A Design Destined for Disaster – The de Haviland Comet

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A Design Destined for Disaster – The de Haviland Comet

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Following the United States entry into World War II and the disastrous invasion of the Soviet Union by Nazi Germany, planners in Great Britain were confident of a favorable outcome for the Allies in the war in Europe to the degree that by 1943 they were already looking ahead toward post-war commercial ambitions.

Below, Figure 1: Comet 1 - airframe registration G-ALYP with BOAC markings.

Dawn of the Jet Age

In March of 1943, the Cabinet of the United Kingdom formed a committee to research Great Britain's airliner capabilities after the conclusion of the 2nd world war. The committee members knew very well that the United States had dominated the civilian airliner market before the war with the U.S. built Douglas DC-3 carrying over 90 % of commercial air travel in 1939. While the DC-3 was a non-pressurized plane with a ceiling of only 10,000 feet and a cruising speed of 205 miles per hour, more advanced propeller driven designs had been developed by both Boeing and Lockheed by 1943. Boeing had introduced its model 307 airliner which was the world's first pressurized

airliner. With an operational ceiling of 20,000 feet, the 307 required only about a 4 PSI differential of cabin pressure to meet the pressure requirement of an 8,000 ft. Altitude equivalent cabin pressure needed for passenger comfort (approximately 11 PSIA). The Lockheed Constellation, introduced in 1943, had a cruising speed of just over 300 miles per hour at an altitude of 25,000 feet which required an internal cabin pressure of 5 ½ PSI over the outside atmospheric pressure at that altitude to meet the same 8,000 ft. Similar requirement. The Constellation was the first pressurized airliner to see general service.

A total of 5 design proposals were put forth and included both conventional piston engine and turboprop designs. One of the committee members was Sir Geoffrey de Havilland who was also the head of the de Haviland Aircraft Company. Sir de Haviland used his influence and his company's reputation and experience with wartime aircraft building to promote the development of a jet-propelled aircraft, and he proposed a specification for a turbo-jet powered airliner. The committee accepted the de Haviland proposal calling it the Type IV and awarded a development and production contract to de Haviland under the designation Type 106 in February 1945. The aircraft envisioned in the proposal was to be so advanced that de Haviland would have to develop not only the airframe but also many other systems used on it, much of which had never been done before. The resulting airliner would become known as the de Haviland Comet 1 (figure 1).

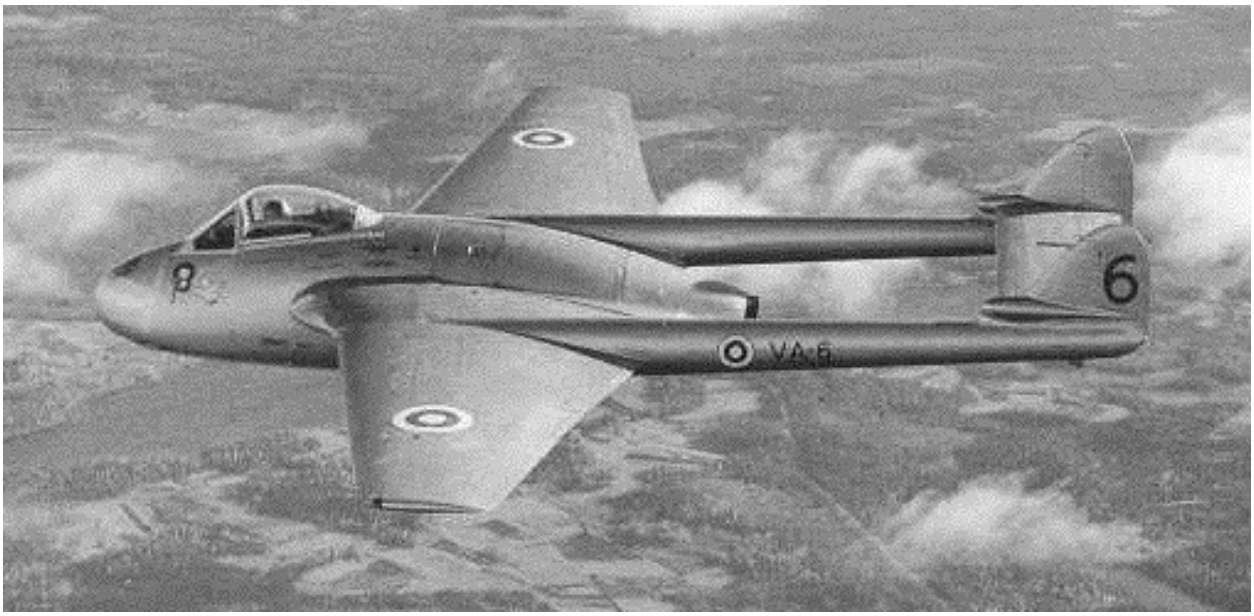
In the years immediately following World War 2, Great Britain was experiencing severe financial hardships; they were a country under re-construction and had a great deal of debt for material purchased during the war. Aircraft technology had advanced a great deal during the war, and both the United States and Great Britain were poised to apply these new technologies to the commercial airline industry and airlines that were expected to experience tremendous growth in the post-war era. The entire Comet project was shrouded in wartime like secrecy to help ensure that Great Britain would beat the United States aviation giants like Douglas, Boeing and Lockheed to the market with the world's first jet airliner and hopefully secure a lasting foothold for dominance in that market. For this reason, the Comet project was given very high priority and

