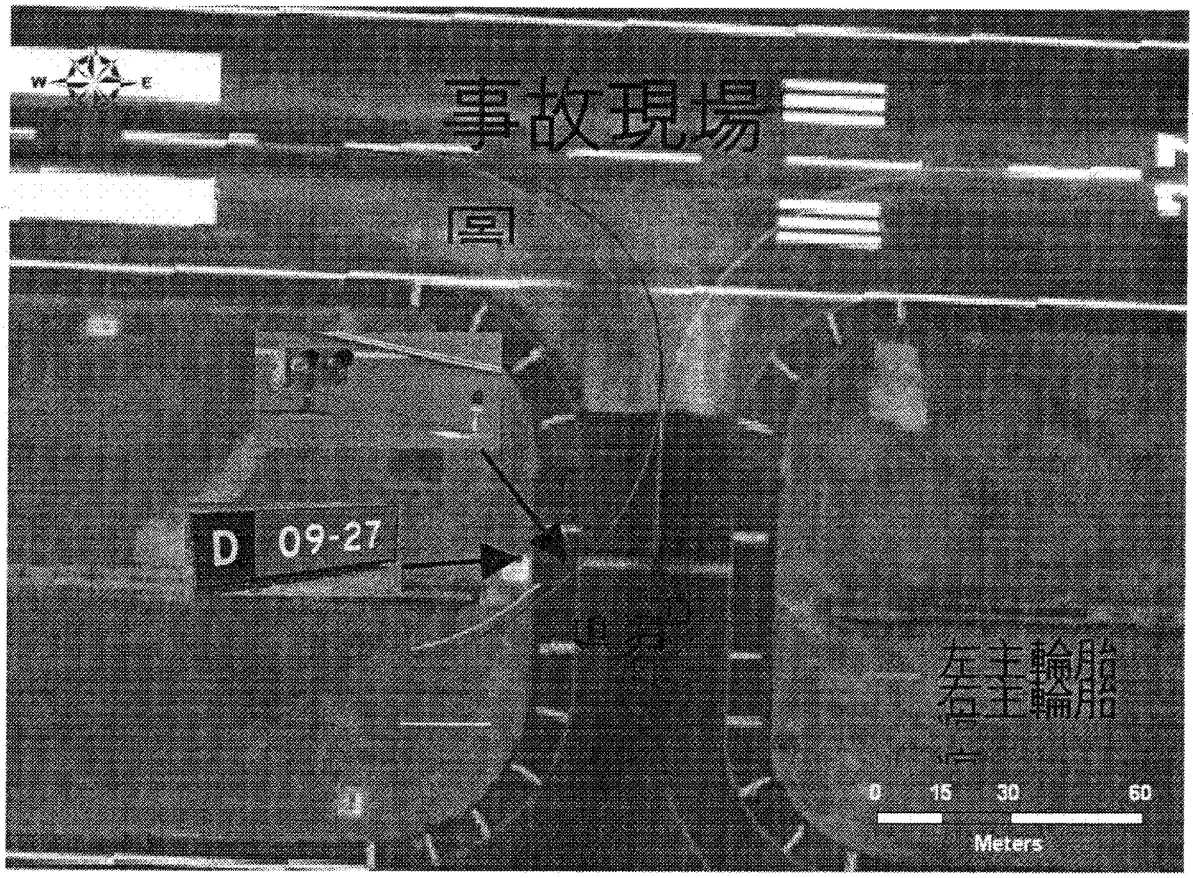
PHOTO 11 - *AIRCRAFT EXIT TO TAXIWAY DELTA*



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APPENDIX B - FLIGHT DATA RECORDER PLOTS

