F-106 Delta Dart

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TO put it simply, the F-106 Delta Dart is a honey. And I emphasize the "is" because after fifteen years in my inventory it is still a fine fighter and a joy to fly. My first association came in 1960 when I was given the opportunity to command an F-106 squadron. My first impression, formed on my first day in the squadron, is the same impression that still comes to me every time I cross the ramp to the "six" I am scheduled to fly.

When you see a "six" sitting on the flight line, you have to be impressed by its sleek beauty. It is the kind of aircraft that seems to be flying even when waiting silently on the ramp. The clean, slim, Coke-bottle fuselage is enhanced by the elegant delta wing and sturdy rakish vertical fin. These features all combine to produce a feeling in the viewer that this machine was meant to fly.

From a distance her sleekness masks her size; only when you are standing by the wing do you realize that this baby is as long as a C-47 and can gross over 40,000 pounds. But the power of her Pratt & Whitney J-75 engine augmented by an afterburner can lift her mass into the air and up to 40,000 feet and more in minutes.

The F-106 was designed as an interceptor, and the air-to-air role has been her mission ever since. Not once has she been called on to sling bombs or rockets from her wings. Instead her punch is safely stored in a missile bay and exposed only at the moment of launch. Originally she was designed to stand ready against the threat of invading bombers. Today that role has been expanded to include air-to-air combat against other fighters. Her inherent good design, improved by air-to-air refueling and the capability to carry the 20 mm Gatling gun, make her a worthy air-to-air opponent even now in her venerable years.

When the F-106 came into the inventory it boasted several innovations. Although it bore a family resemblance to the F-102, it was a new aircraft with more sophisticated systems. The area rule fuselage and vertical tape flight instruments were two of the more noticeable. The MA-1 weapon control system is the electronic heart of the airplane, providing digital computer displays to the pilot which solve the intercept or navigation problem related to the tactical mission. Part of this system is contained in the tactical situation display—a rather large circular map located forward of the control stick between the pilot's knees; by using various TACAN station selections, it shows in map form the area surrounding the station. An interceptor bug on the face of the display continuously locates the aircraft visually in relation to its position over the ground. A target bug is also available to assist in displaying the intercept problem to the pilot in the tactical mode or for other functions in the navigational mode. Other features include automatic control of the aircraft via ground-air data link, automatic navigation, and coupled ILS approach. Many other sophisticated features make it a complex aircraft; the pilot must have a thorough knowledge of all of its systems if he is to stay abreast of all the information available to him and fly the airplane to the extent of its capability.

Cockpit entry is conventional, making use of a special ladder which hooks over the cockpit rail. The clamshell, clear-vision canopy is well out of the way in its full open position. The pilot places his back-type parachute in the cockpit first and connects it to the seat survival kit. Next he connects the parachute firing lanyard to its receptacle on the ejection seat, completing an essential step in the sequenced, one-motion ejection system. Once he stows his other gear it is an easy step over the rail, making sure as his feet ease down into the rudder alleys that a careless toe does not come into contact with the secondary canopy jettison lever located on the lower left forward part of the seat. Out of respect for this particular lever, a "six" pilot never puts anything in his lower left flying suit pocket and always keeps the zipper zipped.

After donning the chute and fastening seat belt and shoulder harness, the pilot has completed the links that provide a rapid and effective ejection system. The one-motion system is started with the pilot raising either hand grip. The canopy leaves the aircraft, and seat ejection follows. Seat-man separation occurs, then forced parachute deployment and survival kit deployment. The system is designed to work from zero feet–zero speed up to 450 knots. Certain combinations of critical attitudes and sink rates introduce limitations, but generally the system is highly effective.

Getting ready to start the engine involves a complete cockpit check to make sure that every switch and lever is properly positioned and every instrument is properly set or giving the right indication. Prior to cockpit entry, the pilot and his crew chief have already completed a walk-around inspection of the aircraft to insure that pressure gauges and fluid levels are in order, leaks have not developed, ground safety pins are pulled, and the aircraft by tacit agreement between the two is ready to fly. When the cockpit check is complete and the pilot is ready to go, he watches for the crew chief to signal that the aircraft is clear and he then is ready for the start.

