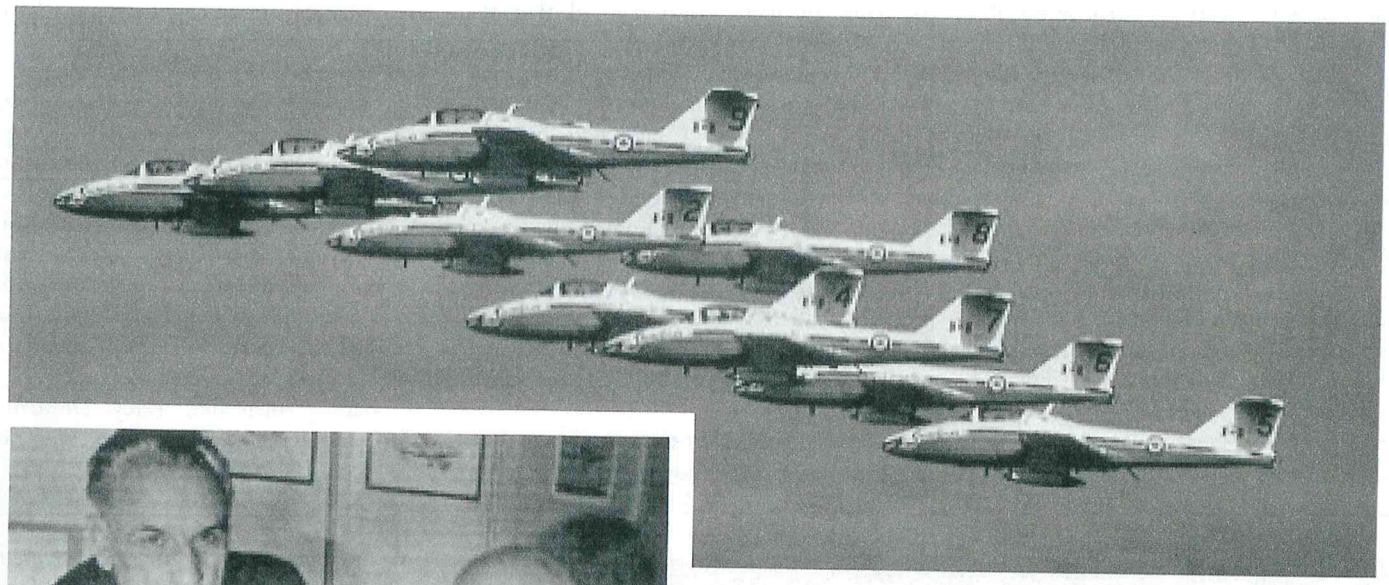


HATCHING THE SNOWBIRDS

THE CANADAIR CL-41/CT-114 TUTOR ITS EARLY HISTORY REMEMBERED

R. W. Dishlevoy

It wasn't until around 1950 that any serious thought was given to the use of a turbojet engine in a small, light aircraft. The first small turbojet engines were simple, expendable ones, with a very short life, used exclusively in target aircraft and not really suitable for a man-carrying aircraft. The high cost of developing and manufacturing small, long-life turbojet engines predestined them for use initially in the military. Armstrong Siddeley, in England, had such an engine in the Viper, which they further developed into a more reliable model in the ASV.5 rated at 1640 lb static thrust. This engine was then adopted by Percival Aircraft and incorporated into a modification of the Provost, their two-place, piston engine trainer aircraft, making it into the Jet Provost which first flew on 16 June 1954.

Circumstances were much the same in the United States, with small turbojet engines still under development. The United States Air Force (USAF) however, had set out requirements in 1952 for a jet-powered "basic" trainer, and Cessna Aircraft took up the challenge. The only suitable engine in the US at the time was the Turbomeca-designed Maboré- Continental J69-T-15 rated at only 920 lb ST (static thrust), so a twin-engine design took shape in the Cessna T-37A.

At that time W.K.(Ken) Ebel the president of Canadair had been on tour in the United Kingdom in search of personnel for the company. It is noteworthy that Ken Ebel had been a test pilot with the Glen L Martin Aircraft Company in his early career days and test flew the Marauder medium bomber and the prototype Mars flying boat, two of which are still flying today as water bombers in British Columbia. He recruited P.R. (Percy) Dowden from Percival and appointed him as Section Chief of the Preliminary Design department. As might have been expected, Canadair embarked on a Basic Jet Trainer design using the Armstrong Siddeley ASV5 for its power, and side-by-side seating similar to the Percival Jet Provost. The Canadair design was project number 41 in the Preliminary Design department and so the aircraft was known within the company as the CL-41.

When I joined the Preliminary Design department in early 1954, I saw drawings of the CL-41 made by William (Bill) Shakespeare (no relation to the Bard of Avon), which in retrospect looked a lot like the Jet Provost. Shortly thereafter Shakespeare left Canadair for employment in the US and the CL-41 design studies were taken over by Bob Werrett and Ed Pain. Bob Werrett diligently produced both side-by-side and tandem-seating variants while the RCAF personnel that were being consulted, vacillated over their seating preference for pilot trainers. I was kept busy producing three-view general rrangement drawings for analysis by the aerodynamics department.

On 12 October 1954, Cessna Aircraft flew their prototype T-37A. Difficulties were experienced with the engines in the twin-engine configuration as well as with the aircraft itself and it wasn't considered satisfactory as a basic trainer. A small quantity was ordered by the USAF as an intermediate stage between

piston-engine primary trainers and high-speed jets. The Percival prototype Jet Provost Mk1 having flown earlier in June of 1954. with great success, was quickly followed by the all new designed Jet Provost MkII powered by the more powerful Viper (ASV8) with 1,750 lb ST. The opinion in the RCAF logically concurred that a single-engine aircraft would be the best configuration from an operational and simplicity point of view.

In July 1955, with the understanding that the RCAF intended to supersede the Harvard as the intermediate type trainer, Canadair submitted their proposal for the CL-41 as an ab-initio or basic training aircraft.

Since the RCAF did not have an official requirement out for the aircraft, Canadair submitted a comprehensive proposal and specification based on discussions with both DOR and Training Command personnel, and indicated the intention of also meeting USAF Specification No 1815B with respect to flying qualities. It recognized that the selection of suitable turbojet engines at around the estimated 2,000 lb. thrust that would be required was limited. Although General Electric, and Continental Aviation had programmes to produce engines of the required thrust, their availability for the target date of 1957 was considered unrealistic and it proposed to use the Viper for study purposes in the design. The Viper was already being produced and flown in England, was being further developed, and potentially would be produced in Canada by Orenda if a demand existed.

Canadair proposed that they would:

(a) Establish a firm aerodynamic and structural configuration,
(b) Precisely define the aircraft systems and equipment,
(c) Manufacture an engineering mock-up of the complete aircraft
(d) Do sufficient wind tunnel testing of models to check calculated parameters and characteristics.

At the end of this phase, Canadair stated, it would be able to proceed confidently with detail engineering and manufacture of the aircraft and indicated that on the basis of technical agreement on fundamental features of the design by the end of 1955, evaluation timing and contractual arrangements, mid-1957 deliveries could be met.

