AEROSCIENCE

Flight of the Flamingo (Maiden Test Flight)

Aviation: Aircraft Design & Development

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The following is a blog (presented here in the format of a company profile) representing part of my aspirations for becoming a pilot. The products and organization described here are absolutely fictitious, but the locations described are as real as the author.

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Genesis

I needed developers in the fields related to what I wanted to achieve, so I set out to pick the relevant minds that think the way I do or at least minds that can appreciate the way I think. Almost all the time the answer to that was "the youth", so I set out to recruit young, humorous, talented, dare-to-try, undergraduates and graduates from the academic fields of Fluid Dynamics (both Aero and Hydro), Aeronautics, Optics, Mechanics, Electronics, Electricals, Software, Hardware, Networking, Processing, Graphics Design, Systems Integration & Interfacing, Material Sciences (ceramics and metallurgy), you name it. As for sponsors, that was the easy part; I had already run into more than enough of them to get the endeavor off the ground, provided my homework was in order.

I told the young blokes through my online advertisement that I was recruiting interested candidates for an undisclosed set of related experiments and what the immediate goals were. What I didn't tell them was what the bigger picture was about; the eventual union of those experiments. To ensure that I was getting attention via the ad, I stressed that the experiment would be the beginning of something big and sustainable but only if we all insist on patience, sacrifice and dogged determination, and that its success would inevitably lead to the commencement of a full blown project that only they could be a part of (since they would be the pioneers at the experimental age). I felt this was the most objective way to find out who was willing to put his/her faith in what I believed in without necessarily knowing what I intended to achieve in the end; the emergence of a hard-core, local, state-of-the-art aircraft manufacturing firm with an independent subsidiary in the form of an electronics manufacturing firm to produce all the avionics for the aircraft manufacturer. As a result, I got an army of young blokes (men and women) signed up, I carefully kept them on a need-to-know basis of their respective tasks and that's how the AeroScience workforce was born.

Design Trend

Departure from the Conventional

I wanted to minimize the number of overall components so I merged the Primary Flight Display (PFD) and Navigation Display (ND) into one...the Integrated Flight Display (IFD). The central display for engines, systems and crew-alerting remains the same: a Multifunction Control Display (MCD) for the GCAS (General Crew Alerting System), with the difference being a change in the presentation style. What we have thus are three areas of presented instrumentation. It should be noted that GCAS is to AeroScience what ECAM (Electronic crew Alerting System) is to Airbus, and what EICAS (Engine Indication & Crew Alerting System) is to Boeing and many other aircraft.

But when you look at these three areas while the cockpit (and the aircraft as a whole) is in an unpowered state; what you see is absolutely bizarre. The three areas look clean, dark and empty; as if they were meant to be large cubby holes or spaces for drawers...nothing is there, until the avionics array is powered up. Those empty spaces you are looking at are the projection areas for the High-Definition, touch-field Pscholographic Display System (PDS). This complex architecture requires lots of raw computing/processing power and I for one believe in providing more than what is required. I told our newly recruited specialists in the areas of optical projections, rendering, video processing, etc. to give me a high-clocked (not over-clocked), quartet of liquid-cooled CPUs (for the complex computations); each running at 2GHz; another quartet of liquid-cooled, 8-Gigabyte graphics card array (video RAM for the display system) and 4-Gigabytes of RAM for ordinary system running. For the Flight Augmentation System, I chose to drop Fly-by-Wire (FBW) for Fly-by-Light (FBL). This means more optic fiber-based networking of Flight Augmentation Computers, databuses, less metal wire networking and plenty of weight-savings.

Primary Flight Control

The Primary Flight Control (PFC) is a side-mounted, twistable joystick a.k.a. "**Twistick**" with tactile and force feedback. The ability for a user to twist it through its "45-degree left-or-right" range represents control for the rudder and nose gear. The turning ratio of the electro-hydraulically powered steering system is speed-governed, meaning the faster one goes the less turn-angle one gets on the rudder and nose gear, even if one twists the stick to either (left or right) of its stops. This, plus the tactile and force feedback, ensures that excess input from the user is minimized, sparing the nose gear and tail fin a lot of stress. It means for instance, that for one to get a full right or left turn lock (nosewheel turned all the way to either end) of 80-degrees, one's taxi speed must be no more than 3 knots. Going any faster than that will cause the steering speed-sensing system to limit steering angle even though one may be holding the Twistick, twisted all the way at its twist stop. This also means that most of the time that the user is steering (in the air or on the ground), the stick actually needs to be held lightly as the system is quite sensitive and a tight hold may trigger off fidgety movements in flight.

