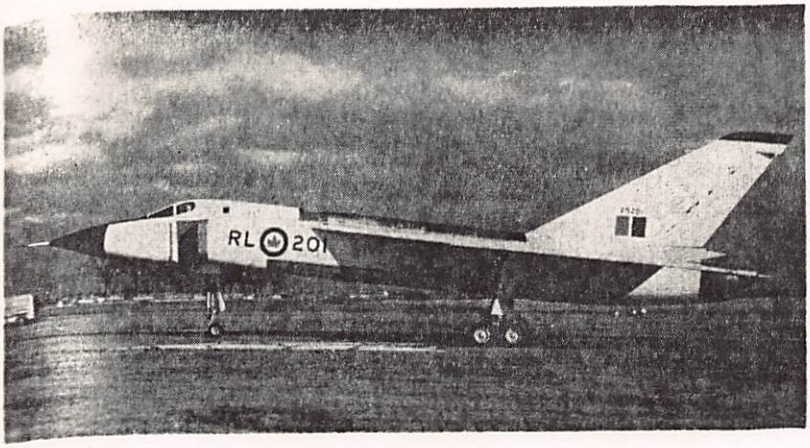
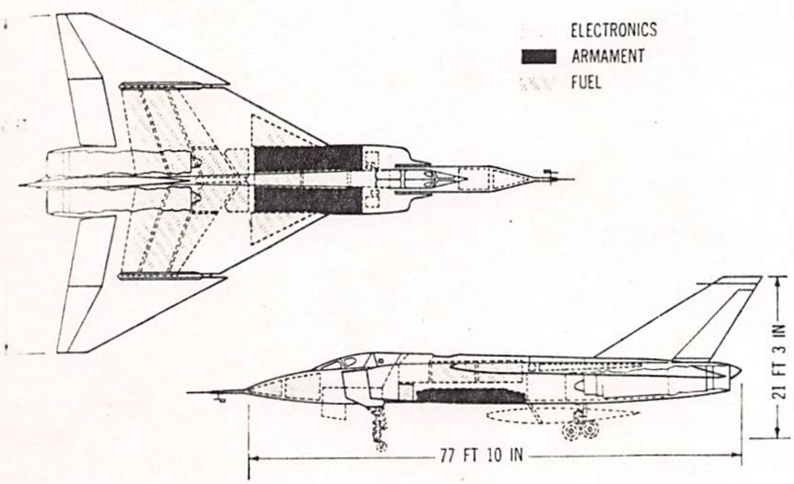
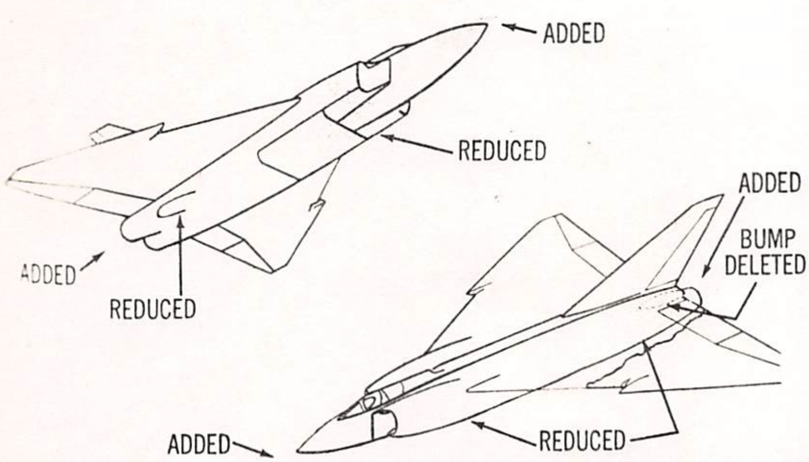




CONFIGURATION was dictated mainly by cockpit, powerplant, and weapon payload. Wing area is 1225 sq ft. With a normal combat gross weight of 64,000 lb, airborne takeoff speed is about 170 knots at an attitude of about 11 deg. Touchdown speed is a bit over 165 knots.



