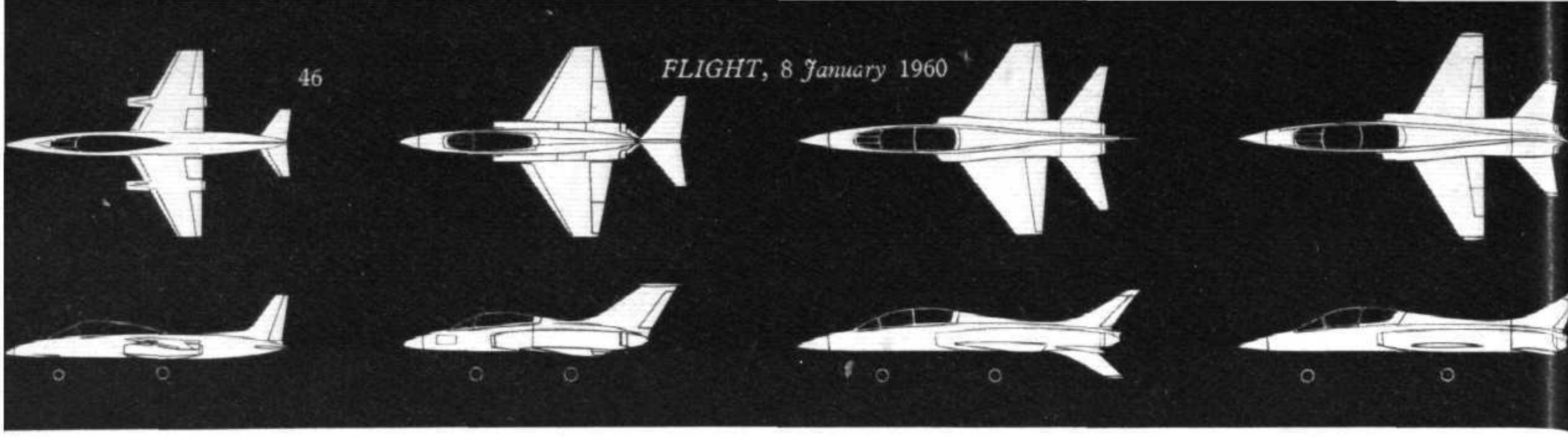


Evolution of the N-156F: above are the N-156TX (March 1955), PD-2706 (November 1955), PD-2812 (January 1956) and PD-2832 (March 1956)

"Freedom Fighter" . . .

was planned as an M1.5 machine, with a potential of greater than M2 when sufficient engine thrust could be provided.

The changes necessary on the fighter revolved around three main areas. The wing had an extension added at the inboard leading-edge root in order to decrease the local t/c ratio and increase the mean sweepback; this also decreased the wing wave drag. The engine intake ducts required a new inlet designed for maximum speed, and the M2 airplane will have variable intake geometry provided by an internal movable ramp. Another external change was the addition of leading-edge flaps, to increase the maximum lift coefficient to match the fighter's higher gross weight. Leading-edge flaps achieve this without the drag and pitch-up associated with other high-lift devices, and result in very small trim changes. In order to obtain the required short landing roll, a container was added above the rear fuselage to house a 15ft-diameter ring slot braking parachute.

In summary, it can be said that the N-156F design proceeded smoothly along a definite line of continual improvement, without some of the extreme overall changes suffered by many other aircraft during their gestation period. To a considerable extent this is due to the firm direction by Northrop's aerodynamic department, under G. C. Grogan. Credit must also be paid to General Electric's Small Aircraft Engine Department, who surpassed the performance promised many years previously.