Shortly thereafter, Percy Dowden left Canadair to take a position with Hiller

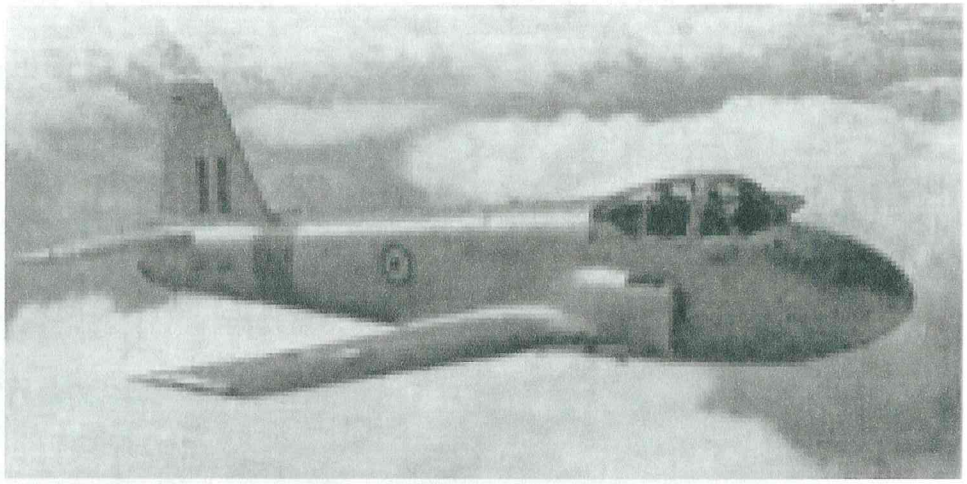
Heading: *flying the Canadair Tutor, even after its retirement from active service, the Snowbirds continue to dazzle North American audiences.* CANADAIR. ***Inset:*** *Karl Irbitis and Fred Philips.* AUTHOR. ***Left:*** *the prototype Tutor, with civil registration CF-LTW-X, made its first flight on 13 January 1959.* CANADAIR. ***Below:*** *the Preliminary Design Team on assignment at Hiller Helicopters in November 1955, L-R: P.R. (Percy) Dowden, A.G. (George) Parker, Les Stepinski (Transmission Specialist), R.W. (Roy) Dishlevoy (author of this account), and George Mapleston.* AUTHOR.

Helicopters in San Jose, California, and F.C. (Fred) Philips, coming from McDonnell Aircraft Corporation, took over as head of Aerodynamics and the Preliminary Design department. Fred Philips took the CL-41 to heart and with great enthusiasm and determination persuaded the RCAF to commit to a preference for the side-by-side seating arrangement as was chosen by Britain in the Provost and by the USA in the Cessna T-37. The convincing argument was the ability of the instructor to see the behavior and reactions of the student pilot throughout all phases of training. He also received the approval of the company to proceed with the proposal that had been put forth earlier.

The Preliminary Design department was moved into a larger office and a few more people brought in for this phase of the design. The original Preliminary Design staff consisted of the author, the aforementioned Bob Werrett and Ed Pain, and George Mapleston, Karl Irbitis and A.G. (George) Parker. George Parker was our elder statesman chronologically, and though he was a power plant expert brought a lot of experience into the office. Of English extraction he fondly recalled that as a youth he saw the Comte de Lesseps perform one of the first "loop de loops" in a Bleriot IX at an air show near London.

Immigrating to the United States, George designed the engine installations in the Barling bomber and had occasion to be acquainted with people like Chance Vought and Tony Bellanca. Coming to Canada, George was responsible for the engine installation in the Noorduyn Norseman and often, while sucking on his pipe or puffing on a fine cigar, reminisced of those difficult early days when the Norseman was getting started and of the comraderies that developed under duress. After Noorduyn, George went to work at Fairchild Canada and designed the engine installation for the Fairchild Husky and subsequently came to Canadair as an engine specialist. After some initial work on the CL-41, and other projects, George went into an inventive mode and designed various adjustable nozzles for jet tailpipes. He obtained patents on many of them, and continued this line of work after his retirement from Canadair. Some of his ideas appear to be in use now as evidenced by the variable jet pipe nozzles that one can see on the fighters of today, with their so-called "vector thrust" features.

I can't recall how Karl Irbitis was involved in the CL-41, if at all, but his genius can't be overlooked and it is quite probable he may have been involved in its very early stages. A heavy set, mild-mannered man, he was a senior member of the staff, coming to Canadair with a considerable amount of aircraft design experience. He graduated as an engineer from the Latvian Government Technical College and although aeronautical engineering wasn't officially taught, he was encouraged in his aeronautical pursuit and had completely designed his first aeroplane while in college



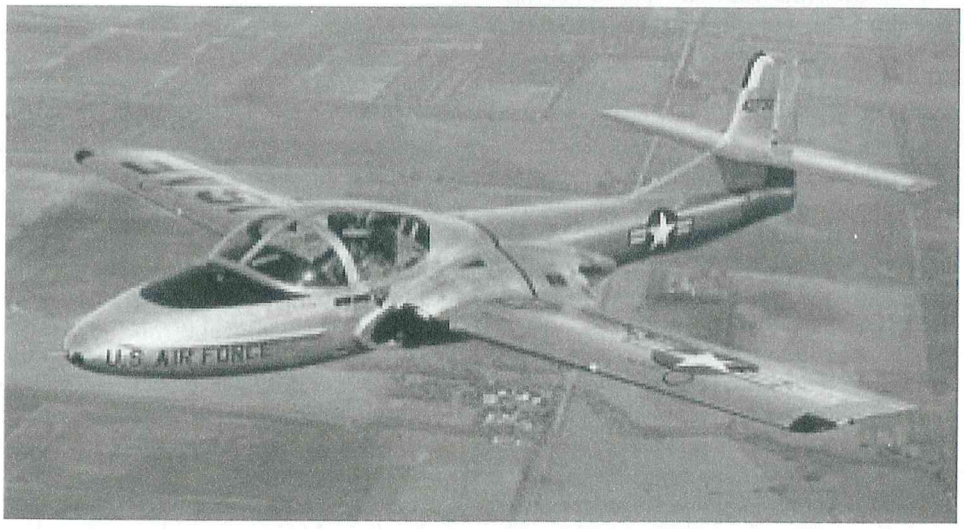
His little single-seater, called the Spriditus (Tom Thumb), was built for Nicholas Pulins the son of a shipping company director, in the company shop, and coincidentally made its first flight on 13 June 1925, the day Karl Irbitis graduated. He went on to design 17 aircraft over the next 15 years of both single- and two-seat varieties, which included sportplanes, high-speed trainers, and a light fighter. Karl Irbitus was a visionary who was quick to incorporate new theories and ideas into the designs and concepts of his aircraft and had a penchant for depicting his designs with marvelous illustrations. In the 1960s, he conducted extensive studies, on V/STOL aircraft, and designed the ingenious mechanical "mixing box" used on the CL-84 tilt-wing aircraft to programme the various controls relative to the wing tilt. Had the world not gone to war in the 1940s, Karl Irbitus may have ranked among the world's touted aircraft designers.

