
# *FLIGHT TESTING THE CONVAIR F-106 DELTA DART AT McCLELLAN AFB 1984 -1986*

by Lt. Col. Dick 'Taz' Stultz, USAF (Ret)

Afterburner take-off: Vector zero-one-zero

I was approximately 17 minutes into my flight since take off from McClellan AFB in Sacramento (CA) and well on my way towards performing a standard functional flight test of a single seat F-106A model Dart that had undergone reskinning of its wing surfaces. My callsign was China 02, as Operations Chief of the Sacramento Air Logistics Flight Test Branch (SAC-ALC). Per the established procedure, the flight was flown in VFR (Visual Flight Rules: clear weather) conditions and the sun bore down noticeably bright through the Perspex of the canopy as I pointed the aircraft's pitot tube northward; in the distance lay snow-capped Mount Shasta. Climbing at Mach .92, or about 530 knots (600 mph), all the initial inflight checks had been performed and signed off. I had successfully completed a myriad of other 'checks' by turning flight controls, dampers, emergency generators, , fuel pumps, cabin pressurization switches and various instruments  to 'off' and then back to 'on' settings, verifying function of a dizzying array of warning systems and annunciators in the cockpit. Simultaneously, I was actively monitoring outside air traffic as I climbed out under Sacramento Approach Control's observation.

Negative Gs – pushover

Among the flight's scheduled tests, I had performed a *pushover* maneuver to one and a half Gs to see what sort of debris and dirt from the maintenance work remained in the cockpit (hoping that a wrench or heavy spiral notebook didn't suddenly rise above me) and checked for other loose equipment that wasn't secured. This was a very effective way to collect all that loose dirt in one easy catch as positive Gs were slowly restored by releasing the pushover stick pressure: *gently!* During this phase of the pushover, many of the warning lights suddenly illuminate and rudder effectiveness reverses; upon completion, hopefully all the warning lights go out and systems operate normally. At least the pilots who will be operating this aircraft in future against a simulated aggressor during some high-pressure air combat exercise will not encounter any unsuspected failures that could have (but should not have) occurred during a negative-G maneuvering test (an unpleasant surprise one *doesn't* need to experience in critical maneuvering areas of the performance envelope).

Touring Northern California

My flight profile was a standard counter-clockwise loop around northern California that imposed extra challenges on the radar control facilities because it required me to climb rapidly through altitude and airspace (used by various agencies and other fliers) and included a supersonic speed run aligned in a southward direction from Trinity Lake towards the San Francisco Bay Area (specifically Lake Berryessa), finally culminating in a zoom *maneuver* to 45,000 feet with a subsequent spiraling down to a low fuel state recovery at McClellan. The test flights are generally completed from take-off to landing in only about 22-35 minutes, due to the high fuel demands of the Mach run. The aircraft's kerosene based JP-4 fuel burns out rapidly in afterburner mode. Depleting at a rate of about 60,000 pounds of fuel per hour, the F-106 carries only 9,000 pounds of internal fuel so there's little margin!

The FAA directs the *Cadillac*

As I began a left turn southward into my vertical airspace block of from 35,000 to 50,000 feet altitude, Oakland Center advised me of large commercial air carriers passing on the nearby north-south air routes between Seattle, points north, and Los Angeles and other points south. Commercial flights, typically cruising at about 30,000 to 35,000 feet leave contrails that typically dissipate in warmer months, but during colder winter months are clearly visible as long white strings long after their passing. In-flight visual references to other aircraft, contrails, and cloud formations at such moments present the only real sense of speed at altitude, while references to ground features occur even more deceptively. At its best maneuvering airspeed of about .93 Mach, the single engine F-106 slices cleanly and rapidly through the turn. Its area-ruled fuselage (commonly referred to in the 60s as being 'coke bottle shaped') and advanced NACA *case 29 airfoil* wings (copied by the French for their *Mirage* series of fighters) helps minimise external drag, resulting in exceptionally clean aerodynamics.