EXTENSIVE AREA RULE study resulted in many modifications. During the preliminary design, Avro sharpened the radar nose, cut down the thickness of the intake lips, reduced the cross-section of the fuselage below the canopy and in the aft section, and added an extension fairing at the rear to smooth out the bumps in the area rule curve.

design progress

by **Victor DeBiasi**
Associate Editor

Avro Arrow: New frontiers of fighter design

AVRO's CF-105 ARROW was designed from scratch to meet interceptor requirements no other plane could meet: supersonic speed, all-weather capability, unusually long range, fully automatic fire control, above-average kill probability on the first pass. With an installed thrust well over twice the CF-100's 7000 lb plus, the Arrow is know to have flown over 1000 mph at 50,000 ft in a climb while still accelerating during its first month of flight tests in early 1958. From the start, the CF-105 was designed to have a fully integrated electronics system. This included automatic equipment for flight control and stability damping; radar target detection and acquisition; attack approach, intercept, and breakaway; optimum range and angle missile launching; telecommunications; and navigation. With two men it would have been possible to carry out missions in fully or semi-automatic, or manual modes.

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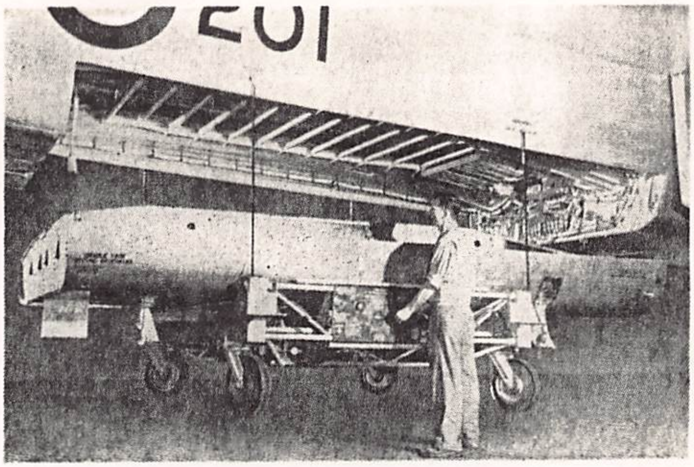
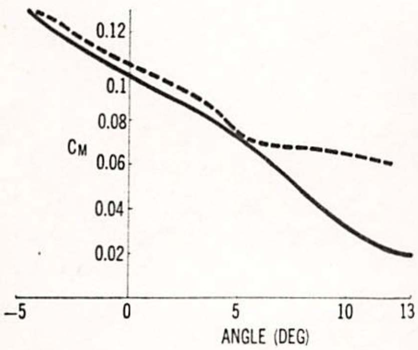
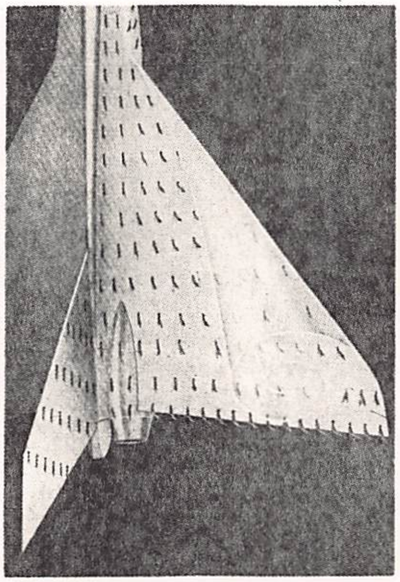
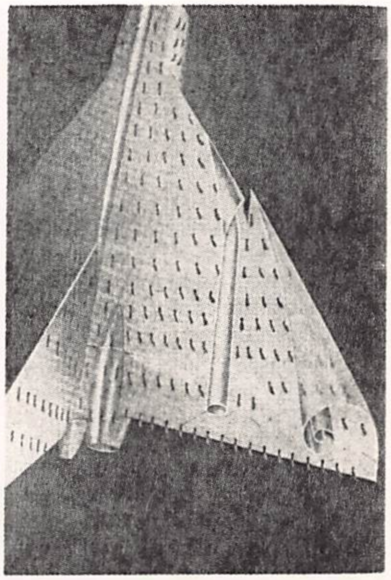