The others on staff at that time had been recruited from the aircraft industry in England as were so many in those days. The plant and especially the drafting department, was filled with Europeans. For a short time I was the only Canadian in the "PD" department. A youngster by comparison, but enthusiastic about the opportunity, I was given conceptual design work, having only been at Canadair for two years after graduating in Aeronautical Engineering. Most of the others had, on average, ten years of experience including their apprenticeship in the aircraft industry, which was how they learned the intricacies of an aircraft, and they did that very well.

For that first phase the staff was complemented by Les Britton, a power plant specialist who took over from George Parker, Sid Warren a structures designer, Phil' Harper an undercarriage specialist, and Fred Bodek a clever Czechoslovakian mechanical engineer. Fred Bodek, a small man, maybe five-foot-six, in his mid-30s at that time, with a jovial impish face, investigated various undercarriage arrangements. Then, when Phil Harper joined the office, he was assigned the task of designing the cockpit canopy. After some study, a hinged canopy configuration was selected for its simplicity. Hinged at the rear, the canopy moved back and upward to open and down to close and then slid forward to lock into position. Fred never ceased to amaze everyone with the cardboard models that he would make to test out and illustrate the operating mechanisms that he conceived.

"For a short time, (the author) was the only Canadian on the 'PD' (Preliminary Design) Team."

I ceased being the youngest in the office when Keith Mathison joined our group. Keith was a recent graduate of the Southern Alberta Institute of Technology in Aeronautics and came to the PD Department as part of the work tour given to new engineering employees at Canadair. Shortly after joining the department, he, along with his colleague Jim McMaus in the aerodynamics department — with their aircraft modeling hobby experience — were contracted out to make scale models of the CL-41 for testing in the Spin Tunnel at the National Research Council facility in Ottawa. By this time the fuselage envelope had been established. Bob Werrett and Sid Warren had all the equipment positioned and Ed Pain had the cockpit layout established and a simple mock-up of it made for evaluation. Ed Cross, in the Weights Department, had the

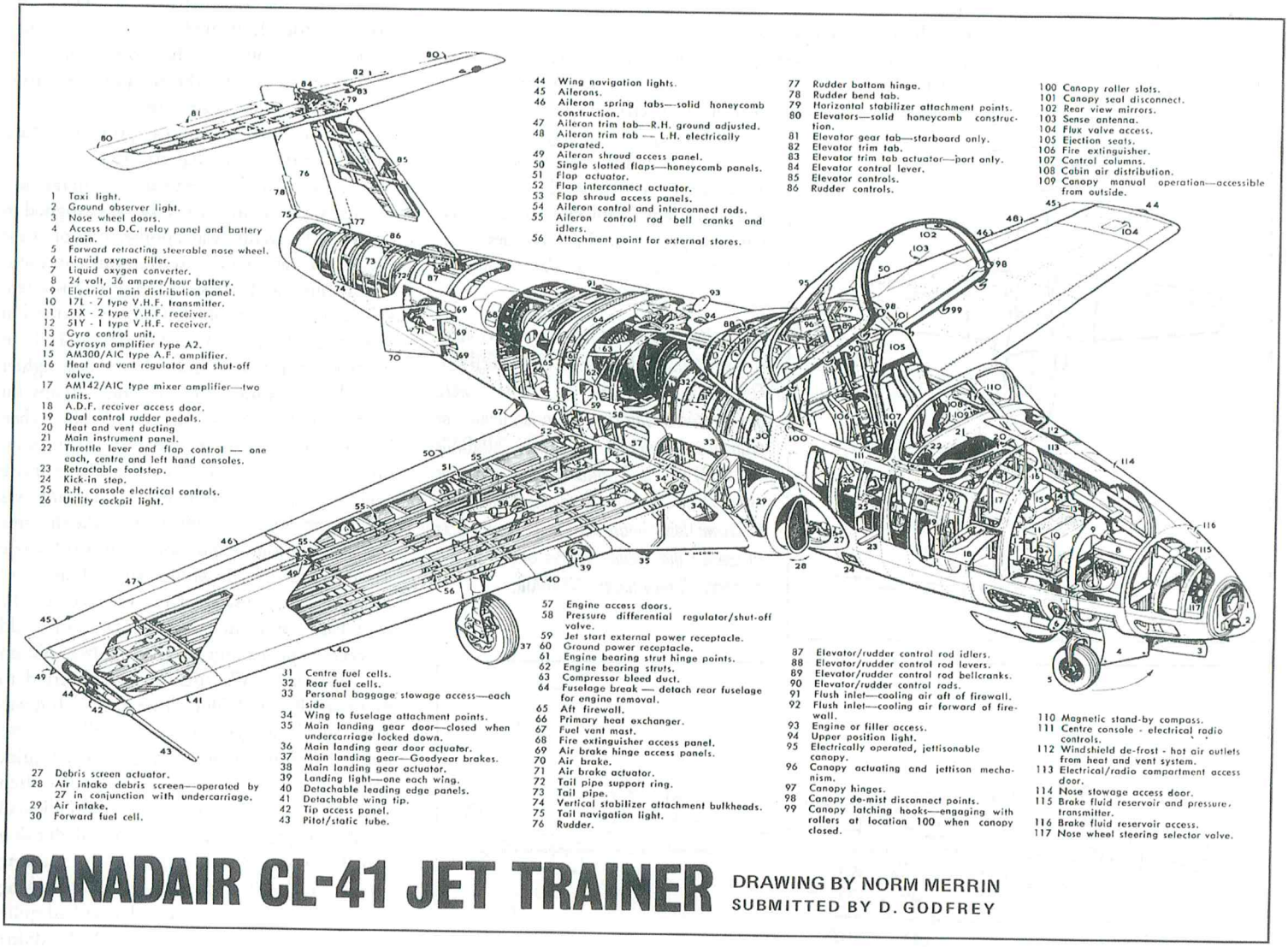


***Opposite:** the RAF's Percival Jet Provost which flew initially on 16 June 1954 employed side-by-side seating, later adopted for the Tutor.* RAF. *Top: the compact Tutor configuration is seen to advantage in this shot.* CANADAIR. ***Above:** the Cessna T-37 first flew in October 1954 and also seated instructor and student side-by-side.* AUTHOR.

aircraft weight and balance calculated and the CG location confirmed. The configuration of the aircraft for all intents and purposes was sufficiently established for construction of an aerodynamic model to check out the aircraft's spin characteristics, which was so important in training combat pilots. The spin-test models one might say, being made at home, were built accidentally in secret. The PD office had a large, empty, walk-in vault attached to it and that occasionally became Keith's workshop. Without windows or air conditioning it had to be very uncomfortable on those hot summer days when Keith was working on the model.