Although 25 years old (as of the mid 80s), the aircraft I was flying was still as formidable as its production block forbear that had set the world's single-engine speed record back in 1958 (over 1,565 mph, a record that still stands today). The F-106 design, by Convair (formerly *Consolidated Vultee Aircraft*), was regarded by those who flew *Sierra Hotel* ("s**t hot", in USAF parlance) fighters in the 80s as the *Cadillac* fighter of its day. Amazingly advanced for its day, among its state-of-the-art innovations an early F-106 flight test prototype had even tested a side-stick controller system (much like that used in its present day F-16 counterpart). Other advanced aspects of its design were found in internalised armament storage very similar to that later featured in the F-117 *Nighthawk* (stealth fighter) and F-22 *Raptor*. The twin external wing-mounted auxiliary fuel tanks normally carried on active ADC service were supersonic rated; I once exceeded Mach 1.8 with the tanks installed, a feat unheard of among F-4, F-15 and F-16 pilots.

Speeding and *maching* around

Finding the coldest level above FL 35 in which to perform the mach acceleration test, we pilots thought it was really cool that we could access the aircraft computer to give us the outside air temperature. Usually the external ambient temp at altitude ran at 48 to 56 degrees below zero F, but in the winter, temperatures from the Siberian highs could sometimes bring that down to the minus 60 range. At those temps, the Six really liked to accelerate and the computer generated Mach indicator that usually rested on about Mach 2 would drift on out to higher speeds. On one occasion at minus 72 degrees, the Mach limiter indicated Mach 2.21! On that day the aircraft accelerated faster to Mach 1.2, 1.5, 1.8, and 2.0 faster than any other occasion and fuel remaining indications were much higher than anticipated. In speaking with the pilot who had set a world's speed record in the Six, Col. Joe Rogers, he confirmed that he had accelerated to Mach 2.43 on one leg and then returned on the second leg to achieve Mach 2.41 in the opposite direction. That's *really* smokin' in any single engined aircraft, even by today's standards!

## The speed of heat

Entering any Mach run increases the pilot's adrenaline proportionate to the rapid speed increase, as fuel decreases dramatically and the potential for something to go wrong is compounded. This acceleration causes fuel to shift aft, along with the center of gravity, as Mach is approached. In the Six, as in most aircraft, there was no palpable sense of having passed through the *sonic barrier*—except for very slight visual perceptions of shock wave lines passing after along the canopy and a slight jump in the altitude and airspeed indicators. As speed increases, the nose of the aircraft lowers and stick pressures become sluggish. The Six's steel forward canopy splitter frame took began to take on more air flow and pressure around the clear upper canopy became excessively noisy. [When the same Pratt & Whitney J-75 engine had been tested by the US Navy in their F8U *Crusader*, tests had to be stopped because the canopies absorbed too much heat, becoming softened to the point of possible collapse!]. At Mach 1.2 some of the fuel transferred to allow better aerodynamics and the variable inlet ramps (AKA: 'vari-ramps') began to extend to keep supersonic air from flowing into the engine. The bright yellow 'Max Maneuver' light came on when the skin temp reached 249 degrees F and every well informed Six driver was supposed to understand that at that point the aircraft's physical structure was 'getting soft'; any excess input by the pilot to the control stick at that critical part of the flight performance envelope might permanently disfigure this expensive 'national defense system'. I recall actually seeing what were the beginnings of a ripple effect in the leading edge of the F-106's Perspex canopy more than once, while flirting with *that 'do not fly beyond'* limit.

## Goodbye fuel, hello *stall buzz*

During any test flight the clock is monitored to verify acceleration times to various speeds and a lot of focus is placed on the sole fuel-remaining indicator. As total quantities of fuel decreased, the pilot needed to manually select left or right positions on the selector to determine left and right wing, and #3 tank (always a critical indication due to the fuel pumps being located in the #3 tank) quantities remaining, With over 85 valves, floats, and gravity dependent actions, the fuel sequencing became critical to survival because one particular failure had happened on more than one occasion in the past. This involved a couple of float-activated fuel value failures, resulting in fuel being trapped in one wing (and thereby inaccessible), meaning that total fuel available was approximately 1200 to 1500 pounds less than indicated! This could be particularly disconcerting, as above Mach 1.8 pilots were told not to move the throttle forward or aft, since stall-buzz was likely to occur in the engine. Why the aerodynamicists selected stall-buzz as the operative term is beyond me, because the moment you had encountered stall-buzz it was normally too late to do anything more than savor the resulting heart-stopping experience that ensued! But let me explain that delightful anomaly a bit further.