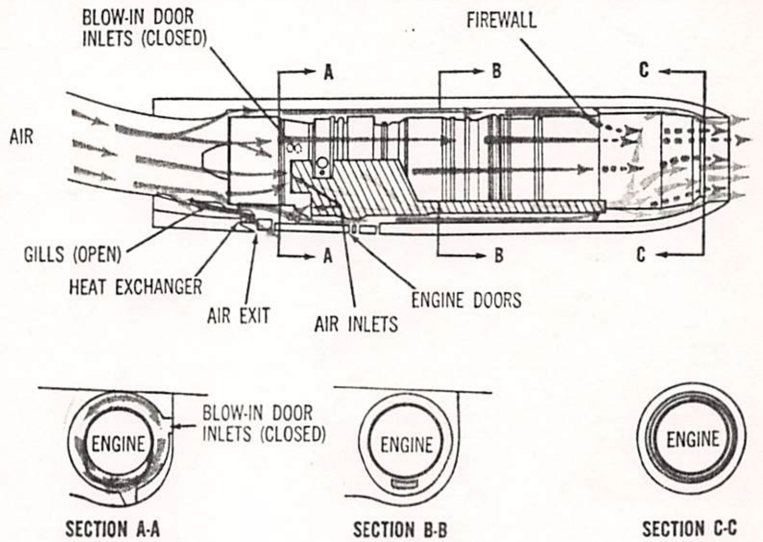
ARMAMENT PACK is designed for fast replacement. Several different missile weapon packs can be used interchangeably. The pack is lifted into place by a self-hoisting mobile support carriage (which also serves as a transport dolly) and is secured flush with the underside of the fuselage at four connection points. Estimated size of armament bay is 16x9x2½ ft. Arrows show hoist point.