The CL-41, as initially proposed, had a wing that was different from the one that it was built with. It had a straight-through constant-chord center-section outboard to the location of the landing gear, then tapered outer wing panels with five degrees of dihedral. This configuration, at one time, with easily replaced outer wing panels, was considered to be desirable for training aircraft. It was quickly concluded however that a full wing panel with attachment at the fuselage was a cleaner more efficient aerodynamic configuration and would be easier to manufacture. At the same time it was also decided to add a couple of keel members in the center section of the fuselage to prevent excessive damage in the event of a wheels-up landing. These later became convenient structures for attaching external stores, external fuel tanks, or the smoke generators used by the Snowbirds.

The aircraft started out with the horizontal tail attached to the top of the rear fuselage, this being the obvious best structural and simplest location. The model was put in the tunnel but reportedly wouldn't spin. This would hardly be what the RCAF desired for their basic trainer. Presumably, the tail was being blanked out by the very wide forward fuselage, which was necessary for side-by-side seating. The horizontal tail was moved half way up the fin and rudder to a cruciform configuration and the model put in the tunnel again. This time the model spun but didn't give adequate recovery. The rudder was still presumably, being blanked out by the horizontal stabilizer. Finally, the horizontal stabilizer was moved up to the top of the fin and rudder. Spin and recovery characteristics were then considered satisfactory and the T-tail configuration was adopted for the final design. We noted that in



CANADAIR CL-41 JET TRAINER

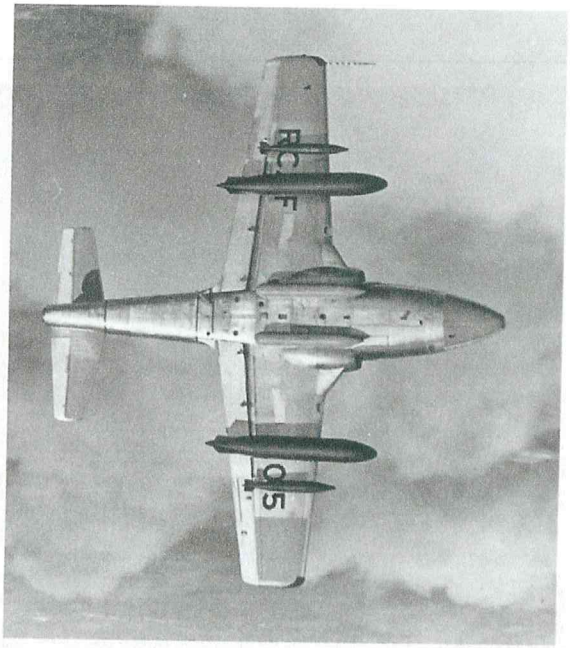
DRAWING BY NORM MERRIN
SUBMITTED BY D. GODFREY

recovering from a spin the model arrived in a pronounced dive attitude, so we also decided to add dive brakes to the aircraft. These were later more appropriately referred to as just speed brakes.

The CL-41 as defined by the work of Phase I was well received by the RCAF and they indicated approval of the design. Although the RCAF had a team evaluating the British Jet Provost, the French Air Fouga Magister, and the Cessna T-37A, and there was no guarantee they would buy the CL-41, the project was so well received by the RCAF that the Company decided to design and build two prototypes with its own funds. An early design team was assembled in Plant One, then relocated to the second floor above the shop in Plant Four at the Cartierville field where fabrication was conducted as soon as drawings could be released to the shop.

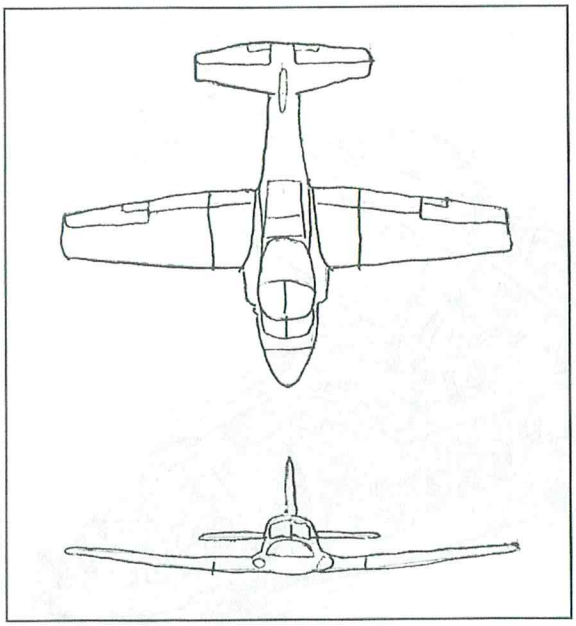
The design of the aircraft structure was headed by Joe Knapp who was assigned to the project as Chief, assisted by Walter Zalinski as Group Leader. Both of these men were Polish expatriates. Joe Knapp, besides being an engineer, had been a Spitfire pilot in England with the expatriated Polish forces. Joe Knapp was very astute, and knowledgeable in the ways of aircraft fabrication and construction and easily commanded the attention and respect of those that worked under him. He had a tremendous grasp of his newly acquired English language, spoke with a bit of an accent and did occasionally misquote a phrase or saying (perhaps intentionally) like "killing a bird with two stones," which brought a quiet, private chuckle to those of us that noticed it.

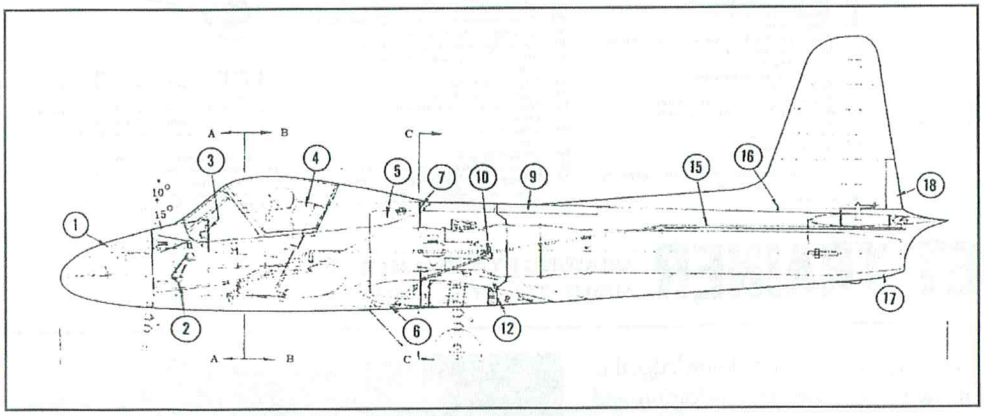
The aircraft structure was divided into several components, each of which was assigned to an individual designer for detail design. The components were to be designed simultaneously, and, if all went well would be manufactured simultaneously and would all come together quickly into one assembly. The nose section up to the cockpit's forward bulkhead was assigned to Sid Warren. The cockpit portion back to the sloping bulkhead was the responsibility of Bob Werrett. The rest of the fuselage was broken into two sections, a centre section and a rear fuselage, which included the tail. The rear fuselage was to be designed so it could be quickly detached for easy access to the engine and tailpipe. The center section, sloping bulkhead to the fuselage break, was assigned to me, and the rear fuselage given to Keith Mathison who



stayed in the department for the duration of the project. The cockpit canopy and its intricacies continued to be Freddie Bodek's responsibility, The wing structure became the responsibility of Reg Bridgeman, who was assigned to the project for design of that component, and also supervised Keith Mathison in the design of the empennage.