## Whoa Nellie!

Any time a pilot is thrown forward into the shoulder straps, thoughts of having a bad day begin to occur and the face of your nearest friend, spouse, or family member appears briefly, followed by a loud banging sound that persists rather alarmingly. On the Six, this attention-getting sound has been compared to someone dropping large metal gym lockers down the concrete stairwell of a large, high-rise sky-scraper. It is accompanied by a sudden sideways yaw of 10-20 degrees (the immediate sensation seems to be that of going sideways) as the engine has just attempted to swallow supersonic air, regurgitated it at a very high speed and sent the air backwards (forward) out of the intake. All this while the onboard computer tries to figure out what's going on, tightly shutting the *vari-ramp* on one side of the fuselage, while opening wide the *vari-ramp* on the opposite of the aircraft.

The *'bam-bam-bam'* noise of this sequence of events continues as the aircraft slowly decelerates; warning lights are flashing everywhere and the aircraft seems to be bucking with the un-harnessed energy of a wild stallion (at night, the shocks being sent forward appear as fireballs, reminding one of some sort of George Lucas *Star Wars* weapon device…*cool!*). Kicking rudder to align the fuselage with the slipstream helps to reassure the pilot that he is still in control, but pulling back on the throttle quadrant does nothing at all until the speed decreases below Mach 1.5 (sometimes persisting to below Mach 1.0). While pilots will invariably declare an emergency and assuredly get a lot of irrelevant assistance from ground control on their first experience with this phenomenon, the event is not that uncommon and is actually an accepted circumstance that merely requires some rudimentary corrective maintenance upon landing. Usually this 'corrective maintenance' takes the form of an adjustment to the intake *vari-ramp* computer, the *vari-ramp* drive system, or a centerline realignment of the engine. Sometimes all that is needed is a polishing of the internal air conduit surfaces of the intakes themselves!

After the work has been completed, the aircraft is invariably ready for flight again the next day, the problem completely resolved, and once more certified to be flown at higher speeds. No actual damage occurs to the airframe or engine when stall-buzz sets in at altitude and speed, but had the condition occurred at altitudes below 20,000 feet it could have been…what's the best way of putting this?...*catastrophic*. I am reminded that Ol' Col. Rogers once shared with me the fact that he *never did* get used to those stall-buzzes.

Higher, but less pressure

Achieving the desired speed in the desired time with proper sequencing of fuel, the major portion of the 'Six' flight test is now complete and you have to slow down, but you can't touch the throttle above 1.8 Mach, so....? Begin slow backpressure on the control stick and the F-106 zooms up, just as in the earlier days when zooms over 50,000 and sometimes 60,000 feet were allowed to slow the aircraft down. However, after more careful consideration, the time-of-useful-consciousness (TUC) limit of three to nine seconds above 45,000 feet for such maneuvers was determined to pose too great a risk and the regulation permitting zooms was consequently rescinded. Pressure suits of the type used in the SR-71/U-2 programs are a must.

Looking into the rear-view mirrors mounted on the canopy bow and watching the bright white contrails leaving their undeniable record of where you've just been is an awesome sight, as the slightest input of finger pressure or rudder wiggle leaves wavy ripples in the snake trail the aircraft is leaving behind (and below) it. You can corkscrew that presentation with some back-stick and some rudder, look back and see the spiral; tighten the pull or rudder and the spiral tightens. Just a few seconds of vicarious pleasure can thus be stolen from the work routine to *enjoy the 'place'*.

Can I get down (and go home now)?

Slowing down below high Mach, it is now time to verify with Oakland Center that you are ready to come down as you un-corkscrew and bend the contrail eastward toward the general vicinity of McClellan. The long ribbons of concrete runway and buildings contrast visibly against the agricultural patterns of the Sacramento valley. Floating upside down for a better view and still decelerating, one can see nearly 400 miles in all directions: eastward to the arid desert areas of Nevada and westward to the cloud covered Pacific Ocean region that lies beyond the Coast Range. Airspeed of only 230 knots indicated but still at Mach .97 at 50,000 feet means you can fall rapidly out of the sky, straight down to McClellan…which is exactly what Oakland Center usually *wants you* to do, to get you out of their ATC hair. However, care must be taken to not get too fast pointed downwards, as carrying a supersonic shock wave experience to the population below can have predictable and unpleasant consequences.

