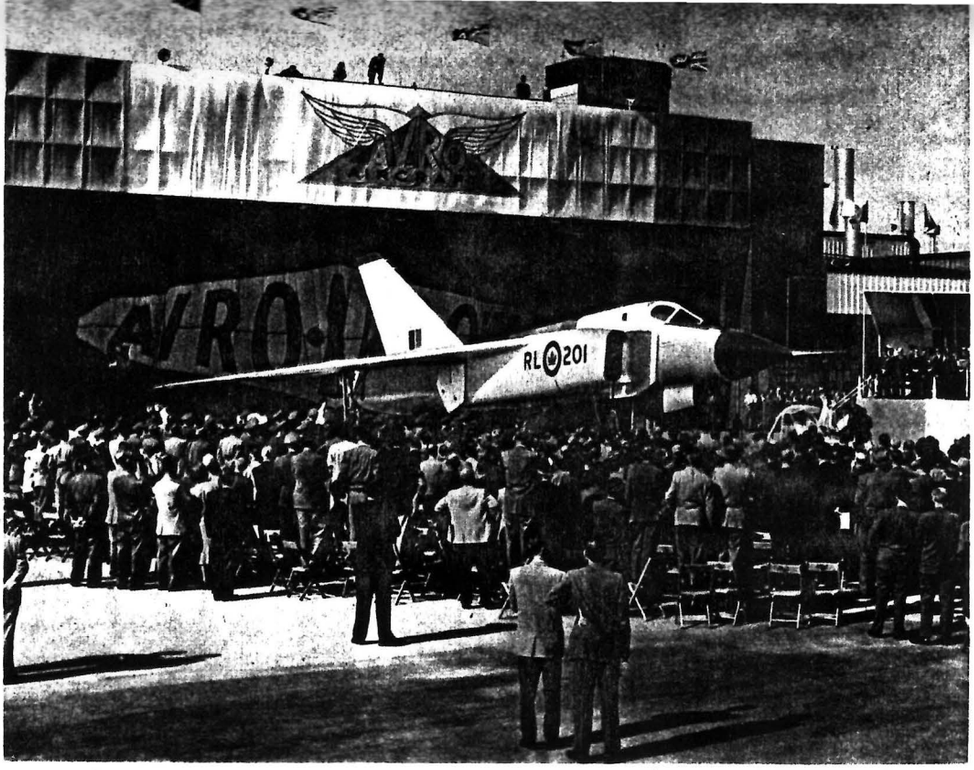
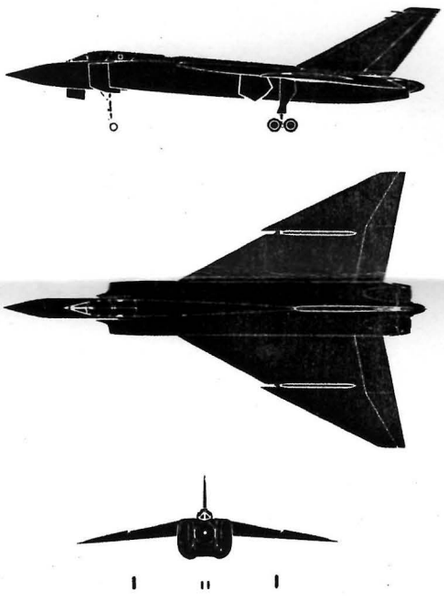
The Avro CF-105 Arrow Rolls Out



On the afternoon of October 4th, 1957, Canada's Defence Minister George R. Pearkes unveiled a new twin-jet supersonic fighter at Avro's Malton, Ontario, plant. It is to be incorporated in the wide-spread defensive system for the North American continent which Americans and Canadians have jointly constructed.