George Mapleston had worked for a bit on the engine installation prior to the arrival of Les Britton, a powerplant specialist brought in for that job, but stayed with the project to design the fuel tanks, engine air intakes, as well as the wing root intake fairings. Phil Harper remained with the group for the detail design of the undercarriage. Ed Pain however, remained behind to continue doing conceptual work with the PD department, which was now almost decimated by our departure. Others were brought to the project from other departments to handle the disciplines requiring total devotion to ensure the success of the design. Probably the most important of these came from the Stress Department.





Opposite, top: *Canadair CL-41 Tutor cutaway drawing.* N. MERRIN via D. GODFREY. ***Opposite, bottom:*** *all CL-41s were manufactured with six suspension points for ordnance or external fuel tanks.* CANADAIR VIA GODFREY. ***Left and below:*** *drawings of the CL-41 as originally proposed.* AUTHOR. ***Bottom:*** *flying Tutors, the Golden Centenaires succeeded the Golden Hawks as the RCAF's aerobatic display team.* CANADAIR.

The structural strength of the aircraft was assured when Wilhelm Krause was assigned to the CL-41. Willie was another one of those men who was small in stature but enormous in capability and the knowledge he possessed. One of the last aircraft that he was involved in the design of was the Focke Wu1f Fw 190. In its final form, it was probably the best fighter that the Luftwaffe ever had, and perhaps for a time the best in the sky, and Willie, when he had the opportunity, never failed to point out its greatness, with a chuckle. His intuitive skill in guiding us through our designing was always appreciated. Willie would take the time to circulate around and look at our work while it was in process. He would grunt, "hmm" and mumble as we discussed it. Occasionally he would ask "can we do it like this? Ja?" and would proceed to pencil and doodle in a free spot on your drawing. We affectionately referred to those doodles as "Willie's flute music." If it was a reasonable suggestion, as it usually was, we knew that doing it that way guaranteed quick approval of the drawings. These doodles often were done at the designer's expense. Willie had a habit of picking up a mechanical drafting pencil that might be laying on the drawing board to doodle, then forgetfully walking away with it. His office desk drawer had quite a collection of pencils of which Willie didn't know the owners.

In his pocket, Willie carried a 10-32 bolt with a nut on it. He often fiddled with it when he talked with you and it just looked like something he nervously played with, but this was his makeshift micrometer! He used it from time to time to check the thickness of aluminum sheet that he would come across in his wanderings through the shop during the aircraft's fabrication. A half turn on the nut was 1/64 of an inch, a full turn 1/32, and so on.

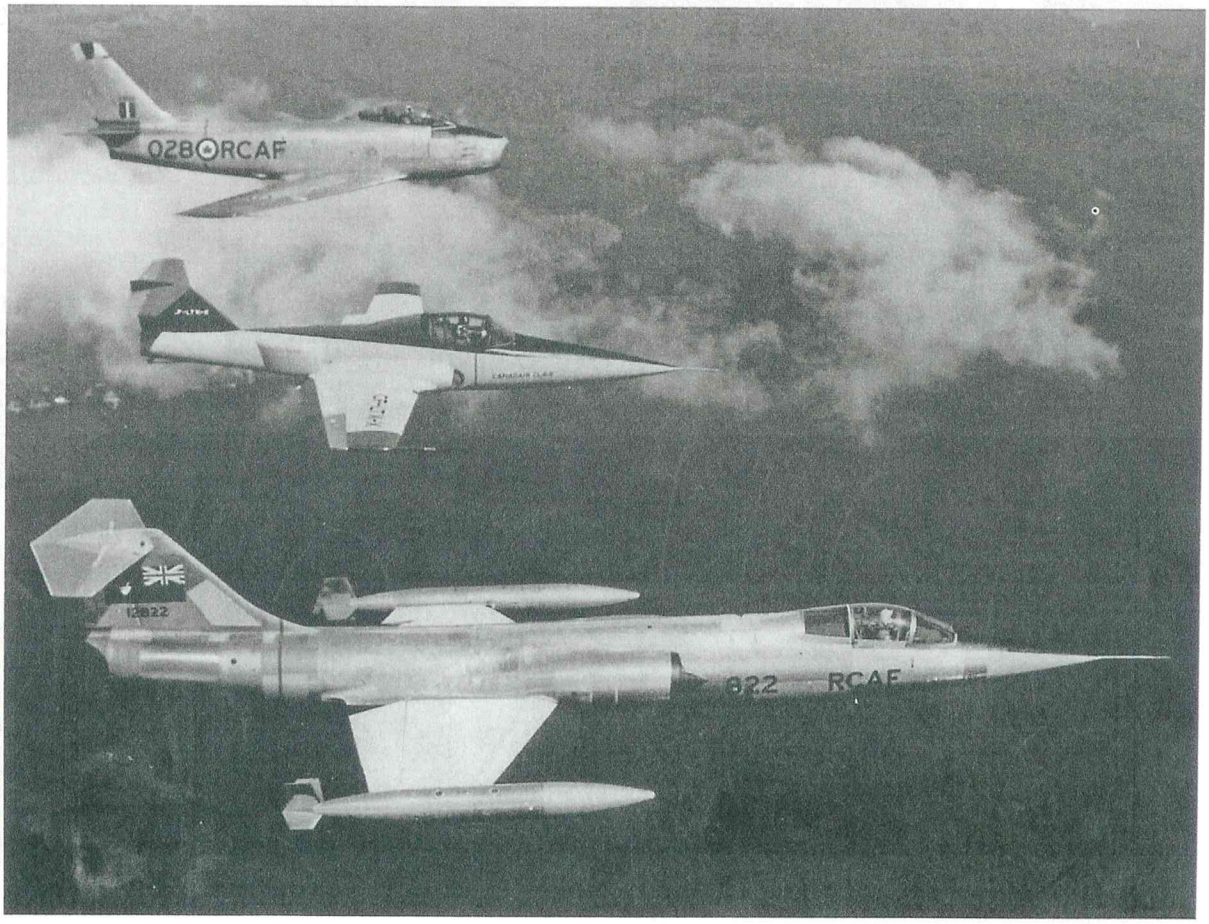
"The aircraft started out with the horizontal tail attached to the top of the rear fuselage . . the best structural location."

"Stress and Strain" — the analysis of structures and materials, involves the use of formulae derived empirically through much testing. Willie had a collection of these; though a bit different from the ones to which we were accustomed — being in German— they produced equal if not better results. When the longeron "bathtub" fittings, which were used at the connection of the rear fuselage to center section, were being tested to destruction, Willie had calculated the number of load cycles they would withstand. Amazingly, the fitting under test reached the calculated number and then failed only moments later. That was how accurate Willie's calculations were.

