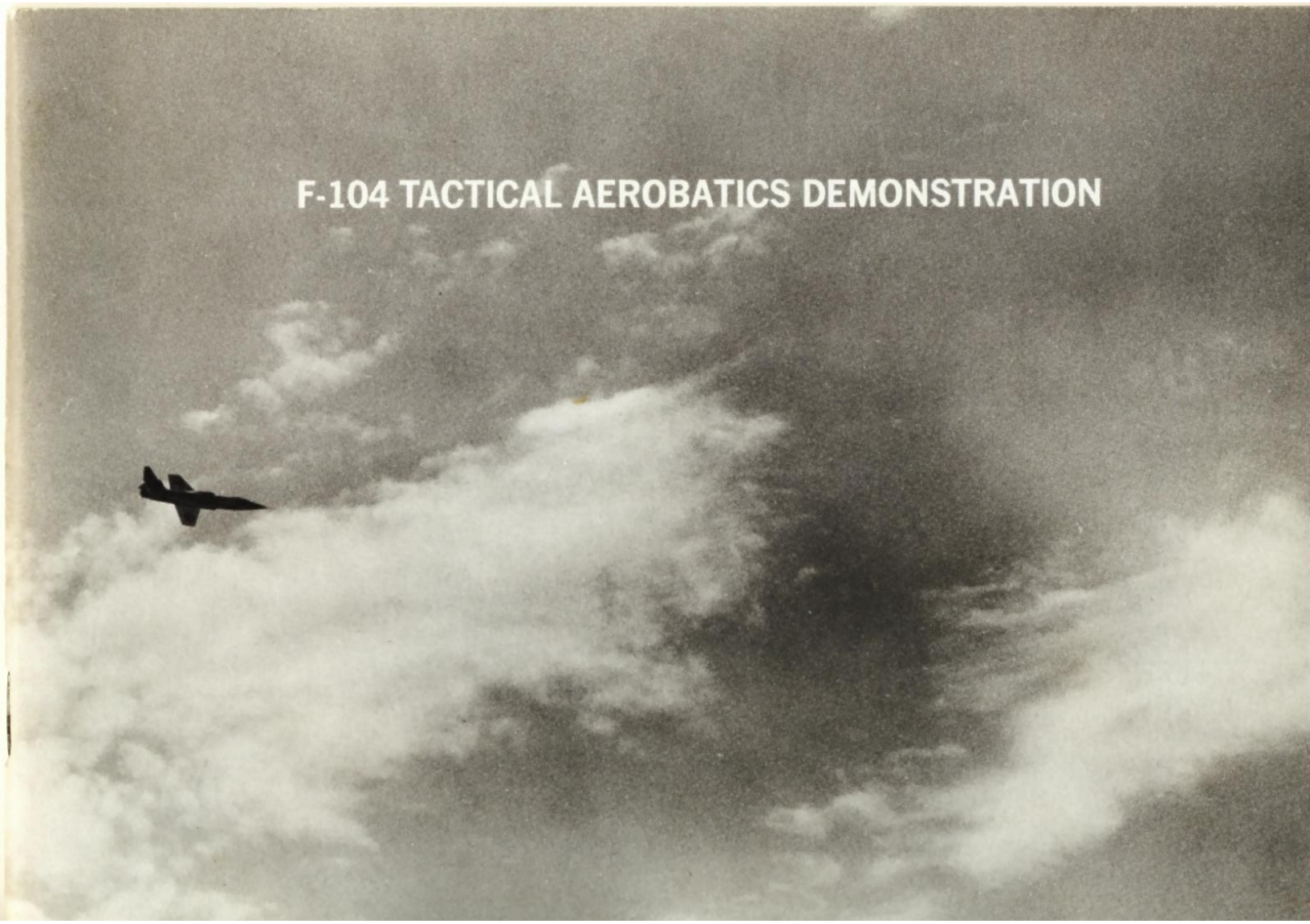
F-104 TACTICAL AEROBATICS DEMONSTRATION

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F-104

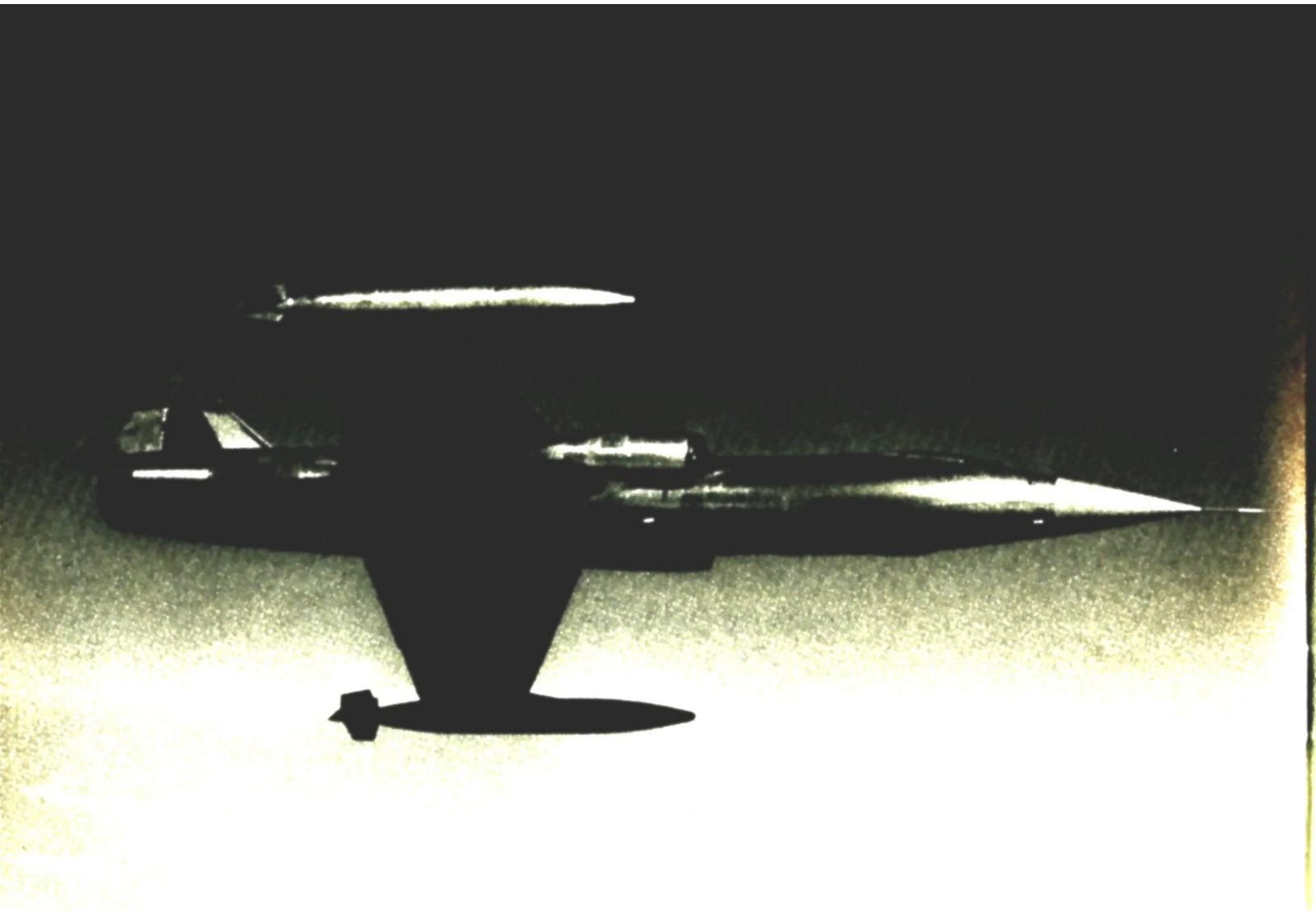
TACTICAL AEROBATICS DEMONSTRATION

Flown By

Glenn "Snake" Reaves

of

Lockheed-California Company



Today you are going to see a flying demonstration of the Lockheed F-104 Starfighter, one of the finest all-around tactical fighters ever built. The F-104 has a truly international character, having been manufactured in seven countries of the Free World and is now serving as a first-line fighter with 14 air forces around the globe.

The Starfighter is unique as it is the only fighter ever to hold three world records simultaneously: the World Altitude Record, the World Speed Record, and the World Time-to-Climb Record.

The first record established was a world altitude record of 91,243 feet (27,811 meters). Eight days later an F-104 flew faster than any other plane – 1,404 miles per hour (2259 Km per hr.) or more than twice the speed of sound. Sometime later a Starfighter set a new time-to-climb mark of 82,020 feet (25,000 meters) in only 4 minutes and 26.03 seconds.

After losing the altitude record, the F-104 came back to set an even higher record when it zoomed to 103,395.5 feet (31,515 meters). En route to this new mark, the F-104 also established a new time-to-climb record of 98,424 feet (30,000 meters) in only 15 minutes and 4.92 seconds from brake release.