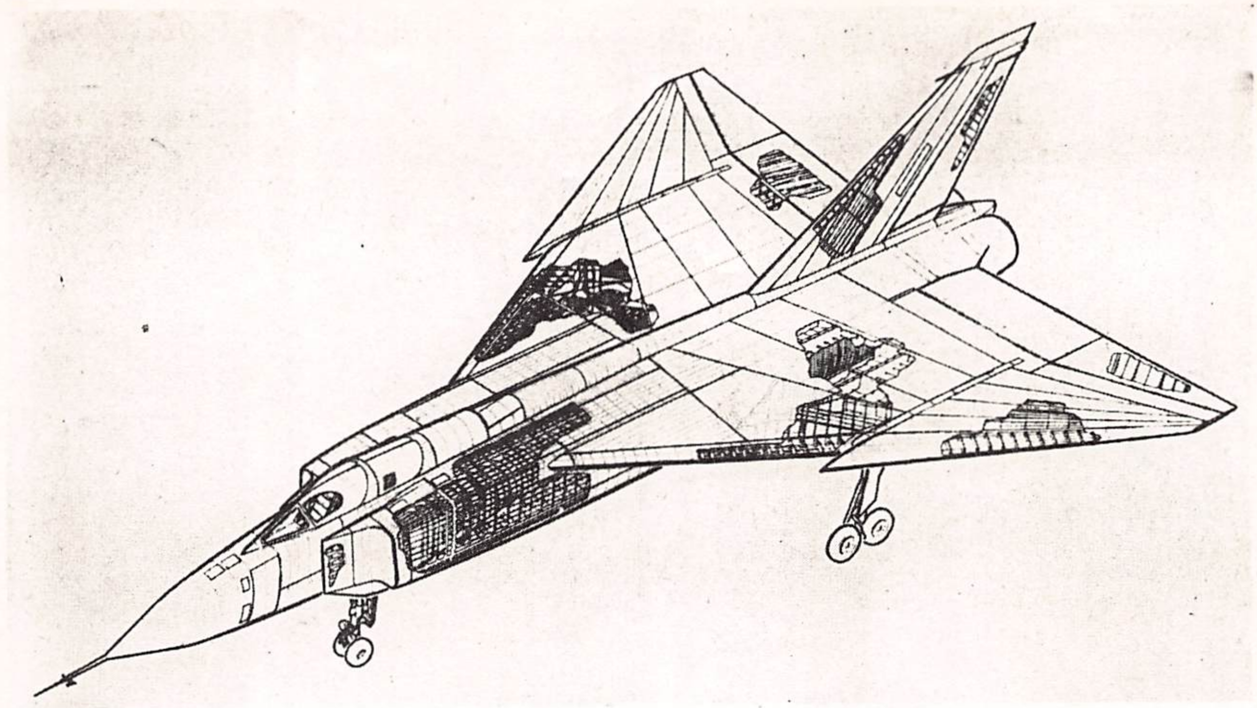




ORIGINAL WING (near right) was plain. Wind tunnel tests on a sting-mounted three per cent complete model revealed a pitch-up condition at moderate angles of attack. The air flow would break away outboard of the area covered by the vortex envelope. This caused the effective aerodynamic center to shift forward and produced an abrupt change in the moment curve. Modifications helped make the moment curve more linear. Plot is for the modified wing (solid curve) vs the original plain wing at Mach 0.9 and an elevator angle of −20 deg. Droop of eight degrees inboard and about four degrees outboard helped extend the buffet boundary considerably. At normal subsonic cruise of Mach 0.925, C_L for buffet onset is increased from 0.26, with a leading edge extension alone, to 0.41 with the extension and the plus droop. Modified wing (far right) has both a five per cent notch about midspan and a 10 per cent increase in the outboard leading edge as a cure for pitch-up. Notch helps prevent flow separation and reduces the area of disturbed flow over the wing. Eight different notches and three extended leading edge combinations were tried. The depth of the notch proved to be the most critical parameter.

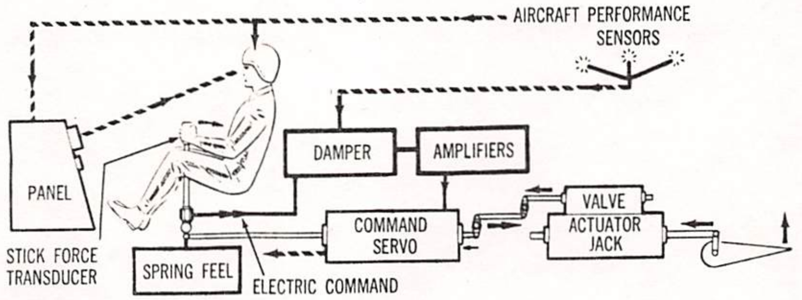


CF-105 was to be powered by two Orenda Iroquois engines with integral after-burners. Over Mach 0.5, ram air opens intake gills near compressor to bypass cooling air around engine. This also reduces spillage at high speeds. Result is near-optimum performance at all speeds despite fixed geometry intake.



WING DESIGN started out with a three per cent T/C ratio throughout the spar. Aileron reversal forced compromise of 3.5 per cent at the wing root and 3.8 per cent at the tip. Negative wing camber of ¾ per cent was chosen to avoid excessive trim drag otherwise needed at high altitudes. Inner wings are joined at the center line of the aircraft. Outer wings are attached by a peripheral bolted joint. Inner wing consists of a main torsion box made up of four 75ST6 spars with ribs running parallel to the plane's centerline and 75ST6 machined skins with integral stiffeners connected by posts. Main torsion box also acts as an integral fuel tank pressurized to 19 psi. Fin has a four per cent T/C ratio. Structure consists of a multi-spar box beam with heavy, tapered 75ST6 skins and ribs normal to the spars. Fin is attached directly to a box section aft of the main torsion box. Outer wing consists of a multi-spar box beam with heavy 75ST6 tapered skins and ribs running normal to the main spars. Trailing edge control box houses the aileron control linkage system to which the control surface is attached by a continuous piano hinge. Structural materials are mostly aluminum alloy. Inner wing skins are machined from a solid billet stretched a nominal two per cent immediately after solution treatment and before artificial aging. New 7079 aluminum alloy was used for parts machined from hand forgings for sections up to six inches thick.

BASIC FLIGHT CONTROL system is fully powered. Even in an emergency, the system cannot be powered manually. Each aileron is operated by tandem actuators powered by independent 4000-psi hydraulic systems. Full control can be exercised with only one engine or one hydraulic system operative.



AUTOMATIC FLIGHT CONTROL system includes damping to augment longitudinal dynamic stability at altitudes over 40,000 ft for weapon launching. System also augments lateral static and dynamic stability at high altitudes and speeds for basic controllability. Emergency damping system is duplicated in the yaw axis.