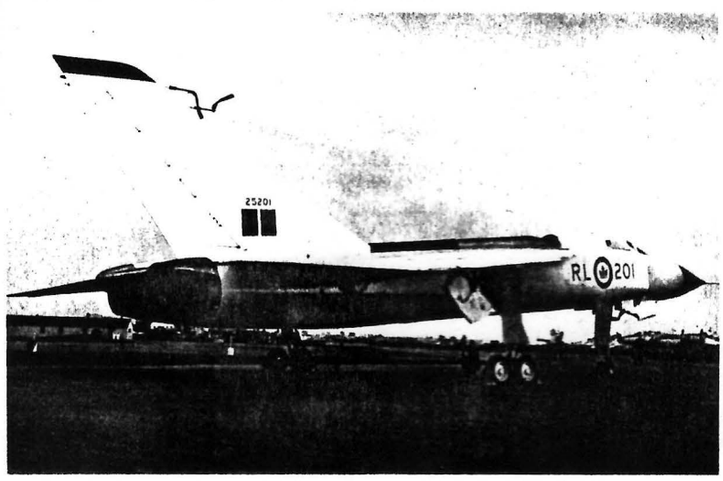
The expanse of the area to be protected—almost four times the size of Europe—was the decisive factor in planning the Avro CF-105 *Arrow*. Had it been desired to defend the 10,000-mile Canadian border eastwards, northwards and westwards by means of anti-aircraft rockets, it would have been necessary to build and maintain hundreds of guided missile bases. And the expenditure involved would have far surpassed the cost of the CF-105 programme.

Canada therefore decided to develop a two-seat all-weather fighter of long range. The result is an aircraft which has aroused genuine admiration throughout the world, and particularly in the Commonwealth. No other Western air force today has a fighter which is anything like as big, as long-range or . . . as costly. Obviously, no aircraft of this category can be produced overnight. The project for a successor to the Avro CF-100, first tackled in 1951, had to be repeatedly modified before the R.C.A.F. approved the provisional design in 1954. Shortly afterwards Avro Aircraft Ltd., the main contractor for the CF-105 weapon system, was made responsible for completing the detail design work and awarding sub-contracts. Development was delayed, however, because the projected engine types (originally the Rolls-Royce RB. 106, later the Wright J67 and finally the Orenda PS. 13) were not available in time. Eventually it was decided to fit the first version of the CF-105—the *Arrow Mk. 1* now completed—with Pratt & Whitney J75 jet engines. The same applies to all the pre-production models so far ordered. Later, the Mk. 2 version, destined for