With the T-38 Talon on the initial production lines, the Northrop management, under the direction of the late Whitley C. Collins, gave the engineering department the go-ahead on the N-156F on May 27, 1958, and set a date of May 31, 1959, for the roll-out. Project engineer Ray Gardner's team had many trials and tribulations in engineering the necessary changes; but close co-operation with the shops resulted in the target dates being met, and the roll-out was attended by representatives from over 40 "Allied" nations, at Norair's plant in Hawthorne, Cal. (The company had undergone a corporate reconstruction and became known as the Northrop Corporation, with the Norair division responsible for manned aircraft and missile production).

Prior to this, the aircraft became unique when the US Department of Defense allocated nearly $50m to Northrop and G.E. for engineering development of the airframe and engines. Norair's $32m covered three aircraft and a static-test airframe.

This unprecedented sponsorship of the N-156F is reflected in the first example's use of an Air Force serial number (59-4987) without any Air Force insignia and markings. Thomas V. Jones, president of Northrop Corporation, termed the aircraft a symbol of real partnership, and said that for the first time the Department of Defense had applied advanced technology directly to the military airpower problems existing abroad.

The fighter made its initial flight on July 30 last, going supersonic despite the low thrust available from the early non-afterburning YJ85-1 engines. Flight testing has proceeded smoothly, considerably assisted by experience with the first two YT-38 Talons. All flying has so far been at Edwards AFB, and throughout Norair's chief test pilot has been Lewis A. Nelson, whose views are given in the next eight paragraphs.

From the outset, the N-156F was designed with the pilot in mind. Throughout the design and development phases consideration of the pilot's inputs resulted in many of the outstanding features of the aircraft, such as the spacious cockpit with its outstanding visibility through the one-piece curved windshield. The most desirable control travel and forces were determined on a full-size flight control stand.

Among the facilities utilized in perfecting the flight behaviour were numerous tunnels, the full-size control test stand with simulator, actual system component parts, and the variable-stability F-86 aircraft of NASA. This F-86 was particularly valuable when early tunnel testing indicated a possible lateral directional-control deficiency with the existing vertical tail design. Actual flight experience with it confirmed these predictions, and led to the present vertical tail with increased area and reduced sweep.

Flight testing has advanced very rapidly, as borne out by the fact that a "three-card" test (of flight-test requirements) was conducted on the initial flight, and that the aircraft was flown for preliminary evaluation by a US Air Force project pilot on its third flight. These facts attest to the excellence of the engineering effort in the design stages and to the thoroughness of pre-flight planning. They are all the more impressive when one considers that all flying to date has been conducted with modified prototype YJ85-1 "missile" engines. These were utilized in lieu of production J85-5s in order to start flying at the earliest possible date. As they produce only about half the thrust of the reheat engines, all flying has, in effect, simulated the one-engine-out case. Notwithstanding this, 94987 has flown carrying some 1,200lb of test instrumentation (quite often with one engine out).