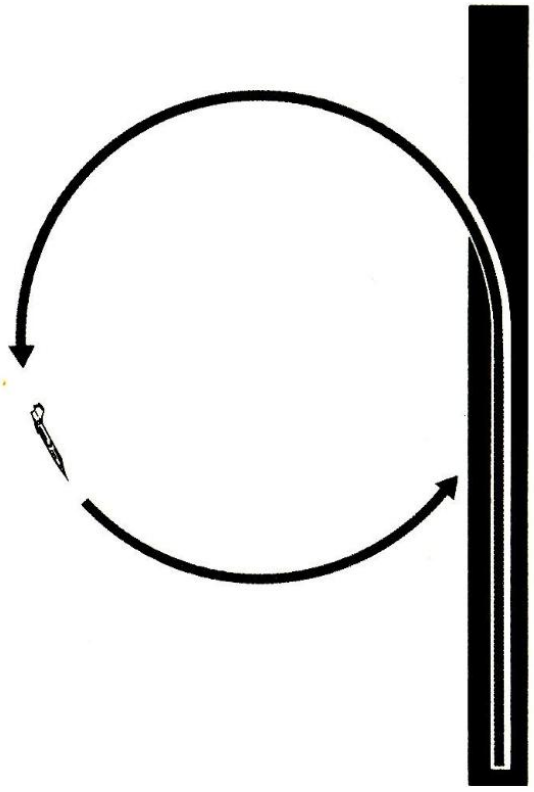
The Starfighter still holds the U.S. Air Force time-to-intercept record. In this instance, the two participating pilots took off and intercepted a target flying at 35,000 feet (10,668 meters) located 172 miles from their base. The two Starfighters – traveling at an average speed of 1150 mph (1850 Kmph) – intercepted and "killed" the target in only 8 minutes and 59.9 seconds from brake release.

Although the various records which the F-104 has earned are impressive, its true tactical importance rests on its proven operational ability. For ten years the Starfighters of the USAF Tactical Air Command have been the first air units summoned to any scene of world tension. F-104s have patrolled the air corridors to West Berlin, maintained peace in the Formosa Straits, stood guard during the Cuban missile crisis, and have met the challenge in Viet Nam.

Today, Lockheed test pilot Mr. Glenn "Snake" Reaves will be flying the Lockheed F-104, an airplane he has spent more than 10 years testing and flying throughout the world. To illustrate the F-104's versatility, he has selected twelve maneuvers, some of which no other aircraft in the world can perform.

MANEUVER #1: **Takeoff Followed By Low-Level 360° Tight Turn**

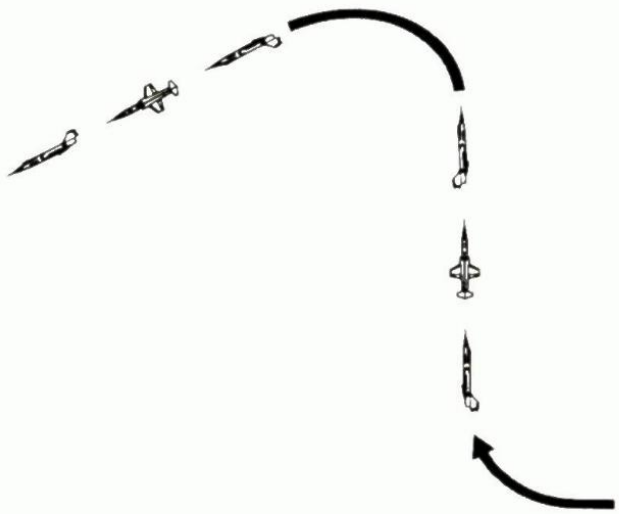
Normal takeoff is made and as soon as landing gear is fully retracted, the aircraft is banked to 90° and the turn away from the runway begins. Full afterburner with takeoff flaps is used throughout the turn. The Starfighter will accelerate around the turn and after 360°, the airspeed will be 400 knots. Altitude during the turn will be approximately 100 feet (30 meters).