The Secondary Flight Control (SFC) comprises the landing gear lever, wing lever (which controls wing sweep angle and flap/slat settings), the speed brake lever (spoiler flaps), pitch trim lever, throttle and reverser levers. All of these are flight configuration controls that the Speed and Flight Envelope Protection (SAFEP) can control when enabled by the crew. There is a master switch for it at the front end of the throttle quadrant. Yes, this means that the Flamingo can and will reconfigure itself after takeoff, during climb, cruise, descent, approach and partially after landing. The only time it won't do so is just before takeoff and after it has landed, the crew must reconfigure (flaps down, spoiler and auto-brake armed) or deconfigure (flaps up, spoiler and auto-brake deselected) the aircraft manually.

On the aspect of computer mouse and/or touch-screen interfacing between crew and systems, I've come up with an evolved solution; enter the Touch-field Cursor System (TCS). The TCS is made up of 2 distinct subsystems; one is part of the display system and the other is part of the user. If you remember, I said earlier that the Integrated Flight Display System (IFD) and General Crew Alerting System (GCAS) in the Flamingo are provided by a Pscholographic Display System (PDS) with a 3-axis, infra-red grid, touch-field. It's a 3-dimensional version of the conventional touch-screen, flat panel display systems in many other aircraft today. The inner walls of the PDS are lined grid-style with many infra-red transducers and tri-color light projectors which create a hologram of the PFD, ND, GCAS, etc. Because these displayed items are not static (have changing values), the hologram needs to be animated; animated holograms are known as pscholograms. The 3D image would require a mouse that can operate in 3-dimensionss without exerting unnecessary workloads on the user. Our solution is a touch-screen style system…which we've tailored into a touch-field system. Along with those projectors in the PDS is a grid the 2-way, infra-red transducers that form a spatial tracking system for the user's finger when it tries to point-at or select the object-oriented symbols being projected in the PDS.

The user part of the TCS is an articulated, finger-worn glove (so-to-say) that has infra-red transducers on it. A power/data cable running from the ventral side of the finger-worn glove connects the user part of the system, to the display part of the TCS. This all works with the spatial tracking system of the PDS to tell its computer what object-oriented icon or symbol the user is pointing at or interacting with (clicking, dragging, etc). It uses its own little 3-D coordinate addressing technique (akin to a tiny local GPS system) to know where every projected holographic object/icon is. If the coordinates of the tip of the finger-worn mouse device matches the coordinates of an icon, then it means that icon is the user's item-of-interest (ioi) and the icon becomes highlighted as if asking/telling the user that he/she is a step away from interacting (selecting or clicking) with that icon.

To click, the user simply uses his/her thumb to press the click button on the side of the finger-worn device. Double-clicking requires 2 rapid succession presses while dragging requires holding down the button while the hand moves around...the relevant icon(s) will follow. Dragging any of the outer-most borders of the whole display will cause the whole display's orientation to rotate horizontally and/or vertically; one can view the PFD or ND for instance, from the top, side, rear, and front or from under. Because this is an absolutely unchartered area of user interfacing technology, I expect it to require a lot of "getting used to" by everyone. Even I had to mentally reaccustom my arm and hand muscles so that it would appear to everyone that I was already used to it since I invented the entire concept from scratch…how's that for innovation? Pointing at icons causes a floating flyout box to appear beside it with a summary of the icon’s properties, for instance, a VOR or NDB would show its identifier, frequency, type, Morse code. Because I am also a born artist with a flair for Systems & Graphic Interfacing Symbology, I had to create 3D versions of the universal symbols for items you normally find on aircraft system displays. Clicking on it causes a flyout box to appear; revealing additional info such as its name, coordinates and the option to fly-direct-to, add-to-route, remove-from-route, join-to, etc. The magenta course line of the route being flown is also an “object” that “dragging” can influence. You can modify a route by dragging any part of the line to a waypoint and “drop” it there. The waypoint is joined to the line as a segment of the route. For traffic, “pointing” at transponder-replies (representing nearby aircraft) causes a flyout box to appear beside the nearby aircraft pointed at, with speed, altitude, heading, and vertical speed info of the associated aircraft. Clicking once adds to that, reg. number, flight number and aircraft model. TCAS adds to this, a trajectory trend-line (or comet-tail if you prefer so from the settings menu) to each intruder and the normal status symbols.