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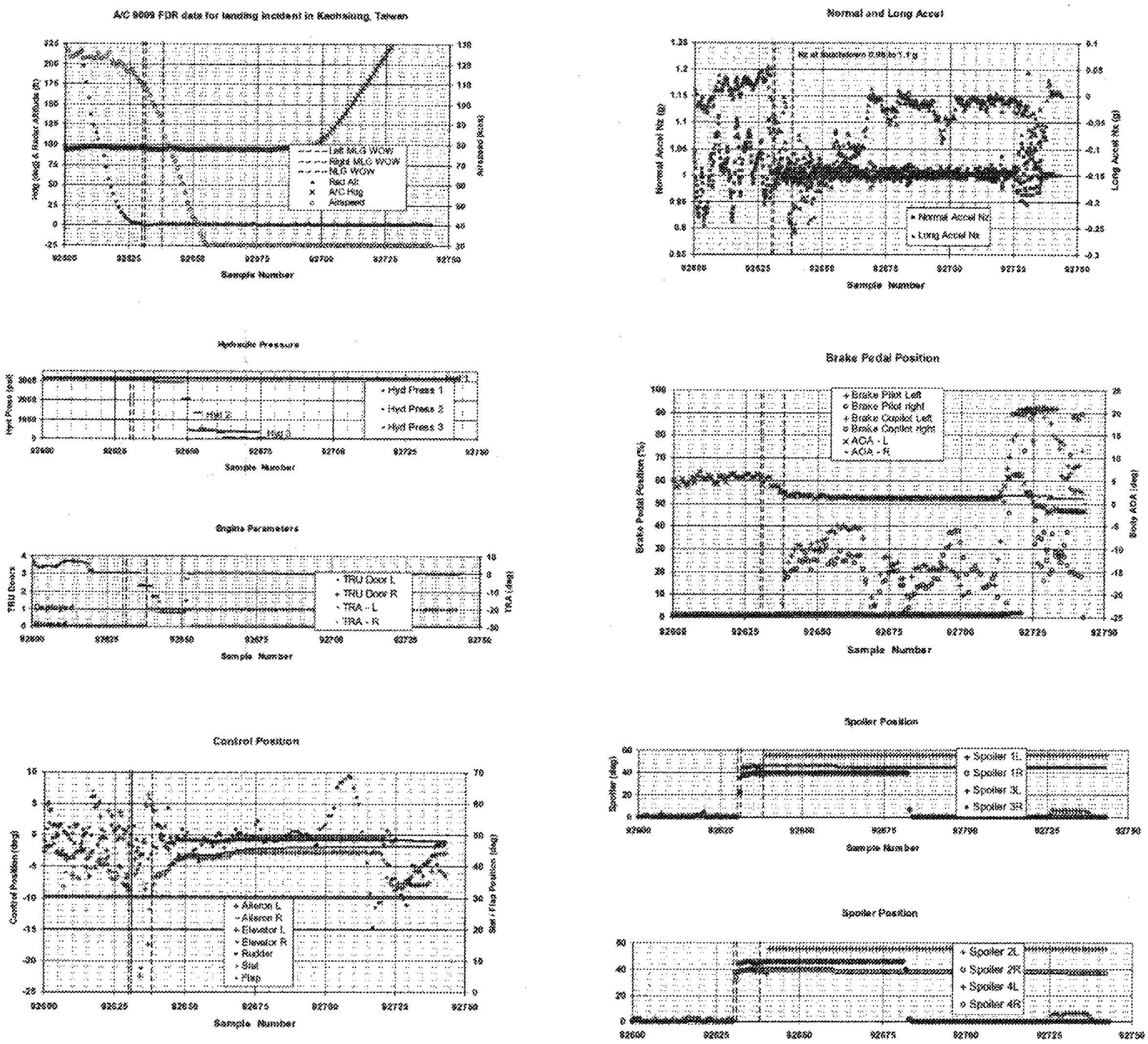
DATA PLOT 1 (SUMMARY)



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