This pilot's view of the RCAF's CF-104 was written by Canadair test pilot Bruce Fleming for the Canadair Service News. It provides a good insight into what a fast-thinking flyer must do to stay on top of a fast moving manned-missile.

AUTHOR/TEST PILOT Bruce Fleming astride CF-104.

Taming a flying tiger

By Bruce Fleming

Primarily intended for use by the RCAF as a fighter-bomber, the CF-104 nevertheless retains the characteristics of the original "ideal" fighter designed by Lockheed engineers.

Entering the cockpit, the unacquainted pilot will find himself in a beautifully laid-out "office" that has every control but one in view and within easy reach even with the shoulder harness locked. Even circuit breakers are accessible without developing a stiff neck. The one thing out of view, alternate trim control, is within reach.

Full ejection capability

Noticeable additions to the cockpit are the NASARR screen and controls, and the auto pilot. However, these will not be entirely new to those who have flown the CF-100. The seat itself, is a little straight-backed for complete comfort but this is a price that must be paid for a full speed-range capability ejection system. To compensate for this, a large amount of rudder pedal adjustment is possible.

The pre-taxi check must be carried out with the aid of a crew chief or lead hand, as the control surfaces are out of view from the cockpit due to their extreme aft location. Checks are tallied off by finger signals generally in the following sequence:

1. Speed brakes out and in.
2. Aileron, elevator and rudder movement.
3. Alternate trim.
4. Stick and rudder trim.
5. Stability augmentation or damper systems.
6. Automatic pitch control or shaker-kicker and shaker systems.
7. Take-off and land flap and Boundary Layer Control air.
8. Ejection seat safety pin.

The chocks are pulled and the pilot prepares to taxi. If tip tanks are fitted, a stray-voltage check must be carried out by ground crew prior to removal of the safety pins. This should be done clear of personnel, aircraft, hangars, fuel tenders, etc. Inadvertent firing of tip tank explosive jettison charges will blast them a considerable distance. The check takes about two minutes and can be handily used to set up the NASARR, zero the navigation system and request taxi instructions.

Taxiing, the pilot will observe a greater turning radius than the Sabre's due to the longer wheel base and narrow tread of the main wheels. He will also notice, during the testing of the brake systems, the difference between the manual and power brakes (which become anti-skids at more than 12 knots).

In our Canadian climate, large temperature variations with resultant changes in fuel flow and thrust will preclude cut-and-dried procedures for take-off. Consideration must be given to ambient temperature, airfield altitude, length and grade of runway, aircraft weight and configuration, etc., just as it would with a heavy transport aircraft.

Take-off considerations

Afterburner lighting technique is a question that will have to be resolved on the unit. On initial afterburner ignition, there is a momentary drop in thrust and one method is to await this, prior to brake release, meanwhile eyeballing the engine gauges for evidence of afterburner light-up. One drawback to this procedure is that in warm weather it is possible to push a wave of macadam ahead of the tires, thus incurring the displeasure of runway maintenance personnel.

On cold days, with greater available thrust, tires are apt to blow if the brakes are not released prior to the upsurge of thrust following afterburner ignition. However, both of these possibilities are preferable to sailing off the end of the runway, which can happen when the pilot fails

to recognize that no afterburner light-up has been achieved and even military power has been lost through a wide open nozzle.

During the take-off roll, the pilot should always have a reject speed in mind, established by the unit or computed from the E.O.'s and taking into account all the variables. The drag chute and hook are available should some warning make an abort advisable but remember that, being mechanical, these aids can fall subject to "Murphy's Law." Try not to paint yourself too tightly into a corner.

Take-off in the clean CF-104 is an exciting experience and once the pilot has gotten over the exhilarating acceleration, he will find himself at home in the aircraft. Once airborne, the undercarriage up selection must be made immediately to avoid exceeding undercarriage maximum permissible transient speed.

Vertical climb out

When flaps up are selected there is a nose up tendency for which a short jab of trim will compensate. Then the aircraft is going to go! With full afterburner thrust, the pitot boom will point almost vertically if speed is to be kept subsonic.

The three axis damper system makes smooth manoeuvring a simple matter. Aileron control is excellent and the rate of roll greater than on almost any other type of aircraft. Rudder deflections are almost unnecessary except perhaps for a cross-wind landing.

The incorporation of the automatic pitch control (stick shaker and pusher, or kicker) prevents quick alterations of angle of attack. This system has been incorporated to help avoid a manoeuvre known as "pitch up" which is uncontrollable and is to be avoided at all costs.