By depressing the start button on the throttle and manipulating the throttle, the combustion starter is activated, with engine light off taking place a few seconds later. The start is normally assisted by an air cart and electrical power cart, although the airplane can start on its own stored high-pressure air and the aircraft battery. Once the start is complete, aircraft power is turned on and another cockpit check brings all systems on the line. Instruments such as the altimeter and engine pressure ratio gauge are set, and you are ready to taxi.

Up to this point you have been busy making sure that everything has been done properly. As you taxi you have a second to appreciate the power you hold in your left hand and the responsiveness of this beautiful machine, even on the ground. Nosewheel steering is available at the touch of a button on the stick. After engagement, control of the nosewheel is obtained by pressure on the left or right rudder pedal. Once rolling, the "six" is inclined to keep going as if anxious to get airborne; as with a spirited horse that needs a tight rein, you have to hold it in check by gentle use of the brakes.

Additional checks completed while taxiing include such things as the radar and the ground-air data link. Final checks before lining up for takeoff include canopy locked, pressurization on, fuel switches on, ejection seat safety pin out, and no warning light on in the cockpit. With clearance from the tower and the airplane lined up on the runway, the throttle is advanced all the way. The primary gauge at this moment is the engine pressure ratio gauge, which indicates whether engine thrust on the ground is suitable for takeoff. One final check that all systems are go, and brakes are released. Immediately the 16,000 pounds of thrust push you back in the seat as the "six" accelerates down the runway. A quick look at the instrument panel tells you all is O.K., and the throttle is moved outboard to light the afterburner. The bang as the burner lights and another push in the back tell you that the additional 8,000 pounds of thrust have taken hold and you are being propelled down the runway at an ever-increasing pace. Nosewheel liftoff speed of about 130 knots is soon reached, and back pressure on the stick smoothly lifts the nose to takeoff attitude. Proper angles of attack are important at this point; either too high or too low will increase the ground roll. Putting the nose on the horizon or 10° up on the attitude indicator allows the aircraft to fly at the best ground roll for the field elevation and surface temperature. Once safely airborne the landing gear must be retracted immediately since the gear-down speed can be exceeded very easily.

The airplane flies in a most conventional fashion despite its delta wing and lack of conventional empennage. It is completely responsive to the controls, and a light touch with the stick is the name of the game. Inattention or ham-handedness can result in being a thousand feet higher than you want or over on your back. When flown within its envelope the "six" has no bad habits. However, like most high-performance aircraft, if you venture outside the envelope, you do so at your own risk. The Mach 2 speed capabilities of the aircraft give it a wide range of options in its combat role, and it is a potent adversary against targets well above 50,000 feet.

With its two 360-gallon external supersonic fuel tanks, the F-106 has a most comfortable range and endurance compared with other fighters of its vintage. When afterburner is used, fuel consumption goes up and range and endurance correspondingly decrease. But all things being equal, it is no problem for the "six" to leave a West Coast base and cross the continent with only one refueling stop. If air refueling is used in a deployment, spanning an ocean becomes quite practical.

Landing an aircraft has always been the most challenging phase of flight to me, and landing the F-106 is no exception. The handling characteristics of this aircraft at pattern speeds and altitudes are excellent. The landing approach can be made from a visual overhead pattern or by use of ground controlled approach (GCA) or instrument landing system (ILS) approach. The landing gear is lowered at 250 knots and checked down by three green lights indicating each wheel. Flaps do not come into play (the "six" is not so equipped), but speed brakes are opened as the descent is started on final if under GCA or ILS. Approach speed varies with the gross weight of the aircraft as affected by remaining fuel and armament on board. Using 180 knots as a good average approach speed, altitude is held at 1,500 feet AGL (above ground level) as you approach the GCA glide path. As speed bleeds off, the delta wing configuration causes the angle of attack to increase continually. Since this subtle change is not particularly discernible unless you watch the attitude indicator and altimeter, it is easy to lose altitude gradually because outside references incline you to under-compensate for the amount of nose-up required to maintain level flight. When the glide slope is reached and the controller tells you to begin your descent, you open the speed brakes, reduce power, and establish your rate of descent. Airspeed to the knot is displayed on the vertical tape airspeed indicator, which can be cross-checked against the angle of attack tape read-out. Airspeed and rate of descent are essentially controlled by power adjustments.

