

by Kevin R. Dingman

Paper Airplanes

Once in high school my English teacher had me “write sentences” as punishment. You know, write 100 times: “I will not talk out of turn in class?” I’d been caught throwing (who’d-a-guessed) a paper airplane in class. If I hadn’t constructed it so well it may not have been airborne long, and my transgression would have gone undetected. It was, however, and remained aloft long enough to be seen by all.


I was already learning to fly real airplanes by this point in high school and all my classmates knew it. So my response to the teachers query predictably drew quite the cheer, despite his angst.

I’m a Test Pilot

Being the wise guy that I sometimes still am today, my response to his question of “Why’d you throw that?” was quite proudly: “I’m a Test Pilot.” Yep, I had to write 500 times, by tomorrow: I-am-a-Test-Pilot. No contraction and use capitals in the title. One hundred sentences was the norm, but he was upset with me to the 500-sentence level. Now that I think about it, I had to write sentences a lot in school. I enjoyed writing them. Some kind of psychological thing is still with me today, fill-in lines in the logbook, track stocks, make lists and check things off, write stories.

Motivational speakers tell you if you say something positive about yourself over and over it will help keep you motivated until you get to that goal. I didn’t need the 500 sentences to motivate me, but they

High Flight



Oh, I have slipped the surly bonds of earth
And danced the skies on laughter-silvered wings;
Sunward I've climbed, and joined the tumbling mirth
Of sun-split clouds – and done a hundred things
You have not dreamed of – wheeled and soared and swung
High in the sunlit silence. Ho'ring there,
I've chased the shouting wind along, and flung
My eager craft through footless halls of air.
Up, up the long delirious, burning blue
I've topped the windswept heights with easy grace
Where never lark, or even eagle flew.
And, while with silent, lifting mind I've trod
The high untresspassed sanctity of space,
Put out my hand, and touched the face of God.

- John Gillespie Magee, Jr.

didn't hurt. Glad he didn't have me write: “Airplanes Cost Too Much.”

Looking out the side of the tinted canopy, I watch as the airport below me drops away at over 50,000 (yes five-zero) feet per minute. Visibility today is at least 100 miles. The distant horizon is in view beyond the mountains of Vegas within two seconds of the 6g pull I had initiated a moment ago, and 90 degrees from its previous position. Glancing at the artificial horizon, the airplane symbol is fixed in the little round section that shows straight up – the exact center of the blue.

I'm by myself in the most modern single-seat, single-engine jet in the world, letting more than 25,000 pounds of thrust push me up, for the moment, faster than the Shuttle and faster than Apollo. My thrust-to-weight ratio today is almost 1:1. I'm in a vertical climb and barely decelerating. Yes Goose, we're going ballistic. Talk about making the sun rise and set with my gloved hand. Holy crap, is this fun or what!

It Needs Somebody to Wring It Out; Twist My Arm

This day, I'm not a Test Pilot; I'm the squadron FCF Pilot (Functional Check Flight Pilot). I fly with the 430th Tactical Fighter Squadron Tigers, 474th Tactical Fighter Wing, Nellis Air Force Base, Nev. This F-16 has a newly installed motor from Pratt, and it needs somebody to wring it out. Twist my arm. Fifteen seconds ago I had pushed the single throttle forward to MIL power, checked the gauges, then rotated it slightly outboard and shoved it the rest of the way to full AB. That's the way us fighter guys say it by the way. MIL is short for Military and pronounced “mill” as in sawmill, and A-B (said as two letters) is Afterburner.

MIL is full power and AB is full power plus a bunch of raw fuel dumped into the exhaust section just after the last turbine section, then lit on fire. At night you can see a 30-foot plume; and the sound is ... the sound of freedom.



The F-16 has five stages of AB and one of my jobs today is to make sure all five will light. It happens fast so you have to know what to listen for and, more accurately, feel for. Five distinct kicks in the hind-end. The only indications in the cockpit are the exhaust nozzle position going full open and the fuel flow gauge pegging off scale high; close to 60,000 pounds per hour. At \$2.50 per gallon that's about \$6.25 per second.

I'm Going Straight Up Over Government Property

Somewhere close to 150 knots I apply very slight back pressure on the side stick (that only moves a half inch total) and the jet's in the air as I reach for the gear handle. I release the back pressure on the stick so little that it's more like a thought than an action. I'm level at 20 feet accelerating above the hot desert runway; I can see the heat waves. If I let it continue, I'll be supersonic by a half mile off the end of the runway and out of fuel in seven minutes. Not today though. For this takeoff my goal is to get some energy as quickly as possible in case something bad happens, and keep me, my jet, and its pieces-parts on government property if it does. At 350 KIAS I pull back on the stick again – this time to 6g's. The back pressure on the stick to get to 6 g's is less than five pounds. I'm going straight up over government property.