Speaking of TCAS, AeroScience has coupled together the Flight Director guidance system with TCAS so that when LNAV/VNAV (FMS-autopilot) is flying and an intruding aircraft triggers off a Resolution Advisory (RA), the aircraft will execute the RA-guided, evasive manoeuvre. The capability for this autopilot-driven avoidance system is known as a Resolution Execution (RE). What this means is that when you look at the TCAS panel on the pedestal, you will find along with TA and TA/RA, a position or detent position for RE; where TA = Traffic Advisory, RA = Resolution Advisory and RE = Resolution Execution. Simply put, this is what you will see on its panel:

TA – TA/RA – TA/RA/RE (where RE = Resolution Execution, auto-evasive action).

The Auto-brake features a Brake-to-Exit (BTE) system that is coupled to the GPS and an electronic map of certain airports paved surfaces (runways and their exits). It also uses airport info in the navigation database to ascertain runway length and surface type. These plus FMS info on aircraft weight at the time of approach/landing, aid the autobrake in determining the amount and application pattern of brake pressure that is needed to slow the aircraft down to the chosen exit. It works like this, when ATC's approach team issues you a runway to land on, you set the auto-brake switch to BTE then point-select (using your finger dressed in the finger-worn device) the airport icon in the nav display, and select the . Either this action or its command in the ARRIVAL or APPROACH pages of the FMS calls up on the lower part of the MFD, an object-oriented version map of the airport's paved surfaces. You point/select (point-and-click on) the desired runway exit you want to vacate the runway through; this brings up a flyout box with the options "Cancel" and "Enter". Select "Enter" and the autobrake looks in FMS to see the aircraft's current weight as well as the runway length and GPS coordinate of your chosen exit. From this it calculates the correct amount of brake pressure and duration to apply during the landing rollout up to the chosen exit. This system is designed to extend the service life of the brakes and prevent occupant discomfort by avoiding those sudden, harsh decelerations.

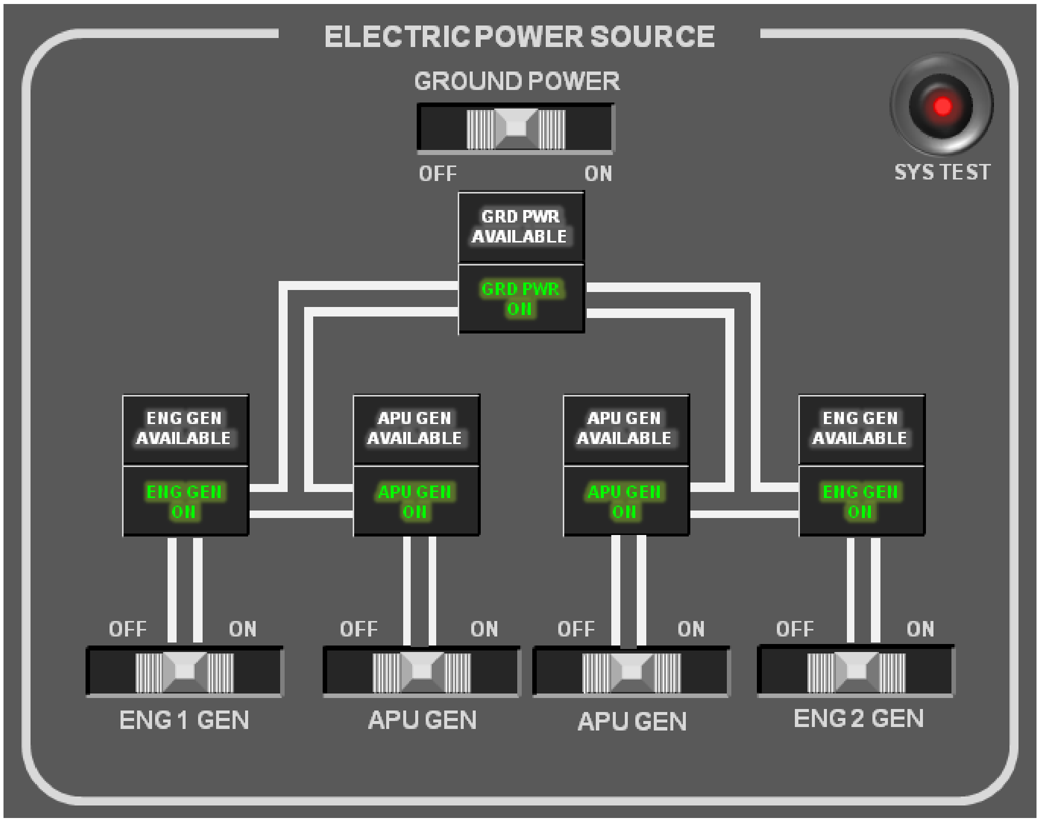
We are also doing research on the possibility (practicality) of integrating the nosewheel steering to BTE so that the aircraft can turn into the exit as it slows to stop on the hold-short marking whose GPS coordinate represents the exit on the electronic map of the airport in the nav database. If we can achieve that, it would also mean that when the aircraft comes to a stop on the hold-short mark, opening the throttle to taxi-in would result in FADEC ignoring your movement of the throttle lever (refusing to add engine power) because the autobrake is still engaged. You would have to turn autobrake off either by setting its switch to OFF or by stepping on the brake pedals (by the way: pedals don't control rudder, joystick's twist does). Only then will FADEC allow you command of engine power so you can taxi.