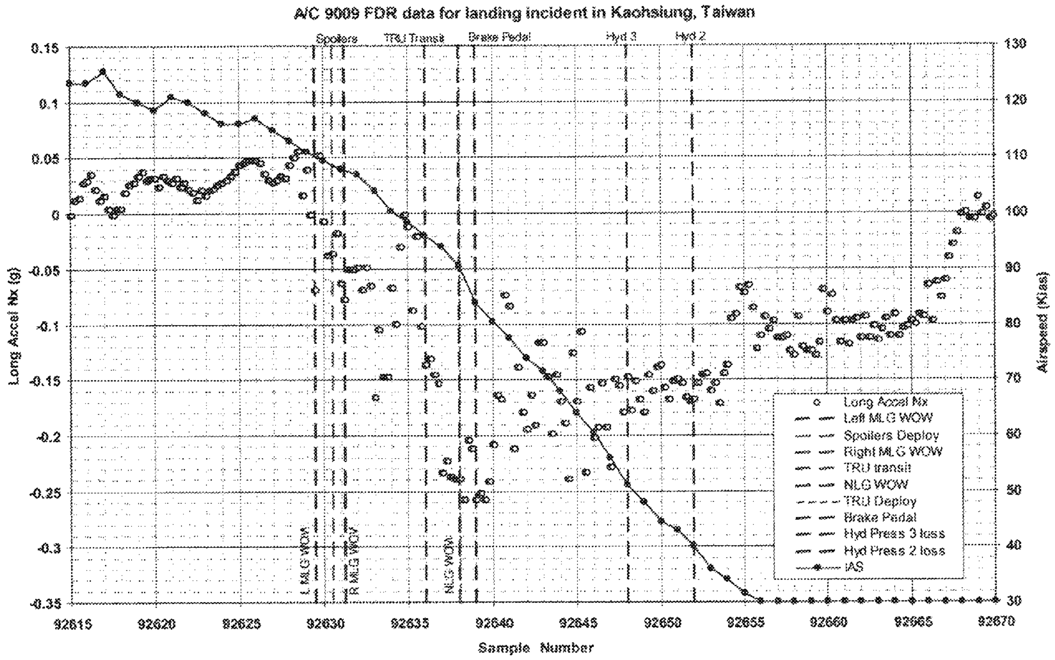
DATA PLOT 2



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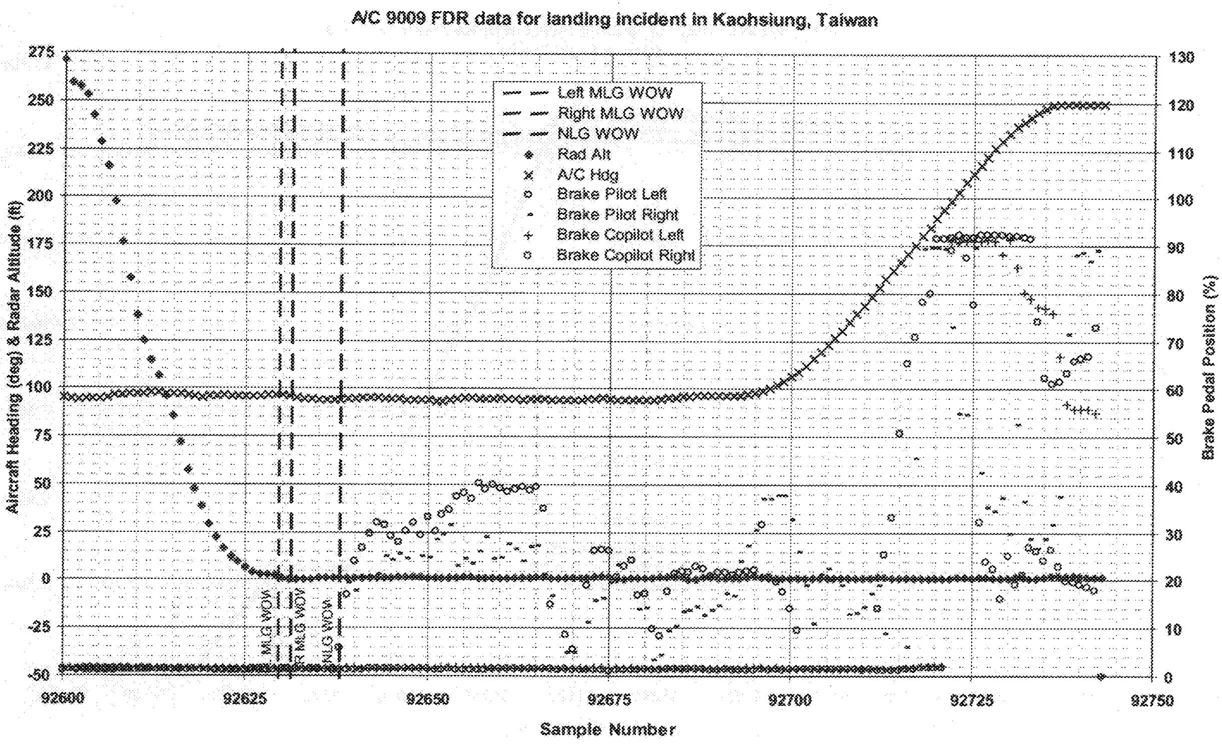
DATA PLOT 3