Then too, if you get too extreme a descent angle the already low fuel status may be so low as to uncover the pump intakes in the critical number three tank and *P*O*O*F*…flameout city! I think the tech order (TO) says *"…it will take up to four minutes to accomplish an engine restart after experiencing a flameout from fuel starvation",* but I can't even imagine a pilot who would hang around for four minutes while dropping at a rate of 5,000 feet per minute (unless he did it under a parachute canopy)! If the Six did flameout, I would have to position myself directly over McClellan AFB at about 12,500 feet in order to make just *one* safe 360 degree spiral down to an acceptable *dead-stick landing*. And getting Approach Control authorisation to practice a few of those 'simulated flameout' approaches at McClellan typically took a Congressional amendment (at least) and likely a further EIS endorsement from the Sierra Club, as well (probably the same problem all Air Force bases experience these days, given burgeoning urbanization in major population centers).

Final approach & debriefing

Setting up on final approach to land a Six, it is important to ensure the *Instrument Landing System* (ILS) is functioning normally, as the ADC pilot who will arrive at McClellan to fly this ALC maintained aircraft back to its home base will undoubtedly reply on this system to penetrate the rotten weather typically associated with the Northern Tier and Coastal bases that fly the ADC (Air Defense Command) 24-hour, all weather air defense mission. As I let down, I am gratified (but no longer amazed) to find that every aspect of the Hughes/Sperry automatic pilot control feature is operating perfectly. This was not characteristic of my experiences in the Six, back when I first flew the aircraft in 1968. Airplanes coming back into service after ALC maintenance at McClellan today were by far much better and more reliable than those I flew in the 70s. On the deck and completing the mission debrief with the maintenance folks, the aircraft's four months worth of ALC attention typically culminated in a normal flight with no discrepancies.  That's a pretty good statement coming from an officer who had once gained a rep for writing up airplanes with dirty windscreens, poorly waxed fuselages, and unpolished hubcaps! The mission thus ended, I'd return to the Flight Test Office and wait a few days for the keys to the next completed F-106 Delta Dart to be handed over to me and off we'd go again for more junior birdman thrills and chills in the Stratosphere!

With over 3250 hours in the Six and the benefit of many such experience as the above, I have no doubt that I'd be able to get in the bird and fly her again today….if I could just squeeze back into the required Weber force-deployed, back style parachute!

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[Note: This article was originally put together in 2000 for the newsletter of the *Aerospace Museum of California*, looking back to the mid 80s ADC period. It is worth mentioning that *Taz*, the author of this piece (and notorious for his vastly amusing 'nose art' creations that frequently adorned some F-106 squadron birds participating in the 'William Tell' annual ADC Fighter weapons competition, conducted at Tyndall AFB, FL), is an artist of note who is still known today for his serious art, as well as his unique cartooning abilities. Dick Stultz is a personal friend and fellow emeritus board member at the *Aerospace Museum of California*, in addition to serving as present chapter president of the Air Force Association's *Sacramento Claude Farina/Gold Rush Chapter*. I can't help but reflect that it would take a true artist to *draw* (pun intended) a parallel between doing a sobering Mach climb flight test and engaging in an aesthetic creative act, such as is referenced towards the end of this most interesting first-person account of flying the fabulous delta-winged *'Ultimate Interceptor'* (a sobriquet reserved solely for the Convair F-106 *Delta Dart*. You simply don't find many artists who fly *Sierra Hotel* fighter jets these days (or who pilot spacecraft), although art and military science would not be resources mutually exclusive of each other for inclusion in any worthy modern renaissance man. The image below shows the *Maestro,* Dick Stultz, in his ADC hay-days.]