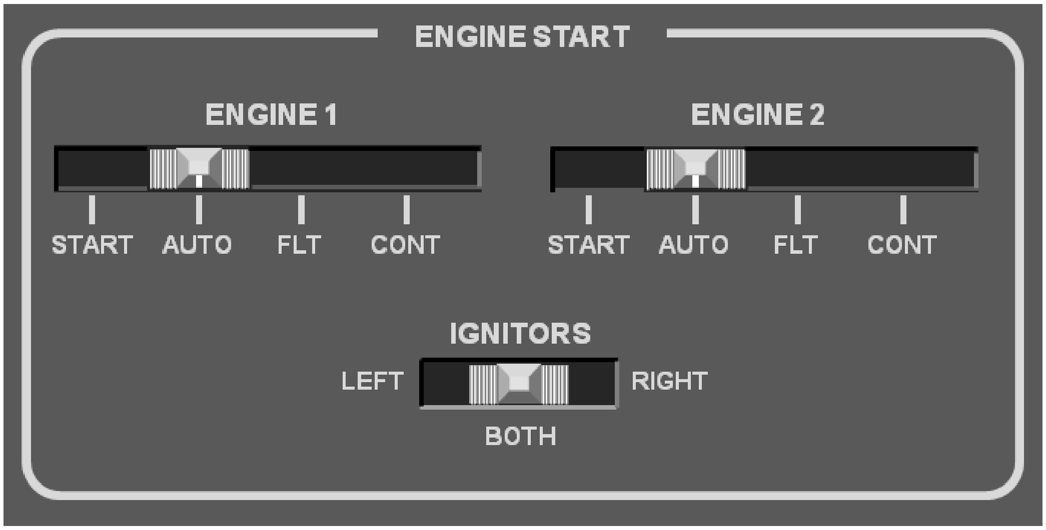
The windscreen/windshield panes are made of a newly discovered glass composite formula which is an AeroScience secret. The recipe allows for good transparency, UV filtering, variable tinting, and strength for prolonged supersonic speeds and sustained multiple bird strikes at 300 knots. The bi-dimensionally curved panes are laminated for extra protection. On the inside, it is further laminated with a transparent Active Matrix Organic Light Emitting Diode (AMOLED) film. Along the frames, this AMOLED film is joined by power and data connectors to the Heads-Up-Guidance System (HUGS). So instead of the bulky, overhead mounted Heads-Up-Display projector and the fold-away combiner in front of the pilot, you have the HUGS computer hidden away, yet joined to the front window. A pair is installed; one for each front window (and its pilot). The Flight Instrument Display is highly redundant because it comprises not only what appears on the PDS but also on the Heads-Up-Guidance System (HUGS). When turned on from the IFD menu, a multi-colored reticle of PFD and ND symbology is drawn on the windows. An optional EFIS feature draws a 3D-looking course/route line; the same as the magenta line on the ND that shows the path the aircraft is to follow. Because pilots differ in height, a settings page in the HUGS Chapter of the MFD menu allows one to adjust position and alignment with eye level-to-horizon, brightness, modes, overall reticle size, etc. We are also doing research to create a touch-screen version so that pilots can make these adjustments by hand, directly on the reticle itself (contact with the window’s surface) at short notice. We expect challenges to come from the presence of the window heater and a host of other freak factors, and we expect to overcome those challenges God-Willing.

First Flight

Cross-section of Overhead Panel Subsystems

The following images are a few of the subsystem panels that makeup the Overhead Panel. Their indicators/annunciators are illuminated in the test-mode.