Approaching the end of the runway at 180 knots is a thrill to say the least, and at that speed the margin for error is minimal. Back pressure on the stick is applied and power smoothly reduced as the touchdown is approached. The main gear tires gently kiss the runway as the power hits idle. The drag chute handle is pulled, and a few seconds later a definite tug is felt and deceleration increases. At 90–100 knots the nosewheel is lowered gently to the runway by easing the back pressure on the stick, and the rollout is under way. Nosewheel steering is engaged, and gentle braking slows the aircraft down for the turnoff at the runway end. Dropping the drag chute, cleaning up the cockpit, and a careful taxi back to the ramp completes the mission. At this point any F-106 pilot has a deep sense of satisfaction.

I have flown about 400 hours in this airplane, and if I had to pick a favorite among all the fighters I have flown, the "six" would be it. It is a complex and challenging airplane to fly, but it is honest. I have enjoyed and appreciated each moment I have flown it and look forward to many more hours of association with this fine aircraft.

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ON Armed Forces Day in 1961 I stood beside the runway mobile unit and watched a "fourship" of F-106s prepare to take off for their flyby. The noise was deafening, and sooty black smoke billowed out behind the aircraft as the pilots ran the engines up. I could see the element leads clearly as they nodded their heads to signal brake release, and then as the afterburners lit on those big J-75s I knew I wanted to be an Air Force fighter pilot. More than that, I wanted someday to fly that very airplane—the F-106. It was quite a few years from that day as a high school sophomore until November 1970 at Tyndall Air Force Base, Florida, when I was once again listening to an F-106 engine run up. But this time I was in the airplane and preparing to fly it for the first time. Now, three years later, I still get the same thrill listening to that engine and flying what I consider to be one of the finest true fighter aircraft in the world.

The technology behind the F-106 was pushing the state of the art in the mid-fifties, and the aircraft was the first Mach 2 production fighter. Its computerized fire control system was a revolution in avionics. Designed as an interceptor against large bomber-type targets, its speed, maneuverability, armament, and the later addition of external fuel tanks for long range were the fulfillment of the very same requirements that a successful interceptor needs today. Despite the seventeen years since the first models rolled off the assembly lines, the F-106 remains our first line of defense against an aircraft threat to the North American continent.