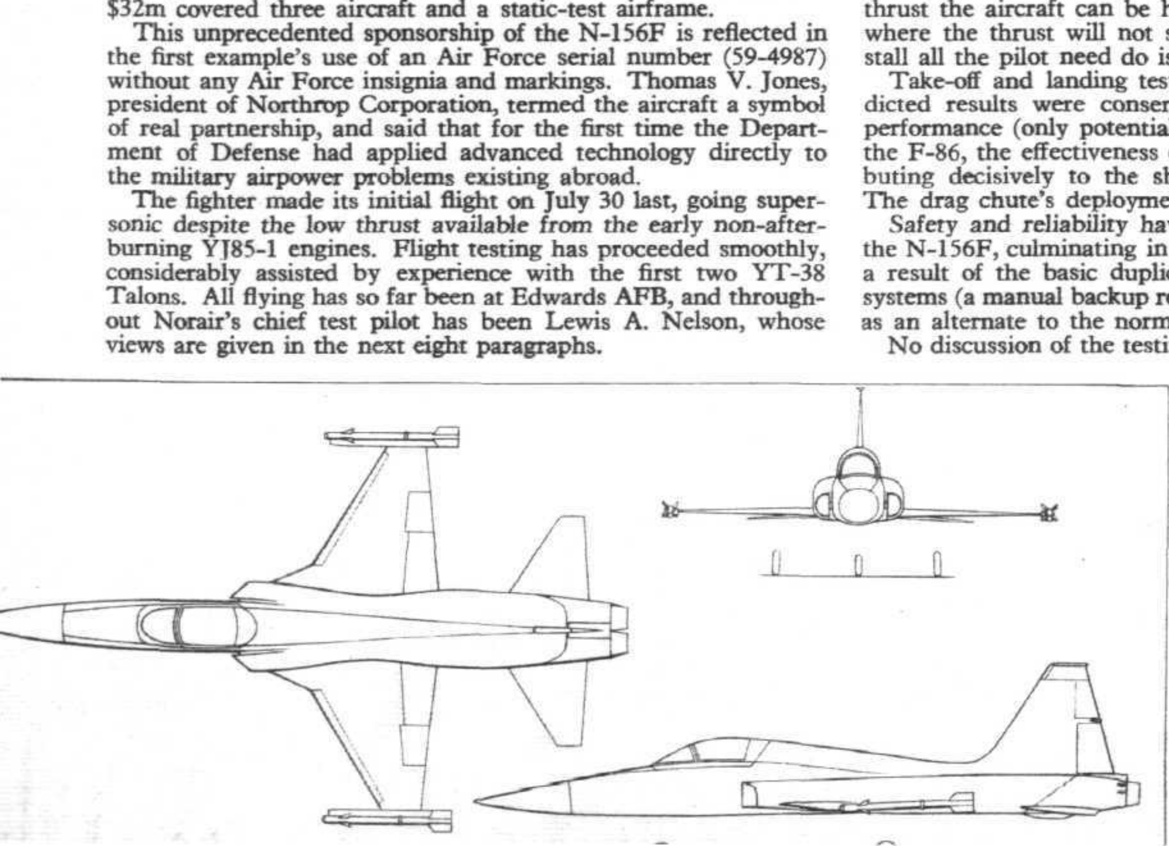
A prime reason for the rapid progress of the test programme has been the lack of need for any major alteration to the airframe or its systems. Flutter proof-testing has advanced rapidly to supersonic speeds and high "q" dynamic pressures, both with and without the wing-tip missiles. Proof-test maximum speed is the same for both the clean and missile-installed configurations, and has only been limited by the low thrust so far available.

Aircraft characteristics throughout the flight envelope are "as requested" by the pilots during the design phase. From first climbing aboard the pilot feels at home, and needs only apply light pressure to obtain the desired response. The aircraft can be flown hands-off at any speed—supersonic, transonic and right down to the stall. With regard to the stall: with the present low thrust the aircraft can be held completely controlled at a point where the thrust will not sustain it, and in order to break the stall all the pilot need do is lower the nose and fly out.

Take-off and landing tests indicate conclusively that the predicted results were conservative. The N-156F combines M2 performance (only potentially as yet) with the landing speed of the F-86, the effectiveness of the wheel brakes and drag contributing decisively to the short roll necessary in forward-areas. The drag chute's deployment rate and stability are outstanding.

Safety and reliability have been key words in the design of the N-156F, culminating in a reduction in emergency systems as a result of the basic duplication of powerplants and accessory systems (a manual backup release is provided for the landing gear as an alternate to the normal utility hydraulic system).

No discussion of the testing of the N-156F would be complete



This drawing depicts the final N-156F design. The following data apply: engines, two GE J85-5; span, 25ft 3in; length, 45ft 1in; height, 13ft 1in; tailplane span, 15ft 4in; wheelbase, 11ft 2in; track, 10ft 9in; gross weight, 12,190lb (overload limit with external stores, 16,300lb); max speed, in excess of M2 (1,320 m.p.h.); range, more than 2,000 miles with external tanks; landing distance from 50ft, approximately 3,000ft