Fighter pilots around the world appreciate an aircraft that has the ability to turn tightly – both for offensive and defensive maneuvering. Snake will show the Starfighter's quick reaction and turning ability by taking evasive action immediately after becoming airborne. By using it's full afterburner thrust and maneuvering flaps, the F-104 can turn in a radius of less than 5000 feet (152 meters). For the first quarter turn, the airspeed will be 250 knots at a load factor of 2 g's. Halfway around the turn the airspeed will have increased to 300 knots and the acceleration will have increased to 3 g's. By the three-quarter point, the airspeed will be up to 350 knots and Snake will be pulling 4 g's so that in the cockpit his body will be subjected to a force of four times its normal weight. Finishing up the turn, the F-104 will be running like a wild tiger, and airspeed will have reached 400 knots. Utilizing the Starfighter's acceleration, Snake will go immediately into the second maneuver.

MANEUVER #2: **Vertical Climb With Half-Roll And Immelmann**

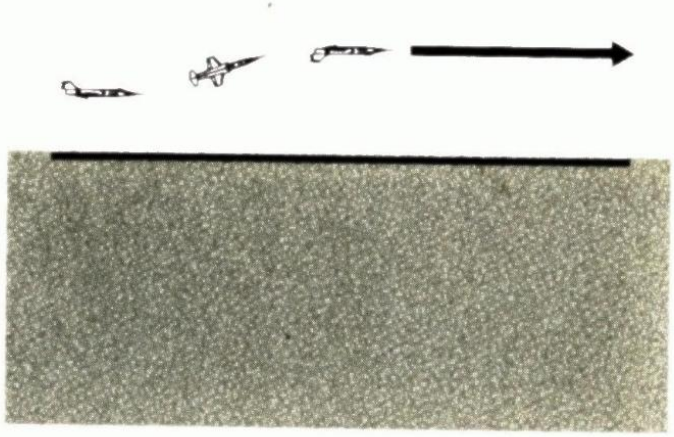
Upon completing the turn, the F-104 is rolled out to level attitude and then pulled up into a vertical climb. When the vertical attitude is reached, the F-104 is half-rolled and then pulled over the top into an inverted position. From here, another half-roll completes the Immelmann.



Rolling out of the turn exactly over the runway, Snake will then pull the Starfighter up into a vertical climb. You will see an amazing climb capability considering the tight turn that preceeded the pull-up. In the vertical climb, the F-104 will be half-rolled then pulled over the top of the climb into an Immelmann. From this point, Snake will do a Whifferdill turn around and dive back to the runway for the next maneuver. These two successive maneuvers – the low-level turn and the vertical climb combined with an Immelmann – will display the amazing agility of the Starfighter and its ability to continue its acceleration throughout these intricate aerobatics.

MANEUVER #3: **Inverted Pass**

After the high turn, the F-104 will approach the runway at high subsonic speed in level flight. At the end of the runway, it is pulled up and rolled to an inverted position. The inverted attitude is held as the F-104 flies down the runway. Upon completion of the pass, the F-104 is rolled back to straight and level flight and the return is initiated.



During air combat, a fighter must have the ability to fly in all attitudes in order to be positioned for firing on the enemy. This means that all systems must remain "go" while the fighter is being flown in any attitude. Snake will now demonstrate the ability of the Starfighter to maintain full attack readiness even under the most severe condition – prolonged inverted flight. Following this pass, Snake will turn around for the next maneuver.

MANEUVER #4: **Eight Point Roll**

F-104 approaches end of runway, pulls up and is rolled with the aircraft being momentarily stopped at eight distinct points, 45° apart, during the 360° roll.

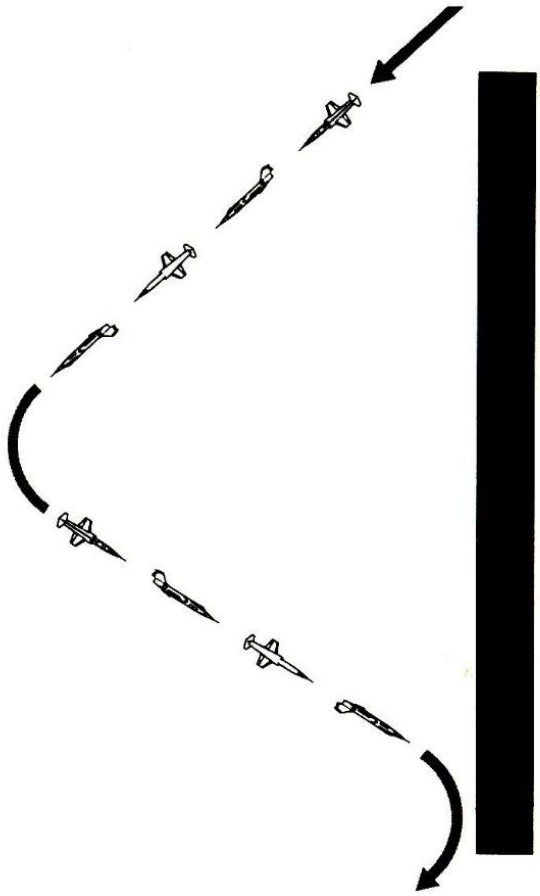
a. Roll left, stopped with wings 45° to horizontal.
b. Roll left, stopped with wings vertical.
c. Roll left, stopped with wings 45° to horizontal.
d. Roll left, stopped with wings level and aircraft inverted.
e. Roll left, stopped with wings 45° to horizontal.
f. Roll left, stopped with wings vertical.
g. Roll left, stopped with wings 45° to horizontal.
h. Roll left, stopped with wings level.