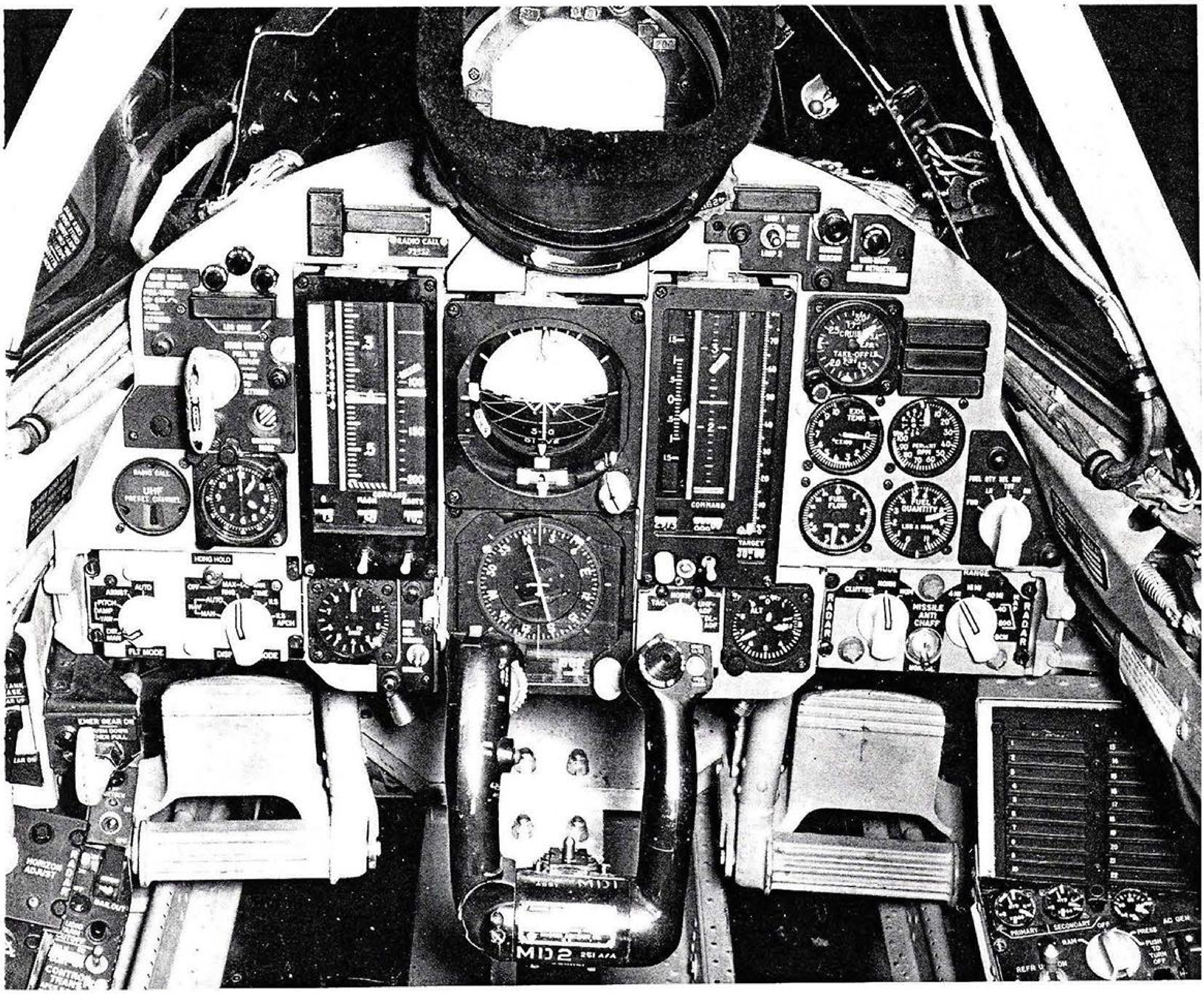
Many modifications have enhanced the airplane's capabilities. Originally conceived as a point-defense aircraft that would operate out of only one base for its entire life span, the "six" has been retrofitted with such items as an air refueling system, solid-state avionics components, and a clear-topped canopy (the old canopy had an eight-inch-wide steel bar running longitudinally through the apex) and soon will be modified for quick installation of the M-61 Gatling gun and a fantastic new gunsight. The designed 3,000-hour lifespan of the airframe has been more than doubled through a structural integrity evaluation. If future modification proposals are approved, the airplane will virtually have a new lease on life. It currently carries a worldwide deployment capability.

