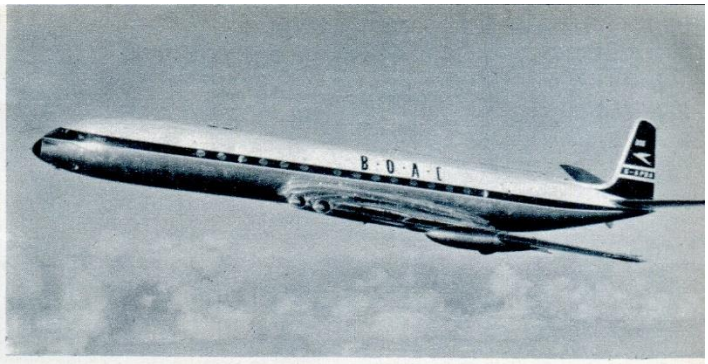
Comet 4

The de Havilland Aircraft Co., Ltd., Hatfield, Herts.



AFTER ten years' continuous design development and testing, the de Havilland Aircraft Company's Comet jet transport, in its Series 4 form, will soon permit the resumption of British commercial jet transport operations.

The first production Comet 4, G-APDA, made its initial flight on April 27 this year, and is undergoing an intensive airworthiness certification programme. Delivery of a production aircraft is expected to be made to the British Overseas Airways Corporation (who have ordered 19 Comet 4s) in September, and it is hoped that B.O.A.C. will inaugurate a token Comet 4 service across the North Atlantic before the end of this year.

The history of the Comet's development is discussed in the section which follows, headed Commercial History. At present offered is a family of jet airliners which can fairly claim to be the most completely tested of any type of aircraft, jet or turboprop, now available to the airlines. The Comet 4, which has been ordered by B.O.A.C. and Aerolineas Argentinas, is the type which will issue from production lines first. It is in a traffic class which is quite distinct: it is a medium capacity airliner (maximum economy-class seating for 80 passengers) with medium to long-range performance; that is to say, the aircraft can carry its first-class capacity payload of 16,800 lb over stage-lengths (with reserves) of up to 3,000 miles. It thus approaches the route capabilities of the big American jets, but without the very large capacity which these aircraft require to be filled.

The response of the Comet's designers to the requirement for *short-haul* jet operations, following the long-haul jet sales of late 1955 and early 1956, finally evolved as the Comet 4B variant, six of which have been ordered by British European Airways. The 4B is designed to apply the Comet's power to lifting payload rather than fuel. The fuselage was extended by 7½ft, to give a total seating capacity of more than 100; and at the same time the wing span was clipped by 7ft 2in and the external fuel tanks omitted. The outcome of this and other changes—including all-round structural strengthening—was an aircraft capable of offering higher speed (20 or 30 m.p.h. more than the Comet 4) and lower seat-mile costs over the shorter stages. Stage-length with capacity payload when operated to a medium-altitude (23,500ft) high-speed technique is of the order of 1,900 st. miles, with full reserves. By using the Comet 4's long-range, high-altitude cruising procedure this stage-length is increased to about 2,550 st.m.

The natural sequel was the 4C, a variant combining the longer fuselage of the 4B with the wing of the 4, to offer the maximum possible exploitation of the Comet in terms of payload and fuel.

COMMERCIAL HISTORY The Comet formula was conceived in 1946, and applied to public service in May 1952. After the suspension of services in 1954, following the two Comet 1 accidents, and applying the new structural knowledge gained as a result, de Havilland concentrated upon the development of the Comet 4. This Rolls-Royce Avon version has twice the power and over twice the capacity of the early Ghost-powered Comet 1. **B.O.A.C.** placed an order for 19 Comet 4s in February 1955. The next order came in July 1956 from **Capital** for 14 4s and 4As but this was subsequently cancelled. In August 1957 **B.E.A.**, faced with the prospect of Caravelle competition, placed an order for six Comet 4Bs to be delivered in 1960. The only other carrier to order Comets is **Aerolineas Argentinas,** delivery of their six Comet 4s—ordered last spring—being spread between early next year and 1960.

STRUCTURE This is the outcome of a programme aimed at two objectives: the establishing of a new anti-fatigue design formula; and the testing of actual components designed according to this formula. The programme has been planned to achieve a useful operational life of not less than 30,000 hours for all Comet 4 variants. (Naturally, the requirements for the achivement of this for the Comet 4B's structure are more severe than they are for the Comet 4, since the shorter-range Comet 4B will spend more of its life flying at lower altitudes at higher speeds, will be pressurized more often and make more landings.)