resources from the highest levels of the British government. The project was also placed on a very aggressive schedule. Jet airliners would offer many advantages over contemporary piston engine driven types. With a nearly 50% reduction in travel time combined with the ability to fly above weather in the vibration free and relative silence of the jetliner cabin, it was reasoned that airlines and passengers would soon settle for nothing less.

Comet 1 Design, Development and Testing

In 1945, turbojet engines consumed about three times as much fuel as piston engines at the altitudes typically flown. De Haviland knew that if the new jetliner could be designed to cruise at the height of up to 40,000 feet, the colder and rarified atmosphere would reduce drag and increase the engine efficiency making the new jet economically viable with as few as the 24 seats called for in the original specification. The government-backed British Overseas Airway Corporation (BOAC) found the planes' specifications attractive and initially proposed a purchase of 25 aircraft however in December 1945, when the contract was firmed up, the order was revised to 10 airliners with seating for 36 passengers, another order from Air France for 3 of the aircraft soon followed. With commitments to purchase 13 Comer 1 airliners, development, testing and production pushed ahead. Though de Haviland had no prior experience in building a large all-metal aircraft, they were a world leader in turbojet engine technology and had produced Britain's first jet-powered fighter aircraft, the Vampire, which first flew in 1943 (Figure 2). De Haviland had planned on installing four of the same type engines it had previously used in the Vampire to power the Comet airliner.

Below, Figure 2: de Haviland Vampire fighter plane powered by a de Haviland Goblin engine.