Approaching an F-106 on the ground you can't help but admire the natural beauty of the airframe. The long needle nose is angled slightly downward since the airplane sits a little "downhill." It's not a small airplane (combat weight is 42,000 pounds), and the single cockpit sits high off the ground. But the 70-foot fuselage is gracefully curved by the Coke-bottle waist or "area rule" design—one of the key reasons the airplane is able to go Mach 2. Like its predecessor the F-102, the "six" has delta wings with elevons. These control surfaces replace the aileron/horizontal stabilizer package and are on the trailing edge of the wing acting as elevators and ailerons simultaneously. Lack of flaps or boundary-layer devices dictates a higher final approach airspeed than most fighter aircraft, normally in the 180-knot range. The Delta Dart is powered by the J-75 axial flow engine with an afterburner thrust rated at 24,500 pounds and a military thrust of 16,100 pounds. One of the finest features of the F-106 is this outstanding Pratt & Whitney engine. Being a single-engine fighter, the reliability of that engine is most important, especially on missions several hundred miles out over water or up into the Canadian wilderness. Even with occasional problems of a serious nature, the engine continues to get the pilot home. I once had a main bearing failure 200 miles from the nearest suitable landing field. Despite severe vibrations and noise so loud I couldn't hear my UHF radio turned full up, I flew the 200 miles and landed safely. Upon landing I also had a primary hydraulic failure which was attributed to the hydraulic reservoir cracking from the severity of the engine vibrations. The ruggedness in this incredibly reliable engine is added insurance appreciated by the pilots.

The pilot preflight is really simple for so complex an aircraft. During the walk-around the pilot or crew chief pulls the gear pins and the safety pins for the external tanks and the tail hook. The pilot checks the engine access panels to make sure they are closed and examines fittings and lines for general condition and leaks. Certain hydraulic reservoir and accumulator gauges as well as the missile bay and the system air pressure are given cursory examination, but these are quick looks and not time-consuming. Although the pilot's checklist itemizes the preflight sequence, each pilot develops a habitual pattern that includes items not listed in the checklist. This results in the pilot preflight becoming a *very personal* action.

Climbing into the cockpit you are aware of the comfortable surroundings and ample leg room. The radarscope sits directly in front of your face. The right and left consoles are crowded with switches and dials, but the cockpit layout is convenient. When strapped in you are snug but not crowded. Engine start requires pressing the ignition button atop the throttle and listening for the familiar pop of the combustion starter; then into idle at 10% and disconnect the ground power. Once the generators are switched on the line and the radar is turned on, you are ready to taxi. There is very little to turn on after engine start in an F-106, and this makes a scramble easy. I have seen a flight of two break ground 2 minutes and 43 seconds after a no-notice active air scramble. Nosewheel steering is activated by a button on the stick, and the airplane taxis easily. ADC (Air Defense Command) squadrons perform "last-chance" just prior to takeoff. This last-minute once-over by a ground crew has spotted many aircraft malfunctions that have manifested themselves between the parking area and the runway—mainly in the area of leaks or unsecured panels that would probably come off in flight. I have personally seen a pair of chocks in the gear doors, a small nosewheel-well fire, cut tires, and large air system leaks caught in last-chance. A thumbs-down by the last-chance crew is a mandatory no-go; the pilot must go back to the parking area for a fix or, if that's not possible, a ground abort. In three plus years of flying the F-106 I have been turned back three times; twice I had to abort the mission. It goes without saying that if the additional quality control provided by last-chance has saved even one aircraft, it has been worth the time and effort.

On engine run-up you check the hydraulic pressures, oil pressure, exhaust gas temperature, fuel flow, and EPR (a measure of engine efficiency dependent on temperature). You also set the attitude indicator to show 5° nose low, and as you rotate for takeoff you raise the nose to indicate 10° nose high. This compensates for gyro acceleration error in the indicator and prevents overrotation. The pilots soon develop outside references for takeoff, such as the "put-the-pitot-boom-on-the-horizon" method. Of course these vary according to the individual's height. The same explanation can be made for landing attitudes. (Check the skid plate under the tail of



Cockpit of the F-106.

almost any F-106 and you will see the system isn't foolproof!) One last flight control check and then you release brakes. After insuring that you are rolling straight, you pull firmly on the throttle outboard of the full forward position to light the afterburner (AB). With pressure applied the throttle clicks out to the AB range. It can then be smoothly moved back and forth from min to max AB just as if you were moving it normally; AB is *not* forward of the military position but alongside of it. Full mil is as far forward as full AB, and min AB is about equal to the 92% (normal thrust) position.