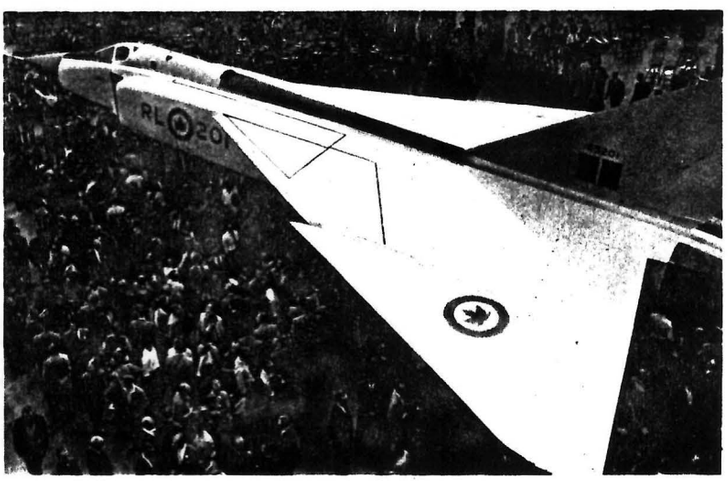


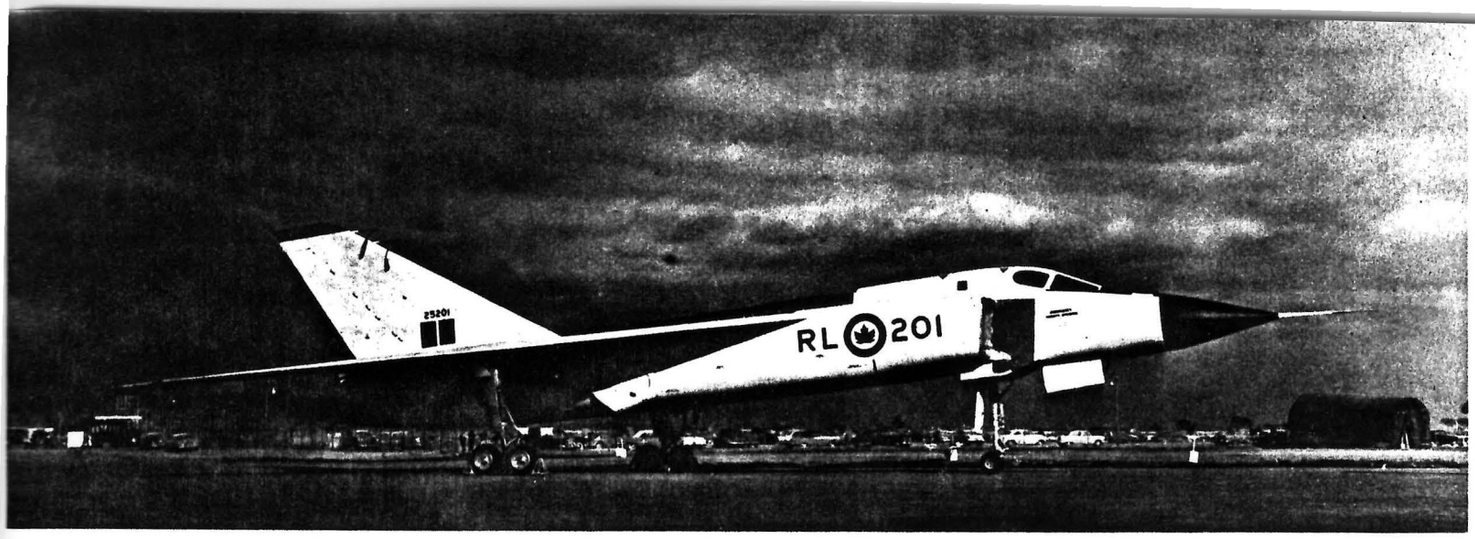
Three-view drawing of the Avro CF-105.

Long-legged undercarriage and high-set rudder unit... two features of the CF-105 which emerge particularly clearly in this photograph.

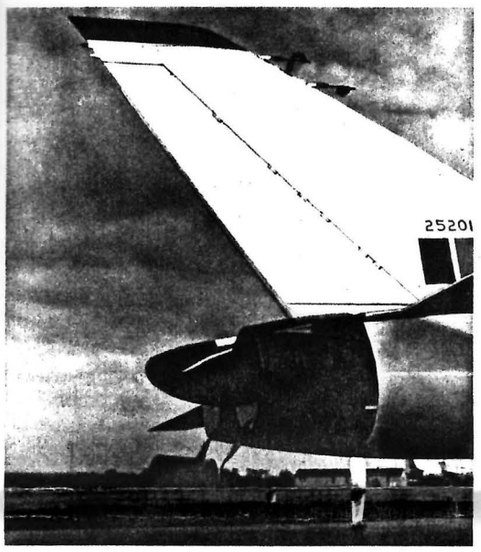


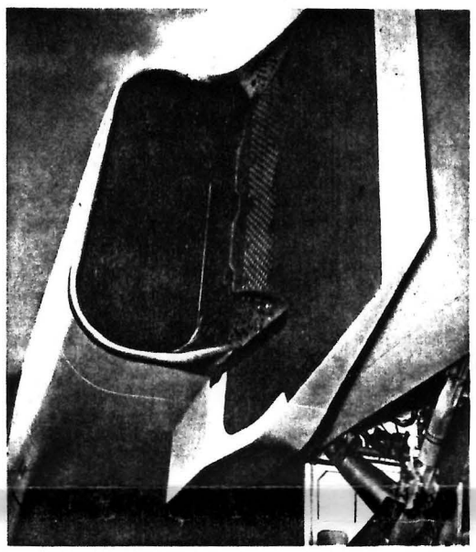
The leading edge of the large-area delta wing has a saw tooth, which – in conjunction with a groove-like cut-out – reduces flow of the boundary layer towards the wing tips.



