CRASH OF AF68-218 C-5A ON 4 APRIL 1975

By: John W. Edwards

Supervisor: LAC Technical Team
Serving Aircraft
Accident Board

AF 68-218 departed Ton Son Nhut Airport Siagon S. Viet Nam on 4 April 1975 and crash landed approximately 28 minutes later in a rice paddy while approaching the runway from which it had just de-parted.

At the time of the decompression the aircraft had climbed to an altitude of 23,200 feet approximately. The aircraft continued its climb for an additional nine (9) seconds to a maximum altitude of 23,424 feet at which time it began a descent. According to the on board data recording system, MADAR, the aircraft first reached 10,000 feet altitude approximately seven (7) minutes and 51 seconds later. Attachment 5 dipicts the altitude time history.

1.0 The g'loads on the occupants at the decompression were essentially negligible as substantiated by the following information:

1.1 The Engineering analysis exhibit D-2 page 90 fifth paragraph indicates structural responses rather than airplane motions.

1.2 All crew statements described the decompression in terms of noise only, i.e., "Loud Pop" rather than airplane motion. Example: Harriett Mary Neill court testimony page 174 (Aimmerly case) last paragraph. "I remember the first thing I was aware of was that there was a loud pop and ---".

DEFENDANT'S EXHIBIT D1298

2.0 Regarding the effects of Hypoxia, it should be noted that the altitude of 68-218 at 23,424 feet was more than a mile lower than Mt. Everest which has been climbed by man many times.

2.1 Chanute AFB in Illinois has a Physiological Training Unit which publishes an Atmospheric Pressure Table which advises that the time to parachute from 20,000 feet to 10,000 feet is 6 minutes and 30 seconds whereas the time of useful consciousness is over twice that or 15 minutes for a working crew member. A person at rest would consume less oxygen. Attachment 5 shows that the time from rapid decompression until the aircraft descended to 10,000 feet was 7' 45" approximately. This table is repeated below for convenience.

U. S. STANDARD

ATMOSPHERIC PRESSURE TABLE

PREPARED BY THE PHYSIOLOGICAL TRAINING UNIT CHANUTE AFB, ILLINOIS

DO

1. Get annual physical within 60 days of birthday. (AFR 160-10)
2. Have base line ECG in records. (AFR 160-121)
3. Get physiological training refresher course every 3 years. (AFR 50-27)
4. Hand carry medical and dental records to new station. (ATC Sup 1 to AFM 160-5)
5. Eat before flying -- prevents hypoglycemia.
6. Pilots should not eat at same facility to avoid food poisoning.

DON'T

1. Fly while you have a cold or are fatigued.
2. Donate blood unless emergency -- no flying for 72 hours after donation. (AFR 160-92)
3. Fly without flight clearance from Flight Surgeon when reporting to new station. Time will not be logged. (ATC Sup 1 to AFM 160-5)
4. Fly for 24 hours following ingestion of drugs such as antihistamines (PBZ, benadryl, etc), narcotics or alcohol, etc. (Check with Flight Surgeon.)
5. Fly after injection treatment or drugs from Dentist.

PREVENT BURNS: Always wear coverall and gloves. Do not wear nylon undergarments or socks. Wear helmet and oxygen mask at all times in jet aircraft.

DON'T DOCTOR YOURSELF: Don't take any medicine unless your Flight Surgeon advises it. If you are sick, see your Flight Surgeon -- he is interested in your health.

OXYGEN LACK AND BAIL-OUT

ALTITUDE (feet)	TIME OF USEFUL CONSCIOUSNESS	TIME TO FREE FALL TO 10,000 FT	TIME (MIN) TO FALL TO 10,000 FT WITH 28 FT CANOPY OPEN	SYMPTOMS OF OXYGEN LACK
10,000	Many hrs	0:00	0:00	Fatigue, headache, drowsiness.
20,000	15 min	0:49	6:50	No sense of time, over-confidence, poor judgment, impared vision, faulty reasoning, unconsciousness.
30,000	1 1/2 min	1:31	12:28	
40,000	15 sec	2:05	16:54	If any of these symptoms appear, use 100% O_2 or Pressure. Check "P. D. McCripe" for oxygen leak!
50,000	9 sec	2:32	22:08	
60,000	9 sec	3:02	over 28:00	
				P - Pressure; R - Regulator; D - Diaphragm Reg.; I - Indicator
				M - Mask; P - Portable eqpmt
				c - Clamps; E - Emergency eqpmt; C - Connections

1. Standard bail-out bottle lasts 8 - 10 minutes.
2. Temperature - 67° F at 40,000 ft and above.
3. Free fall mandatory above 30,000 ft, due to extreme opening shock of parachute, temperature and oxygen lack.

382-8127

Altitude (Feet)	Pressure mm. Hg.	p.s.i.
38000	154.8	2.99
38500	151.2	2.92
39000	147.5	2.85
39500	144.1	2.79
40000	140.7	2.72
40500	137.4	2.66
41000	134.1	2.59
41500	131.0	2.53
42000	127.9	2.47
42500	124.9	2.42
43000	121.9	2.36
43500	119.0	2.30
44000	116.2	2.25
44500	113.5	2.19
45000	110.9	2.14
45500	108.2	2.09
46000	105.6	2.04
46500	103.1	1.99
47000	100.7	1.95
47500	98.3	1.90
48000	96.0	1.86
48500	93.7	1.81
49000	91.5	1.77
49500	89.4	1.73
50000	87.3	1.69
50500	85.2	1.65
51000	83.2	1.61
51500	81.2	1.57
52000	79.3	1.53
52500	77.4	1.50
53000	75.6	1.46
53500	73.8	1.43
54000	72.1	1.39
54500	70.4	1.36
55000	68.8	1.33
55500	67.1	1.30
56000	65.5	1.27
56500	64.0	1.24

Altitude (Feet)	Pressure mm. Hg.	p.s.i.
19000	364.0	7.04
19500	356.5	6.89
20000	349.1	6.75
20500	341.8	6.61
21000	334.6	6.47
21500	327.6	6.33
22000	320.8	6.20
22500	314.0	6.07
23000	307.4	5.94
23500	300.8	5.82
24000	294.4	5.70
24500	288.0	5.57
25000	281.8	5.45
25500	275.8	5.33
26000	269.8	5.22
26500	263.8	5.10
27000	258.0	4.99
27500	252.4	4.88
28000	246.8	4.77
28500	241.4	4.67
29000	236.0	4.56
29500	230.6	4.46
30000	225.6	4.36
30500	220.4	4.26
31000	215.4	4.17
31500	210.4	4.07
32000	205.6	3.98
32500	201.0	3.89
33000	196.3	3.80
33500	191.8	3.71
34000	187.3	3.62
34500	183.0	3.54
35000	178.7	3.46
35500	174.4	3.37
36000	170.3	3.29
36500	166.3	3.22
37000	162.4	3.14
37500	158.6	3.07

Altitude (Feet)	Pressure mm. Hg.	p.s.i.
0	760.0	14.70
500	746.4	14.43
1000	732.9	14.17
1500	719.7	13.92
2000	706.6	13.66
2500	693.8	13.42
3000	681.1	13.17
3500	668.6	12.93
4000	656.3	12.69
4500	644.2	12.46
5000	632.3	12.23
5500	620.6	12.00
6000	609.0	11.78
6500	597.6	11.55
7000	586.4	11.34
7500	575.3	11.12
8000	564.4	10.91
8500	553.7	10.71
9000	543.2	10.50
9500	532.8	10.30
10000	522.6	10.11
10500	512.5	9.91
11000	502.6	9.72
11500	492.8	9.53
12000	483.3	9.35
12500	473.8	9.16
13000	464.5	8.98
13500	455.4	8.81
14000	446.4	8.63
14500	437.5	8.46
15000	428.8	8.29
15500	420.2	8.13
16000	411.8	7.96
16500	403.5	7.80
17000	395.3	7.64
17500	387.3	7.49
18000	379.4	7.34
18500	371.7	7.19

Altitude (Feet)	Pressure mm. Hg.	p.s.i.
57000	62.4	1.21
57500	61.0	1.18
58000	59.5	1.15
58500	58.1	1.12
59000	56.8	1.10
59500	55.4	1.07
60000	54.1	1.05
60500	52.8	1.02
61000	51.6	0.998
61500	50.4	0.975
62000	49.2	0.951
62500	48.0	0.928
63000	46.9	0.907
63500	45.8	0.886
64000	44.7	0.864
66000	40.6	0.7861
68000	36.9	0.7145
70000	33.6	0.6494
72000	30.4	0.5903
74000	27.7	0.5365
76000	25.2	0.4876
78000	22.9	0.4430
80000	20.8	0.4028
82000	18.9	0.3661
84000	17.2	0.3327
86000	15.6	0.3024
88000	14.2	0.2749
90000	12.9	0.2498
92000	11.7	0.2270
94000	10.7	0.2063
96000	9.7	0.1876
98000	8.8	0.1704
100000	8.0	0.1549
120000	3.24	0.0628
140000	1.51	0.0293
160000	0.787	0.0152
180000	0.433	0.0083
200000	0.238	0.0046

CONVERSION FACTORS

I. PRESSURE:

1 atmosphere = 14.696 psi = 760 mmHg = ~~29.92~~ 29.92 in Hg = 1013.3 mb.

1 mmHg = 13.595 mmH_2O = 0.535 in. H_2O = 0.0193 psi

1 psi = 51.715 mmHg

1 in. H_2O = 1.868 mmHg

II. ALTITUDE:

1 foot = 0.3048 meter

1 meter = 3.2808

1 mile (US) = 1.6093 kilometer

1 kilometer = 0.62137 miles

III. VOLUME:

1 cu ft = 28.316 liters

1 liter = 0.03532 cu ft = 61.025 cu in

1 cubic meter = 35.314 cu ft

IV. TEMPERATURE:

Deg. Centigrade (°C) for Deg. Fahrenheit (°F)

$°C = 5/9\ (T°F - 32)$

Deg. Fahrenheit for Deg. Centigrade

$°F = (9/5\ T°C) + 32$

Temp. absolute (K) from Centigrade

$K = T°C + 273.16$

2.2 The medical attendants in the aft troop compartment reported no signs of Hypoxia. Example: Court testimony of Mary Neill (formerly Ms Goffenett) page 178 (Zimmerly case).

3.0 The vertical g' loads at the first impact were essentially negligible as substantiated by the following data.

3.1 Capt Traynor noted that the sink rate was between 500 and 600 feet per minute as documented in his court testimony page 90 (Marchetti case) second answer.

3.2 The engineering analysis section of the Accident Report notes that the landing gear would have failed at 11 to 16 feet per second rate of sink at the gross weight of 450,000 pounds due to the high vertical load which did not happen since only the two aft main gears failed at the first impact and broke in a drag load direction as a pencil would when held tightly in the fist and thrust across the table striking a heavy object.

3.3 The marks in the soil showed indentations of only the aft gear which broke and the stubs of these broken gear then plowed into the soft farm land digging up furrows too narrow for the entire gear. Reference Photograph 3G.

3.4 The remaining forward main gear and the nose gear were carried by the aircraft to the second impact point across the river.

3.5 Capt Traynor's court testimony on page 89 (Marchetti case) describes the first impact as "--- normal or less than normal rate of descent ---".

3.6 Harriett Mary Neill (Goeffenett) court testimony on page 180 (Zimmerly case) describes the first impact as "--- a firm commercial airliner landing ---".

4.0 The longitudinal decelerations at the first impact were essentially negligible as substantiated by the following data.

4.1 The engineering analysis, exhibit D-2, on page 90 third paragraph, shows the airpseed 3.6 seconds prior to first impact as 270 knots or 455 feet per second. On the fifth paragraph of the same page, the airpseed just prior to the second impact is listed as the identical 270 knots (455 feet per second), therefore, the speed did not reduce noticeably.

4.2 The crew statements as summarized in 3.5, 3.6 above also pertain to the absence of longitudinal deceleration since no sudden "bumps" were discussed.

4.3 Calculations of the change in aircraft velocity due the energy absorbed by breaking one of the aft main gear as detailed in attachment #1 show that the aircraft would slow down by .2 feet per second from its initial velocity of 455 feet per second. The second aft main gear would have broken later with an additional .2 feet per second slow down.

4.4 Exhibit 3g which is a color photograph of the first impact point clearly shows:

A. The left aft gear striking the ground first - rolling a few feet and breaking off at about the same time the right aft gear strikes the ground rolls for a short distance and also breaks off as evidenced by a discontinuation of the tire marks. The aircraft in a left wing low attitude, continues to settle and the broken stub of the aft main gear starts plowing through the soft farm land. At the same time the two left engines come close enough to the ground to "vacuum" up the soft dust and rice straw as evidenced by the two clean streaks widely spaced at the same spacing as the two left engines on the C-5. The inboard door of the left aft gear, now being free to swing downward because of the broken gear strikes the ground just to the right of the deep darker plow mark and scrapes the surface of the soil resulting in a wider mark but less dark in color due to the lesser penetration of the soil. At this time the aircraft starts to gain altitude since no engine "vacuum" marks are in evidence. The aircraft still being close to the ground continues to blow away surface dust and straw.

The left aft gear tumbles free and stops to the left of the flight path near the vegetation that runs lateral to the flight path. The right aft gear ends up near the line of palm trees just to the right of the line of flight. The aircraft continues on toward the river with the right wing cutting off four (4) small palm trees in an ascending manner.

5.0 The vertical g loads on the occupants at the second impact were essentially negligible as shown by the following data.