There is a very definite kick in the pants, especially noticeable in the winter or in an airplane without the two 360-gallon external tanks, when that AB cuts in. Airspeed increases rapidly to the rotation speed of 120–135 KIAS (knots indicated airspeed). At this speed you pull back smoothly on the stick until the nose is raised 15°. Holding this altitude the airplane becomes airborne at about 184 KIAS. The F-106B, the tandem two-seater, flies at slightly higher airspeeds. Takeoff distance is normally between 3,000 and 4,000 feet, depending on temperature and winds. At 250 KIAS the afterburner is terminated and the airplane is accelerated to 400 knots and climbs at this airspeed until Mach .93. This Mach is held for all further climbs and cruising. If the mission is to be a practice intercept sortie, the armament safety check is completed and the IR (infrared) system is initially tuned. The IR seeker head is recessed in the top of the aircraft nose and is raised at the flick of a switch. This system allows the pilot to acquire a target by homing on the radiation of its engine exhaust and is a great aid when the radar is malfunctioning or during an attempt to track a heavy ECM (electronic countermeasure) emitter.

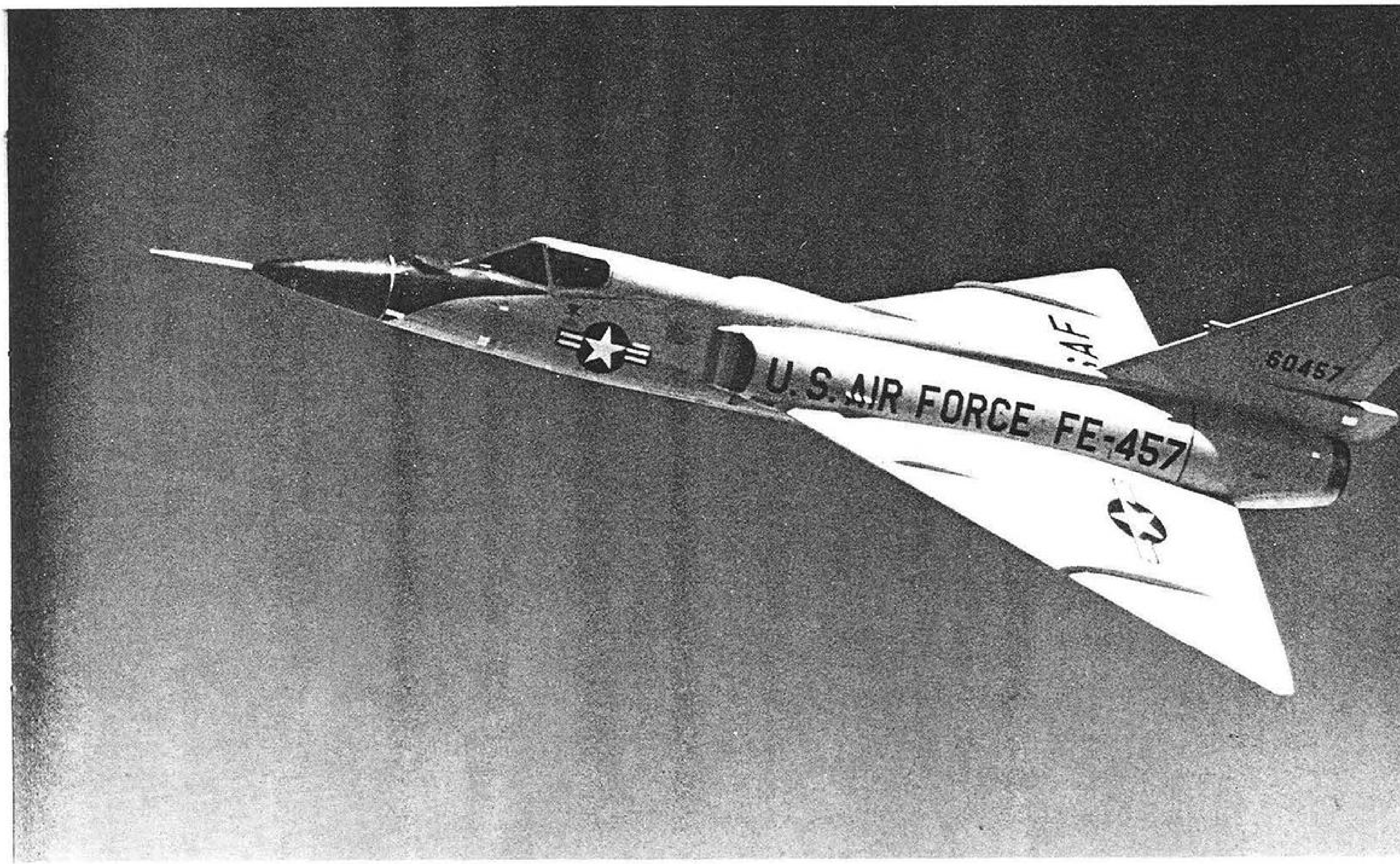
Soon after takeoff the pilot selects the data link receiver to begin receiving the coded UHF messages that inform the aircraft computer what type of intercept and target information is available. This information is displayed to the pilot on his instruments; the mission is not dependent on voice communications with GCI (ground control indicator) controller.