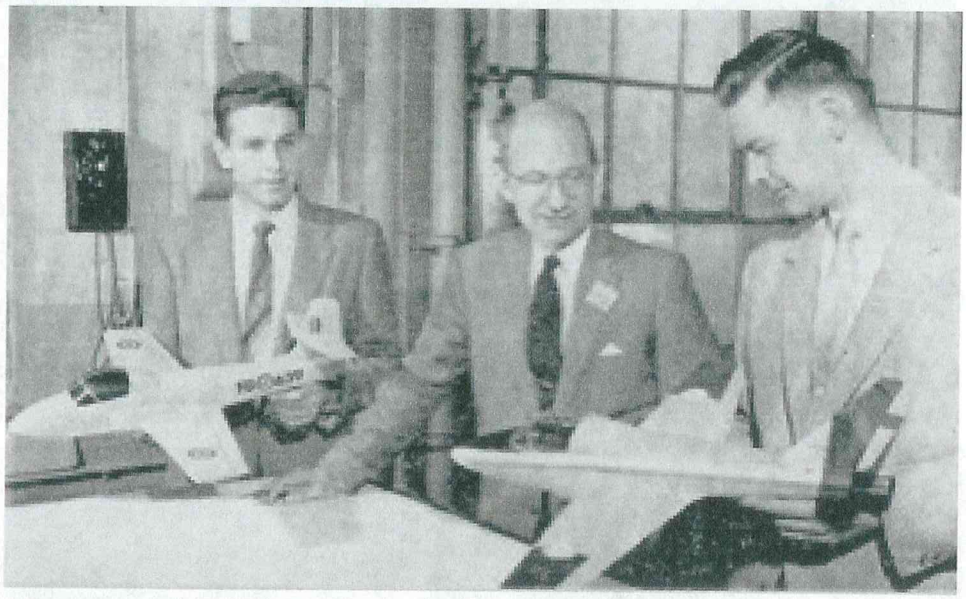
The wide forward body of the CL-41, and in particular the canopy, was recognized very early to be a high drag area of considerable aerodynamic importance. To properly understand its effects, and to arrive at the best aerodynamic shape, a scale model of the canopy was built for wind tunnel testing. Under the guidance of Ken Kimber of the aerodynamics department, the model was liberally 'tufted' as well as being dotted with openings from which pressure readings were taken. With the tufts providing a visual picture of the airflow the canopy was put in the tunnel several times and the shape adjusted to give the best aerodynamic properties before molding of the plastic was carried out. To no one's surprise, as was expected there was considerable suction generated over the canopy. This, of course, was now in addition to the loads that would be imposed on the canopy latches due to pressurization. On the positive side, the suction would pull the canopy away and clear of the aircraft when it was ejected. This was demonstrated in reality during one of the early test flights of the prototype when the canopy was accidentally ejected in flight. Ian MacTavish returned and landed without any problem, but it verged on disaster for Canadair. An RCAF evaluation team was to arrive the very next day to evaluate the CL-41 for the first time and a spare canopy was not to be had. The canopy however, was located the same day from the air when its glistening shape was spotted right side up in a snowdrift. It was retrieved — with only minor damage to some piping — repaired, reinstalled on the aircraft and flown the very next day. It must have fluttered down to the ground like a leaf.

Selecting an engine for the CL-41 was a problem at the outset, but Pratt & Whitney Canada were concurrently developing a suitable engine and so it was that the CL-41 prototype was to be powered by a prototype

Below: *CL-41s under construction.* CANADAIR via D. GODFREY. ***Bottom:*** *an RCAF Sabre and Starfighter formate with the CL-41R, CF-LTX-X.* CANADAIR via GODFREY. ***Opposite, top:*** *the first Tutor flown by the RCAF was the Avro 621.* RCAF VIA GODFREY. ***Middle: L-R:*** *Jim McManus, Fred Philips, Keith Mathieson.* AUTHOR. ***Opposite, bottom:*** *the unique CL-41R "stiletto" version of the Tutor with a CF-104G nose adaptation.* AUTHOR.



engine, the Pratt & Whitney JTC12A. It may have been unique to have a prototype aircraft powered by a prototype engine. This engine, which developed 2,900 lb of thrust would be de-rated to 2,400 lb for the CL-41 to prevent a "too-steep curve for the student pilot" but would still have a good power margin. The production JT-12 was expected to develop 3,000 lb of thrust. The structure of the CL-41 was designed to also accommodate the Armstrong Siddeley Viper ASV11, the General Electric J85 and the Rolls-Royce RB.145.

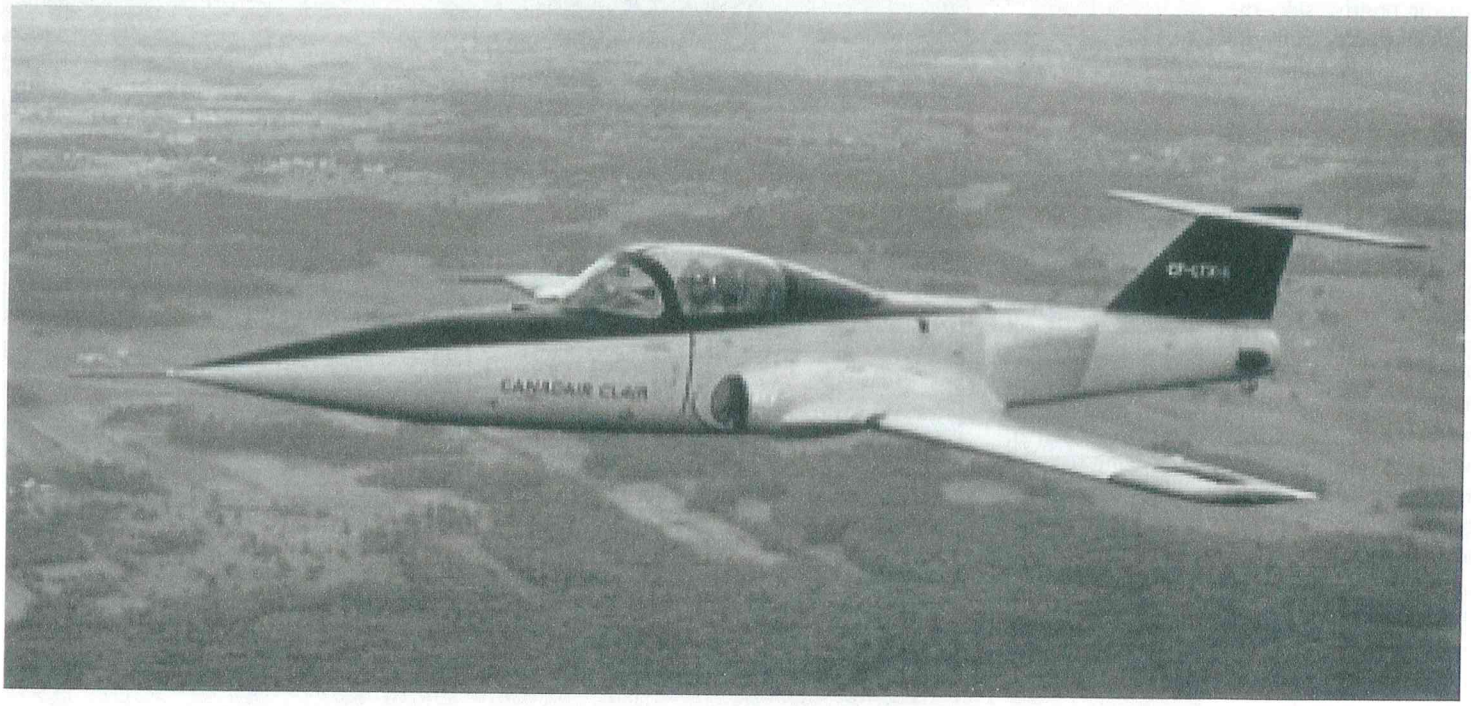


It might be noted that when the CL-41 went into quantity production, the Government specified the General Electric J85-CAN40 engine to be produced by Orenda in Toronto. The production J85-Can 40 originally had a takeoff rating of 2,825 lb ST with a Normal rating of 2,633 lb.