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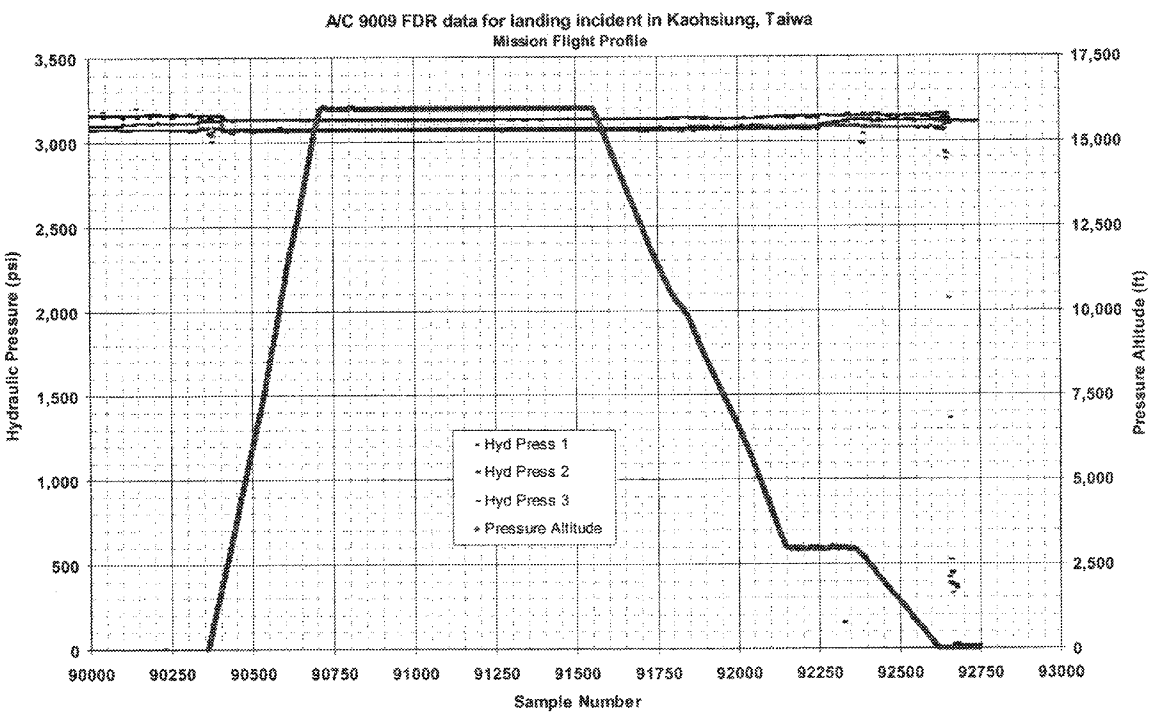
DATA PLOT 4



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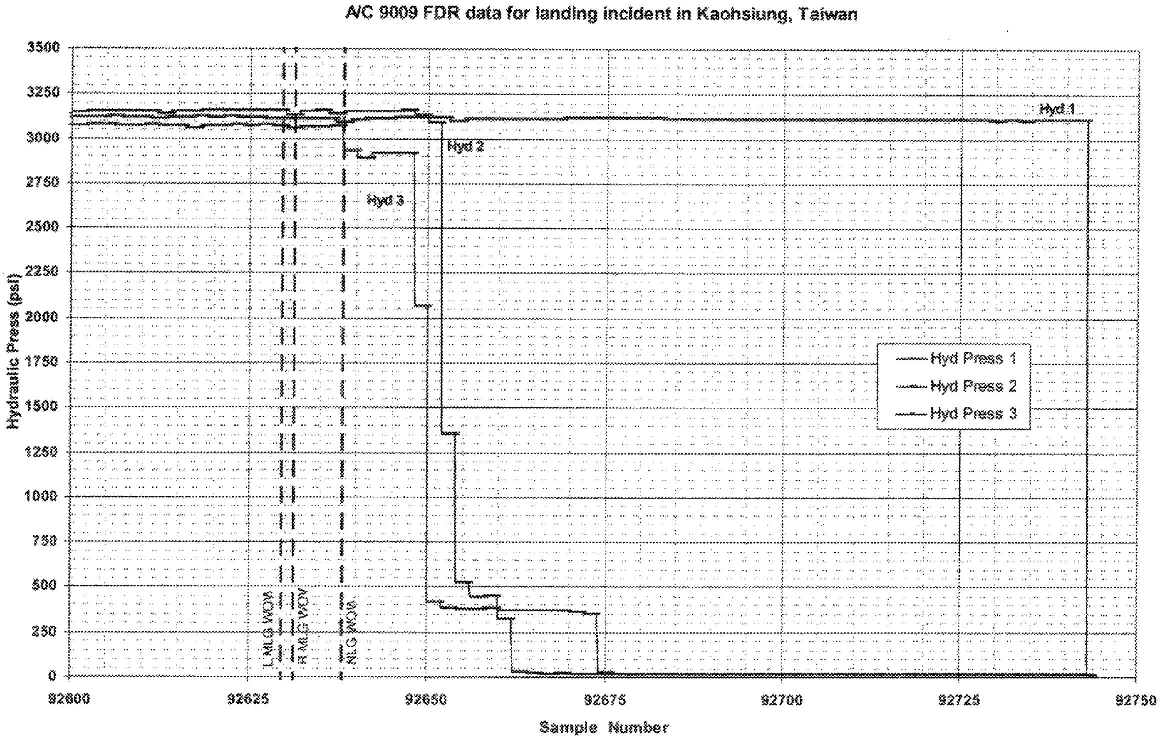