Once the target appears on the radarscope as a small blip, the pilot must use the left half of the Y-shaped stick and lock onto the target by moving the stick to superimpose a "gate" on the radarscope over the target. Once this is done, the fire control system automatically displays steering information and overtake rate.

The pilot has a choice of weapons—two radar-guided AIM-4F Superfalcons, two AIM-4GIR Superfalcons, or the AIR-2A Genie nuclear-capable rocket (sometimes called the blivet or the bean). This mixed load makes the F-106 a multishot weapon and adds versatility to combat not only against high-speed, high-altitude targets but also against high-speed, low-altitude targets. With the addition of the M-61 20 mm gun, the F-106 will have the close-in kill capability it currently lacks. All weapons are carried internally and cause no performance restrictions.

The average training mission flown by squadron pilots consists of a profile of intercepts and tactics. A formation takeoff and cruise to the intercept area is followed by low-altitude intercepts against a T-33. The venerable T-bird is equipped with chaff and an ECM pod. By varying his use of these countermeasures and varying his heading and airspeed, the target pilot attempts to cause the interceptor to miss its attack. If it is missed because of a mistake made by the interceptor pilot, it is called a "PE" or pilot error. If the attack is successful, the pilot calls "MA"—mission accomplished. Following several low-altitude passes the fighters move to the medium-altitude area where they may "bump heads" or take turns being targets themselves while the other fighters attack. A few high-altitude snap-ups complete the profile. Here the F-106 target is cruised subsonic or supersonic at 49,000 feet while the attackers combat from 34,000. The attacker must lock on, accelerate, and pull sharply up (snap-up) to fire against the high-altitude target. The maneuver is actually a simulation of the type of attack necessary to combat a bomber target in excess of 55,000 feet. Following completion of the intercepts the fighters reach "bingo fuel." This means they have to return to base because they have only a predetermined amount of fuel remaining. The formations rejoin and recover to single-ship or formation landings.

Since 1968 ADC has been training its pilots in air combat tactics (ACT). The Command-initiated idea was soon adopted by the Navy and Marines, and more recently TAC (Tactical Air Command) established a squadron of T-38s used as "aggressors" against the TAC fighter squadrons.