Without recourse to the afterburner and its resultantly high fuel consumption, pilots on earlier models of the aircraft found it almost impossible to indulge in subsonic manoeuvres requiring large G forces and big changes in angle of attack (dog-fighting, loops, pull-outs, etc.). For this reason, the RCAF insisted that on the CF-104, the flap structure be beefed up.

The take-off position now doubles as "manoeuvring flap". This makes tighter turns and loops possible using full military power only. However, successful dicing and tangling with Sabres, T-birds and Canucks at subsonic speeds is a thing of the past — this is a supersonic fighter and low speed manoeuvring is apt to end in disappointment or disaster. It is when the CF-104 is exceeding Mach 1 that you know you've got a tiger by the tail!

There is almost no indication the aircraft is going supersonic. Apart from the "Mach jump" of the pitot-static instruments, the effect in the cockpit is negligible since there is very little change in trim and the controls are irreversible.

Approaching Mach 2

Approaching Mach 2, the ball will start to go out to the left indicating that left rudder is required but this is a minor point. Aileron effect is excellent and high G forces are now possible and can be sustained without deceleration.

In this speed range, the ground goes by at a great rate. Remember though, that this speed is being paid for with fuel, which in afterburner throttle range, is being gobbled up rapidly by the engine, even at high altitudes. The use of afterburner in climb and cruise must always be considered with regard to the mission profile.

Throttling back to military at supersonic speeds will not result in rapid deceleration but the use of speed brakes must be anticipated if the pilot doesn't want to leave the imprint of his face on the instrument panel. It is a good idea to always do up the lap belt and shoulder straps as tightly as possible. As mentioned earlier, everything can be reached with the harness locked, so why not make it a practice to leave it that way?

On descents, even in idle power, it will be necessary to monitor the Mach-meter to avoid showering the underlying countryside with "sonic booms".

Speed brakes are very effective throughout the speed range of the CF-104 and have little effect on stabilizer trim. However, since there is no speed brake position indicator other than the switch they are apt to be forgotten and with landing flap selected, undercarriage down and speed brakes out, it will be impossible to maintain level flight with full military power.

Low speed handling

At low speeds the pilot is warned of an inadvertent stall by airframe buffet, followed by sticker shaker and kicker action. This action is influenced by angle of attack (through the automatic pitch control vanes) and by pitch rate (measured by the pitch rate gyro of the Air Data Computer).

The effect of the shaker is difficult to ignore and that of the kicker, impossible. However, kicker action is dependent upon the proper operation of a number of electrical circuits, so never press on below a reasonable kicker speed for weight and configuration and, better still, keep an eye on the automatic pitch control gauge and let off on the control column when the needle approaches 5. Otherwise, pitch-up will get you if you don't watch out.

Approach and landing techniques for both normal and precautionary conditions are well covered in the E.O.'s and should be adhered to. It is a good idea to standardize as much as conditions will allow. This will result in better and tighter circuits as the learning curve goes up.

By judicious use of "G" on the break and correct spacing of undercarriage and land flap selection, it is possible to select a power condition that will allow the whole landing pattern to be flown and the proper speeds to be achieved. In this way, the throttle need not be retarded until touchdown or during roundout.

Drag chute effect

The sooner the drag chute is deployed the more effective it is. Its effect becomes barely noticeable at under 100 knots so get it out as soon as nose wheel steering is engaged. Engagement can be detected by the loss of carrier noise on the UHF (the nose steering button doubles as a UHF transmit button) when the weight on the wheels has closed the ground-air safety switch, positioned in the left main wheel well.

Proper liquid spring extension is vital to safety switch functioning and the springs should be carefully serviced according to the E.O. This same switch also controls the anti-skid brake function, so that its importance cannot be over rated.

In a cross wind landing, it is just as well to keep a hand on the drag chute handle so that should the chute cause the aircraft to swerve badly after deployment, it can be quickly released. With under 3,000 pounds of fuel aboard, the aircraft C of G is well aft thereby causing a nose oleo extension greater than that of other F-104 models (these aircraft being equipped with a cannon in place of fuel as in the CF-104). This aft C of G position is apt to reduce the effectiveness of nose wheel steering until the flaps can be raised and more weight put on the liquid springs and nose wheel.

The CF-104 will open up a new world to the pilot who has gained experience on the trusty old T-birds and Sabres. The marvels of NASARR, the auto-pilot, the TACAN, the inertial navagator, the armament systems — these supply the many thrills that come from flying an aircraft that is truly modern, even in this space age.