During the prototype design stage consideration was given for growth in the aircraft for greater utilization than just that of a basic pilot trainer. The structure was designed for outfitting with wing-tip fuel tanks and hard points were provided in the wing for additional external fuel or armament packages. These were features considered to be attractive to small countries that might find use for the aircraft in ground support or tactical roles and would make longer ranges, and longer mission times possible. In fact, the Malaysian government later acquired some 20 CL-41G-5 aircraft as ground-attack fighters.

As soon as the major components of the prototype's structure were fabricated, the structure was subjected to extensive non-

"Selecting an engine for the CL-41 was a problem at the outset . ."



destructive testing to verify the strength and integrity of it under all of the design conditions. These were closely monitored by the Structural Test Department — Willie Krause of course — and with more than casual interest by Ian MacTavish who was to test-fly the aircraft. At one point in the testing the tail and rear fuselage were loaded like "a chicken having its neck wrung" when a buckle appeared in the fuselage skin behind the speed brake. There were a few people around with concerned expressions on their faces but Willie just smiled knowingly. When the structure was unloaded and everything returned to its normal shape the concerned expressions were replaced by ones of relief, especially on Ian MacTavish. Later on when the aircraft structure was tested, as it were, to destruction, the forward fuselage and wings didn't fail until reaching 140 % of the Design Ultimate load. The rear fuselage and empennage failed only after reaching 152 % of the Design Ultimate load. The ruggedness of this little aircraft was to be confirmed by its continued long service in the RCAF until it was retired in 2001.

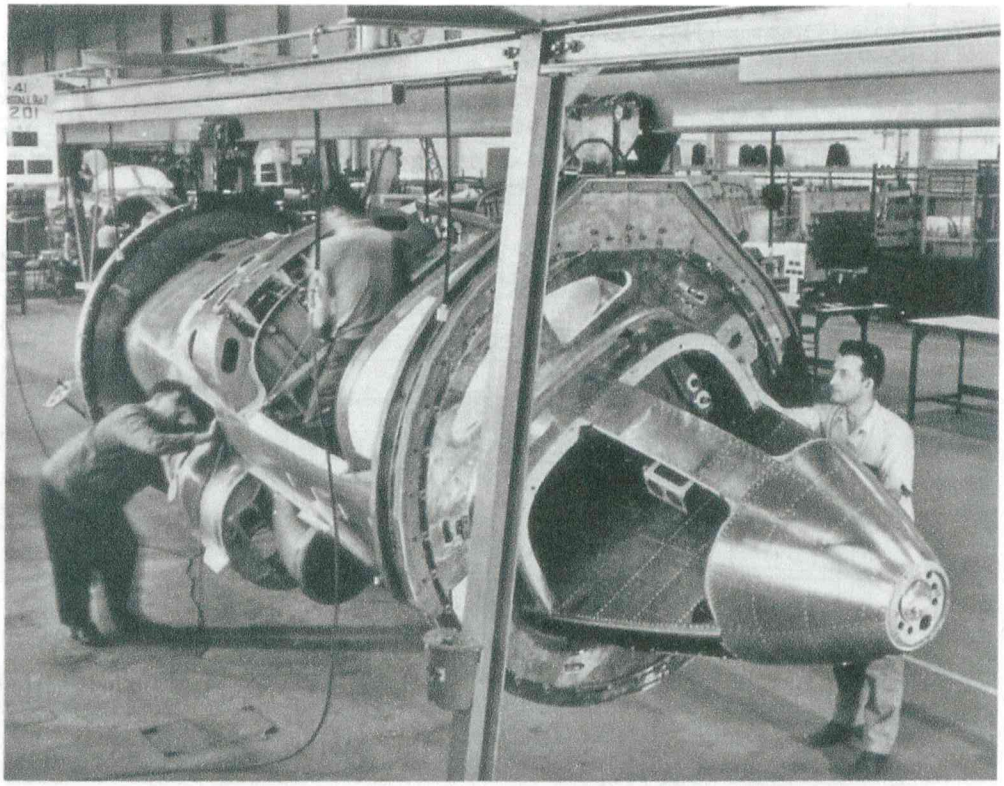
The prototype was then outfitted, and readied for its first flight. During all this preflight activity at one point when the aircraft was being checked out with the engine running, Willie Krause wandered, as he often did, around the aircraft and got in front of the air intake. Suddenly the lower part of his jacket was sucked into the duct. Reacting quickly, Willie was able to pull out his coat tail with only minor tears to a pocket. Fortunately none of the contents in his pocket got sucked into the engine, which could have had disastrous results. That was the last time Willie got close to a jet aircraft with the jet engine running.

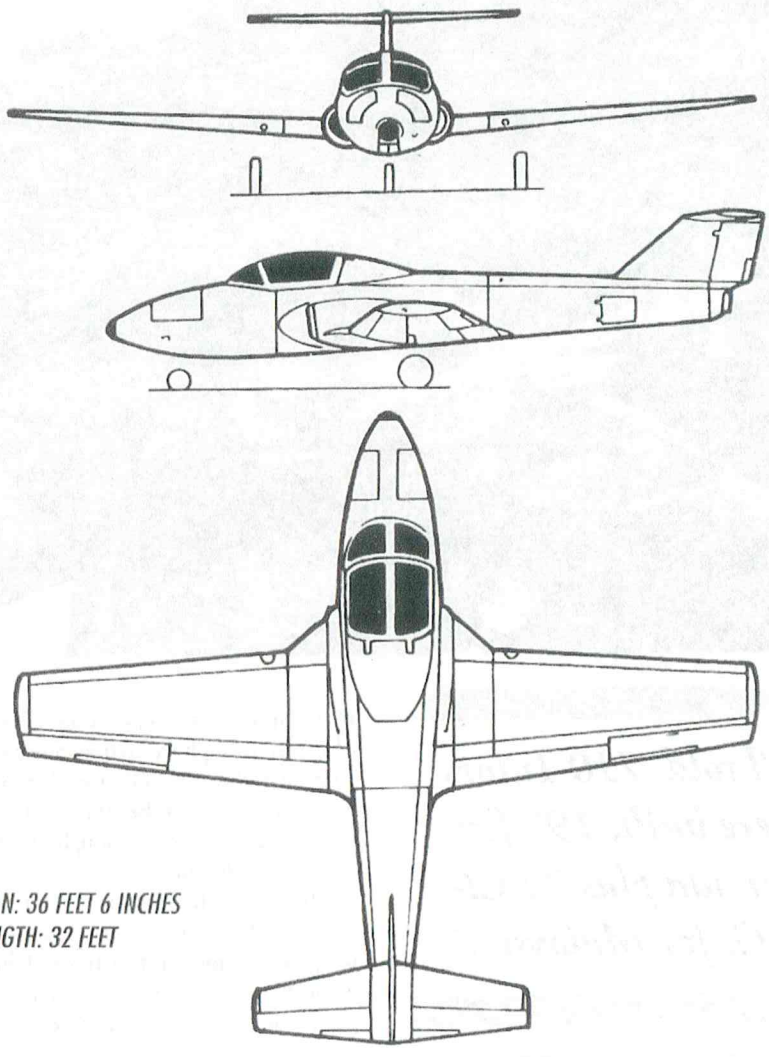
With all things done that had to be done before the first flight, including some high-speed taxi runs down the runway, in the late afternoon of January 1959 the CL-41 bearing the registration CF-LTW-X made its first flight.