5.1 The aircraft was very close to the ground as shown by color photograph exhibit 3F which shows the effects of the broken stubs of the aft main gear plowing through the vegetation on the river side of the dike. It is very noteworthy that the nose gear was above this vegetation on the river side of the dike since no middle plow mark was left by the nose gear. This nose up attitude of the aircraft allowed the main fuselage to clear the dike therefore the aircraft literally flew onto the rice paddy severing the nose gear and then the remaining two forward main gear at the dike. Again the color photograph indicates the aircraft was in contact with the rice paddy very shortly after crossing the dike.

5.2 The plow marks on the river side of the dike are essentially uniform from the river to the dike as shown by exhibit 3F indicating that the aircraft was not descending rapidly. An appreciable descent rate would have shown a widening and deepening of these plow marks.

5.3 The pilot of the aircraft, Capt Traynor, in his court testimony on page 2215 (Schneider case) describes the second impact as "This time it shook the aircraft a little bit more" and "well, it was a vibration like I had blown a tire or run off a runway."

5.4 Neither pilot nor co-pilot mentions being bounced up and down which would be indicative of vertical g loads.

5.5 In the aft crew compartment all adult occupants were in positions other than normal seats. Mrs Neill (formerly Goffenett) was in between two rows of seats with her arms spread over the seats she was facing. None of these occupants were dislodged from their position despite the lack of normal seat belt restraints except Mrs. Neill who was between rows of seats 2 and 3 from the front, as evidenced by her court testimony on page 87 (Marchetti case). Mrs. Neill stated that after the first impact she " must have let loose", "and the second impact, I was thrown forward against the forward bulkhead".

Doctor Stark in his court testimony (Marchetti case) on page 25 stated that none of the adults had seats. Because of his concern for the impending landing, Doctor

Stark had sat down between two rows of seats (page 30) and braced himself against the seat at his back and was not dislodged from this position during the entire sequence. Also, on page 30 he describes the sequence "--- and there was certainly a very definite impact but everything remained pretty much as it was." On page 34 he refers to the condition of the children as "---essentially, unchanged from the time they were aboard the plane, as near as I could determine."

Capt Marcia Gray Tate was on her knees between two rows of seats leaning forward over the seats in front of her as discussed in her court testimony (Marchetti case) on page 33. On page 35 she testified that she stayed in that position until the aircraft came to a complete stop. Also, on page 35 she described the landing as "--- bumpy but it was not particularly violent", and compared the landing on page 36 as "yes, there was -- very similar to me -- to a rough landing in a commercial aircraft that I had been in previous to that."

Lieutenant Aune was sitting in the aisle with her legs crossed and bracing herself with the seats according to her court testimony (Marchetti case) on page 1914. Also on page 1915 it is noted that she was not dislodged except as a result of turning loose to grab someone's ankle who was standing. At this time she went sliding along the floor to the front.

These statements together with the physical evidence and photographs indicate that the vertical g loads were negligible.

6.0 The longitudinal decelerations were fairly uniform and of a relatively low magnitude for an airplane crash.

6.1 The g loads as computed by using velocity and distance were 1.6 average for the occupants of the aft troop compartment and 1.46 for occupants of the flight deck. Refer to Attachment 2.

6.2 The expected variation in this average would be a peak of 3.91 g's as scaled from 27 different tests of rocket sled test by the Air Force in 1951 used to develop restraint systems. The cover sheet and tabular data sheet is listed as Attachment 3.

6.3 The terrain was flat, wet, grassy and free of any obstructions such as trees or rocks.

6.4 The aircraft sliding in essentially a straight line stayed in contact with the ground at all times as shown by photographs 3E, 3F, and 3B.

6.5 The occupants were seated in rear-ward facing seats which means that the occupant is pressed into the seat cushions by the decelerations.

6.6 The occupants are seated approximately 20 feet above the bottom of the fuselage which means that the soft aluminum structure absorbs and cushions the shock loads in a manner similar to the soft body structure of a racing car which is termed " deformable" by race car drivers.

The errosion of this structure by the scrubbing action of the rice paddy would be felt as vibration and noise rather than a shock due to the cushioning action of the structure between the occupant and the ground.

6.7 The average g' load of 1.6 would be only one-tenth that of the average of the 43 rocket sled test in the attachment 3 report. In all these cases the deceleration distance was from 24.6 feet to 47.1 feet with a velocity change of ranging from 77 feet per second to 181.5 feet per second.

6.8 The peak deceleration of 3.91 g's is about one-half of what one experiences in an amusement part ride which range from 1.53 g's to 6.2 g's.

6.9 The aircraft skidded through the wet rice paddy in a slightly nose up attitude as indicated by the front end of the aircraft being more intact - that is the entire circumference of the nose section, although severely damaged was with the crew compartment as shown in photo 3C. The crew compartment actually skidded on the lower portion - and after coming to a stop - rolled over on the right side since no mud is noted on the cab top.

6.10 The copilot, Capt Harp, actually described the stopping of the aircraft in his court testimony on page 2143 (Schneider case) as "It seemed like we were sliding through a bog. The slide itself was relatively smooth."

7.0 As the aircraft slide through the rice paddy, the errosion of the lower fuselage up to the cargo floor severely diminished the structural integrity of the aircraft. This scrubbing action tore off pieces of structure - absorbing the speed of the aircraft and opening up cracks in the structure.

7.1 When the errosion penetrated the cargo floor at about 800 feet from the dike the cracks opened up the sides of the fuselage and the wing - still having lifting power due to the remaining velocity, actual broke free from the flight deck in front of the wing and the aft troop compartment aft of the wing, and literally flew off separately. The wing landed a football field and a half in front of the aft troop compartment where a fire broke out consuming most of the wing.

7.2 At about the same time the empennage, due to the structural cracks formed by the scrubbing away of the aft fuselage, and having lifting power also, broke loose and flew separately off to the right side.

7.3 The flight deck, with the lower portion more intact, continued to slide through the wet rice paddy and curved off to the left. At the end of the slide the flight deck turned over on its right side. The total distance traveled by the flight deck was scaled from the wreckage diagram attachment 7 as 2,209 feet which computes to an average g load of 1.46 in the longitudinal or X axis and the lateral movement was scaled as 607.89 feet from the time of separation. This computes to 1.07 g's in the lateral or Y axis as shown in attachment 4.

7.4 The aft troop compartment, at the time of separation from the wing and empennage, continued to slide through the rice paddy. Since the lower portion of the fuselage under this troop compartment was not intact, the friction was greater and the distance traveled was less - actually scaled as 2,012 feet computing 1.60 g's in the X axis. The lateral movement was also less - actually scaling at 121.58 feet which computes at .29 g's in the Y axis.

7.5 The aft troop compartment was now open at the front end due to the departure of the wing. This opening allowed relatively warm 100°F airto enter this compartment which was previously cooled at about 70°F. This sudden inrush of warm air would have been noticed by the occupants. The aft troop compartment came to a rest about 150 yards from the burning wing, pointing almost directly at the fire area. Although the wind was blowing in a direction to carry the smoke and fumes away from the aft troop compartment, undoubtedly some fire oder would have been noticed even 150 yards away.

7.6 There was no fire in the area of the aft troop compartment as evidenced by color photograph 3B and my own personal observations at the site.

7.7 There was no fire in the area of the crew compartment as evidenced by photographs 3C and my own personal observations at the site.

7.8 The only fire was in the wing area as shown by 3A.

The foregoing opinion is based on a total assessment of all the available evidence and information and includes; actual on the site participation in the search for pertinent aircraft parts, an examination of the wreckage, evaluation of recorded data on the on-board recording system MADAR, evaluation of all crew statements made to the Collateral Board, evaluation of statements made by crew members in depositions, evaluation of statements made by some crew members in court testimony, evaluation of aerial photographs, and on the site knowledge of the type of terrain.

The preponderance of evidence leads to a reasonable engineering conclusion that the occupants of this aircraft were not harmed by the g' loads at either the Rapid Decompression or the impacts with the ground.

Further it is a considered engineering opinion that the occupants were subjected to far less severe conditions of "thin" air than that which is expected to be harmful.

John W. Edwards
Chief Project Engineer
Lockheed-Georgia Company

JWE:bg

Determine Aircraft Velocity Change due to breaking of main gear strut due to drag loads:

KE_1 = before 1st impact

$KE_1 = 1/2\ MV_1^2 = 1/2\ \frac{451000}{32.2} \times 455^2$

$KE_1 = 1.4498 \times 10^9$

Energy absorbed by breaking one gear:

Assume gear picked up drag load for 10 feet starting at 0 drag and increasing to 250000 at 10 feet

$\therefore$ Average distance is 5 feet

$\therefore$ $Fxd = 250000 \times 5 = 1.250 \times 10^6$ foot pounds

KE_2 = energy left after breaking first gear.

$KE_2 = KE_1 - 1.25 \times 10^6$

$KE_2 = 1449.8 \times 10^6 - 1.25 \times 10^6$

$KE_2 = 1448.55 \times 10^6$

Velocity after 1st impact:

$KE_2 = 1/2\ MV_2^2$ or

$$V_2^2 = \frac{2 \times KE_2}{M}$$

$$= \frac{2 \times 1.44855 \times 10^9}{\frac{451000}{32.2}}$$

$$= 2.89710 \times 10^9 = \frac{2.8971}{1.40062N0^4} \times 10^9$$

$V_2^2 = 2.068441 \times 10^5$

V_2 = 454.80 feet per sec*

The aircraft would travel this 10 feet in $\frac{10}{455}$ or .022 sec., therefore, Velocity change .2 feet sec. in .022 sec.

$V = AT$ or $A = \frac{.2}{.022} = 9.09$

$g's = \frac{A}{32.2}$ $g's = .28$

*This is for one gear - the second gear would impart a similar .2 ft decel at a later time.

G LOADS ON PASSENGER COMPARTMENTS

Given: a) Velocity = 270 knots

or $\left(270 \times 1.15 \times \frac{88}{60}\right) = 455$ Feet per Sec.

b) D = Distance - 2012 for aft troop compartment

c) D = Distance = 2209 for Flight crew compartment

A. Distance = Velocity x time with constant velocity

$$D = VT$$

B. Distance = $\frac{(V_1 + V_2)}{2}$ x time for varying velocity

if $V_2 = 0$

Then $D = \frac{V_1}{2} \times T$

$$T = \frac{2D}{V}$$

C. for an accelerating (or decelerating) object

$$D = \frac{1}{2} AT^2$$

$$\text{or } A = \frac{2D}{7^2}$$

Substituting equation B into equation C -

we get $A = \frac{2D}{\left(\frac{2D}{V}\right)^2} = \frac{2D}{\frac{AD^2}{V^2}} = \frac{V^2}{2D}$

I for Aft Troop Compartment $A = \frac{V^2}{2D} = \frac{(455)^2}{2 \times 2012} = 51.56$ F.P.S.

A = 51.56 F.P.S $\quad$ g's $= \frac{51.56}{32.2} = 1.6014$ g's

II for Flight Crew Compartment $A = \frac{V^2}{2D} = \frac{(455)^2}{2 \times 2209} = 46.96$

A = 46.96 $\quad$ g's $= \frac{46.96}{32.2} = 1.46$

III for Section of Cargo Floor $\frac{(455)^2}{2 \times 853} = 121.63$ $\quad$ g's $= \frac{121.63}{32.2} = 3.77$

J. W. Edwards

ATTACHMENT # 3

AF TECHNICAL REPORT No. 5915, Part 2 December 1951

HUMAN EXPOSURES TO LINEAR DECELERATION

Part 2. The Forward-Facing Position and the Development of a Crash Harness

John Paul Stapp, Major, USAF (MC)

[redacted]

United States Air Force
Wright Air Development Center
Wright-Patterson Air Force Base, Dayton, Ohio

