No: 12/91 **Ref: EW/C91/8/2** **Category: 1a**

Aircraft Type and Registration:	Vanguard 953C Merchantman, G-APEM
No & Type of Engines:	4 Rolls-Royce Tyne 506 turbine engines
Year of Manufacture:	1961
Date & Time (UTC):	14 August 1991 at 2055 hrs
Location:	Manchester International Airport, Cheshire
Type of Flight:	Commercial (positioning)
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Substantial to left main landing gear and lower wing skin
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	42 years
Commander's Flying Experience:	4,852 hours (of which 1,607 hours were on type)
Information Source:	AAIB Field Investigation

History of the flight

The aircraft was on a positioning flight from East Midlands Airport to Manchester International Airport. It carried no freight or passengers and its weight and centre of gravity were within the prescribed limits for the flight. The crew, which consisted of two pilots, was well rested and qualified to undertake the flight. The weather at Manchester was fine with a visibility of 4,000 metres and a surface wind of 130°/08 kt. The commander, who was the handling pilot, elected to fly a manual ILS approach to runway 24. Both pilots stated that the approach was well flown and this view is supported by evidence from the Cockpit Voice Recorder (CVR) and the Flight Data Recorder (FDR). The runway threshold was crossed at the target speed of 110 kt and the aircraft flared for a gentle touchdown 260 feet beyond the runway visual aiming point markings. After touchdown, the commander lowered the nosewheel onto the runway and called for the propellers to be selected to "ground idle". As the propellers reached the "ground idle" position some six seconds after touchdown, the commander commenced gentle braking. Almost immediately, both the commander and the first officer heard and felt a "thump" from the left side of the aircraft. The commander suspected that a tyre had burst on the left main landing gear and anticipated a yaw to the left but this did not occur immediately. As the aircraft decelerated however, it began to pull strongly to the left and the

commander had to apply considerable nosewheel steering to the right and differential braking in order to keep it straight. The aircraft came to a halt slightly to the left of the runway centre line and 2,920 feet from touchdown. The commander became aware of a strong smell of burning rubber and saw an orange glow to the left of the aircraft. He instructed the first officer to alert the emergency services, shut down the engines and together with the first officer, abandoned the aircraft using the emergency rope at the crew door. The emergency services arrived promptly and extinguished the fire which by this time had engulfed the left main landing gear.

Analysis of the CVR supported the crew's account of events. Specifically, it was found that the approach had been stable and that the speed during the latter part of the approach correlated well with the reported threshold speed. The quality and volume of the sounds generated at touchdown were consistent with a smooth landing and earwitness reports confirmed that the tyre burst occurred after the propellers had achieved "ground idle".

Engineering Evidence

The aircraft had come to rest and a hydraulic fire had burned around the left hand landing gear until extinguished by the Fire Service; this had led to a small area of fire damage to the runway. There was fire damage to the left gear/engine nacelle and to the left inner wing area and to the closing panels at the rear of the left inner wing. Both left hand main wheel tyres had burst and the wheel rims had then caused further tyre abrasion until the rims themselves suffered substantial damage from direct contact with the runway.

Recovery was delayed by the lack of jacking adaptors and the airport was closed for over four hours, however, during the recovery operation the No 2 brake system was found to work normally.

Runway marks consisted of a single rubber track from each of the left hand pair of main wheels, the two single tracks were followed by a short discontinuity, after which each left wheel provided a double track from the deflated tyre beneath each wheel rim. Some traces of aluminium wheel rim were apparent in this section of the runway marks. There was no evidence of flailing of the damaged tyres. The runway marks and the condition of the tyres and rims indicated that the left hand main wheels had not rotated significantly since the brakes had been applied.

The left hand main wheel tyres had both failed in a similar manner with an abraded ellipse equivalent in size to the loaded footprint appropriate to the weight of the aircraft. The damage was consistent with the wheel rim breaking through the tyre wall after deflation. The tyre manufacturer's analysis

concluded that the full aircraft's weight was on the tyres at the time of the incident; if the brakes had been on at landing a much smaller area wear ellipse would have been produced.

The brake system provides maxaret units in the No 1 system and a straight pressure line, without a return, in the No 2, or emergency system; both systems work at a supply pressure of 900 psi.

After the aircraft had been recovered from the runway there was a continuous hydraulic leak from the No 1 system return pipes to the left hand brake units. The flexible hoses connected directly to the maxarets and the No 2 system pressure pipes were damaged.

Both maxaret units were found to be serviceable, therefore a common failure mode for both brake units was sought. Discussions with the (retired) hydraulic system designer confirmed that a common failure mode could be produced by:

A back pressure in the maxaret return line of approximately 100 psi which could prevent the maxaret unit releasing the brake pressure, such problems could be caused by a blockage of a hydraulic return pipe (however the amount of fluid released into the return line by each maxaret action is small).

A leakage of pressure across the single 'O' ring seal separating the No 1 system from the No 2 (non-maxaret) system in the walking joint.

Examination of both the return system pipes and the walking joint failed to reveal such a condition.

The landing gear was fitted with a heavy landing indicator on each main leg, set to trip at 2.45g. The indicator on the right hand leg had been tripped, and subsequently the company found tailplane damage normally associated with a heavy landing. The heavy landing indicator was checked and found to be working within its specification, however, in the absence of flight data records for the last flight, there was no positive indication of when it had tripped or when the tailplane damage occurred.

Flight Recorders

The aircraft was fitted with a Plessey-Davall PV710 Flight Data Recorder system which comprises a control unit on the flight deck, a processing unit in the electronics bay and a drive unit in the tail cone which houses the crash-proof cassette. The data is stored magnetically on stainless steel wire and the cassette runs for 300 hours before requiring to be removed and rewound. The processing unit samples 24 channels per second, a synchronisation code being recorded in word 1, and these channels

are recorded as 10 bit words, padded to 11 with zeros in a reflected binary format. A total of 11 analogue parameters are recorded.

The cassette was returned to AAIB for replay but when the cassette was rewound, the wire broke causing the loss of data around the final approach and landing. A satisfactory replay of the rest of the flight was obtained.

No information was available on the conversion of the parameters to engineering values, calibrations were therefore carried out on the accident aircraft G-APEM and another Merchantman G-APEJ to obtain these.

A satisfactory replay of the Fairchild A100 Cockpit Voice Recorder was obtained. This installation has a 4 channel "hot mic" system and both engine noise and the aircraft touchdown could be clearly heard on the area microphone channel. The tape splice occurred six seconds after touchdown and no data was recorded for 1/3 of a second. However, immediately following the splice there was a rapidly decaying large amplitude signal. The characteristics of this signal were consistent with it being a genuine sound rather than a processing feature following the reappearance of signal after the tape splice.