With January sub-zero afternoons, outdoors in Montreal is not the most pleasant place to be — but most of the design team watched excitedly, like expectant parents, as their baby took off on runway 28 at Cartierville (a suburb of Montreal adjacent to Canadair). The flight was reportedly uneventful lasting an hour and 10 minutes and the aircraft was declared by Ian MacTavish to be "a winner."

In the following months the CL-41 underwent a period of extensive testing by Canadair until finally being evaluated by an RCAF team in December 1960 for purchasing consideration by the Canadian Government.

While still in the prototype stage, a unique "stiletto"-looking version of the CL-41 designated the CL-41R was produced using the second prototype and adapting a CF-104 nose





SPAN: 36 FEET 6 INCHES
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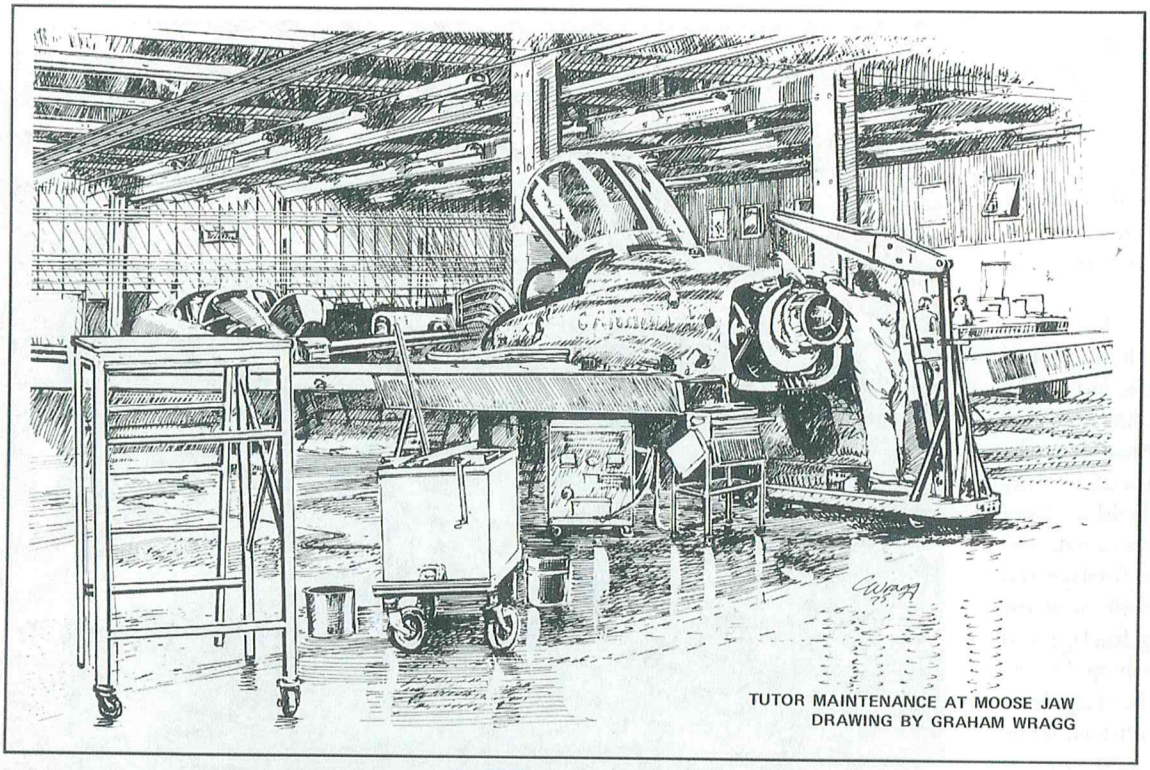

TUTOR MAINTENANCE AT MOOSE JAW
DRAWING BY GRAHAM WRAGG

Opposite, top: *Tutor fuselage under construction in a rotatable jig.* CANADAIR via GODFREY. ***Opposite, bottom:*** *GA drawing of the Tutor in its final configuration,* CANADAIR, THE FIRST FIFTY YEARS. ***Left:*** *Tutor maintenance at Moose Jaw. From a drawing by* G. WRAGG. ***Below:*** *Tutor production.* CANADAIR via GODFREY.

"All told, 210 Tutors were built, 190 for Canada plus 20 Cl-41Gs for Malaysia."

to it. The intention was to train pilots in the use of the 104's sophisticated avionics equipment. Although the CL-41R was demonstrated to various operators of the 104G and well received there wasn't interest in enough of a quantity to justify a production run.

It wasn't until September 1961 that the CL-41 was ordered into production for the RCAF, designated as the CT-114 Tutor. Changes were made for the production aircraft to facilitate production manufacturing otherwise it differed little from the prototype.

Some changes no doubt were made in its lifetime to accommodate the provisions or external stores for different models like the CL-41G, but probably easily go unnoticed. Outwardly visible were 'strakes' added at some point to the nose of the aircraft to enhance its aerodynamics and spin characteristics, otherwise it was basically the same as the prototype.

All told, 210 Tutors were built, 190 for Canada plus the 20 CL-41Gs for Malaysia. Production CL-41's were all manufactured with six suspension points, two under each wing, plus two under the fuselage that had been added to the design prior to going into production. Fuel lines were installed in all production aircraft enabling them to carry armament or fuel, or any combination of both.

When the Golden Hawks were retired, the RCAF was hard pressed for an aerobatic team. The ability to perform all aerobatics at a reasonably slow speed, within close viewing range, and the fine handling qualities of the Tutor made it an excellent candidate for the job. Dressed in gold and black the Golden Centennaires aerobatic team took on this role and performed in air shows across Canada and the US. Their performances were considered spectacular.

Then, with new white and red colors, which seemed to enhance their performance, and their smoke generators, they became The Snowbirds. With some new routines, they have dazzled spectators all over North America and continue to do it even after the Tutor was retired from active service. How much longer they will continue beyond this writing is unknown, but their excellence will be a hard act to follow.

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