TABLE II ANALYSIS OF TIME - DISPLACEMENT DATA

Run No.	Subject	A Initial Velocity (ft/sec)	B Final Velocity (ft/sec)	C Velocity Change (ft/sec)	C Velocity Change (mph)	D Duration (Seconds)	E Equivalent Stopping Distance (Feet)	F Calculated Slope (g/sec)	G Calculated Plateau (g)	H Weight of Subject (pounds)	I Force G x H (pounds)	J Harness Area (sq. in)	K Harness Pressure (PSI)
		Configuration No. 1 Deceleration Distance, 47.1 feet Active Brake Units, 1,2, —— 12, 13, —— 23. 24.											
96	JPB	217	115	102	69.5	.30	12.6	1170	11.3	172	1940	137.5	14.1
101	JPB	No displacement record											
119	JPS	202.5	95	107.5	72.6	.33	15.6	1060	10.9	174	1893	217.5	8.7
120	DIM	No displacement record											
121	WAR	200.5	72	128.5	87.6	.37	20.5	575	11.9 —	152.5	1814	207.5	8.7
		Configuration No. 2 Deceleration Distance 35.4 feet Active Brake Units 1,2,3, —— 12, 13 14, —— 23, 24											
94	JPB	216	128	88	61	.21	8.5	1055	15.0	172	2575	261	9.9
95	JFF	No displacement record											
97	WAR	226	149	77	52.3	.21	4.1	1079	15.0 —	155	2310	244.5	9.5
98	WAR	214	116.1	97.9	66.0	.21	11.0	1150	16.8 —	154	2586	207.5	12.5
102	RHA	216.2	121	95.2	65	.21	10.0	1165	16.7	170	2840	265.5	10.7
106	DIM	220	126	94	64.2	.21	9.0	1170	16.6	176	2920	271.0	10.8
117	RHA	220	145.5	74.5	50.7	.21	4.9	980	13.9	170	2366	204.0	11.6
118	RL	202	113.5	88.5	60.4	.22	10.6	923	14.3	177	2522	238.0	10.6
149	FHB	215.5	123	92.5	63.2	.235	16.5	970	17.5	197	3445	198.2	17.4
150	BD	223,5	141	82.5	56.3	.22	4.4	935	16.9	208	8500	198.7	17.6
164	WJAM	195	92	103	70	.22	15.2	940	15.0	(142+21)	2445	168.0	14.2
		Configuration No 3. Deceleration Distance 26.7 feet Active Brake Units, 1,2,3,4 —— 12,13,14,15.											
99	JFF	216.2	126	90.2	61.5	.16	6.5	1101	21.2	149	3160	201.3	15.7
100	WAR	220	129.5	90.5	61.8	.16	6.0	1080	20.4 —	155	3225	244.5	13.2
142	WAR	222	135	87.0	59.4	.16	5.1	1150	21.2 —	155	3280	176.5	18.6
143	JFF	219	128	91.0	62.2	.16	6.2	1015	23.5	149	3500	170.3	20.6
146	WAR	220	131	89.0	60.8	.16	5.7	1022	23.3 —	155	3610	176.3	20.5
147	JFF	210	108	102	69.6	.175	7.8	1000	24.1	149	3590	170.3	21.2
148	WAR	No dis lacement record											
162	JPS'	No displacement record											
163	JPB	132	0	132	[illegible]	.23	18.5	894	32.0	(170 + 21)	6112	186.0	32.9
165	JPS	206	126	80	54.4	.17	5.3	934	18.0	(170 + 21)	3436	186.0	18.5
166	JPS	200	107	90	63.2	.175	8.0		19.4	170	3298	186.0	17.7
		Configuration No 4 Deceleration Distance 25.7 feet Active Brake Units, 1,2,3,4,5 —— 12,13,14											
103	JFF	224	140	84	57.3	.16	3.3	1110	25.8	155	4000	240.3	16.7
104	WAR	208.6	122.2	86.4	59.	.16	6.2	975	24.3 —	152	3695	207.5	17.8
105	RHA	No displacement record											
122	JFF	204	126	78	53.2	.16	5.6	980	25.0	152	3800	201.3	18.9
		Configuration No. 5 Deceleration Distance 24.6 feet Active Brake Units, 1.2.3.4.5.6 —— 12.13											
107	JFF	218	134	84	57.3	.16	3.2	946	27.0	149	4030	240.3	16.8
108	WAR	212	129	83	56.7	.15	4.0	980	28.9 —	153	4422	207.5	18.1
109	RHA	213	133	80	54.6	.155	2.4	990	28.2	170	4800	204.0	26.9
110	JPS	226	142	84	57.4	.15	2.0	1150	31.8	172.5	5490	217.5	25.2
111	JFF	211	104	107	73.0	.15	8.0	1170	34.6	152	5255	240.3	21.8
123	RHA	197.6	106	91.6	62.0	.16	7.7	910	28.5	170.5	4859	204.0	23.8
124	JPS	210	134	76	51.7	.16	3.2	900	26.7	174.5	4659	217.5	21.4
129	WAR	No displacement record											
130	JFF	201	124	77	52.5	.16	4.8	796	24.8	153	3791	240.3	15.8
		Backward Facing, Seated Position *											
113	WAR	206	90	116	72.1	.16	8.2	1156	35.0 —	152	5320	260	20.5
134	JFF	208	96	112	76.4	.16	9.2	1160	34.8	153	5324	252	21.1
		Configuration No. 6. Deceleration Distance 24.6 feet											
133	RL	213	87	126	86	.155	11.1	1370	38.6	177	6839	238	28.7
135	JPB	220	105.5	114.5	78.9	.16	7.7	1344	38.1	172	6553	217.5	30.2
		Configuration No. 7 Reduced Brake Pressure											
		Deceleration Distance, 39.5 feet. 38 consecutive brakes at 150 to 200 p.s.i. closing pressure											
210	FHB	210	116	94	64.2	.237	12.0	281	13.9	206	2864	280	10.2
		Deceleration Distance, 36.4 feet 35 consecutive brakes at 200 to 250 p.s.i. closing pressure											
211	JPB	218	123	95	64.8	.215	9.9	288	20.6	175	3604	217.5	16.6
		Deceleration Distance, 34.3 feet 33 consecutive brakes at 250 to 300 p.s.i. closing pressure											
212	FHB	210	89.5	120.5	82.2	.217	14.9	300	32.7	206	6738	280	24.1
		Deceleration Distance, 36.4 35 consecutive brakes at 250 to 300 p.s.i. closing pressure											
213	JPB	224	71.0	143	97.5	.250	18.7	314.5	36.5	175	6386	217.5	29.4
		Deceleration Distance, 36.4 35 consecutive brakes at 300 to 350 p.s.i. closing pressure											
214	FHB	222.5	41.0	181.5	123.8	.283	24.8	331	38.62	206	7938	280	28.35
		Deceleration Distance 31.2 feet 30 consecutive brakes at 350 to 400 p.s.i. closing pressure											
215	JPB	226	50.2	175.8	120.	.228	19.7	493.5	45.4	175	7942	217.5	36.5

A. Velocity at entry to brakes
B. Velocity at exit from brakes
C. Velocity change in miles per hour and feet per second
D. Duration of deceleration
E. Calculated equivalent stopping distance for the observed deceleration if final velocity were zero
F. Initial slope of deceleration-time curve calculated from displacement-time record.
G. Plateau of trapezoidal deceleration-time curve calculated from displacement-time record.
H. Weight in pounds of subject just prior to run.
I. The product of calculated plateau g-times the weight of the subject , from columns F and G.
J. Measured area of harness webbing impinging on the subject in the forward seated position.
K. The force in column H, divided by the harness area column I, to give average harness pressure

* Measured back area of subject against seat.

REF: HUMAN EXPOSURE TO LINEAR DECELERATION AF 5915 PART 2 DATED DECEMBER 1951
TABLE II, PAGE 20

RUN #	A AVERAGE g ⚠1	B PLATEAU (TABLE II)	C PLATEAU 218 ⚠2	D PEAK g - SEAT ⚠3	E PEAK g -SEAT 218 ⚠4
96	10.56	11.3	1.71	11.0	1.67
119	10.12	10.9	1.72	13.5	2.13
121	10.79	11.9	1.76	15.5	2.30
94	13.01	15.0	1.84	27.8	3.42
97	11.39	15.0	2.11	*	*
98	14.48	16.8	1.86	*	*
102	14.08	16.7	1.90	21.5	2.44
106	13.90	16.6	1.91	24.5	2.82
117	11.06	13.9	2.01	19.0	2.75
118	12.49	14.3	1.83	*	*
149	12.22	17.5	2.29	*	*
150	11.65	16.9	2.32	*	*
164	14.54	15.0	1.65	*	*
99	17.51	21.2	1.94	25.5	2.33
100	17.57	20.4	1.86	26.5	2.41
142	16.89	21.2	2.01	*	*
143	17.66	23.5	2.13	*	*
146	17.27	23.3	2.16	*	*
147	18.10	24.1	2.13	*	*
163	17.82	32.1	2.87	*	*
165	14.61	18.0	1.97	*	*
166	15.97	19.4	1.94	*	*
103	16.30	25.8	2.53	35.0	3.44
104	16.77	24.3	2.32	34.0	3.24
122	15.14	25.0	2.64	18.0	1.90
107	16.30	27.0	2.65	35.0	3.44
108	17.18	28.9	2.69	28.5	2.65
109	16.03	28.2	2.81	35.3	3.52
110	17.39	31.8	2.93	38.0	3.50
111	21.74	34.6	2.55	44.5	3.28
123	17.78	28.5	2.56	22.0	1.98
124	14.75	26.7	2.90	36.0	3.91
130	14.95	24.8	2.65	*	*
113	22.52	35.0	2.49	38.5	2.74
114	21.74	34.8	2.56	29.9	2.20
133	25.25	38.6	2.51	*	*
135	22.22	38.1	2.74	*	*
210	12.32	13.9	1.81	19.9	2.58
211	13.72	20.6	2.40	23.0	2.68
212	17.25	32.7	3.03	31.0	2.88
213	17.76	36.5	3.29	36.0	3.24
214	19.92	38.6	3.10	38.5	3.09
215	23.95	45.4	3.03	47.0	3.14
TOTAL	694.67		100.11		75.68
AVERAGE	16.16		2.33		2.80

* CURVE FOR SEAT DECEL NOT GIVEN IN REF REPORT

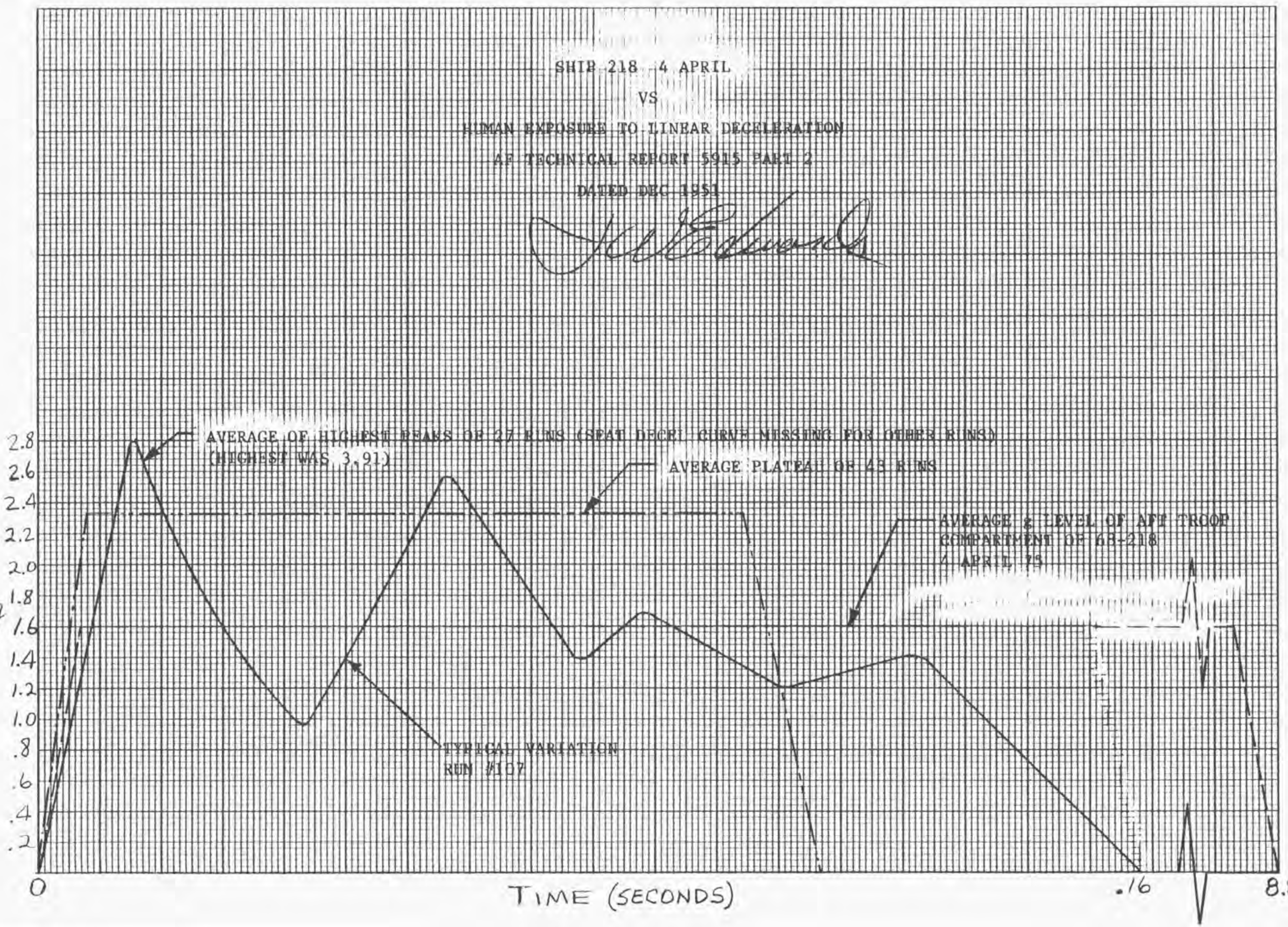
REF: HUMAN EXPOSURE TO LINEAR DECELERATION AF 5915 PART 2 DATED DECEMBER 1951
TABLE II, PAGE 20

(1) Velocity change divided by duration divided by 32.2

(2) Divide Column B by Column A and multiply by 1.6 in order to ratio the sled decels to the airplane average decel.
2.33 (average plateau for the airplane) is used to construct the curve.

(3) Scaled from seat decel curves in referenced report

(4) Divide Column D by Column A and multiply by 1.6 in order to ratio the sled seat decels to the airplane average decel.
The 2.80 average was used for the highest peak on the variable curve which was patterned to resemble Run #107 seat curve whose average decel is close to Column A Average.



ATTACHMENT #3

"Y" AXIS g LOADS ON PASSENGER COMPARTMENTS

Note (1) Troop compartment traveled 121.58 feet in the "y" axis after separation from the aircraft.

