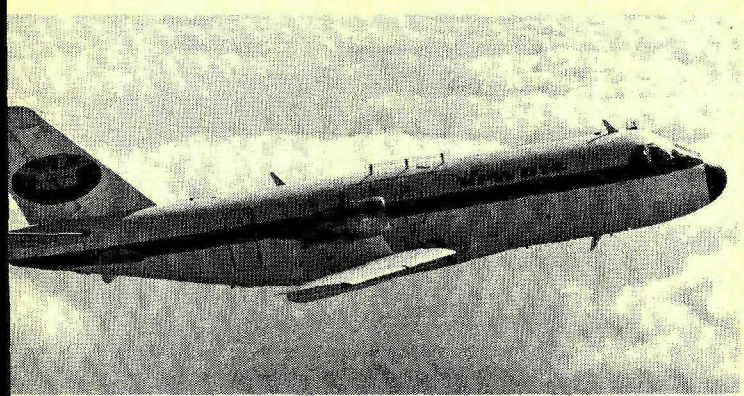
VFW 614 tests

Getting the minibus right

THE MAIN thrusts of the flight-testing of the VFW-Fokker 614 feeder airliner were directed at solving problems of an all-new airframe and engine. Part of the latter's difficulties may have been caused by the growth of the aircraft from a 36-seater in 1961, when the basic configuration was planned, to a 44-seater in service, with consequent thrust increases from the engine.

The test programme was sadly marred by the loss of the first prototype aircraft on February 1, 1972. The accident was caused by flutter of elevator servo tabs, now replaced by hydraulic actuation.

Control development had been the pacing factor in the flight-test programme since the first flight on July 14, 1971. The 614 had been designed with servo-tab elevators, control and trim tabs on the rudder, and spring and trim tabs on the ailerons. The result of this was a very complex mathematical model of vibration characteristics, which was not complete by the time of the first flight. This was



accordingly limited to a maximum indicated airspeed of 140kt and an altitude of 3,000ft. Flight tests were pushed out towards the edges of the envelope: 330kt IAS, Mach 0·74 diving speed; 285kt IAS, Mach 0·65 V_{MO}. Real-time data monitoring and transmission was used to assist in observing the flights.

Flying went ahead cautiously in the second half of 1971, because ground-resonance testing of the 614 was not showing full correlation with prediction. As the envelope was extended small explosive charges—"bonkers"—were used to stimulate flutter conditions.

The most serious flutter problem centred on the elevators. At 260kt IAS and 10,000ft and above, the firing of asymmetric bonkers on the elevator caused a 3sec flutter phase. This was stopped either by a reduction in speed or a permanent distortion of the tailplane structure. Apart from the restriction caused by the flutter problem, the first 614 cleared the flight envelope to 260kt IAS and 25,000ft, for lateral, directional and longitudinal stability.

The accident to the first aircraft occurred after it had been fitted with flutter dampers. The effect of these was to re-introduce the asymmetric flutter at 220kt and 10,000ft on a check flight. This time the flutter could not be eliminated by slowing down and the crew abandoned the aircraft. Co-pilot Hans Bardill was killed when his parachute failed to open.

VFW 614s G2 and G3 feature elevator control by double hydraulic booster, with a boost ratio of 4:1. A geared tab allows elevator stick-force adjustment. Other, more minor, changes were made to the other primary flying controls and the hydraulic system was duplicated. In this form flight-testing resumed in the summer of 1972. The structure of the tailplane, elevator and rear fuselage is slightly beefed-up by comparison with the first aircraft.

Other snags were of a much more minor nature, and in some respects the aircraft has bettered predictions. VFW-Fokker had expected a degree of longitudinal instability to manifest itself at Mach 0·55 and above, and a Mach trim compensator was installed in the prototypes to cope with this. In fact the compensator is not needed at level flight speeds, only being required at Mach 0·72 and above. The Luftfahrt-Bundesamt (the German certification authority, LBA) and the US Federal Aviation Administration have both cleared the aircraft without the compensator, but the French Secretariat Général à l'Aviation Civile is demanding its installation in any 614s on the French register.

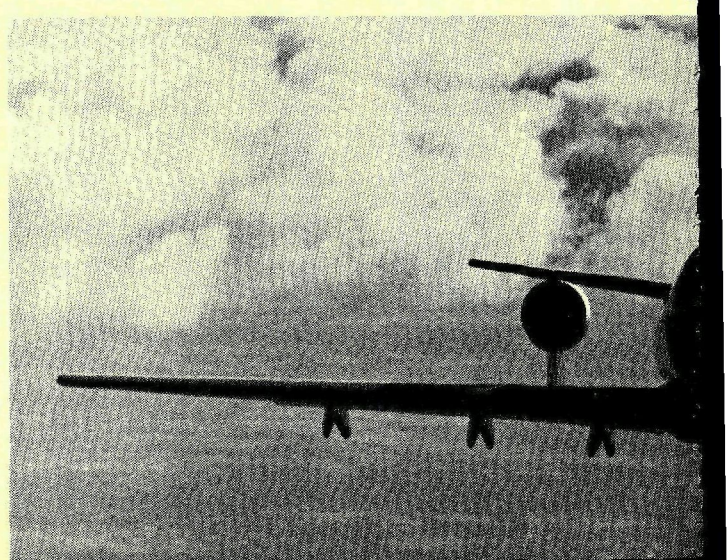
Stall problem solved

Stall testing revealed a serious and unacceptable roll-off following the breakdown of flow over the entire wing, which occurred at an angle of attack of 19°. Various fixes were tried, involving modified wing profiles and stall strips on the roof leading edges. One stall strip installation caused surge in both engines when breakdown occurred. Finally a combination of a shorter stall strip and altered camber on the outer wing solved the problem before the production configuration was frozen.

In the air the 614 shows not much rolling moment with sideslip. On the ground, it soon became apparent, it was a different story. Possibly because of ground effect, the rolling moment is high. Early trials showed that the 30kt, 90° crosswind landing and take-off required for certification could not be achieved. The problem was overcome by giving the pilot better control rather than by overcoming the aerodynamic problem. The aileron leading edges were changed from an elliptical to a circular section, improving gap sealing. At the same time care was taken to reduce friction in the circuit, with considerable success. The 614 can now be held with one hand in a 30kt crosswind and has been operated in winds up to 50kt.

Pilot reaction to the developed and certificated 614 is reported to be favourable. The handling has been praised with and without hydraulic boost, the spring-tabs being described as "perfectly satisfactory" in the reversion case. The quietness of the 614 expedited flight testing; in one six-month period 1,200hr were flown from Filton alone, starting as early as 0700hr in the morning and involving overshoots and low-altitude circuits. No noise complaints were received.

Rolls-Royce did not expect a totally smooth and trouble-free development for the M45H engine. It was designed for a very demanding requirement in terms of component life and flight cycles. The average flight for component



Adapted from a presentation made on April 1 to the Royal Aeronautical Society Test Pilots' Group