Under the supervision and direction of the Interceptor Weapons School (IWS) at Tyndall Air Force Base, Florida, ADC conducts College Dart. This ACT program features the F-106 flying against F-4s, F-8s, and A-4s from Navy, Marine, and TAC squadrons. Pilots get a full week of advanced air-to-air training against an aircraft very different from their own. College Dart has demonstrated the fantastic air-to-air potential of the F-106. Only within the last four years has this most underrated fighter been given some of the recognition it is due. Closely approximating the MIG-21 in overall performance, the F-106 is (in 1974), in the opinion of most fighter pilots who have flown in it or against it, the best production air-to-air machine in the U.S. inventory. Its acceleration enables it to engage and disengage comfortably. The ability of the delta wing to turn at high altitude is used to great advantage. Because it is a single-seat aircraft, ADC has developed the "Six Pac" tactics group to enable the F-106 pilot to best employ the aircraft in a fighter-versus-fighter environment. The tactics are based on an element of two aircraft both employed as shooters but maintaining close mutual support. Those familiar with the F-104 double-attack system and the Navy's loose-deuce tactics would notice many similarities in Six Pac. Obviously one week at a time does not an ace make, so the squadrons have their own ACT continuation training program. The pilots are required to fly a mandatory number of these missions each year. Because of the excellent support given by headquarters of ADC, the individual fighter squadrons are encouraged to make trips to various Naval fighter bases to participate in more dissimilar combat. The Navy squadrons also fly into the Sixes' home bases on occasion. The flying that results is aggressive,

F-106 Delta Dart in flight.

spirited, and educational. The mistakes made by both sides are lessons well learned in peace and won't be forgotten in combat.

I have yet to describe the actual flying characteristics of the airplane itself. In a word they are super. It is feather light in pitch responsiveness compared to the T-38. Without the external fuel tanks it is almost as responsive in roll as a T-38; with full external tanks the roll is slower and restricted to 100°/sec. The airplane has 752 KIAS "Q" limit, a Mach 2 restriction, and a skin temperature limit. It will easily go supersonic right on the deck or exceed the Mach 2 at altitude. During a recent TAC exercise two F-106s caught and successfully intercepted an F-111 going supersonic below 1,000 AGL (above ground level). Approach to a stall is very honest with light, medium, and heavy buffeting. Then lateral instability sets in causing the nose to wander in yaw. If the angle of attack is increased further beyond the critical, the adverse yaw induced by any aileron input will trigger a violent roll and pitch-up maneuver known as the post stall. The aircraft will oscillate about all three axes and if not recovered will likely enter a flat spin. Once established, the developed spin can be difficult to break. The rudder in the F-106 is extremely effective and in the high angle of attack regime is used to roll, thus avoiding the adverse yaw caused by aileron. The zero G maneuver to kill drag and prevent the stall is also effective in countering out-of-control flight. The F-106 accelerates beautifully, especially if already flying at a high indicated airspeed. By lighting the afterburner and pushing the nose over to zero G, the airspeed increases almost unbelievably. This airplane will go supersonic in a climb; it will even go super at high altitude in idle power by simply lowering the nose a few degrees. In fact if there is one complaint a "six" pilot has, it is that the airplane is difficult to slow down when you want it to.

Back in the landing pattern you fly initial at about 325 knots. The "break" is in a clean configuration rolling out on the downwind around 1,500 feet AGL, gear down, at about 240 knots. The final turn is flown at 200 knots in moderate buffet with a cross-check on the angle of attack. The pilot may opt to extend the speed brakes anywhere throughout the final turn or on approach. Power is gradually reduced after rolling out on final to transition from the final approach speed to the prior-to-flare speed. Then power is retarded to idle and the aircraft rate of descent is gently killed, causing airspeed to decrease another 10 knots to the touchdown speed. All three speeds are based on fuel remaining during landing. Once the wheels touch, the drag chute handle on the upper left side of the instrument panel is pulled and the drag chute deploys, causing a definite tug in the cockpit. The pilot raises the aircraft nose up to about 16° causing aerodynamic braking, being careful not to scrape the tailpipe. (That could cost him a case of beer to his crew chief.) When approaching 100 knots he lowers the nose to the runway and touches the button to engage the nosewheel steering. After turning off the active runway, he jettisons the drag chute by simply pushing the handle back in, and all the after-landing checks are then completed. The normal mission is two hours long, and unrefueled cross-countries have gone as much as three hours and fifteen minutes, covering over 1,600 N.M. Not bad for a fighter.

After 600 hours in the F-106 I still get a thrill walking up to her side. Airborne she's a thing of beauty to watch and a thrill to fly. Tactically the bulk of North American Air Defense responsibility still rests on her venerable old shoulders, and she always handles the job with style.

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