- o Total travel time $\frac{455}{51.56} = 8.82$

  T = 5.083 for 1159 feet

- o $d = 1/2\ AT^2$ or $A = \frac{2d}{T^2}$

- o $A = \frac{2 \times 121.58}{(5.083)^2} = 9.41$

  $g's = \frac{9.41}{32.2} = .29$

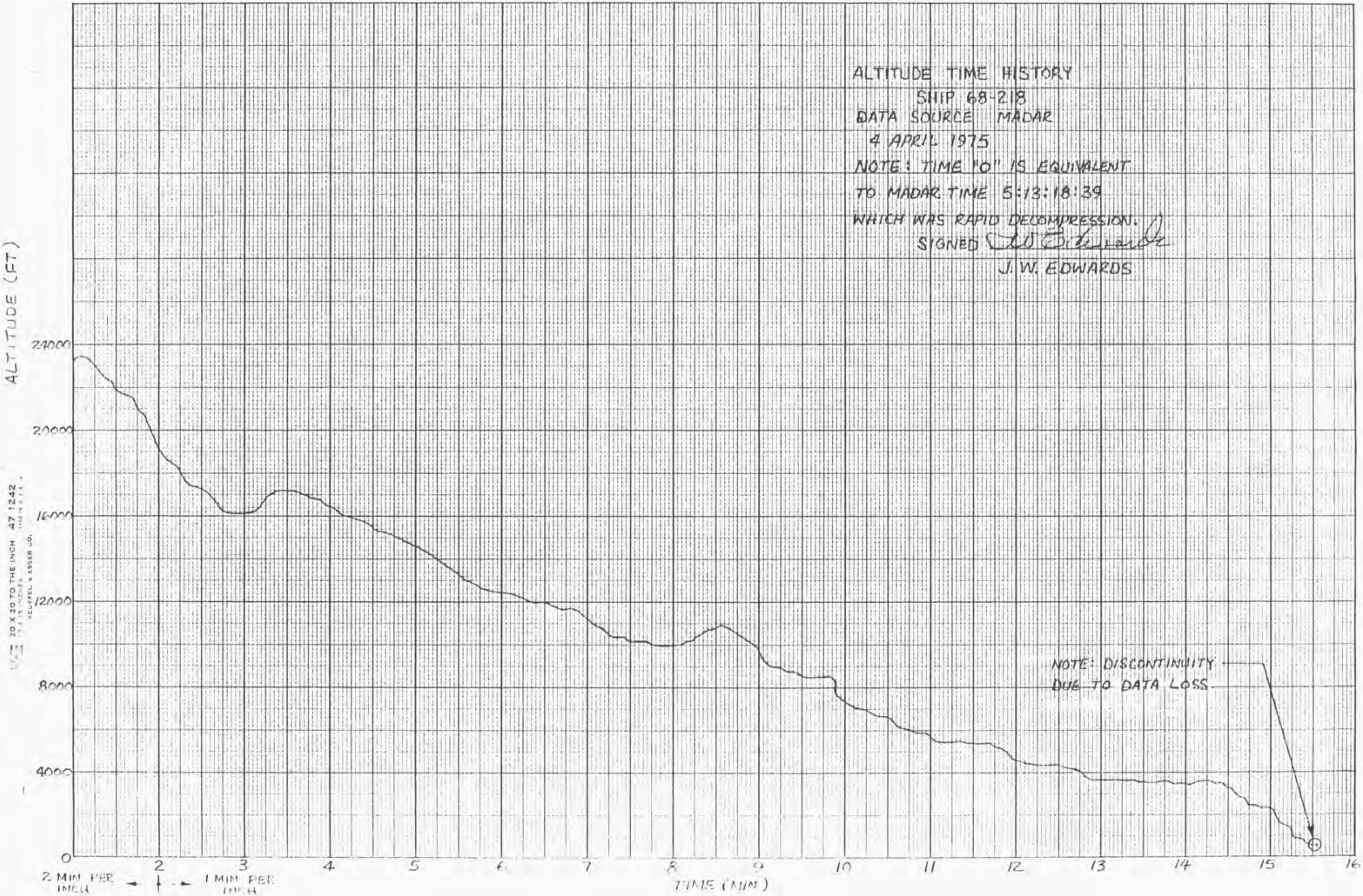
(2) Flight Deck traveled 607.89 feet in the "y" axis after separation from the aircraft.

- o Total travel time $\frac{455}{46.96} = 9.69$

  T = 5.94 sec for 1356 feet

  $A = \frac{2 \times 607.89}{(5.94)^2} = 34.45$

  $g^1 = \frac{34.45}{32.2} = 1.07$



ALTITUDE TIME HISTORY
SHIP 68-218
DATA SOURCE MADAR
4 APRIL 1975
NOTE: TIME "0" IS EQUIVALENT
TO MADAR TIME 5:13:18:39
WHICH WAS RAPID DECOMPRESSION.
SIGNED
J. W. EDWARDS
NOTE: DISCONTINUITY
DUE TO DATA LOSS.
ALTITUDE (FT)
24000
20000
16000
12000
8000
4000
0
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
TIME (MIN)
2 MIN PER INCH
1 MIN PER INCH
20 X 20 TO THE INCH 47 1242
KEUFFEL & ESSER CO.

HARRY L. GIBBONS, M.D.
~~12601 South 1565 East~~
~~Draper, Utah 84020~~
5827 Stanida Cir.
Salt Lake City, Ut
84121

Haight, Gardner, Poor & Havens
Federal Bar Building
1819 H Street N.W.
Washington D..C. 20006

Re: FFAC v. Lockheed

Att. John J. Connors

Dear Mr. Connors

Oxygen, water and food constitute the three basic essentials of life. There are of course time limits beyond which the body will suffer or die if these essentials are not provided. Regarding oxygen, there are numerous cases of complete recovery following complete depravation for long periods of time, particularly in children. There is general agreement with the statement quoted by Dr. Busby in <u>Clinical Space Medicine, A Prospective Look at Medical Problems from Hazards of Space Operations</u>, NASA Contractor Report CR-856 July 1967 which states "It is a well established fact that serious permanent damage of brain tissues begins to occur about 4 minutes after arrested cerebral circulation. This time might be somewhat increased in cases where the cardiovascular system continues to function, and so continues to supply glucose and other nutrients to and remove toxic metabolites from the brain."
I would only add that some of the [illegible] cases of complete recovery following prolonged depravation are probably due to cooling of the body. Where as the above quote applies to adults, there is also general agreement that children are even more resistant to hypoxia that adults, as mentioned in the testimony of Marianne Schuelein M.D. in the <u>Zimmerly</u> Trial, April 22, 1980. We should be reminded that the complete depravation of oxygen can only occur in a space situation or with drowning or other similar separation of air from the body since there is oxygen in the atmosphere to tremendously high altitiudes.

Oxygen in the body is described or measured in the body in various ways. The percent oxygen saturation of hemoglobin is one way, and at sea level the body usually has 97% saturation. Im sure that there would be no diagreement with this statement but it can be substantiated on page 60 in Randel, <u>Aerospace Medicine</u>, (1971). The volumes percent of oxygen carried by blood is also used to decribe the amount of oxygen carried. For example, arterial blood usually carries about 20 volumes percent and the venous blood being returned to the lungs for reoxygenation carries about 14 volumes percent. For the sake of this dixcussion I will use another measurement, the partial pressure of oxygen

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since it can be used to also describe the pressure or availability of oxygen in the ambient atmosphere as well as in the lungs and through out the body as air is inhaled and oxygen extracted and oxygen pressure diluted by competitive water vapor pressure and carbon dioxide.

The atmosphere is compressed through its own weight through gravitational forces, and although the atmosphere extends for hundreds of miles, the pressure at sea level is reduced to one half at 18,000 feet altitude. Sea level pressure at standard temperature of 59° F. is 760 mm Mercury. That is sea level pressure will support a column of mercury 760 mm high or about 30 inches. At the location of the take off of the air craft, the density altitude was not sea level because of the high temperature, however standard temperature pressures are used in the following computations since there is nothing to suggest that the temperature at altitude was significantly different from standard for that level.

The following computations compare the effect of both dilution and compensatory mechanisms at sea level and altitude on oxygen pressure. The dilutions are caused by water vapor and carbon dioxide. The compensatory changes are given in figures where they are measurable but in some cases they cannot be measured. Never the less, they have a definite effect on maintaining life systems and consiousness.

SEA LEVEL	23,400 FT. (AND BELOW)
pressure 760 mm Hg	303 mm Hg

Although 47 mm Hg pressure is usually accepted for the water vapor pressure in the lungs, (as a result of the body being a saturated system,) that is the pressure of pure water. Considering airway temperature, electrolyte and protein content of the respiratory fluids, the actual pressure in the lung is about 45 mm Hg, not 47. (Randel, Aerospace Medicine page 58.) This pressure is constant and must be subtracted from the overall pressure.

760	303
-45	-45
715	258

Oxygen is .2095% of the atmosphere and applying Daltons law, the partial pressure of oxygen in the alveoli, (the terminal lung sacs,) can be derived.

760	303
-45	-45
715	258
x .2095	x.2095
149.8	76

In the alveoli, the constantly produced carbon dioxide also participates in the total pressure and competes with oxygen. For adults the accepted figure is 38-42 mm Hg. 40 is the figure internationally utilized. (page 59, Randel, Aerospace Medicine) For children, a leading and well accepted textbook of pediatrics gives the level at 32-36 or as we averaged and accepted in adults, 34 mm Hg. (page 1512, Textbook of Pediatrics by Abraham 16th edition.)

760		303
-45	water vapor	-45
715		258
x.2095	oxygen	x.2095
149.8		54
-34..	carbon dioxide	-34
115.8		20

At this point, the decreased oxygen pressure has a distinct effect on the body. The first breath taken at reduced pressue or at high altitude, that is within a matter of 2-4 seconds at normal breathing rates, will result in blood passing through the lungs as it normally does, but with a reduced oxygen pressure. As this blood circulates past the chemoreceptors in the neck, (the carotid and aortic bodies) these are stimulated. (page 63 Randel, Aerospace Medicine) The average circulation time in an adult is 15 seconds, and less in a child, but utilizing 15 seconds, this less satutated blood would leave the lungs, go through the right side of the heart, out the aorta and reach the neck vessels and therefore the chemoreceptors in approximately 5 seconds and certainly less than 10 seconds. It would take a few breaths for the level to drop a significant degree, but the body will begin to respond at a reduced pressure corresponding to an altitude of only 3900-7900 feet.(page 63, Randel Aerospace Medicine).

The resultant action is an increased breathing rate and depth. The maximum breathing effect is reached at 22,000 ft.. and of course continues at higher altitudes. This aircraft was at 22,000 ft. in approximately one minute. This respiratory effort will confer 20 mm Hg. additional oxygen pressure. at 22,000 ft. (page 63 Randel, Aerospace Medicine) At 23,400 ft. it will confer 20-25 mm Hg. as measured on figure 23, page 64 of the same reference.

115.8 mm Hg.		20 mm Hg.
	respiration	+20
115.8		40

Whereas the overall effect of hypoxia on respiration confers the above oxygen pressure advantage, by increasing the arterial oxygen tension, the effect on the cardiac function is to increase venous oxygen tension. The overall effect, with many complex interactions, is to increase the cardiac output. The minute rate at 22,000 ft. is increased by 1/3 and there is an increased stroke volume. (page 64 Randel, Aerospace Medicine) The resultant increase at 22,000 ft. is to double the cardiac output. This increases the venous oxygen pressure which increases the oxygen pressure to the cells by 5 mm Hg. See fig. 19 page 60 Randel, Aerospace Medicine also see page

65, same reference.

Sea level		23,400
	venous oxygen pressure (cardiac output effect)	+5 mm Hg.

Even in adults which do not have the same advantages that children do, the cardiac output alone raises the venous pressure from 17 mm Hg. to 23 mm Hg. "sufficient to maintain consciousness" at 22,000 ft. (Randel, Aerospace Medicine page 65)

Other factors which play a role, but are difficult to quantify include physiologic shunting which increases oxygen tension. Also there may be some improvement in the total diffusing capacity of the lung. There is a remarkable reduction of the arterial-venous pressure gradient due to the change in oxygen hemoglobin dissociation. The graient is reduced from 60 mm Hg. at sea level to only 7 mm Hg. at 22,000 ft. (all the above are found on pages 62 and 63, Randel, Aerospace Medicine.)

It is my opinion with more than reasonable medical certainty that there is no basis for considering that anyone on the C5-A experienced any significant degree hypoxia, and therefore, certainly, no brain damage. The hypoxic episode was simply too mild. Had there been adequate exposure to produce any damage, it would have been observed in the adults first. There have been millions of adults exposed to these levels of hypoxia in aircraft decompressions, both military and civilian, and altit ude chamber flights, both military and civilian some breathing oxygen and some breathing air prior to the decompression, with extremely rare episodes of significant hypoxia. Children, with the advantages mentioned earlier and with more compliant and effective lungs as to their abilty to convey oxygen to the blood stream, and with less or no arteriosclerosis to interfere with the oxygen reaching the cells of the body, are even less likely to have any residual from hypoxia,

Harry L. Gibbons M.D. M.P.H.

P.S. I apologize for lack of a discussion of time of safe unconsiousness. I would partially justify that with the expanation that there was no degree of unconsiousness on the aircraft attributable to hypoxia.

CHARLES A. BERRY, M.D., M.P.H., P.A.
2537 SOUTH GESSNER
SUITE 238
HOUSTON, TEXAS 77063
(713) 978-7755

Preventive Medicine | Consultant | Aerospace Medicine

Carroll E. DUBUC, Esq.
Haight, Gardner, Poor & Havens
Federal Bar Building
1819 H Street, N.W.