By the time I've watched the altimeter spin for eight seconds

it's time to pull over onto my back at 15,000 feet then roll upright. I pull the throttle out of AB, check the engine gauges again, point my nose toward the MOA and slow my climb to 8,000 feet per minute. I'm headed for the FCF area and a working altitude of 25,000 feet. I'll cruise out there at about 350 KIAS. So far I'm one minute into the flight. Another five and I'll be in the MOA, at altitude. This new motor is ... awesome.

Now, there is something you have to realize about these FCF flights. Remember the scenes from the movie *Apollo Thirteen* where they're trying to power up the spacecraft and get it oriented for re-entry after it had been cold-soaked for three days? Hundreds of checklist steps all done in a precise order? That's kind of the way the FCF profile goes. You have about 10,000 things to do and check, and you've already used up a third of your gas just getting off the ground and to the test area.

Most Guys Never Get North of Mach 2

As soon as you hit the test corridor you plug it back into burner and do the speed check. By the time you get to fly the F-16 you've already been supersonic a few times so that's no big deal. Most guys never get north of Mach 2 however, except FCF pilots that is. The actual speed I'm checking is classified, but it's on the checklist to verify that you can get to it. The

new motor does it easily. It's also at these speeds that the stablator starts to also work as a "taileron" taking over from the flaperons.

Now, for you aero folks (short for aerospace engineer) and RC builders, the stablator vs. elevon vs. taileron debate is ongoing. We F-16 guys used to say stablator when the true engineering name would be elevon. In the 16, the "horizontal tail" is actually a combination elevator, stabilizer, and aileron. So taileron, elevon, and stablator all are correct. In any case, what ever it's called, it's a "made-up" word. Made up by you aero people.

In the style of professor William Strunk Jr., who coined the word "studentry" over student body, I though maybe I'd make up a new word to describe the horizontal tail functions. *Staba-later-on!* Pronounced Stabalator with "on" added to the end. Take the hyphens out when you quote me. "I respect a man who knows how to spell a word more than one way." (Mark Twain) It's not a Bonanza rudervator though. The F-16 has a "mostly" normal rudder. It's controlled by the computer, including correcting for yaw when you shoot the gun.

The next step is one we fighter guys used to call a "gut-check." If the test fails you have to restart the motor – if it will start. The engine has some self-protection features (i.e. pilot-proof) to prevent it from "blowing out" if the commanded fuel flow drops off while the airflow is still large. That's what I have to check. At Mach 2 plus, the airflow is large.

The test is to briskly pull the throttle all the way from full AB to idle. If it blows out, you wait until you're subsonic and restart it ... maybe. Or worse, if the IGV's (inlet guide vanes) "flat plate" and severely limit airflow through the engine, you will kind of explode due to the back pressure in the long inlet to

the motor. Bummer. Today it works; thank you Lord.

You Can Feel Your Innards Move

As I slow to subsonic I have to check the over-g limit ability of the flight control computer. It should allow you to pull as hard as you want, as quickly as you want, and not let the jet go to more than 9g's plus-or-minus point four g's. As soon as you drop to subsonic you roll to 80 degrees of bank and quickly pull; about 25 pounds of pressure on the stick. The g-suit squeezes the crap out of you and you push back to stay conscious. A lot of people have said to me over the years that it must be fun to pull 9g's. Nope, 9g's hurts. You can feel your innards move.

If you know anything about GLOC (g-loss of consciousness, pronounced g-lock) you know that the "onset" rate is a major factor affecting whether you black out or not. That means how quickly you

go from 1g to 9g's. The nerve cluster in your upper neck that makes you wake up from a dream when you think you're falling, or makes you gasp when you feel zero-g unexpectedly, is the same one that tells your heart to beat faster when you pull g's. The function is to increase your blood pressure allowing you to stay conscious and to keep most of your vision. This cluster however isn't meant to react to an instant 9g's; there's a delay. Thus the g-suit and the need for your physical reaction in preparation for the g's.

This test requires an *instant* onset rate to verify the computer can catch the impending over-g. Not good for the human body. We lost a handful of F-16 guys because they blacked out at some point in a mission – usually due to high onset rates and ran into the rocks. The good news is you only have to hold 9g's for a few seconds during an FCF.

Doing the Test Naked

At the end of the max-g check you've used up a bunch of energy and slowed to less than 300 KIAS. This sets you up for the next gut-check. The flight control computer has another pilot-proof feature; it shouldn't let you stall – ever. If the F-16 is stalled, it tends to go into a "deep stall" or "deep spin." Picture a falling leaf with the nose pitching up then down, then up, etc. Usually unrecoverable.

The stall is so potentially dangerous they put a special switch in the cockpit called "manual pitch override," or MPO. Pushing this switch gives you extra stabalator (*stabalateron!*) travel to help increase the amplitude of the pitching moment in the stall. Hopefully the extra amplitude in the down direction will be great enough to "fall" out the bottom of the cycle and accelerate to flying speed. This part of the flight envelope was tested at Edwards in an F-16 with a spin chute attached. Today I'll be doing the test naked (no spin chute).