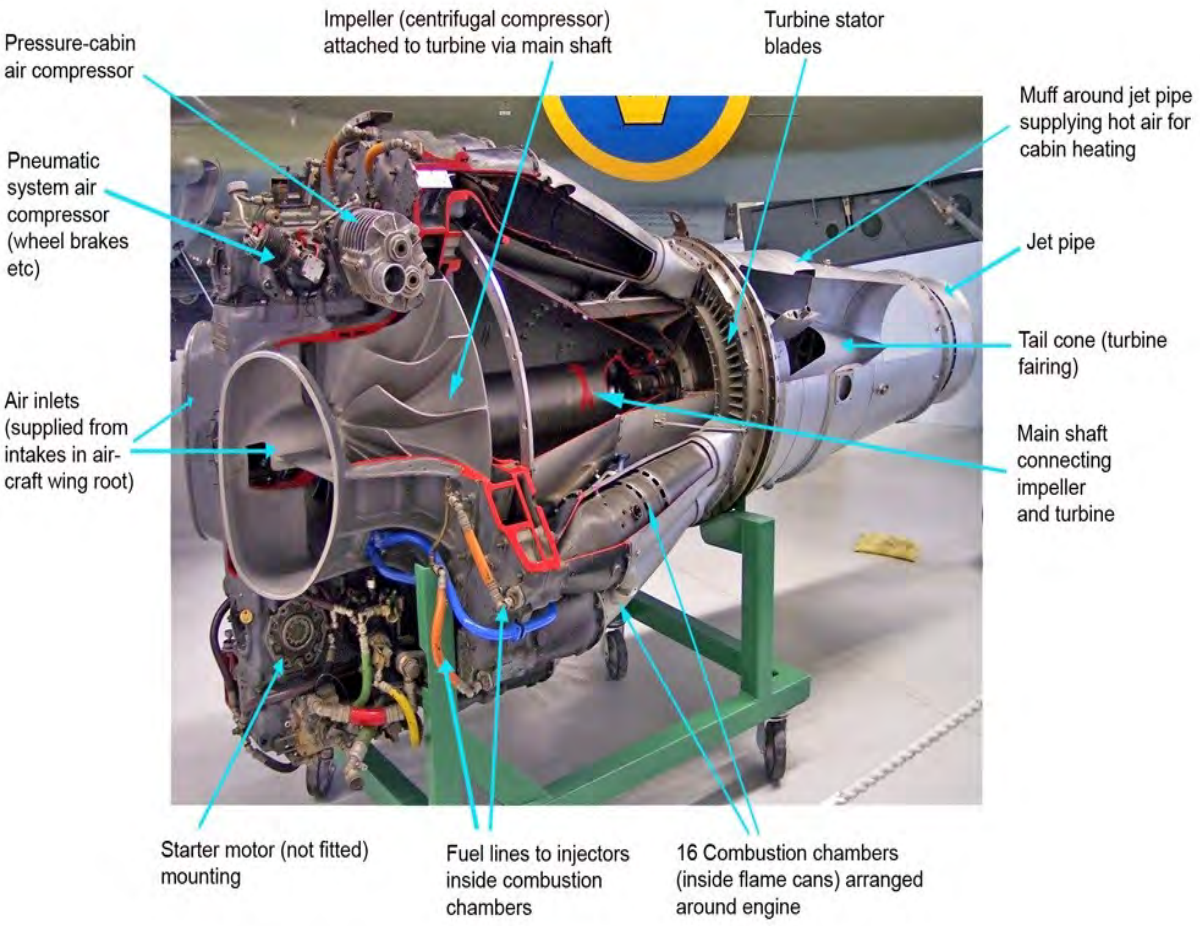


The de Haviland Goblin turbojet engine (Figure 3) would make the Comet airliner and its historical significance possible. The driver was designed by Frank Halford and his London consulting firm in 1941 who based the design on work pioneered by Frank Whittle who is credited with developing the first successful turbojet engine for aircraft in 1937. This engine used a centrifugal compressor to provide compressed air at a 3.3:1 pressure ratio to 16 individual combustion chambers placed around the perimeter from which the exhaust powered a single stage axial turbine. The Goblin was the first "straight through" centrifugal turbojet engine with the exhaust discharged directly at the rear turbine before exiting through the jet pipe. The driver first flew with the de Haviland Vampire fighter in September 1943. After this tremendous success, de Haviland purchased Halford's company and made him Chairman of the de Haviland Engine Company. Goblin engines produced 3,000 lbf thrust at 10,200 RPM. This thrust, when combined with the extended fuselage requested by BOAC in late 1945 caused a weight reduction mandate throughout the Comet project which contributed to the airframe

structural deficiencies that would plague the Comet fleet during its short commercial airliner service.

Given the turbine and compressor blade materials available at the time, centrifugal compressor turbojets were vastly superior to the multi-stage axial compressor types such as the Junkers turbojet engines used on the German Me-262 jet fighter plane introduced late in the war. The overhaul interval for the Goblin engine was a remarkable 600 hours versus 10-15 hours for the Me-262 axial compressor engines due to the high rotational speeds required at the axial compressor blades.

Below, Figure 3: Cutaway model of de Haviland Goblin turbojet engine, twin air inlets are required for a Vampire fighter plane application; Comet application used a large central inlet.



It was decided to bury the engines in the wings (figure 4) to eliminate the asymmetrical thrust condition that would be created if the engines were podded and held below the wings on pylons in the fashion typical of modern airliners. De Haviland Engineers felt that placing the center of thrust near the center of lift on the wing avoided unnecessary stress on the tail surfaces during takeoff. The final 36 passenger design shown in Figure 4, would be 93 feet long with a wingspan of 115 feet and a fuselage/pressure cabin diameter of 10 ½ feet making the plane very similar in size to the Boeing 737-100 which first flew in 1967. The Comet 1 had a maximum all-up takeoff weight of 107,000 pounds. Its cruising altitude of over 35,000 feet and 460-490 MPH cruising speed would meet the proposed specifications however its range was just short of giving it trans-Atlantic flight capability.

Below, Figure **er as developed by de Haviland in 1** **built into the wings. Another novel fe** **gie main landing gear.**