WASHINGTON, D.C. 20006

Reference : C-5A aircraft accident on April 4, 1975near Saigon, Vietnam

Dear Mr. Dubuc,

In accordance with your request, I have reviewed a large number of documents relating to the above accident. These have included the USAF accident report testimony from several individuals involved in the accident, various experts and numerous supporting documents, diagrams, photos and references. In the following statements, I will address my comments to the aerospacemedical issues which are alleged in certain testimony to have produced effects or injury to occupants of the troop compartment of the C-5A aircraft.

The aerospace medical factors which I will discuss are :

- rapid decompression, decompression sickness and trapped gas effects, hypoxia and deceleration forces.

RAPID DECOMPRESSION

The data indicate the occupied areas of the C-5A were pressurized to 12.02 psia at the time of the decompression while the outside pressure (ambient) was 5.82 psia creating a pressure differential or Δ P of 6.2 psi. The troop compartment would have been at an altitude equivalent just below 5,000 ft. and the ambient altitude of 23,400 ft. was reached in the troop compartment in 0.6 seconds.

The troop compartment volume was 6,300 cu.ft. contributing to the slower decompression time in spite of the large opening created by the loss of the cargo compartment door. The typcla fogging due to pressure change occurred but no injuries occurred in the troop compartment as a result of air movement. The gas expansion in the middle ears, sinuses and gut is usually relieved by escape through the normal openings.Numerous human experiments with decompression from 8 or 10,000 ft. to 35,000 ft. have demonstrated no injury or disability in the subjects with open airways. In addition, numerous airliner decompressions have been reported from 1948 through 1978, usually to higher altitude than in this case and there have been very few reports of any difficulty including loss of consciousness.

DEFENDANT'S EXHIBIT
D1300

CHARLES A. BERRY, M.D., M.P.H., P.A.
2537 SOUTH GESSNER
SUITE 238
HOUSTON, TEXAS 77063
(713) 978-7755

Preventive Medicine Consultant Aerospace Medicine

In the USAF aircrews routinely experience rapid decompressions from 8 to 22,000 ft. and thousands have been so exposed in training operations without undue difficulty. I have personally done nearly 100 such rapid decompressions, many to 25,000 ft. as an instructor in physiologic training for aircrews and without any difficulty whatsoever.

DECOMPRESSION SICKNESS AND TRAPPED GAS EFFECTS

Contrary to expectations of some researchers, there is no evidence of an increased incidence of decompression sickness after a rapid decompression.Dysbarism is a term encompassing both trapped gas syndromes (middle ear, sinus, gut, teeth) and the evolved gas syndromes (bends, chokes etc.) more commonly called decompression sickness. The latter are extremely rare below altitudes of 25,000 ft. and the rare one seen is obese with more stored nitrogen to evolve or older. The environment of this accident should not produce any effects of decompression sickness. I have done a great deal of research in this area including documenting and evaluating all the altitude chamber and inflight cases in the USAF to the early 1960s and my thesis at Harvard was on the subject of dysbarism.

HYPOXIA

The important factors to consider in this area are the partial pressure of oxygen available at the individual cell after transport by the blood, thus the time spent in an atmosphere with reduced oxygen levels (the altitude) and the presence and duration of unconsciousness. The altitude time history of the C-5A in this accident shows a maximum altitude of 23,400 ft. In 2 min. it was 19,000 ft., 3 min 16,000 ft., slightly above 16,000 ft. at 4 min. due to a life saving maneuver of adding speed to lift the aircraft nose, 15,500 ft. at 5 min., 12,400 at 6 min., nearly 10,000 ft. at 7.5 min., 10,000 at 8 min., another nose up-maneuver to 11,000 ft. at 8.5 min., back at 10,000 at 9 min. and progressively down from there. Even the time of <u>useful</u> consciousness (time in which an <u>aircrewman</u> could do purposeful action after exposure to reduced oxygen levels) becomes asymptotic at minutes of time on decompression to 25,000 ft. breathing air. Here we are concerned with <u>passengers</u> where the concern is the time of <u>safe</u> unconsciousness.According to the witnesses no one in the troop compartment even lost consciousness and this is certainly consistent with exposures of many persons at such altitudes. The body has a superb set of compensatory mechanism to keep the partial pressure of oxygen at the highest level possible demonstrated by increasing oxygen saturation over time exposed to hypoxic atmosphere. In addition children are more resistant to hypoxic effects. Thus I would not invision any effects of hypoxia on occupaants of the troop compartment.

CHARLES A. BERRY, M.D., M.P.H., P.A.
2537 SOUTH GESSNER
SUITE 238
HOUSTON, TEXAS 77063
(713) 978-7755

Preventive Medicine Consultant Aerospace Medicine

DECELERATION

The injuries produced by deceleration are dependent not only on the level of g force but the axis of the body on which it acts (X - Y - Z), the duration of the force and the body area absorbing the force. In this case, the nose high aircraft attitude on striking the ground, the force attenuation by loss of the landing gear and the long slide across the ground in separating the aircraft at its assembly joints all acted to reduce g forces. That they were less than 2 g is attested to by the fact the adults who were unrestrained could hold onto seats from a position in the aisle and were not injured. In addition the children were in rear facing seats well strapped in and supported by pillows further reducing effects of even the calculated low g in - X axis. Review of a great deal of data here convinces me no injury should have been sustained by restrained or "holding on" passengers.

As a result of my review of the voluminous materials and my own references I am convinced to a reasonable medical certainty that none of the above discussed factors (decompression, decompression sickness and trapped gas syndromes, hypoxia or decelerative forces) were sufficient to produce the alleged permanent effects in occupants of the troop compartment.

I am willing to amplify this opinion in direct testimony as you feel necessary. I deeply apologize for the delay in forwarding this opinion which is being written during my attendance at the 29th International Congress of Aviation and Space Medicine in Nancy, France, sponsored by the International Academy of Aviation and Space Medicine. I am a past president of the Academy and have had a long standing committment to present a paper on "Risk factors in pilots" and then to chair the session on acceleration.

I hope this arrives in a timely fashion through the multiple methods I am using to get it to you in Washington from me in Nancy, France.

Sincerely yours,

Charles A. Berry M.D.

Charles A. BERRY M.D., M.P.H.

Hyperbaric Medicine, P.A.
512-696-7293

JEFFERSON C. DAVIS, M.D.
JARED M. DUNN, M.D.
RICHARD D. HEIMBACH, M.D.

METHODIST PLAZA
SUBLEVEL 2
4499 MEDICAL DRIVE
SAN ANTONIO, TEXAS 78229

September 4, 1981

Carroll E. Dubuc
Haight, Gardner, Poor & Havens
Federal Bar Building
1819 H Street, N.W.
Washington, D.C. 20006

Dear Mr. Dubuc,

Here at last is the information you asked for in a concise format as I can make it. Sorry for the long delay, but other demands on our time interfered.

Sincerely,

Jared M. Dunn

Jared M. Dunn, M.D.

JMD/ybw

DEFENDANT'S EXHIBIT D1304

In the rapid decompression of the U.S. Air Force C-5A, the children and the adults were exposed to a relatively mild hypoxic stress because of the relatively low altitude and the short times of exposure. The aircraft decompressed at 23,400 feet and descended to 16,000 feet within three minutes. The cabin decompressed from 5,000 feet (632 mmHg or 12.23 psia) to 23,400 feet (302 mmHg or 5.85 psia) in approximately 0.6 seconds. This is well within the no damage criteria. The U.S. Air Force has exposed 1-2 million people to rapid decompression. From 1940 to 1955, troops were run from 8,000 feet (565 mmHg or 10.92 psia) to 22,000 feet (321 mmHg or 6.21 psia) in 0.53 seconds or 0.67 seconds depending on the type of chamber used, and since 1955 from 8,000 feet to 22,000 feet in 1 second. Animals have been exposed to much more rapid decompression, ie. dogs, were decompressed from approximately 800 feet (738 mmHg or 14.28 psia) to 150,000 feet (1.02 mmHg or 1.97 psia) in 1 second without damage.

The aircraft began an immediate descent following the decompression and had reached 16,000 feet (412 mmHg) in 2.5 minutes then up to 17,000 feet (396 mmHg) and then down to 15,000 feet (429 mmHg) over another 2.5 minutes and then down to 10,000 feet (523 mmHg) in another 2.5 minutes.

Calculation for partial pressure of oxygen in the alveoli for various altitudes for both adults and children are given in the following table. The calculations were based on the following equation and assumptions:

$$P_AO_2 = F_iO_2 \cdot (47) - P_ACO_2 \left[F_iO_2 + \frac{1 - F_iO_2}{P} \right]$$

which symplified, means the oxygen pressure is equal ambient pressure minus 47 mmHg for water vapor in the lungs, times 21% (% of oxygen in the air, approximately), minus 40 mmHg of carbon dioxide present in adults or 34 mmHg for carbon dioxide present in infants. This also assumes that there is no hyperventilation, which there would be, but for comparing various altitudes or pressures it need not be included. Hyperventilation from hypoxia will increase respirations by 30-40% or more.

Altitude in Feet	Total mmHg Pressure	-47 for H_2O Pressure	X 21%=O_2 Pressure	-40 mmHg Adult P_{CO_2}	-34 mmHg Infant P_{CO_2}
150,000	1.02	0	0	0	0
34,000	188	141	29.61	0	0
25,000	282	235	49.35	9.35	15.35
24,000	295	248	52.08	12.08	18.08
23,400	303	251	53.7	13.7	19.7
22,000	321	274	57.54	17.54	23.54
20,000	350	303	63.63	23.63	29.63
19,000	365	318	66.78	26.78	32.78
18,000	380	333	69.93	29.93	35.93
17,000	396	349	73.29	33.29	39.29
16,000	412	365	76.65	36.65	42.65
15,000	429	382	80.22	40.22	46.22
10,000	523	476	99.96	59.96	65.96

Resistance to hypoxia varies a great deal from individual to individual and from animal species to species. However, we can compare knowledge of animal exposures to have some idea of the severity of the hypoxia stress these children were exposed to.

Dogs have repeatedly been taken from ground level to 150,000 feet or space equivalent in 1 second. They lost consciousness and respirations stopped. However, if they were started back down, within 3 minutes, respiration would start spontaneously and they suffered no detectable, permanent brain damage from the hypoxia, which in these cases really is anoxia or no oxygen was available. Within this 3 minute time period, the children in the C-5A went from 23,400 feet to 16,000 feet where they could have lived for very long periods of time without difficulty.

There have been numerous other passenger aircraft that have had decompressions to much higher altitudes without producing brain damage. National Airlines, Inc., Flight N60NA, on November 3, 1973 lost pressurization at an altitude of about 37,000 feet and the cabin altitude reached 34,000 feet. It then took two minutes to get to 24,000 feet, which is higher than these children started at. Then within three minute and twenty seconds the aircraft reached 15,000 feet. Comparing the two accidents from the hypoxic stress standpoint. At 34,000 feet there is no room in the lungs for oxygen, all lung areas are occupied by water vapor and carbon dioxide. At 23,400 feet the children would have had at least 19.7 mmHg of oxygen in the lungs, available to them. The 34,000 foot decompression, in the DC-10, took two minutes to get to 24,000 feet, which is the approximate altitude at which the C-5A flight decompressed to. In the 2 minute interval the C-5A had descended to 19,000 feet, where there was approximately 32.78 mmHg of oxygen that was available to the children. The "Time of Useful Consciousness", (TUC) at 19,000 feet is approximately thirty minutes. In both of the flights being discussed, 15,000 feet was reached within about 3 minutes. This is only a comparison to show how much more severe one exposure was than the other and yet since no known damage was done by the more severe one, how could one expect to see any from the less severe. Numerous other aircraft carrying passengers, both U.S. Air Force and civilian, have had rapid decompression to above 24,000 feet and have no known brain damage even though many of those exposed lost consciousness. The U.S. Air Force has exposed literally millions of men and women to hypoxia of a greater severity than these children were exposed to without evidence of any damage. In an altitude chamber, the U.S. Air Force exposes subjects to hypoxia at 35,000 feet to the point of "Time of Useful Consciousness" (TUC) and again at 25,000 feet to TUC and 18,000 feet for 15 minutes or so. The TUC at 35,000 feet is about 15-30 seconds, at 25,000 feet 4-5 minutes, and at 18,000 feet-30 minutes. Furthermore, the TUC at 23,000 feet is about 5-10 minutes. Now, the U.S. Air Force exposures are all adults while we are dealing with children. Children, and especially infants, are more resistant to the effects of hypoxia than adults. In animal studies, fetuses require 25-30 minutes of severe hypoxia to anoxia to produce brain damage. Children are more resistant to the effects of hypoxia for many reasons . They have less physiological shunting; their arteries are more distensible, having no atherosclerosis or narrowing. Their hearts, in general, are more responsive, and again have better blood supply. Their lungs are better, having less damage done by smoking and breathing polluted atmospheres; they have less air trapping, less obstructive disease; less diffusion problems. Smoking effects the heart, lungs, and cells and thus reduces tolerance to hypoxia. We have measured carboxyhemoglobin as high as 21% in smokers with an average of about 10%. Therefore, 10% of the blood cannot carry oxygen because carbon monoxide takes its place. Carbon monoxide also ties up the cellular enzymes that utilize oxygen. Thus, that oxygen, that is delivere to the cells, cannot be utilized. All this makes the smoking adult much more susceptible to hypoxia and its effects.

Thus, with the flight profile of the C5-A after decompression, the children never even approached the TUC for those altitudes and times which are much shorter than the times of safe exposure. The total time of 8 minutes from 23,400 feet at decompression to 10,000 feet does not exceed "Times of Useful Consciousness" at 23,000 feet for adults. I can see no way that this hypoxia exposure could produce permanent brain damage in children.