When you reach the point where the flight control computer steps in to "help," you're supposed to get a tone in your helmet followed by something like a stick-pusher in a civilian jet. The stick in the F-16 is unaffected, but the *stabalateron* moves. You fly the test by pulling the jet into a 60-degree climb at low power, then watch what happens. If you maintain a constant 60-degree angle of climb using the flight path marker in the HUD, the AOA (angle of attack) increases as the speed bleeds off. As an FCF pilot you have to let the jet go all the way to the edge of the envelope just in case that's the point at which the computer is set. If it exceeds the critical AOA, it not only fails the FCF but you're very close to a deep stall as well.

Out of Control & Falling Through 13,000 Feet

My enthusiasm for this FCF drops to zero when my AOA reaches the

Pilots N Paws is an online meeting place for pilots and other volunteers

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point at which I should have heard the tone. An instant later the nose drops and for a split second I think the computer has pushed it over and just failed to give me the tone. Not this time. The nose pitches back up, un-commanded. I'm in a deep stall. This test maneuver is started at 15,000 feet for air data computer testing parameters. The minimum altitude for ejection when the airplane is uncontrolled is 10,000 feet. I'm out of control and falling through 13,000 feet. The emergency procedure for out-of-control has only four steps. First release the controls. In the F-16 that's pretty simple; stop applying pressure in any direction to the stick. Step two is MPO switch: override and hold. Third, stick: cycle in phase. That means try to increase the amplitude of the pitch motion in both the up, and down directions. And finally: eject at minimum uncontrolled altitude.

When the nose first pitched down I had already released control pressure; I'm now holding the MPO switch. On the second pitch down I glance at the altimeter to decide if I should push the stick forward or pull the ejection handle; I push forward on the stick. I'm comfortable with the capabilities of the ACES II ejection system. I'll ride it to 10,000 feet; engineers like to pad everything.

The nose hesitates on the down cycle. Just at the point I expect it to pitch back up, it falls through to straight down and I begin to accelerate. Almost as quickly as I entered the stall, I'm out of it. Yeah, right; in dog years. It seemed like 10 minutes of falling. As the airspeed hits 200 KIAS I start pulling back and bottom out at about 10,001 feet.

I finish up the rest of the FCF checklist and take the jet back to base with a failed AOA limiter test to be entered in the maintenance log. I've used up 6,100 pounds of fuel in 42 minutes; a 0.7 hours goes into my logbook. Most of my F-16 time was

accumulated 0.5 to 1.5 at a time. Almost all of it was very intense, fun flying. FCF's, dropping bombs, and fighting against jets from the Fighter Weapon School (Top Gun) or Aggressor squadron.

Fighter time doesn't include ground time either; only flight time. It's no wonder when the airlines look at flying time, fighter time means something different. Frank Lloyd Wright once said, "Early in life, I had to choose between honest arrogance and hypocritical humility." The F-16 can make you arrogant – honest.

G-Measles

It's normal to finish a high-g flight wet with sweat, which I am. As I get undressed I see the g-measles on the inside of my arms. Not something most people are vaccinated for. You get them from pulling g's. The capillaries on the inside of your forearms and your butt a couple inches below the belt line show them the most because that's where the blood pools, more capillaries are close to the surface, and the blood pressure seems to be the highest. They show up as hundreds of small red dots (petechiae). Like pin pricks. You can't feel them but everyone that pulls g's gets them.

If you've never been upside down or beyond 60 degrees of pitch, you need to. As a Part 121 pilot, the chances of being in a "very" unusual attitude are slim. I've been beyond 60 degrees of bank, unintentionally, three times in transport category airplanes. Once was due to wake turbulence at high altitude, another at low altitude. The third time was when I had asymmetrical spoiler deployment due to a failing auxiliary hydraulic pump.

So don't convince yourself that as long as you pay attention to your pitch and roll attitude and airspeed you'll probably be okay, and that upset training is just for fun. If for no other reason it will help you to both recognize your condition more

quickly, and more importantly, you won't be so inclined to soil your trousers when it happens to you and you can get to the task of recovery.

General Yeager once said to me, "Maybe you'll get higher than me." He was talking about the altitude records he set and my just-beginning Air Force career. By the time I left Edwards Air Force base for OTS, I was convinced I wanted to be a Test Pilot. Each time I did an FCF takeoff I thought of his words to me.

I never made it to Test Pilot School and I never set any altitude records, but as the General was quoted in *The Right Stuff* as having said; "I had a ball!" John Gillespie Magee, Jr. said as pilots you and I "have done a hundred things" others have not dreamed of. Look out the window while you're flying and go do another hundred.

Isn't it magical what making a paper airplane can lead to? Don't be afraid to make paper airplanes, and don't be afraid to throw them in class. **T&T**



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