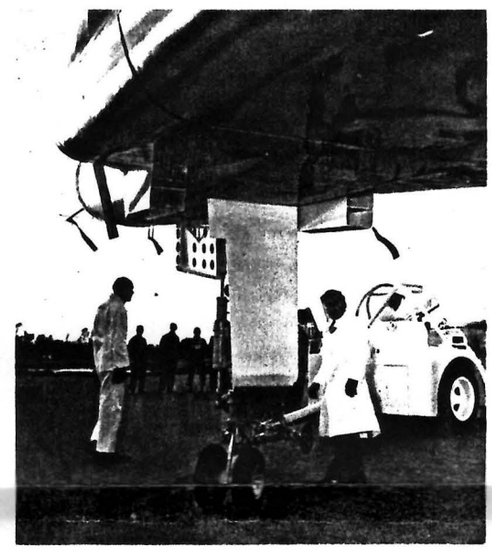


This side view of the Avro *Arrow* reveals the large boundary layer separator in front of the right-hand intake, the tandem wheels of the main undercarriage and the planform of the rudder unit.





Left, the rear fuselage with the two jet pipe apertures (here shown covered); *right*, one of the two intakes with forward-jutting boundary layer separator. The sieve-like perforations immediately in front of the intake serve to carry away excess ram air and prevent this excess from flowing outwards over the intake lips and thus increasing drag.



A large proportion of the boundary layer air which is diverted in front of the intake is passed into the open air flow via the rear apertures in the intake separator.

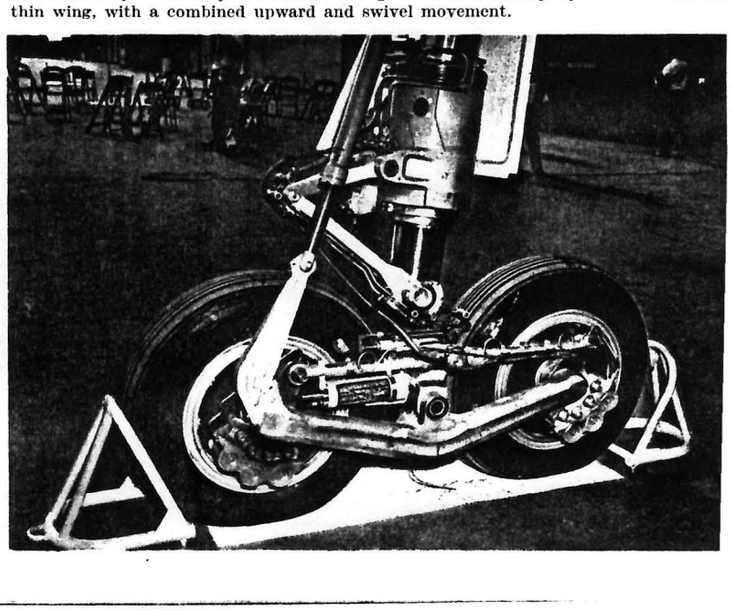
squadron service, will be equipped with the more powerful Orenda *Iroquois*. As the first production aircraft are not scheduled for delivery to the R.C.A.F. until the end of 1959, it will have taken no less than eight years, from the first stroke of the pencil, to get the fighter into service. The result of this intensive development—in which both American and British research have participated—is described briefly here.

