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"455-Forever"



"455-Forever" F-106A 56-0455

Convair Flight Test Stress Testing F-106A 56-0455

By Robert L. Limes, Convair Flight Test Computer Engineer

FORWARD

I was involved as an analog computer engineer/programmer in the F-106 Fatigue Test program in Convair's Flight Test group back around 1959-1960.

Conclusion at end of analysis:

"Nothing short of a crash will ever destroy an F-106."

Well, it looks like that was the truth - our old "455-Forever" crashed in 1969 [after surviving all testing]!

MY STORY

I first encountered the F-106 when I was a college student summer hire in the Convair Analog Computer Facility. This was my second summer there (1955) and I had graduated from filling strip-chart ink wells to more technical tasks (after all, I was about to enter my senior year!). I learned that the big steel box on one side of the lab was some kind of flight control system for the F-106 and that we were simulating the

airframe of that aircraft. If you are not familiar with analog computers, here is a brief description:

The main component is a high-gain, direct-coupled amplifier (vacuum tube, in those days). With resistors on the input and a capacitor in the feedback, it would do the math operation of the integration of the sum of the input voltages. Wire these babies together and you could solve second-order differential equations in real time (or faster!). The control console had a large vertical bay with a myriad of little contacts. A patch board, with plugged-in cables, could be mounted in that bay so that the patch cords could connect the contacts to each other. Those contacts, of course, were wired to the various electronic components behind the console (or, as with the amplifiers, down in racks on the lower floor). The simulation used voltages as proxies for such quantities as acceleration, speed and position. Potentiometers allowed the use of fractional values (the amplifiers had gains of either 1 or 0.1), so one could, with proper patching, set up the solution of something like $A \frac{d^2x}{dt^2} + B \frac{dx}{dt} + Cx + D = 0$, where A, B, C, and D are any fractional constants ... actually, unlike the simple problems in your calculus class, they could be time- or position-varying functions! Ever hear of "non-linear differential equations"? The various output voltages could be routed to strip-chart recorders or put on oscilloscopes for analysis. We did not have graphics terminals, at that time. Input signals could be programmed into the simulation or could be from such devices as a throttle or joy-stick. If the problem involved atmospheric density at various altitudes (for instance), a programmable function generator could be hooked into the simulation. The multiplication of two output functions could be accomplished, too. So, you see, the analog was a very versatile computer. We could actually fly a simulated aircraft that felt (even to an experienced pilot) like the real thing.

Enough, already ... that is probably more than anyone today wants to know about the computing capabilities of the 1950's! Needless to say, as the digital computers of that time were plugging along, struggling with book-keeping and such, the analogs were really flying!

Using this computer simulation, the aerodynamic engineers could study the actions of the F-106 under a myriad of internal and external conditions. Flight control systems could be tweaked; even physical characteristics of the air-frame could be modified.

I think it was in my senior summer break (1956) that they had begun to deliver the F-106 to Edwards AFB. Our building was near that corner of Lindbergh Field (San Diego), near where commercial planes now sit before take-off. We could hear the jet's roar as the ferry pilot pulled into the waiting area. Then he would wind up the turbine, throttle it down, wind up again ... repeating this until he was satisfied with the sound (sometimes NOT!). Then, off he goes! About half-way down the runway, he would hit the after-burner and go up like a sky rocket. The little chase plane never stood a chance of catching him!

After a year of graduate school (but no longer happy with looking forward to a career in so-called "research physics"), I returned to my old job in the Analog Computer Facility. Things got a lot more technical and tasks more in the area of analog device development. Lots more fun that scribbling arcane equations on a black board! I had (in the view of my boss) become adequately proficient in the area of computer development that he transferred me over to the Flight Test Group. They were tasked with analyzing the possibility of the F-106 going to pieces because of stress fatigue. They had an aircraft to play with (tail number 0455) and lots of telemetering capability, but no computer to do the analysis. So, my task was, in consultation with the aero engineers, to design a computer and program to do this. We decided on a single-console machine with all the bells and whistles

then available. We were going to be doing power spectral density analysis on a number of input signals at once. These FM-multiplexed signals came from a one-inch, 32-track tape which got its input during the aircraft's flight via telemetry. These signals were passed through devices called discriminators, which turned the FM signals into analog voltages representing the physical values of the instruments on the aircraft. Just about everything on the aircraft had been instrumented ... strain gauges, accelerometers, etc. scattered about on the wings and fuselage, cockpit gauge readings, pilot input, etc., etc., etc. We were expected to correlate inputs and outputs and such, hoping to define how much strain was being put on the air-frame by such things as turbulence and sudden maneuvers. The military wanted an estimate of how many years they could fly what was now the fasted jet in the air.

To make a much longer story short, I never got close to nor even saw 455. However, we heard lots of stories about her from the pilot and from the ground crew. One such was about our attempts to see how a carrier landing would shake up the aircraft. Miramar Navy (now Marine) base had a simulated carrier landing area with all the trappings of a real carrier. Navy pilots were trained here to bring their aircraft down at a steady descent, right to the deck ... no last moment flare! This put quite a jolt on the air-frame. Our test pilot was retired Air Force ... that was just not the way to land! Every time he attempted a landing there, he flared out at the last moment. So we never got that data input. After all that flying and analysis, the final report was written. In summary: "Nothing short of a crash will ever destroy an F-106!" Unfortunately, that is how 455 ended, killing the pilot.

My last gasp with the F-106 (and with the aircraft side of Convair) was in evaluating the performance of that aircraft in the SAGE program. Interesting, at first, but soon got boring. We manually plotted the tracks of the target and pursuit aircraft in many, many test runs. A call

from the new Convair Company, Astronautics, put an end to my stint in the aircraft industry. Their new Analog Computer Lab needed computer knowledgeable engineers. So, off I went into a new venture. End of my association with the F-106? Not quite.

After some years of retirement, my wife and I moved (in 2018) to a nice independent-living apartment community in La Quinta (south of Palm Springs). About a year ago, with a group from our residence, I toured the Palm Springs Air Museum. They have a wonderful display of both older and newer military aircraft.

I asked a docent if they had an F-106. "Well, yes, sort of. It's in pieces back in the shop." Not a chance of viewing it ... darn!

Then, just this week [30 May 2019] we visited them again. "Why yes ... it's out on the tarmac in front of the hanger. Would you like to see it?"

'Nuff said! There she was, F-106B tail number 57-2509, with the beautiful blue and white B-1 Chase logo on the tail.

Wow, I finally got to approach and even touch this wonderful aircraft! This is how I happened to do more digging and found out about the fate of 56-0455

[https://www.f-106deltadart.com/db/acft/acft_view.php?editid1=336].

So sad! I often think about that aircraft and those that we heard and watched take off from Lindbergh Field. This was a really big part of my early career in computers and simulation.



F-106B 57-2509 on static display at the Palm Springs Air Museum, Palm Springs CA.
Here she sits on 25 May 2019 within days of being 100% completely restored.
Read more and photos <https://www.f-106deltadart.com/piwigo/index.php?/category/494>