In the simplest terms, a fighter aircraft is only a launching platform for bullets, rockets, missiles and bombs. To achieve weapon accuracy, the fighter must have good basic stability, backed up by a precise control system. The smooth response of the Starfighter through an 8-point roll makes an impressive demonstration of its flight control system.

The Starfighter makes the difficult maneuver look impossibly easy. This same flight precision enabled the F-104 team to win the 1962 United States Air Force Tactical Weapons meet. In this "William Tell" competition, a lone F-104 outstripped all competitors in bombing, rocketry, strafing and aerial dart firing.

MANEUVER #5: **Rhubarb Roll**

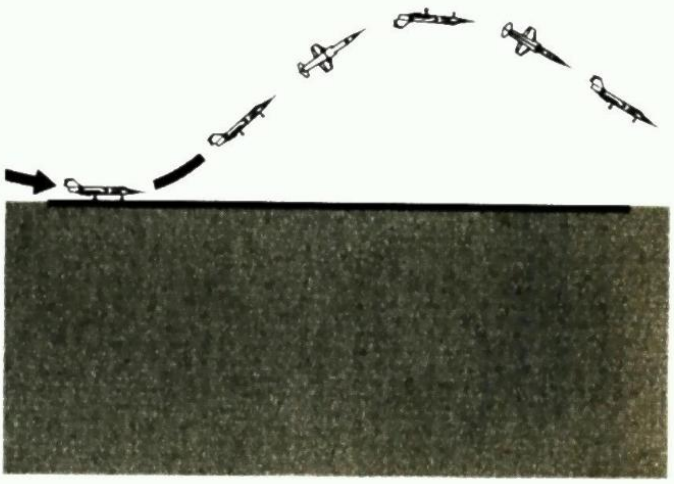
F-104 approaches end of runway at an angle, pulls up and is rolled 270° to the right and then stopped. A left turn is then made, aircraft rolled back level and second Rhubarb Roll started. F-104 is pulled up, rolled 270° to the left and then stopped. A right turn is then made and aircraft rolled back level.



To demonstrate the evasive maneuver capability of the Starfighter, Snake will next perform a maneuver called the Rhubarb Roll. He will roll the F-104 in one direction for 270° and then make a hard turn opposite to the direction of the roll. After turning, Snake will again roll the Starfighter in one direction for 270° and make another hard turn away from the direction of roll. By viewing this maneuver, you can visualize how difficult it is for another fighter to track the F-104, much less be able to fire on it with much accuracy. This Rhubarb Roll plus variations, is frequently used in air combat maneuvering to change the tactical conditions from a defensive posture to the offensive. This maneuver may force an attacking pilot to "overshoot" and find himself in front of the fighter he was attacking.