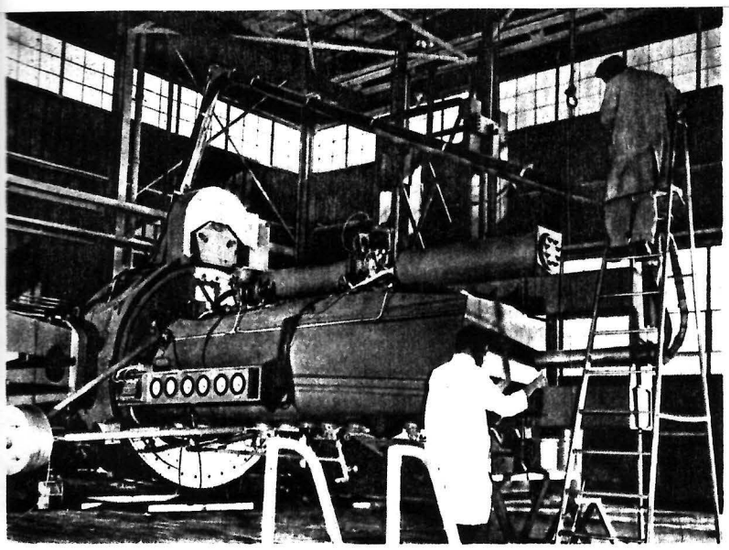
The Avro CF-105 is a delta-wing aircraft with broad, box-shaped fuselage and very thin wing with a leading edge sweep of 63° (on the outer wings). The wing unit as a whole is divided into two inner and two outer wings, which are built up in essentials of vertical webs and integrally stiffened skin plates. Thickness/chord ratio is about 4%, and wing thickness at the roots is just sufficient to take the undercarriage when folded flat. The trailing edge carries a total of four power-boosted control surfaces, the two inner surfaces serving as elevators and the two outer as ailerons. The drooped, saw-tooth leading edge ensures satisfactory lift and drag conditions in the larger angles of attack.

The most striking feature of the fuselage is its rectangular section, which produces an almost flat underside—a shape apparently chosen not

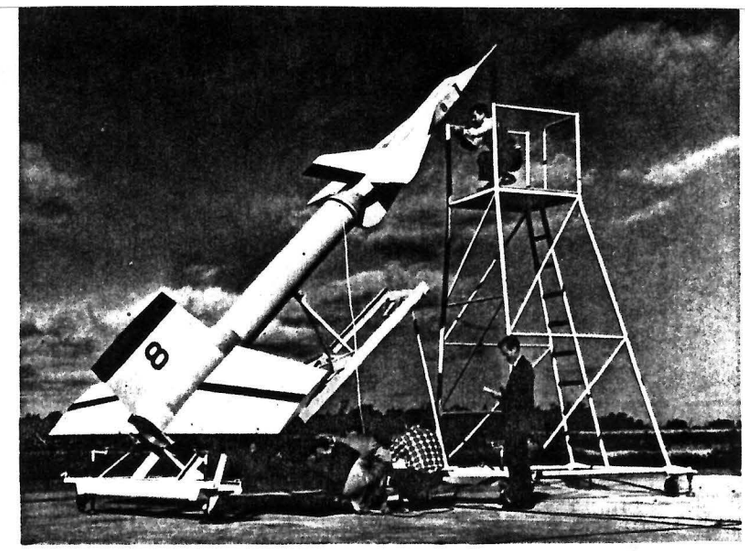
The weapons bay in the CF-105 is bigger than that in the B-29 and carries primarily air-to-air rockets.

The extremely flat Dowty main undercarriage is retracted obliquely forwards into the thin wing, with a combined upward and swivel movement.





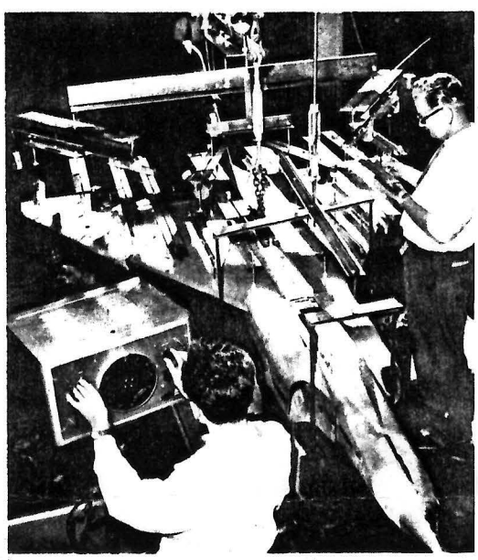
Test equipment for the fuel system. Being housed in a rotating drum, it can make checks in any "flight attitude".