From diagrams, photographs, and descriptions of the accident, the only acceleration of significance applied to the children were +Gz or head to foot and +Gx or front to back. The children were strapped in rearward facing seats which is the best possible condition for preventing injury.

The first impact was nothing more than a high speed landing in soft dirt and if the vertical acceleration was 500 feet per minute as stated, then the Gz would have been 1.7 G's, or only .7 G's over the normal 1 G if we assume 600 feet per minute descent rate, Gz would be 2.025 or 1.025 G's over normal. These could be compared to the G loading of a normal hard bouncing landing on a commercial air craft that we have all experienced if we have flown much. Hardly noticeable and certainly not enough to cause injury to anyone sitting in a standard aircraft seat. It is not even enough to knock some one down who is standing unsupported. The front to back acceleration on this impact was essentially zero.

On the second impact, the only G loading that can be calculated is the average +Gx. From the descriptions of the occupants of the Flight deck and the aft troop compartment the G's were fairly constant and also since the average person can hold on to something with their hand against a sustained acceleration of only 1.5 to 2 G's, which the occupants did, the average G loading of 1.6 for the aft troop compartment would be close to the maximum loading. Even with a peak G loading of 2-3 or 4 G's people in rearward facing seats would not be injured. Peak +Gx loading tolerated by humans without injury have been 30-83 G's depending on the rate of onset and duration. Apollo loading on blast off was 15 G's sustained for several seconds. Man is capable of sustaining +25 Gx for several seconds without permanent damage. Man voluntarily stands + 10Gx for 200 seconds without injury. People, including children are exposed to higher G loading for longer times than they were in this accident in everyday riding devices in amusement parks.

It is our opinion, to a reasonable medical certainty, that the decompression, hypoxic, and accelerative stress involved in the C-5 (68-218) accident of April 4, 1975 were not severe enough to produce any permanent damage to any child strapped in rearward facing seats in the aft troop compartment.

Jared M. Dunn, M.D.

Jefferson C. Davis, M.D.

JMD/JCD/ybw

Pilot
MAJOR D.W. TRAYNOR PP 2223
"Forward G not violent,
IT DIDN'T HURT, I DIDN'T FEEL
THOWN FWD. IT was not significant

2224 Copilot injured leg because of either
crawling out OR ON Rudder Ped

Reports of people not knowing
other then they Had Landed in Sigon
— were generally in good shape.

2230h 16 crew 11 sur 5 Died ?
10 med crew 7 sur 3 Died
2 Photographers Died
Col willis — 1 MAC observer Died

15~~4~~ Died all together

CAPT HARP — copilot
SAYS DID not seem in excess of 2g
Door worked ON TROOP compartment
Marjority of child still asleep JUST BEGINNING
to wake up — DIDNT see cuts or scratches on kids

ORPHANS ON Bd TROOP Comp = 145
Survived = 143

NO ATTENDANTS ——— 7
SURV ——— 6

Both P & CP describe slide as smooth

Flight STA is 34' off gnd almost 4 stories

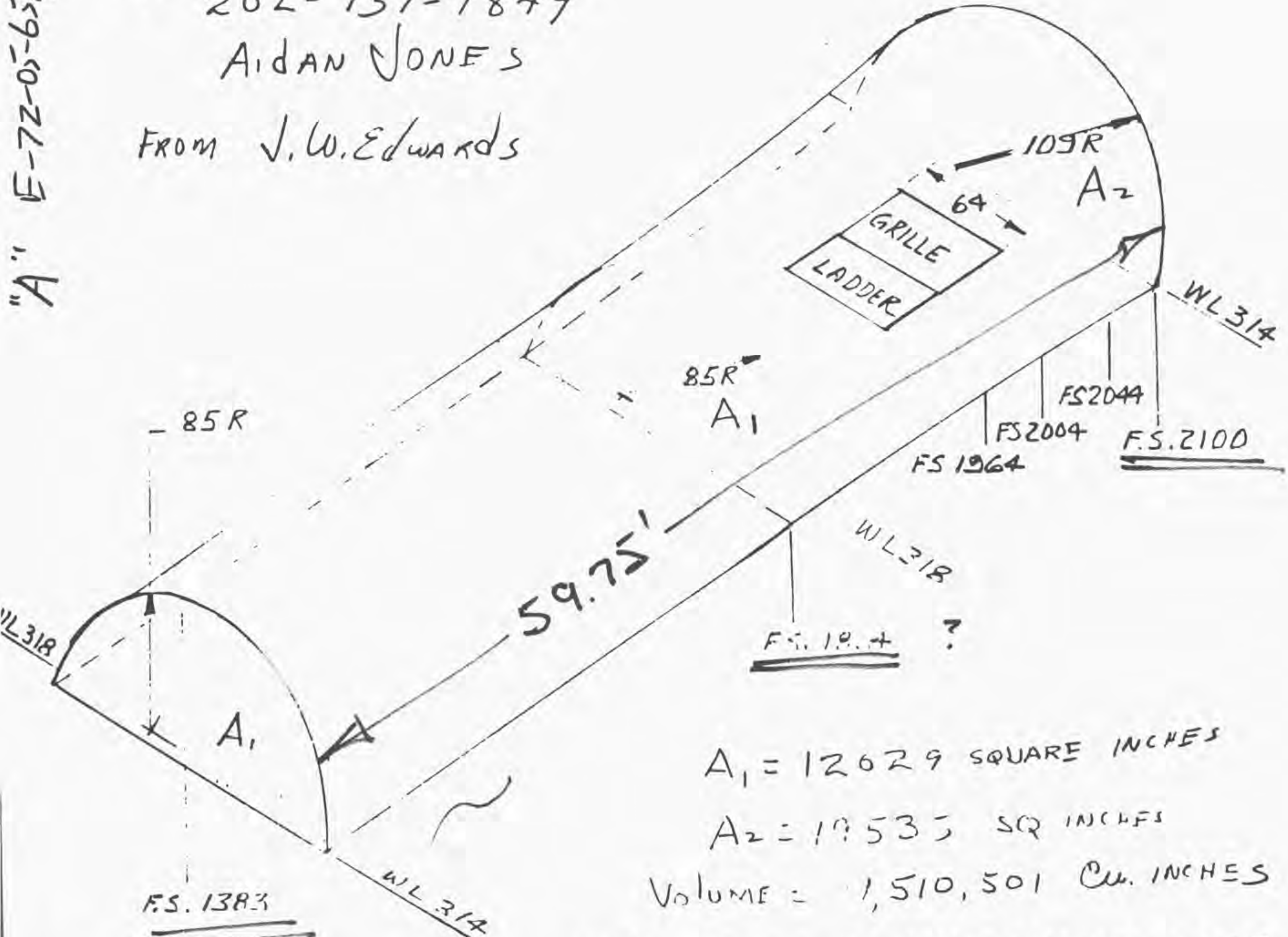
DIST 2209' & 2012 feet scaled

G 3.77 cargo floor
1.45 Flt deck
1.60 Troop cmp

"A" E-72-05-657-8)

to: 202-737-7849
Aidan Jones

From J.W. Edwards



A_1 = 12629 SQUARE INCHES

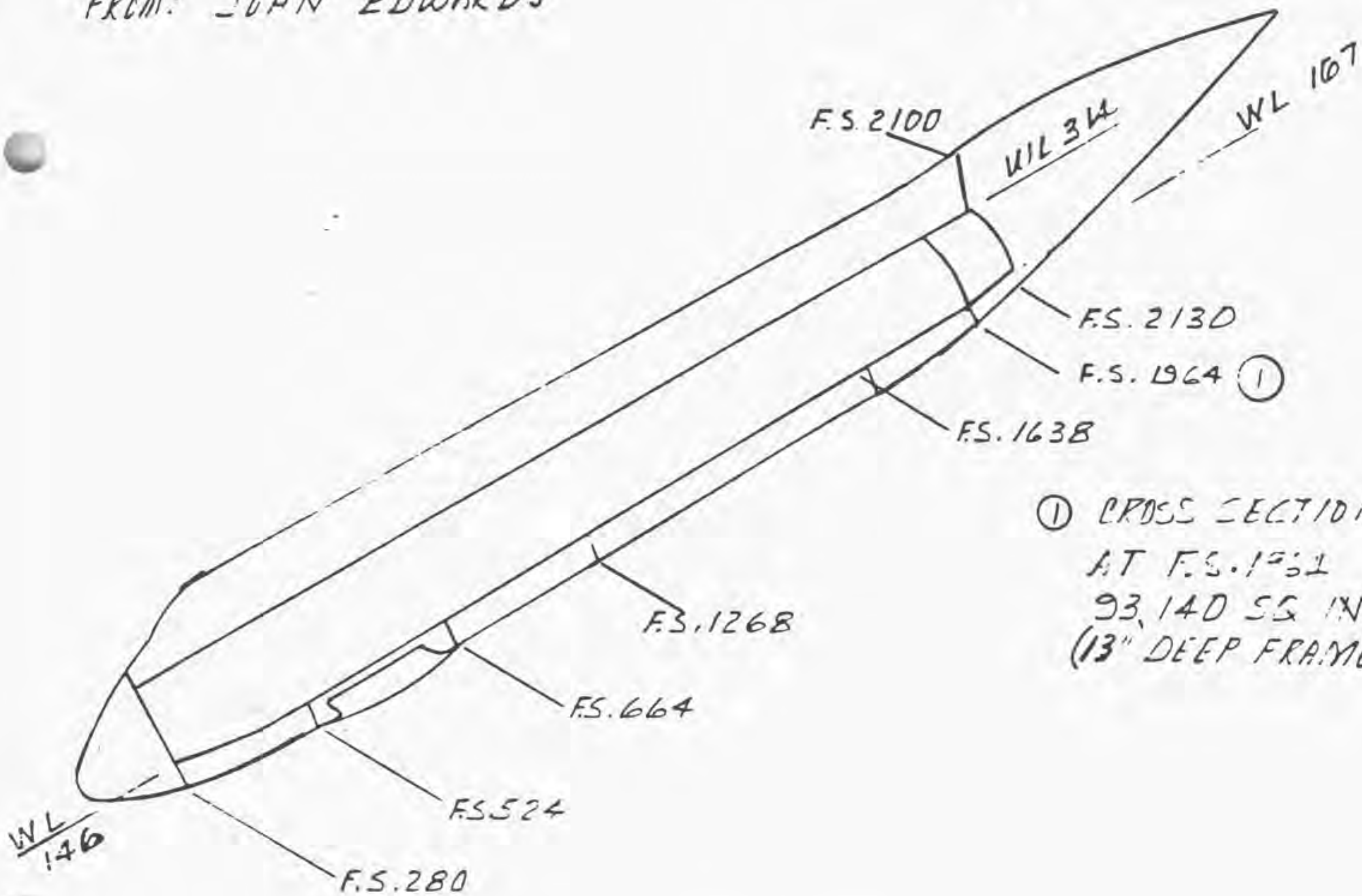
A_2 = 19535 SQ INCHES

Volume = 1,510,501 Cu. INCHES

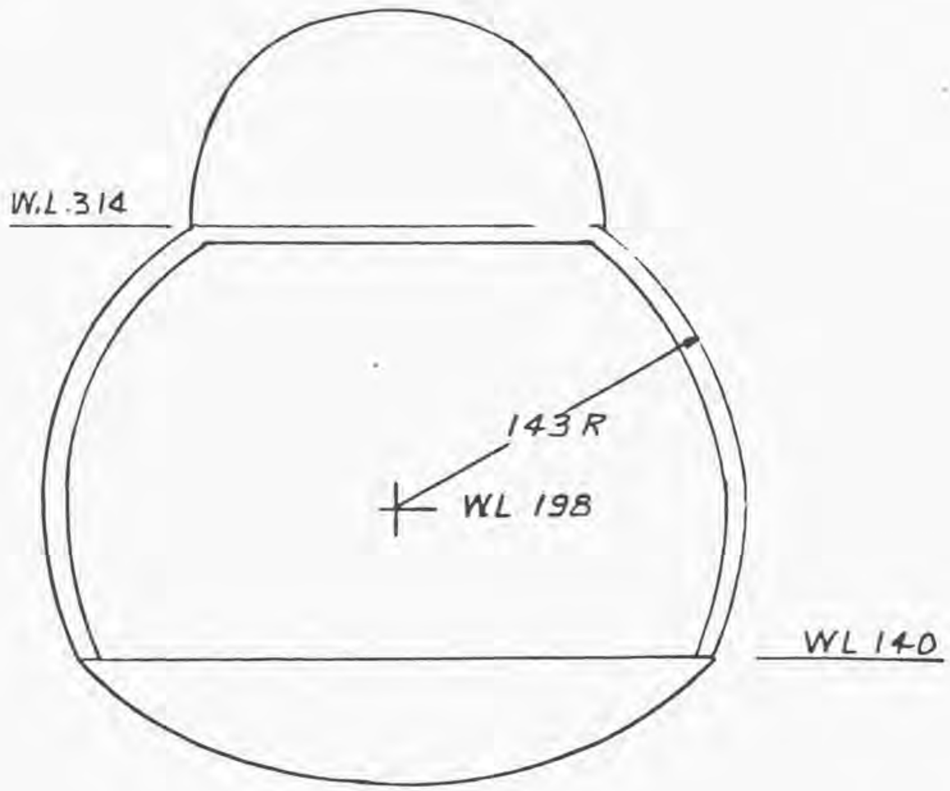
AFT TROOP COMPARTMENT

AIDAN JONES
FROM: JOHN EDWARDS

"A" E-72-05-651-8



(1) CROSS SECTION ARE
AT F.S. 1951
93,140 SQ. IN.
(13" DEEP FRAME)