MANEUVER #6: **Touch And Roll**

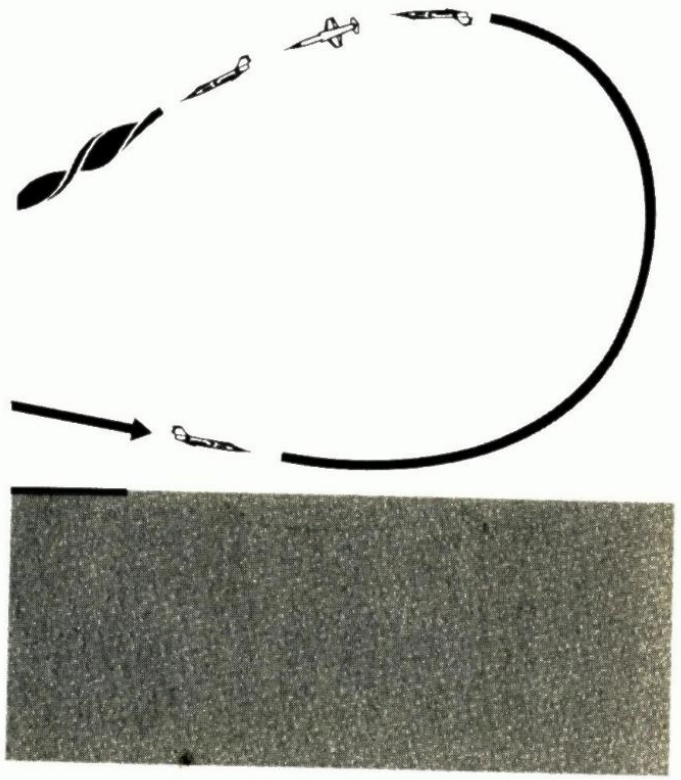
F-104 approaches runway on normal landing glide path with takeoff flaps and landing gear down. Upon touchdown, power is advanced to full afterburner and aircraft lifts off. After becoming airborne, the F-104 pulls up to a high angle of attack and then rolls, with the landing gear and flaps still extended.



Next, Snake will demonstrate what he calls his "Flying Safety" maneuver. He will make a normal landing with the Starfighter, then go to full power and pull up to a high angle of attack followed by a roll with the flaps and landing gear still extended. This will demonstrate the excess thrust and high-safety factor built into the F-104. There is enough excess thrust to enable the Starfighter to pull up at climb angles that would stall other aircraft; it can even slow roll from this attitude. The Starfighter is a forgiving aircraft because of its excess thrust capability. Following the slow roll, Snake will retract the landing gear and again demonstrate the quick reaction of the Starfighter by immediately going into the next maneuver.

MANEUVER #7: **Half-Loop With Rolls**

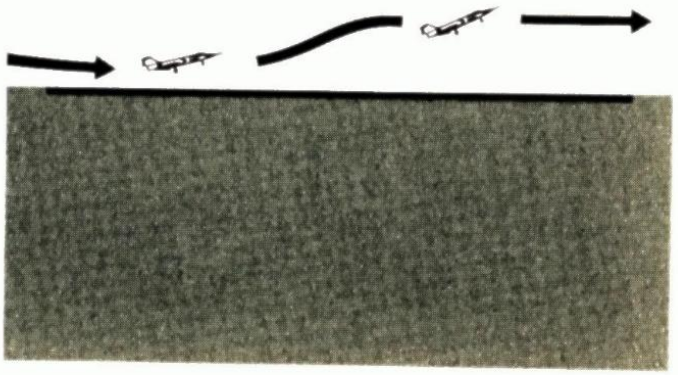
After landing gear is retracted, the F-104 will accelerate beyond end of runway and then pull up into a half-loop. On the topside of the loop, several consecutive rolls will be made as the F-104 now heads back down to the other end of the runway.



Following the low-speed touch and roll, Snake will demonstrate the rapid acceleration and turn capability of the Starfighter by flying a half loop and roll as he dives back to the other end of the runway. Once again, the amazing performance of the F-104 is graphically shown by these consecutive maneuvers.

MANEUVER #8: **Slow Flight**

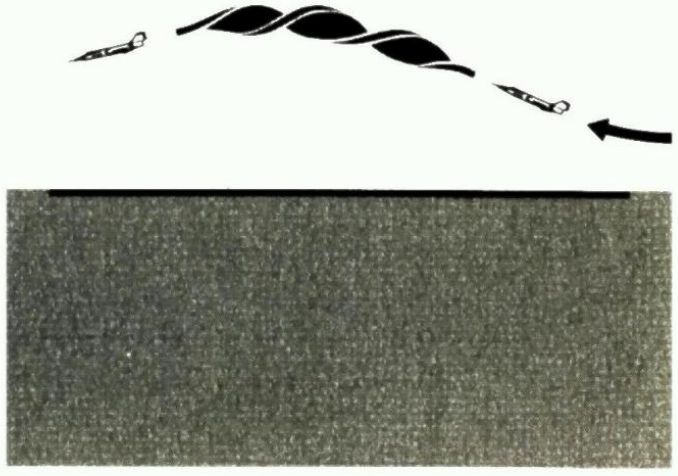
F-104 makes a normal approach and landing touchdown. After touchdown, power is applied and the Starfighter lifts off but flies at slow speed down runway with flaps and landing gear down. At the far end of the runway, full afterburner power is applied and low-level turn started.