POWERPLANT All Comet 4 variants are equipped with the same powerplant: four Rolls-Royce Avon RA.29 turbojets of 10,500 lb sea level static thrust each. These engines are already cleared for commercial operations with an overhaul life of 1,000 hours, thanks in part to the large amount of military (flying) experience, and also to the intensive B.O.A.C. Comet 2E flying programme. Two of these aircraft, which are fitted with two Avon RA.29s in place of the outboard RA.9 engines of normal Comet 2s (as operated by R.A.F. Transport Command), were operated by B.O.A.C.'s Comet unit from August 1957. The main part of this programme was devoted to the amassing of RA.29 engine hours, of which a total of 7,440 hr have been completed to date by the two aircraft. One of the two Comet 2Es operated by B.O.A.C. was the property of the Ministry of Supply, who took the aircraft over from B.O.A.C. last May. Subsequently, B.O.A.C. have operated only the one aircraft, the most important item on its programme having been the transatlantic proving trials between London and New York, via Keflavik, Gander and airports on the Eastern seaboard of the U.S. and Canada.

SYSTEMS **Fuel** The total fuel capacity of the Comet 4 is 8,990 (usable) Imp. gal, and of the 4B, 7,890 Imp. gal, disposed as indicated in the cutaway drawing. (Note that the Comet 4B does not have the 440 Imp. gal nacelles or the wing-tip tankage.)

Flying Controls The system is fully power-operated hydraulically. Artificial feel proportional to air speed is provided in the elevator circuit. The flying controls are operated by Lockheed boosters, duplicated mechanically and triplicated hydraulically and with provision—in accordance with American requirements—for ability to trim in the event of power failure.

Cabin Air The air supply is tapped from the compressor of each engine, maximum differential cabin pressure being 8.75 lb/sq in (8,000ft at 45,000ft). There is a duplicated pressure controller by Normalair which is simple to operate, it being necessary merely to preset the altitude at which it is desired to start pressurizing. Temperatures, mass flows, recirculation (the last-named being by injectors and no longer by a fan) are automatically taken care of. Cooling is by D.H. cold-air units.

Ice Protection Anti-icing of wings, tailplane and fin leading-edges and air intakes is by means of hot air tapped from the engine compressors. Icing clearance is for the heaviest icing conditions envisaged by British airworthiness requirements. De-icing and demisting of the windscreens is by glass with transparent electrically heated elements; pitot-heads are heated electrically.

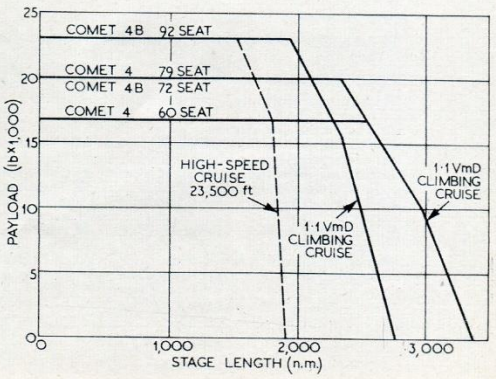
Hydraulics The hydraulic system operates the flying controls, undercarriage, flaps, speed brakes, wheel brakes and nosewheel steering. Normal pressure is 2,500 lb/sq in. The system comprises four separate circuits, colour-coded green, blue, red and yellow.

Electrics Electrical power is supplied by four engine-driven 14kVA alternators, each with a continuous rectified output of 350 amp maintained at 28V. Six 24V, 25 amp-hr batteries are installed. Five of the batteries can be connected in series for internal engine starting.

PAYLOAD ACCOMMODATION **Comet 4** *De luxe* class sleeperettes at 56in pitch, four-abreast, 40 seats; first-class, 40in pitch, four-abreast, 56 seats; tourist class, 40in pitch, five-abreast, 71 seats; economy-class, 34in pitch, five-abreast, 81 seats. Numerous mixed-class layouts are possible in the Comet 4; a typical arrangement is 24 first-class passengers forward and 43 tourists aft.

Comet 4B First-class, 37in pitch, four-abreast, 72 seats; tourist class, 34in pitch, five-abreast, 102 seats.

Each Comet version has three pressurized freight-holds, two under the floor and one at the extreme aft end of the cabin. The two under the floor comprise one forward of the centre section having a capacity of 160 cu ft (Comet 4) or 223ft (Comet 4B); and the other, aft of the centre section, having a capacity of 230 cu ft in each version. The third freight hold above the floor at the aft end of the cabin varies in capacity according to the passenger layout provided, though maximum capacity is about 200 cu ft.



Comet 4 and 4B. Assumptions: 156,000 lb take-off weight; noise suppressors; fuel reserves for 220 n.m. diversion from 1,000ft, climb, cruise and descend again to 1,000ft; ¾ hr stand-off at 15,000ft; 1,200 lb approach fuel.