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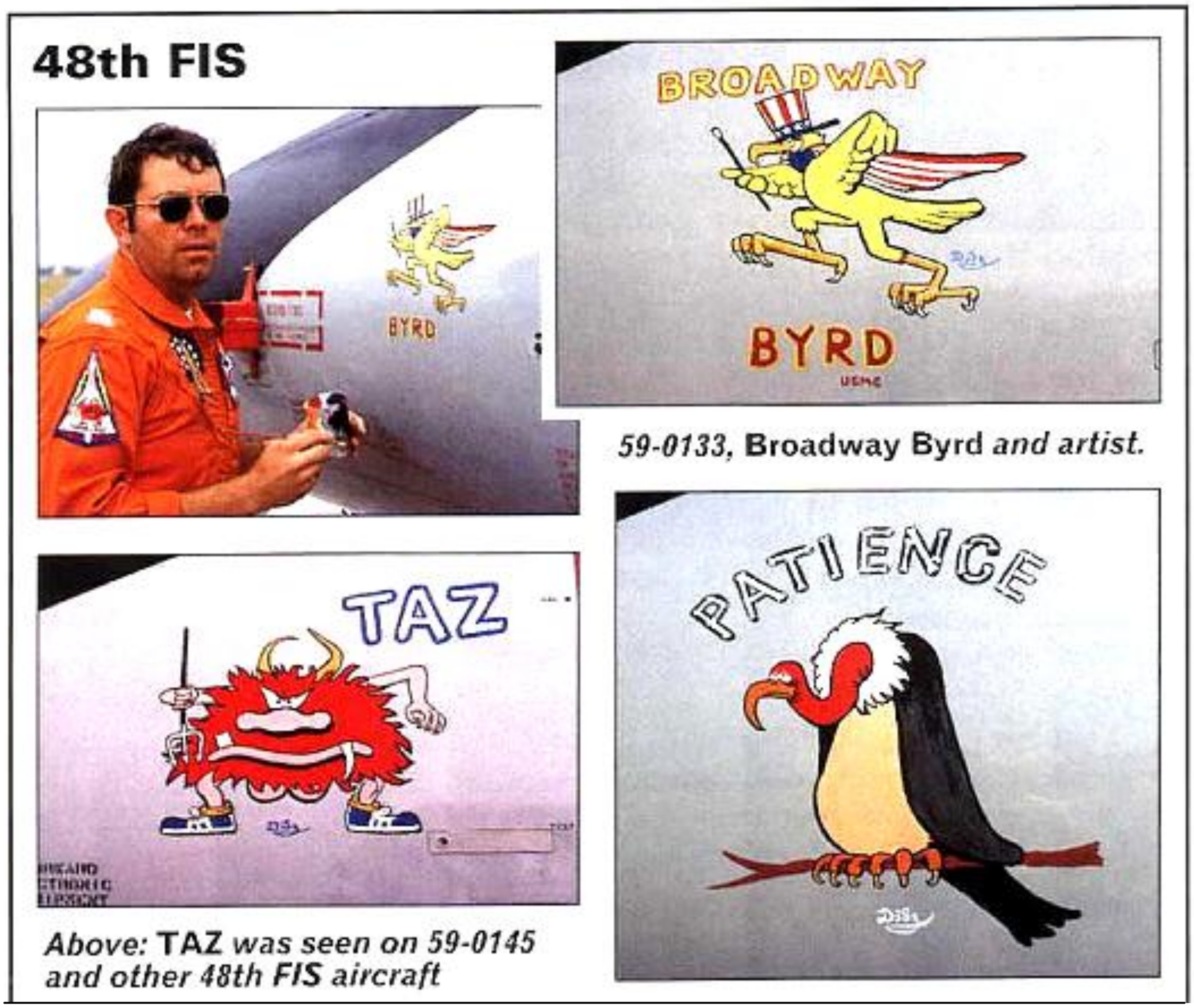
# 'Six' nose art

**Examples of colourful F-106 nose art are associated particularly with the William Tell competitions of the 1970s and 1980s. Designs often followed a squadron-related theme – for example, the 'red bulls' of the 87th.**




*59-0133,* **Broadway Byrd** *and artist.*

*Above:* **TAZ** *was seen on 59-0145 and other 48th* ***FIS*** *aircraft*