Even though the Starfighter was designed for high-speed performance, it also incorporates good, slow-flight characteristics, for flight safety in the landing pattern. Snake will now make a slow-flight parade down the runway to demonstrate the excellent handling qualities of the Starfighter at an airspeed that is even below the normal landing-approach speed. Snake considers this simple "cake-walk" maneuver one of the most impressive abilities of the F-104. The astonishing amount of lift necessary to perform this feat is gained from the Starfighter's boundary-layer-control system which vents bleed air from the engine over the trailing edge flaps.

MANEUVER #9: **Corkscrew Rolls**

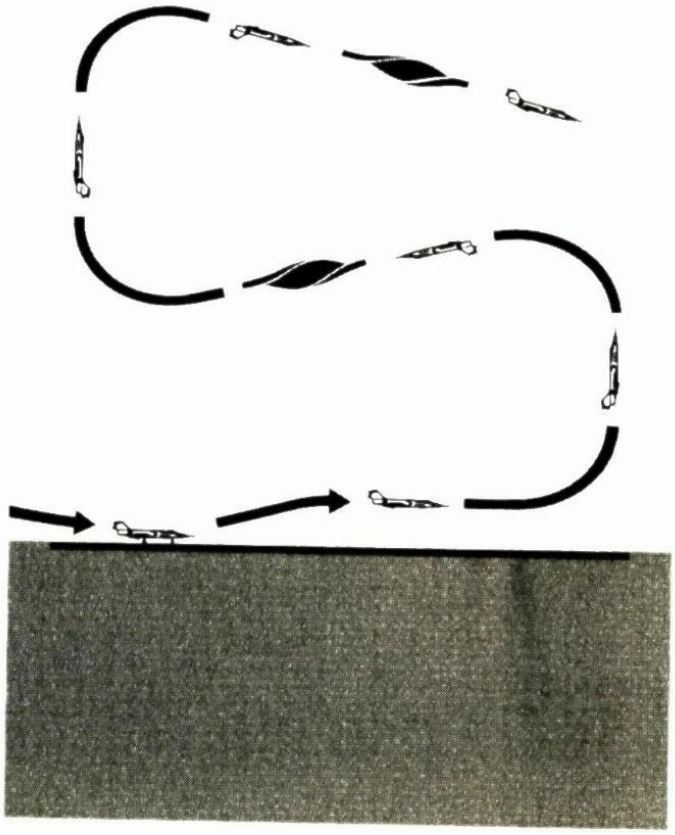
F-104 approaches end of runway at high speed, pulls up and executes several consecutive aileron rolls.



High roll rate is an essential feature in an air-superiority fighter. As the Rhubarb Roll demonstrated, the ability to perform fast rolls is required for defensive combat maneuvering. Snake will now demonstrate one of the most spectacular performance characteristics of the Starfighter. He calls this maneuver the Corkscrew Roll because the F-104 literally cork-screws through the sky and does so faster than any other fighter can.

MANEUVER #10: **Touch And Go With Double Immelmann**

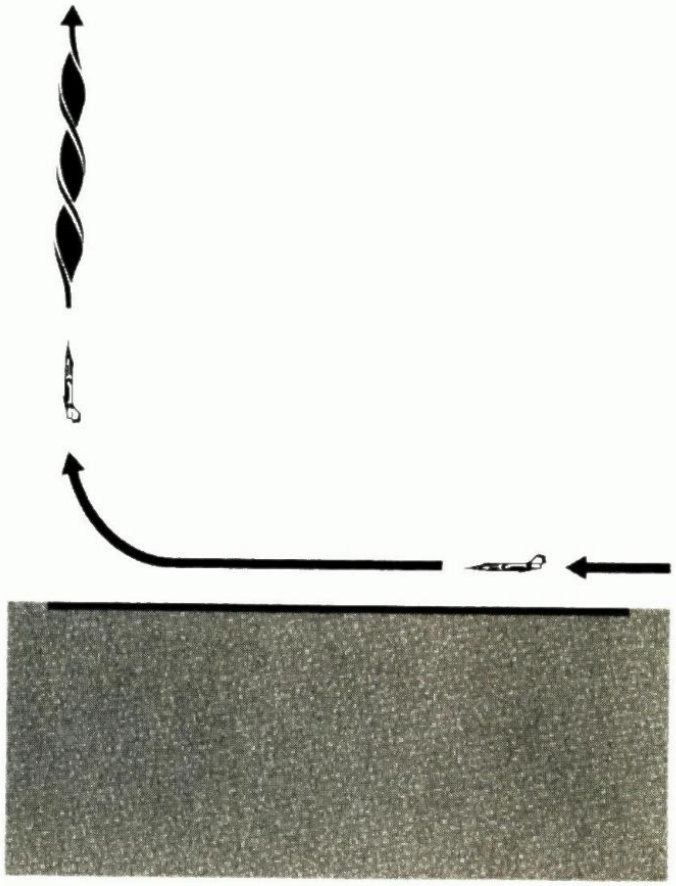
F-104 makes normal approach and landing touchdown. Go-around is initiated with full afterburner. At far end of runway, F-104 pulls up and performs two Immelmanns in succession.