During the long development programme for the CF-105, instrumented free flight models with booster rockets were used to ascertain aerodynamic behaviour at high speeds.

merely for production reasons but also to increase lift at large angles of attack. The roomy fuselage contains, from front to rear, a radar fire control system, the pressure cabin with Martin Baker ejection seats for pilot and navigator, fuel tanks and air ducts with a large weapons bay underneath and, at the rear, two Pratt & Whitney J75 jet engines (later, Orenda *Iroquois*). The two air intakes appear to be of fixed geometry, but have forward-jutting boundary layer separators and perforations for the removal of excess ram air. As both the engines are installed underneath the wing spar webs, the airframe structure can be uncomplicated, with unbroken box-like elements.

It is not possible here to give further details of the new supersonic aircraft's construction, though it should be mentioned that Avro has made wide use of metal bonding, entailing the acquisition of a series of new-type tools and jigs. Altogether, the *Arrow's* manufacturers use the most modern production processes and possess the appropriate equipment. For example, a 200-ton skin mill was purchased from Kearney and Trecker, Milwaukee, especially for the projected *Arrow* production, a machine which enables the integrally stiffened skin plates for the wing to be machined in one operation. Under the CF-105 programme, too, a 15,000-ton hydraulic rubber pad forming press, the biggest of its kind in the world, was acquired from Siempelkamp, of Krefeld, Germany.



Avro Aircraft technicians checking over a free flight model before flight.

No figures have been released for the CF-105's performance, though it is rumoured that the design Mach number is more than 2. Accepting a gross weight of around 65,000 lbs., a figure frequently mentioned but not yet confirmed, the J75 engines (24,000 lbs. of thrust each with reheat) would give a power loading of roughly 1.35 lbs./lb. t., which would suggest max. speeds of well over Mach 2 and exceptional rates of climb. Performance would be even higher with two *Iroquois*, which have a thrust, with reheat, of around 30,000 lbs. each. At any rate, the CF-105 promises to be one of the most efficient instruments of Western air defence.

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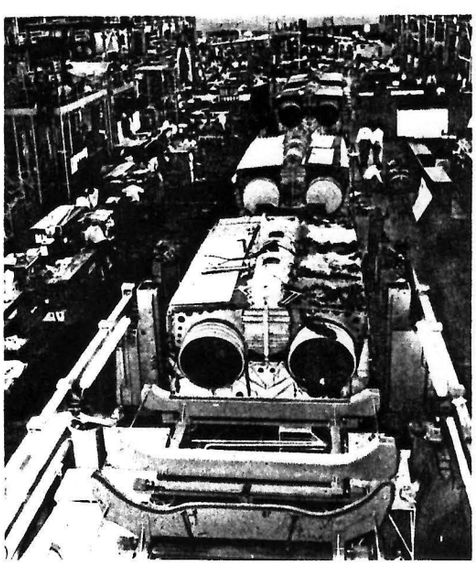
It might seem surprising that the R.C.A.F.—despite the general switch-over to robot weapons—should have opted for a manned *two-seat* all-weather fighter, while even the U. S. Air Force has given preference to a compromise design, in the form of a *single-seat* "semi-automatic" all-weather fighter. A brief consideration of the projected electronic equipment and armament for the CF-105 reveals that Canada has chosen an aircraft which can be used for a variety of missions, including tasks which could not be performed by a smaller model or by any single missile. The Avro *Arrow* is obviously designed not only for bomber interception, but also for a wider range of missions, such as ground support with conventional and atomic weapons, the bombing of distant "point targets" in the enemy's rear, photographic reconnaissance, electronic counter measures, etc.

At any rate the Avro *Arrow* must be regarded as a complete weapon system, on the development of which not less than $200,000,000 had been spent up to the end of 1956—an aircraft project whose scope can be compared only with the American *Hustler* programme.

Inside the final assembly shop; in the foreground are jigs for the assembly of the fuselage centre portion.



Mating the fuselage centre portion to the inner wing.