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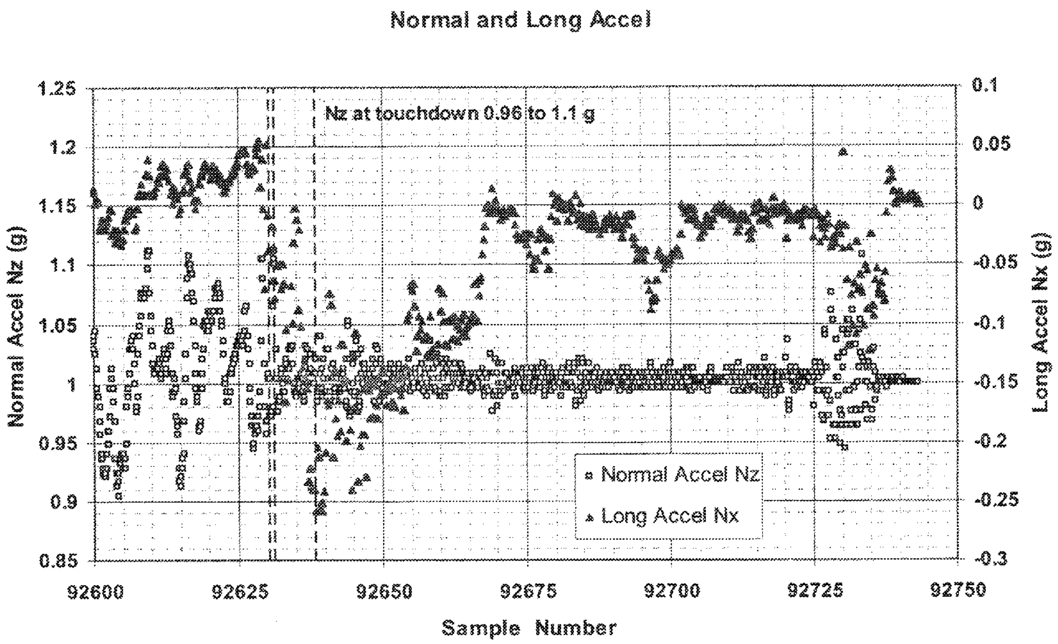
DATA PLOT 6



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