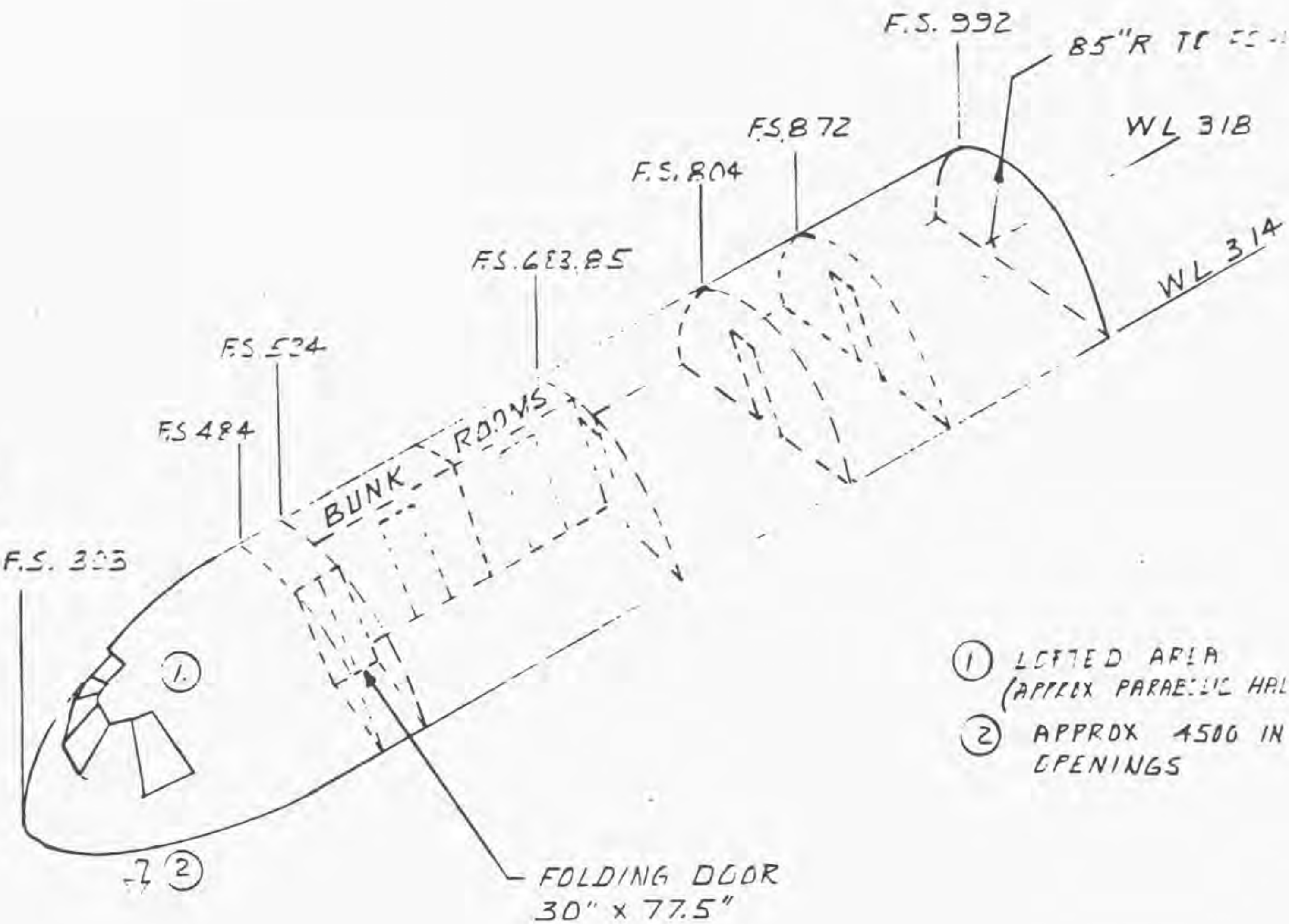


CONSTANT F.S. 524 TO 1964

CARGO COMPARTMENT

TO: 202-737-7649
AIDAN JONES
FROM JOHN EDWARDS

A E-72-05-657-8



(1) LOFTED AREA (APPROX PARABOLIC HAL
(2) APPROX 4500 IN OPENINGS

C-5A FLIGHT STATION

ANALYSIS OF 'G' LEVELS ASSOCIATED WITH THE C-5A ACCIDENT NEAR SAIGON APRIL 4, 1975

by

James W. Turnbow, Ph.D.

Consultant - Aviation Safety

Analysis of 'G' Levels Associated
With the C-5A Accident Near Saigon
April 4, 1975

by

James W. Turnbow, Ph.D.
Consultant - Aviation Safety

References Used:

The following analyses and conclusions are based in part, but are not limited to, a review of the following documents:

1. USAF Collateral Report, Vols. I, II, III.

2. Photographs of the aircraft prior to and following the accident.

3. Photographs of the accident site.

4. Miscellaneous drawings of the C-5A aircraft.

5. Sworn statements of:

   Regina Aune
   Tilford Harp
   Christine Lieverman
   Keith Malone
   Marcia Tate

6. Depositions and/or trial testimony of the following:

   Regina Aune
   Tilford Harp (co-pilot)
   Christine Lieverman
   Harriett Neill
   Merritt Stark
   Marcia Tate
   Dennis Traynor (pilot)
   William Timm
   John Edwards

7. Wreckage Distribution Diagram.

8. Cutaway view of C-5A troop compartment.

9. NASA Technical Report SP-3006 'Bioastronautics Data Book,' 1964.

10. USAF Technical Report No. 5915 Part 2, 1961, 'Human Exposures to Linear Deceleration,' 1951.

11. USAAMRDL Technical Report 71-22, 'Crash Survival Design Guide,' 1971.

12. Plots of the Data Obtained from the onboard recorder (MADAR).

13. The author also draws on some 20 years of experience in aircraft accident reconstruction and full scale crash testing of aircraft. A vitae is attached for convenience of the reader.

ACCIDENT SYNOPSIS

The crash of this aircraft consisted of two ground contacts separated by approximately 875 yards of free flight. The analysis of the data available shows the following concerning these two contacts:

Contact No. 1

This contact has been characterized by several of those aboard the aircraft as 'a near normal touch down' or 'no more than a hard landing typical of military or commercial aircraft.' The sink rate was reported to be 500 to 600 feet per minute by one of the cockpit crew (Mayor Traynor), a fact in agreement with:

a) Extrapolation of the MADAR data.

b) The aircraft attitude and speed, i.e., nose up at touchdown. (It is noted that the nose gear did not contact the ground at this point).

c) The aircraft would have been in 'ground effect' as it approached the surface with resulting tendency to reduce any existing sink rate.

d) Statements of other crew, for example: Capt. Harp said in the Schneider Trial, page 2143, line 4: 'I would say there were hardly any G forces on the first landing.'

The primary structural failure at this first contact was removal of the rear sets of landing gears, probably due to the landing on a less than normally firm runway and to the above normal touchdown speed of 270 knots, both of which could be expected to increase the drag forces on the gear.

Since the ultimate design load for each gear does not exceed 240,000 lbs, and assumption of full design load being developed on the rearmost gears, plus a limit load of 160,000 lbs on each of the forward main gears, gives a total load of 800,000 lbs. This would load the 450,000 lb aircraft to no more than 1.78g's along the longitudinal axis of the aircraft. The vertical loads would have been very consistent with those occuring for a landing at near or lower than normal sink rate. Vibratory oscillations would have been induced into the structure due to failure of the gear, however these, being of high frequency, would have been more of an 'audible' nature to passengers of the troop compartment rather than of a nature such as to produce a displacement or impact type response of those passengers.

No hazard to the occupants of either the cockpit or troop compartments can thus be expected from this contact.

Contact No. 2

This ground contact occurred after the aircraft became airborne following the initial touchdown and crossed the Saigon River. Observation of the forward main gear tire marks relative to a small dike on the far bank of the river shows (together with the absence of nose gear marks) that the aircraft again touched down in level or slightly nose up attitude. The extended nose gear and extended main gear permitted the aircraft to pass over this dike, allowing failure of all of these remaining gears with little or no contact of the bottom of the fuselage with the dike. The decelerations here would again be no more than the values occurring in the first contact. Upon passage over the dike the bottom of the aircraft began a skidding and plowing run through wet and soft rice fields to the final points of rest. Observation of the accident photos and other evidence shows the following:

a) The troop compartment and the crew compartments remained essentially intact, maintaining living space for those occupants.

b) All seats remained attached to the floor and there were no seat belt or harness failures.

c) Seats in the troop compartment are 16g seats attached to the floor with a 9g restraint. All were rearward facing.

d) Skid tracks through the wet/soft marsh-like terrain are strongly indicative of long-duration, low-level, constant deceleration for the cockpit and troop compartments.

e) Break-up of the lower fuselage occurred in many relatively small pieces consistent with many successive failures, again indicative of continued and hence low level continuous deceleration.

f) The failure of the side walls of the lower (cargo) compartment ultimately resulted in the formation of two skids or runners for the troop compartment which guided that compartment in almost a straight track, reducing lateral loads to only those of vibratory nature and allowing the floor to remain intact.

g) Adult occupants seated or kneeling on the floor between rows of seats, without any kind of restraint other than holding by hand were able to stay in place throughout the complete impact sequence without serious injury. Cuts and bruises were reported. Only those occupants in line with an isle and holding by hand appear to have been unable to retain position. These occupants would have been in a condition similar to a 'free fall' at a somewhat elevated 'g' value of about 1.5 to 2.0g as they 'fell' longitudinally along the isle to impact at or near the front bulkhead. Their injuries thus occurred in this mode.

The 'Wreckage Diagram' for C-5A SN 68-218 shows a deceleration distance for the troop compartment of about 650 yards or 1950 feet as scaled from the diagram. For an initial speed of 270 knots or 456 ft/sec the average deceleration over this distance is 1.66g.* In view of the nature of this accident it is the opinion of the author that the <u>peak</u> decelerations which occurred are probably <u>not</u> <u>more</u> <u>than</u> three (3) times this value or about 5g's. The reader should observe carefully the fact that such peaks cannot physically be applied for any appreciable period of time otherwise the aircraft would have to stop in much less than 1950 feet. [The value would be 646 feet at 5g's constant deceleration].

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* See Appendix I.

HUMAN TOLERANCE TO DECELERATION

The voluntary tolerance of the whole human body for short duration pulses with forward facing seat and shoulder harness is at least 40g's or eight times the 5g value mentioned above. For rearward facing seats the voluntary tolerance level is well in excess of 40g. At least one 80g test has been conducted on a voluntary human subject without serious injury.

The tolerance to head impact alone, as established by a Wayne State University research group, indicates that peak accelerations of 15 milliseconds duration would have to be of the order of 140g just to produce unconsciousness. For a 2ms pulse the corresponding value would have to be about 400g.

It should be noted that in the C-5A accident in question many of the children were not even awakened by the crash. In view of: 1) The visually observed response of the children in the troop compartment to the crash (or the lack thereof) and 2) to the extremely large disparity between the probable actual decelerations (both peak and average values) and the limits of voluntary human tolerance to such loads, it appears clear that no hazard to life or health existed due the deceleration environment alone in the Saigon C-5A accident of April 1975.

For the convenience of the reader, copies of several human tolerance charts taken from reference No. 10 are included in the appendix.

CONCLUSIONS

It is the opinion of this author that it is a scientific certainty that the decelerations occurring in the April 4, 1975 Saigon C-5A accident did not provide a direct hazard to the life or health of the children or adults located in troop compartment of that aircraft. More specifically it is not possible that the magnitude of the crash decelerations were such as to result in brain damage for the seated occupants or to those adult occupants who remained in position throughout the crash.

APPENDIX I

For uniform (constant) deceleration the governing equation is:

$$G = \frac{V^2}{64.4S}$$

<u>where</u>:

V = Velocity in ft/sec
= 270 knots = 456 ft/sec

S = Deceleration distance = 1950 feet

The constant 64.4 is twice the acceleration due to gravity or $2g = 2 \times 32.2 = 64.4$ ft/sec^2.

<u>Then</u>:

$$G = \frac{(456)^2}{64.4\ (1950)} = 1.66$$

APPENDIX II

APPENDIX III

APPENDIX IV

VITAE

ORIGINAL + 2 zerox Copies.

ANALYSIS OF "G" LEVELS ASSOCIATED WITH THE C-5A ACCIDENT NEAR SAIGON APR. 4, 1975

by

JAMES W. TURNBOW, PhD
CONSULTANT - AVIATION SAFETY

REFERENCES USED

THE FOLLOWING ANALYSES AND CONCLUSIONS ARE BASED IN PART, BUT ARE NOT LIMITED TO, A REVIEW OF THE FOLLOWING DOCUMENTS:

1. USAF COLLATERAL REPORT VOLS I, II, III.
2. PHOTOGRAPHS OF THE ~~ACCIDENT~~ AIRCRAFT PRIOR TO AND FOLLOWING THE ACCIDENT,
3. PHOTOGRAPHS OF THE ACCIDENT SITE.
5. MISCELLANEOUS DRAWINGS OF THE C-5A AIRCRAFT.
6. SWORN STATEMENTS OF:
   - REGINA AUNE
   - TILFORD HARP
   - CHRISTINE LIEVERMAN
   - KEITH MALONE
   - MARCIA TATE

7. DEPOSITIONS AND/OR TRIAL TESTIMONY OF THE FOLLOWING:

REGIN AUNE
TILFORD HARP (COPILOT)
CHRISTINE LIEVERMAN
HARRIETT Neill
Merritt STARK
MARCIA TATE
DENNIS TRAYNOR (PILOT)
WILLIAM TIMM

JOHN EDWARDS

8. WRECKAGE DISTRIBUTION DIAGRAM.

9. "CUTAWAY VIEW OF C-5A TROOP COMPARTMENT.