The next maneuver is one that Snake believes can *only* be performed by the Starfighter. He will make a normal approach and landing touchdown. At touchdown he will apply full afterburner for the go-around, but at the far end of the runway he will perform a double Immelmann. The Starfighter is the only fighter in the world that has enough excess thrust to perform a double Immelmann from takeoff attitude.

MANEUVER #11: **High Speed Pass With Vertical Rolls**

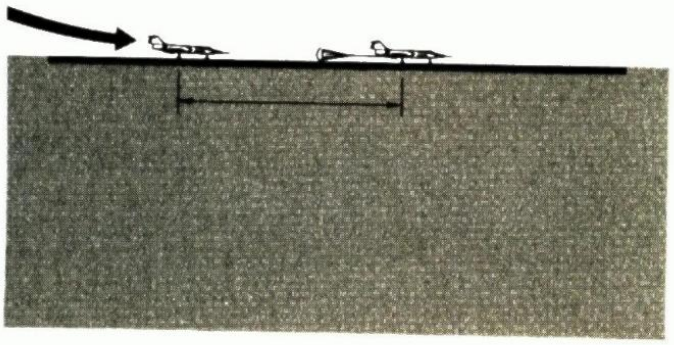
F-104 flies down runway with full afterburner on and accelerates to .95 Mach; then goes into a vertical climb and executes a series of successive rolls while climbing.



As a fitting finale to his demonstration, Snake will now perform a high-speed pass that is awesome to behold. As the Starfighter approaches, there is an eerie silence because it is beginning to outrun its own sound. Just after the Starfighter passes, you will hear the noise and fury of the F-104's General Electric J-79 engine. To keep from breaking the sound barrier, Snake will initiate a vertical climb to remain in the subsonic range. As he streaks skyward, he will execute some vertical rolls as a final salute.

MANEUVER #12: **Tactical Pattern With Short Field Landing**

F-104 performs old style tactical pitch and using the drag chute and maximum braking, the aircraft stops in a very short distance.



The final desirable flight characteristic for a fighter is its ability to land and stop in a short distance. Coming back down from altitude, Snake will now fly a tactical fighter pattern and make a short field landing that will only use about 3000 feet (911.5 meters) of the runway. This short stop is made possible through the combined use of drag chute and the excellent brakes on the F-104.

It is the sincere hope of Snake and Lockheed-California Company that you have enjoyed this demonstration of the F-104 Starfighter – the Free World's defender of the skies.

GLENN "SNAKE" REAVES' enthusiasm for the F-104 is based upon 20 years of flying experience. After serving in the U.S. Navy during World War II, Snake learned to fly jets in the USAF. His first experience was with F-84s. Then during his tour of duty with the USAF 49th Fighter Bomber Wing, Captain Reaves completed 125 combat missions in F-80Cs. Snake's military service earned for him the Distinguished Flying Cross, the Air Medal with eight oak leaf clusters, and his unit won the Korean Presidential Citation for valor.

After the war, Capt. Reaves returned to College, earning his degree in aeronautical engineering from the University of Southern California. But he didn't give up his love of flying; he served with the California Air National Guard, piloting many models of the unit's F-86 jets.

Since 1956, he has been associated with Lockheed-California Company, test flying and demonstrating the company's jet aircraft including T-2Vs, T-33s and all models of the F-104 Starfighter.

For ten years Mr. Reaves has travelled around the world to demonstrate the Starfighter's unique capabilities. He has appeared before audiences numbering in the hundreds of thousands and which have included heads of state, ambassadors, military leaders, government officials, and first-line fighter pilots.

Regarding the F-104, Snake says, "Until 'Kelly' Johnson* designs a tactical fighter that can outperform the F-104, I am perfectly happy with my second love – the Starfighter."

**Mr. Johnson is Vice President, Advanced Development Projects, Lockheed Aircraft Corp. and designer of the F-104.*