

### 3 Conclusions

The combination of touching down at a speed higher than was appropriate for the aircraft's weight at the end of the touchdown zone, the failure of the lift-spoilers to deploy at any time during the landing roll, the commander's mistaken belief that the aircraft's wheel braking systems had failed, and an incorrect braking technique, combined to cause the aircraft to overrun the specified landing distance available. Use of the emergency brake system, which is not fitted with anti-skid protection, caused all four main landing gear tyres to burst.

#### (a) Findings

1. The flight crew was properly licensed, adequately rested and medically fit to conduct the flight.
2. The flight crew operated the aircraft within the limits laid down by the operator's Flight Time Limitations scheme.
3. The aircraft's documentation was in order and there were no relevant outstanding defects recorded in the technical log.
4. The operator required that landings at London City Airport were only to be carried out by aircraft captains, so the commander was the Pilot Flying for the sector.
5. The approach reference speed ( $V_{REF}$ ) was incorrectly determined for the aircraft's actual landing weight as 114 kt, instead of 110 kt, but 119 kt was entered on the landing data card.
6. The commander flew an ILS approach to Runway 10 and gained visual contact at around 1,000 ft aal.
7. The flight crew reported seeing two white and two red PAPI lights during the visual phase of the approach.
8. By 500 ft aal, the aircraft was fully configured for landing with the checklist completed.
9. The reported wind at the time the aircraft was cleared to land was 170°/6 kt.
10. The later stage of the approach was flown at 124 kt, ie, the incorrectly written down  $V_{REF}$  of 119 kt + 5 kt (referenced to a 34 tonne landing weight).

11. The aircraft was seen to touch down at the far end of the touchdown zone.
12. The aircraft touched down in a zero degree pitch attitude and with an indicated airspeed of 119 kt.
13. The correct touchdown speed for the aircraft's actual weight was 103 kt.
14. After touching down, the commander selected the thrust levers to ground idle, the airbrake/lift spoiler lever to 'lift spoilers' and applied pressure to the rudder pedals to operate the wheel brakes.
15. As the co-pilot was about to check for indications that the lift spoilers had deployed and that the wheel brake hydraulic pressure was normal, the commander called "NO BRAKES...." as the aircraft was not decelerating normally.
16. The commander selected the wheel brake hydraulic system from Green to Yellow and because the aircraft was still not decelerating normally, then selected the emergency braking system.
17. Skid marks on the runway surface indicated that all four main wheels had locked up over the last 473 m of the ground roll.
18. The locked main wheels caused all four tyres to be worn through by friction with the surface and to deflate.
19. The aircraft came to a halt on the paved surface beyond the end of the declared landing distance available (LDA), approximately 160 m from the edge of the dock, after a total ground roll of 1,027 m.
20. The flight crew was not aware of the tyre failures.
21. The lift spoiler surfaces did not deploy at any time during the ground roll.
22. Subsequent examination of the aircraft failed to find any defects within the lift spoiler or wheel braking systems.
23. It was established that the force required to move the lift spoiler lever from full airbrake to lift spoiler was 14 lb, and from lift spoiler to airbrake, close to zero. Both values were within the limits specified in the aircraft's Maintenance Manual.

24. A non-mandatory modification, issued in March 1988, to change the operating force characteristics of the lift spoiler lever when moving from 'lift spoiler' to airbrake, from close to zero to 12 lb, had not been embodied on EI-CZO.
25. A manufacturer's analysis of 17 BAe 146/Avro RJ series overrun accidents indicated that non-deployment of the lift spoilers on landing was a factor in only 35% of these events, but three predominant factors were identified; landing long, the condition of the runway (wet or contaminated) and landing with a tailwind component.
26. An analysis made by the manufacturer indicates that the BAe 146/RJ aircraft is no more prone to overrun the runway on landing than other aircraft types with which it was compared.

**(b) Causal factors**

The following causal factors were identified:

1. The incorrect determination of the approach reference speed ( $V_{REF}$ ) as 119 kt, resulted in the aircraft landing faster than was necessary.
2. The data suggested that the control columns may have been positioned forward of their customary position after touchdown, which could have contributed to a reduction of the aircraft's weight applied to the main wheels during the first part of the landing roll.
3. Despite the commander's recollection that he moved the airbrake/lift spoiler lever to the 'lift spoiler' position, the lift spoilers did not deploy, although the system was determined to have been serviceable.
4. The non-deployment of the lift spoiler surfaces after touchdown did not enable the timely transfer of the aircraft's weight from the wing to the main wheels, and hence the effectiveness of the wheel brakes during the early part of the landing roll was not maximised.
5. The commander's perception of brake system failure led him to select the emergency braking system which removed the anti-skid protection.
6. The lack of any positive force required to hold the lift spoiler lever at the lift spoiler activation position probably resulted in the lever moving away from the point of activation before the conditions required to satisfy the lift spoiler deployment logic could be met.