10. ~~[illegible]~~ NASA TECHNICAL REPORT SP-3006 "BIOASTRONAUTICS DATA BOOK", 1964

11. USAF TECHNICAL REPORT No.5915 PART 2, 1961, "HUMAN EXPOSURES TO LINEAR DECELERATION" 1951

12. USAAMRDL TECHNICAL REPORT 71-22 "CRASH SURVIVAL DESIGN GUIDE", 1971

2A

13. PLOTS OF THE DATA OBTAINED FROM THE ONBOARD RECORDER (MADAR).

14. THE AUTHOR ALSO DRAWS ON SOME 20 YEARS OF EXPERIENCE IN AIRCRAFT ACCIDENT RECONSTRUCTION AND FULL SCALE CRASH/TESTING (2 words) OF AIRCRAFT. A VITAE IS ATTACHED FOR CONVENIENCE OF THE READER.

Accident Synopsis

THE CRASH OF THIS AIRCRAFT CONSISTED OF TWO GROUND CONTACTS SEPARATED BY APPROXIMATELY 875 YARDS OF FREE FLIGHT. THE ANALYSIS OF THE DATA AVAILABLE SHOWS THE FOLLOWING CONCERNING THESE TWO CONTACTS:

Contact No 1

THIS CONTACT HAS BEEN CHARACTERIZED BY MOST OF THOSE ABOARD THE AIRCRAFT AS "A NEAR NORMAL TOUCH DOWN" OR "NO MORE THAN A HARD LANDING TYPICAL OF MILITARY OR COMMERCIAL AIRCRAFT," ~~IN NEAR LEVEL ATTITUDE~~ NORMAL LANDING ~~ATTITUDE~~. THE SINK RATE WAS

NO ¶ REPORTED TO BE 500 TO 600 feet PER MINUTE BY ONE OF THE COCKPIT CREW (MAJOR TRAYNOR), A FACT IN AGREEMENT WITH:

a) EXTRAPOLATION OF THE MADAR DATA.

b) THE AIRCRAFT ATTITUDE AND SPEED, ie, NOSE UP AT TOUCHDOWN. (IT IS NOTED THAT THE NOSE gear DIDNOT CONTACT THE GROUND AT THIS POINT).

c) THE AIRCRAFT would have BEEN IN "GROUND EFFECT" AS IT APPROACHED THE SURFACE WITH RESULTING TENDENCY TO REDUCE ANY EXISTING SINK RATE.

d) STATEMENTS of other CREW, FOR example: CAPT HARP SAID IN THE SCHNEIDER TRIAL, page 2143 line 4: "I WOULD SAY THERE WERE HARDLY ANY G FORCES ON THE FIRST LANDING."

¶ THE PRIMARY STRUCTURAL FAILURE AT THIS FIRST CONTACT WAS REMOVAL OF THE REAR SETS OF LANDING GEARS, probably DUE TO THE LANDING ON A LESS THAN NORMALLY FIRM RUNWAY AND TO THE ABOVE NORMAL TOUCHDOWN SPEED of 270 KNOTS, BOTH OF WHICH could be expected TO INCREASE THE DRAG FORCES ON THE gear. ~~ASSUMING A B~~

¶ SINCE THE ULTIMATE DESIGN LOAD FOR EACH GEAR DOES NOT EXCEED 240,000 lbs, AN ASSUMPTION of FULL DESIGN LOAD BEING Developed ON THE REARMOST GEARS, PLUS A LIMIT LOAD of 160,000 lbs ON EACH OF THE FORWARD MAIN gears, gives A TOTAL LOAD of 800,000 lbs. This would LOAD THE 450,000 lb AIRCRAFT TO NO MORE THAN 1.78g's ALONG THE LONGITUDINAL AXIS of THE AIRCRAFT. The vertical LOADS would HAVE

BEEN VERY CONSISTENT WITH THOSE OCCURRING FOR A LANDING AT NEAR OR LOWER THAN NORMAL SINK RATE. VIBRATORY oscillations would have been INDUCED INTO THE STRUCTURE DUE TO FAILURE OF THE gear, However THESE, BEING of High FREQUENCY, would Have been MORE of an "Audible" NATURE TO PASSENGERS of THE troop compartment RATHER THAN OF A NATURE SUCH as TO PRODUCE A DISPLACEMENT OR IMPACT TYPE RESPONSE of THOSE PASSENGERS.

NO HAZARD TO THE OCCUPANTS OF EITHER THE COCKPIT OR TROOP COMPARTMENTS CAN THUS BE EXPECTED FROM THIS CONTACT.

Contact No 2

This ground contact occurred after the aircraft became airborne following the initial touchdown and crossed the Saigon River. Observation of the the forward main gear tire marks relative to a small dike on the far bank of the river shows (together with the absence of nose gear marks) that the aircraft again touched down in level or slightly nose up attitude. The extended nose gear and extended main gear permitted the aircraft to pass over this dike, allowing failure of all of these remaining gears with little or no contact of the bottom of the fuselage with the dyke. The decelerations here would again be no more than the values occurring in the first contact. Upon passage over the dike

THE BOTTOM OF THE AIRCRAFT BEGAN A SKIDDING AND PLOWING RUN THROUGH WET AN SOFT RICE FIELDS TO THE FINAL POINTS OF REST. OBSERVATION OF THE THE ACCIDENT PHOTO'S AND OTHER EVIDENCE SHOWS THE FOLLOWING:

a) THE TROOP COMPARTMENT AND THE CREW COMPARTMENTS REMAIN ESSENTIALLY (SP?) INTACT, MAINTAINING LIVING SPACE FOR THOSE OCCUPANTS.

b) ALL SEATS REMAINED ATTACHED TO THE FLOOR AND THERE WERE NO SEAT BELT OR HARNESS FAILURES.

c) SEATS IN THE TROOP COMPARTMENT ARE 16g SEATS ATTACHED TO THE FLOOR WITH a 9g RESTRAINT. ALL WERE REARWARD FACING.

d) SKID TRACKS THROUGH THE WET/SOFT MARSH-LIKE TERRAIN ARE STRONGLY INDICATIVE OF LONG-DURATION, LOW-LEVEL, CONSTANT DECELERATION FOR THE COCKPIT & TROOP COMPARTMENTS.

e) BREAK-UP OF THE LOWER FUSELAGE OCCURRED IN MANY RELATIVELY SMALL PIECES CONSISTANT WITH

MANY SUCCESSIVE ~~AND PROGRESSIVE~~ FAILURES, AGAIN INDICATIVE of continued AND HENCE LOW LEVEL CONTINUOUS Deceleration. SP?

f) THE FAILURE OF THE SIDE walls of THE LOWER (CARGO) COMPARTMENT ULTIMATELY RESULTED IN THE FORMATION of TWO SKIDS OR RUNNERS FOR THE TROOP COMPARTMENT WHICH GUIDED THAT COMPARTMENT IN ALMOST A STRAIGHT TRACK, REDUCING LATERAL LOADS TO ONLY THOSE OF VIBRATORY NATURE AND ALLOWING THE FLOOR TO REMAIN INTACT.

g). Adult Occupants ~~seated~~ seated OR kneeling ON THE FLOOR BETWEEN ROWS of seats, ~~[illegible]~~ WITHOUT ANY KIND of RESTRAINT OTHER THAN HOLDING BY HAND were ABLE TO STAY IN PLACE THROUGHOUT THE complete impact SEQUENCE WITHOUT SERIOUS INJURY. (Cuts AND BRUISES were REPORTED). ONLY THOSE OCCUPANTS IN LINE WITH AN ISLE AND HOLDING BY HAND APPEAR TO HAVE BEEN unable to RETAIN POSITION. These OCCUPANTS would have BEEN IN A condition similar to A "FREE FALL" AT A SOMEWHAT elevated "g" value of ABOUT 1.5 TO 2.0g AS THEY "FELL" LONGITUDINALLY along THE isle TO IMPACT AT OR NEAR THE FRONT BULKHEAD. Their INJURIES THUS OCCURRED IN THIS MODE.

¶ THE "WRECKAGE DIAGRAM" FOR C-5A SN 68-218 SHOWS A DECELERATION DISTANCE FOR THE TROOP COMPARTMENT of ABOUT 650 YARDS OR 1950 FEET AS scaled FROM THE DIAGRAM.

FOR AN INITIAL SPEED OF 270 KNOTS OR 456 ft/sec THE AVERAGE Deceleration OVER THIS DISTANCE is 1.66g.*

IN VIEW OF THE NATURE OF THIS ACCIDENT IT IS THE OPINION OF THE AUTHOR THAT THE PEAK DECELERATIONS

* SEE APPENDIX PAGE I

WHICH occurred ARE probably <u>NOT</u> <u>MORE</u> <u>THAN</u> THREE (3) TIMES THIS value OR ABOUT 5g's. THE READER should OBSERVE carefully THE FACT THAT SUCH PEAKS CANNOT physically BE APPLIED FOR ANY APPRECIABLE PERIOD OF TIME OTHERWISE THE AIRCRAFT would have TO STOP IN MUCH LESS THAN 1950 feet. [THE value would be 646 feet AT 5g's CONSTANT DECELERATION].

HUMAN TOLERANCE TO DECELERATION

THE VOLUNTARY TOLERANCE OF THE WHOLE HUMAN BODY FOR SHORT DURATION PULSES WITH FORWARD FACING SEAT AND SHOULDER HARNESS IS AT LEAST 40g's OR EIGHT TIMES THE 5g VALUE MENTIONED ABOVE. FOR <u>REARWARD</u> <u>FACING</u> <u>SEATS</u>

THE VOLUNTARY TOLERANCE LEVEL IS WELL IN EXCESS OF 40g. AT LEAST ONE ~~VOLUNTARY~~ 80g TEST ON A VOLUNTARY SUBJECT (A CAPT. BEEDING, USAF). HAS BEEN CONDUCTED. ~~PLACING 80g MEASURED ON THE CHEST OF THE SUBJECT, BY COL JOHN P. STAPP'S TEAM AT HOLOMAN~~ AIR FORCE BASE.

THE TOLERANCE TO HEAD IMPACT ALONE, AS ESTABLISHED BY A WAYNE STATE UNIVERSITY ~~RESEARCHER'S~~ RESEARCH GROUP, INDICATES THAT PEAK Accelerations of 15 MILLISECONDS Duration would Have to be OF THE ORDER OF 140g JUST TO PRODUCE UNCONSCIOUSNESS. FOR A 2MS PULSE THE CORRESPONDING value would Have to be about 400g.

IT SHOULD BE NOTED THAT IN THE C5A ~~AIR~~ Accident in QUESTION MANY of THE CHILDREN WERE NOT EVEN AWAKENED BY THE CRASH.

~~See next page~~ CONTINUED NEXT PAGE

~~CONCLUSION~~

No A → In view of: (1) THE visually observed RESPONSES TO THE CRASH (OR THE LACK THEREOF) of THE CHILDREN IN THE TROOP COMPARTMENT, AND (2) TO THE EXTREMELY LARGE DISPARITY BETWEEN THE PROBABLE ACTUAL DECELATIONS (BOTH PEAK AND AVERAGE values) AND THE LIMITS OF VOLUNTARY HUMAN TOLERANCE TO SUCH LOADS, IT APPEARS CLEAR THAT NO HAZARD TO LIFE OR HEALTH EXISTED DUE THE DECELERATION ENVIRONMENT ALONE IN THE SAIGON C-5A Accident of APRIL 1975.

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¶ FOR THE CONVENIENCE OF THE READER, COPIES OF SEVERAL HUMAN TOLERANCE CHARTS TAKEN FROM [redacted] REFERENCE No. 10, [redacted]. ARE INCLUDED IN THE APPENDIX.

CONCLUSIONS

IT IS THE OPINION OF THIS AUTHOR THAT IT IS A SCIENTIFIC CERTAINTY THAT THE DECELERATIONS OCCURRING IN THE APR. 4, 1975 SAIGON C-5A ACCIDENT DID NOT

PROVIDE — A DIRECT HAZARD TO THE LIFE OR HEALTH ~~PRESENT OR FUTURE~~ OF THE CHILDREN OR ADULTS ~~involved~~ LOCATED IN TROOP COMPARTMENT OF THAT AIRCRAFT. MORE SPECIFICALLY IT IS NOT POSSIBLE THAT THE MAGNITUDE OF THE CRASH DECELERATIONS WERE SUCH AS ~~THE SEATED OCCUPANTS~~ ~~SUFFICIENTLY HIGH~~ TO RESULT IN BRAIN DAMAGE ~~TO~~ FOR THE SEATED OCCUPANTS OR TO THOSE ADULT OCCUPANTS WHO REMAINED IN POSITION THROUGHOUT THE CRASH.

APPENDIX - I

↕ 2" SPACE HERE, MARY

FOR UNIFORM (CONSTANT) DECELERATION THE GOVERNING EQUATION IS:

$$G = \frac{V^2}{64.4\,S}$$

WHERE:

V = VELOCITY IN ft/sec.

= 270 KNOTS = 456 ft/sec

S = DECELERATION DISTANCE = 1950 feet

THEN: $G = \frac{(456)^2}{64.4\,(1950)} = 1.66$

THE CONSTANT 64.4 IS TWICE THE ACCELERATION DUE TO GRAVITY OR $2g = 2 \times 32.2 = 64.4$ ft/sec².