The September issue of the Journal of the Royal Aeronautical Society contains a paper, Powerplants for Vertical Take-off Aircraft, by Mr G. L. Wilde, ARRAeS, chief of preliminary design, Rolls-Royce Ltd, Derby. The following is an abbreviated version of his text, which forms a useful companion to other papers on the subject due to be read before the Anglo-American Aeronautical Conference next week. Rolls-Royce studies, and experience with the Short SC.1, show that two types of VTOL aircraft can be developed in the immediate future. All the engineering problems of their powerplants can be solved using data which is now available or the results of current tests and research.

One of the types is a short/medium-range strike aircraft. It would cruise at high subsonic speed at sea level, carrying a military load equal to about 10 per cent of its gross weight. If supersonic performance at altitude were required this could be provided with reheat on the propulsion engine, but the aircraft weight would be greater. The other type, which could have either VTOL or STOL capability, would be a tactical transport of about 100,000lb take-off weight. It would carry a payload of 20,000 to 30,000lb for ranges of about 500 n.m., cruising at speeds of 300 to 400kt at heights up to 20,000ft.

Both types of VTOL strike aircraft rely on jet-lift engines. The cranked delta has four lift engines in the centre and a single efficient by-pass engine for propulsion. The second type has a wing of higher aspect ratio; the four lift engines are installed in pairs at the front and rear of a central weapons bay. Propulsion is by two turbojets in the wing roots; jet deflectors could give additional lift during take-off. The aircraft are stabilized during the hover and transition by bleed-air jets regulated by an autostabilizer.

The cranked-delta is a refinement of the SC.1 design, with lighter lift engines and a much more efficient propulsion engine. Although the second configuration is new, the layout presents no great difficulties. The pitching moment resulting from an engine failure will be greater than with the cranked-delta, and the aircraft will thus need a greater installed lift/thrust/weight ratio. The propulsion engines will be lighter than the by-pass engine of the other aircraft, but this will be offset by their higher fuel consumption.

It is often claimed that there will be a big saving in installed thrust if aircraft are designed for STOL rather than VTOL performance. This depends on the definition of STOL adopted. If it is taken to mean that the aircraft must reach a height of 50ft in a horizontal distance of 500ft, the thrust/weight ratio needed is 1.05. For STOL, performance of 1.2 is necessary. Installed thrust is not a great deal more than for the STOL, and if the aircraft is designed at the outset for VTOL its take-off and landing will be safer.

This does not mean, of course, that such an aircraft is limited to VTOL. If a strip is available, the VTOL can roll forward at up to, say, 30kt before opening up its lift engines; this will prevent debris ingestion. If no prepared ground is available, the STOL cannot operate, but the VTOL can take-off vertically.

If a definite requirement is stated for an STOL strike aircraft, a choice must be made between the use of a single engine with jet deflection, or a composite powerplant; in both cases a thrust/weight ratio of 1.05 is needed. If a single-engined layout is chosen, the powerplant will have too high a thrust for the cruise and must be designed with a medium pressure ratio to keep the specific weight low and with a high by-pass ratio to reduce consumption. This is because it is necessary to maintain a high "g" capability in a steady level turn at high subsonic speed. The conclusion from these Rolls-Royce studies is that sufficient booster or lift thrust can be installed to achieve vertical take-off and landing without the need for deflection of the propulsive thrust, and that a VTOL aircraft of this type need only be very little heavier than an STOL aircraft with a composite powerplant which has been designed for the same mission.

In estimating weight for the low-level strike mission a delta planform of low aspect ratio was chosen. High-lift devices were omitted, and a lightweight undercarriage was assumed. This led to the assumption that a structure weight of 18-20 per cent was possible, compared with 28-30 per cent for the STOL. Compared with the STOL aircraft a 50 per cent increase in propulsive thrust/weight ratio has been assumed. This is because it is necessary to maintain a high "g" capability in a steady level turn at high subsonic speed.