Wind helped pool fuel fire engulf

At 0612hr on August 22, 1985, British Airtours Boeing 737 G-BGJL, carrying 131 passengers and six crew on a charter flight to Corfu, began its takeoff from runway 24 at Manchester Airport.

About 36 seconds later, as the speed passed 125kt, the left Pratt & Whitney JT8D engine suffered an uncontained failure. The ejected dome of the No 9 combustion can and a small section of fan case struck an underwing fuel tank access panel, creating a 42in hole.

The panel had an impact strength one-quarter that of the lower wing skin. Had the dome struck the adjacent skin, penetration of the fuel tank probably would not have occurred. Neither the access panel nor the lower wing skin was designed to any impact-resistant criteria, nor were they required to be.

The fire ignited when fuel from the punctured tank access panel came into contact with combustion gases from the damaged engine. The crew, hearing a "thud" and believing they had suffered a tyre burst or bird-strike, abandoned the take-off immediately, intending to clear the runway to the right. They had no fire indication until nine seconds later, when the engine fire warning occurred.

The crew responded to the "thud" promptly and in accordance with their experience and training. The first indication of fire occurred at a time of extremely high workload. The commander had no direct means of assessing the extent of the fire, and sought advice from air traffic control on the need for passenger evacuation.

After an exchange with air traffic control, during which the fire was confirmed, the commander warned his cabin crew of an evacuation from the right side of the aircraft, making a broadcast over the cabin address system. He brought the aircraft to a halt in the entrance to taxiway link Delta. The decision to turn to the right into link Delta was understandable, but turning the aircraft had a critical effect on the fire, placing it upwind of the fuselage.

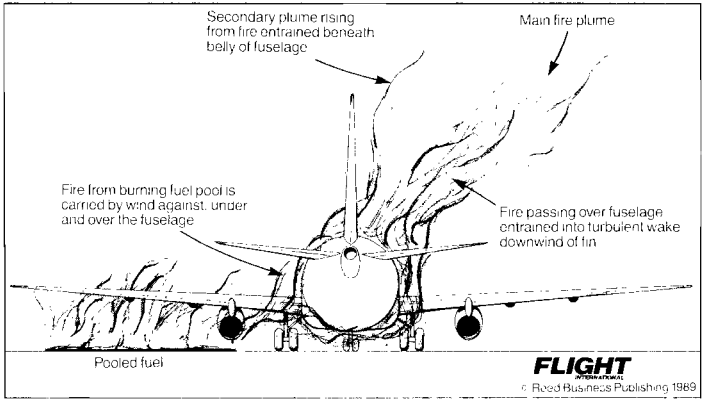
As the aircraft turned off, a 7kt wind from 250° carried the fire on to and around the rear fuselage. After the aircraft stopped, the hull was penetrated rapidly and smoke, possibly with some flame transients, entered the cabin through the aft right door, which was opened shortly before the aircraft came to a halt.

The fire burned in two separate, but overlapping, phases, involving fundamentally different fire mechanisms. While the aircraft was moving at speed down the runway, fuel became entrained into a strong turbulent wake generated by the extended thrust-reverser buckets, and burned vigorously as a "dynamic fire plume". As the aircraft decelerated and the turbulent wake decayed, the fire transitioned into a quasi-static fire burning above the pool of fuel trailing behind the aircraft.

By the time the aircraft stopped, a fully established "static" pool fuel fire was burning adjacent to the left rear fuselage. Although the dynamic fire plume was visually dramatic, hull penetration was caused primarily by the pool fuel fire.

Opening of the aft right door allowed the early entry of smoke, and possibly some flames, but was not the principal point of entry of fire into the cabin. The wind was the principal factor controlling the fire's behaviour, carrying the external fuel fire against and beneath the rear fuselage, causing rapid penetration.

Subsequently the wind induced an aerodynamic pressure field around the fuselage,



737's fuselage

drawing fire products into the hull through the cabin interior and out through open exits on the right side of the fuselage.

The initial fire penetration of the fuselage occurred within 20 seconds of the aircraft stopping, when the lower skin panels on the left side adjacent to the aft cargo hold were burned through, followed shortly afterwards by penetration of the glassfibre acoustic insulation blanket. This gave the fire access to a cavity surrounding the cargo hold, from which it entered the aft cabin via floor air-conditioning grilles on each side of the aircraft.

Within one minute of the aircraft stopping, the fire penetrated the cabin side walls just above floor level adjacent to seats 17A to 19A, giving the fire direct access to the cabin interior. The windows resisted the fire for 40 or 50 seconds after the aircraft stopped, but visible signs of damage, including cracking and apparent melting, were evident to passengers much earlier.

The fire was entrained by the wind beneath the rear fuselage, creating a large area of fire contact with a high rate of heat transfer into the hull, resulting in the rear fuselage and tail collapsing on to the ground.

Initially the internal fire burned in the aft section of the cabin, spreading forwards as roof panels and overhead lockers ignited and collapsed down on to seats. About half the seats suffered little or no fire damage, and many plastic safety cards, magazines and other fragile items survived undamaged in seatback pockets and on seat cushions. In contrast, all ceiling panels and overhead lockers were destroyed and all sideliner panels above cushion level were extensively burnt. There was comparatively little heat or smoke below about 18in above the the cabin floor.

A fully developed flashover did not occur, contrary to much fire research.

The accident confirmed what was known to a small section of the aviation community: a slight wind (2kt or more) of little or no operational significance is nevertheless important as far as aircraft orientation in a fire is concerned.

The speed of response of the Manchester Airport fire service was rapid, resulting in the start of firefighting approximately 25 seconds after the aircraft