

South African Airways Sold-Afrikaanse Lugdiens

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MEMORANDUM

Technical Investigation Committee  
 ZS-SAS "Helderberg" Accident  
 Hangar 1 west  
 Jan Smuts Airport.

CONFIDENTIAL

Ref: AIR/AQC/8-B747/SAS/STABTRIM  
 Tel: B-2286/3106  
 Date: 89/02/02

Chairman  
 "Helderberg" Technical Investigation Committee  
 Room 516 Administrative Building  
 Jan Smuts Airport

ZS SAS HORIZONTAL STABILIZER TRIM POSITION AT IMPACT

Photographs taken on the sea bed of the Horizontal Stabilizer jack screw gimbal assembly revealed the following:  
 The upper section of the jack screw is still in the ball nut with nine grooves extending above the ball nut and four grooves below the ball nut.


Physical check on ZS-SAR with nine grooves extending above the ball nut corresponds with a cockpit stabilizer trim position indication of 3.5 units.

However, it has been suggested that the jack screw fracture possibly occurred at a point flush with the lower surface of the ball nut and that the section of jack screw remaining intact with the ball nut rotated subsequent to the event, due to its mass and the low friction characteristic of the ball nut, resulting in the four grooves protruding below the ball nut.

A further physical test on ZS-SAR with nine plus four grooves, i.e. thirteen grooves extending above the ball nut resulted in an indicated position of 4.75 units stabilizer trim in the cockpit. *(not correct)*

This information to be reviewed in conjunction with attached correspondence with Flight Performance Engineering relating to computed horizontal stabilizer trim configuration on ZS-SAS at the time of the accident.

N.H. Massyn  
 Assistant Investigator.



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MEMORANDUM

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Deputy Manager (Weights Engineering)  
Flight Performance Engineering  
JAN SMUTS AIRPORT

Ref : AIR/MFD/14/9/1/3

Tel : 8-2512

Date : 29 March 1989

Technical Investigation Committee  
ZS-SAS Accident  
C/O Room 516  
Administration Building  
JAN SMUTS AIRPORTZS-SAS (SA295) AMENDED ESTIMATED WEIGHT AND BALANCE INFORMATION

Our like referenced memorandum of 09 February 1989 is amended as follows:

1. Estimated aircraft weight at impact

- |   |              |
|---|--------------|
| a) Weight of departure fuel as recorded on the load-sheet           | = 149 000 kg |
| b) Weight of trip fuel to destination as recorded on the load-sheet | = 120 610 kg |
| c) Difference between 1(a) and 1(b)                                 | = 20 390 kg  |
| d) Estimated weight of fuel for remaining 23 minutes flying time    | = 3 980 kg   |
| e) Aircraft zero-fuel weight as recorded on the load-sheet          | = 210 485 kg |
| f) Estimated aircraft weight at impact; 1(e) plus 1(d) plus 1(c)    | = 242 855 kg |

2. Estimated aircraft center-of-gravity at impact

- |   |                       |
|---|-----------------------|
| a) Zero-fuel weight index as recorded on the load-sheet   | = 8 390.8 index units |
| b) Index unit adjustment for the estimated weight of fuel remaining on-board the aircraft; per 1(c) plus 1(d) | = + 5.7 index units   |
| c) Estimated trim-sheet index units at impact; 2(a) plus 2(b)   | = 8 396.5 index units |

Mass of fuel in the aeroplane at the time of the impact = 1(a) - 1(b) + 1(d)

$$= 149\ 000 - 120\ 610 + 3\ 980$$

$$= 24\ 370\ \text{kg.}$$

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d) Formula to convert index units to %MAC:-

$$\%MAC = \frac{\left[ \frac{5000 (TSI - 7000)}{W} \right] + 65.6}{3.278}$$

W = aircraft weight  
TSI = trim-sheet index units

e) Estimated %MAC at impact = 28.78

3. Estimated stabilizer trim position at impact

Per B747 Combi AFM, code B27, section 4, page 26, (copy attached) for an estimated aircraft weight of 242 850 kg per 1(f) and an estimated center-of-gravity of 28.78 %MAC per 2(e), the stabilizer trim position will be approximately 3.1 units.

4. Estimated stabilizer trim position if passengers in zones C and D move forward

a) With reference to Assistant Investigator N. H. Massyn's memorandum AIR/AQC/8-B747/SAS/STABTRIM of 02 February 1989, we offer the following for your consideration:-

b) This estimate is based on the following,  
1. the 20 rear most passengers in zone C move forward;  
2. all 66 passengers in zone D move forward.

c) The weight of 86 passengers at 80 kg per passenger = 6 880 kg

d) The centroid for these 86 passengers (assuming they were seated in their allocated positions) = 85 141#

e) The center-of-gravity change is calculated by using the following formula:-

$$\Delta TSI = \frac{WEIGHT \times \Delta ARM}{5000}$$

ARM = Body station

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f) This table summarises the effect the centroid of 86 passengers moving from BS 1419 to various forward positions will have on the aircraft trim.

CENTROID Body Station	RESULTANT TSI	RESULTANT %MAC	RESULTANT STABILIZER TRIM
BS 400	6 994.4	20.0	5.1
BS 500	7 132.0	20.8	4.9
BS 600	<del>7 282.3</del> 7 289.6	<del>21.7</del> 21.7	<del>4.7</del> 4.7
BS 700	7 407.2	22.6	4.5
BS 800	7 544.8	23.4	4.3
BS 900	7 682.4	24.3	4.1
BS 1000	7 820.0	25.2	3.9

8095.2

27.0

3.0

Refer to attached trim-sheet for the above points.

It therefore appears feasible that the stabilizer trim could have been 4.75 units, indicating that passengers had moved forward.

Note that with the centroid for the 86 passengers being at BS 400, the aircraft would have been well within the certified trim envelope limits.

With all 159 passengers and crew concentrated in zone A, the resultant TSI is 6728.8 units and the aircraft remains within the forward trim limit (refer to point "A" on the attached trim-sheet).

WHY THESE CALCULATIONS IF THERE WERE NO INDICATORS OF PASSENGER MOVEMENT ON AIRCRAFT?



H. A. Valkenburg  
Deputy Manager (Weights Engineering)  
FLIGHT PERFORMANCE ENGINEERING