INERTIAL REFERENCE SYSTEM
DC POWER
ALIGNING
ALIGNED
FAULT
DC POWER
ALIGNING
ALIGNED
FAULT
OFF
ALIGN
NAV
ATT
OFF
ALIGN
NAV
ATT
TK/GS
WIND
PPOS
HDG/STS
N25°13.49′ E55°20.97′
TK/GS
PPOS
HDG/STS
WIND
1
2
3
N
S
4
5
6
E
W
7
8
9
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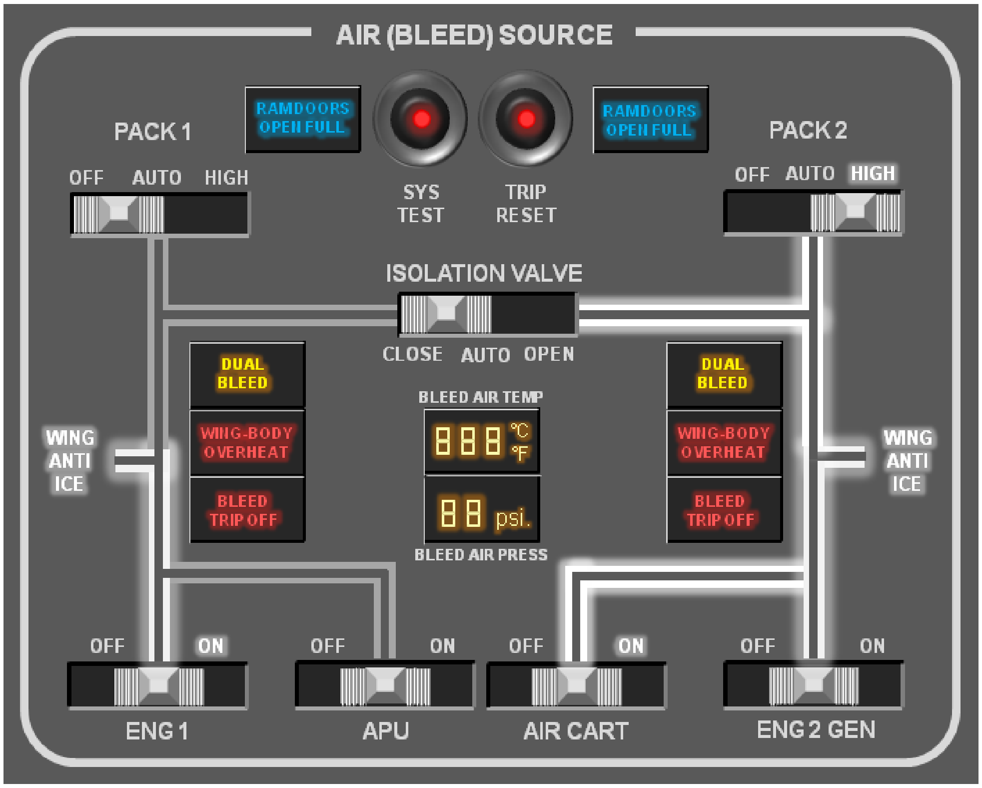
CLR
SYS TEST
IRS SYS L
IRS SYS R


AIR (BLEED) SOURCE
PACK 1
RAMDOORS OPEN FULL
RAMDOORS OPEN FULL
PACK 2
OFF
AUTO
HIGH
SYS TEST
TRIP RESET
OFF
AUTO
HIGH
ISOLATION VALVE
CLOSE
AUTO
OPEN
DUAL BLEED
WING-BODY OVERHEAT
BLEED TRIP OFF
BLEED AIR TEMP
888 °C °F
88 psi.
BLEED AIR PRESS
DUAL BLEED
WING-BODY OVERHEAT
BLEED TRIP OFF
WING ANTI ICE
WING ANTI ICE
OFF
ON
OFF
ON
OFF
ON
OFF
ON
ENG 1
APU
AIR CART
ENG 2 GEN

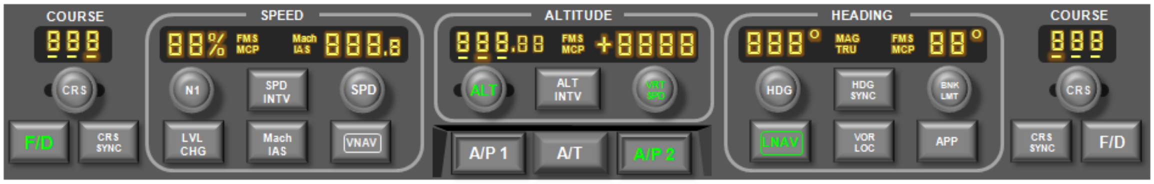


Image of Flamingo's Mode Control Panel (MCP)

Preflight on the Outside

The livery for AeroScience aircraft is simple; our aircraft are given a base color of Gloss White all over, a bright green stripe running on top of a dark green stripe with a gap in-between both. The stripes run from the nose (the upper edge of the bright green stripe touching the center-point of the nose-cone, at a gentle, climbing angle, rearwards –while getting wider, until reaching the rear quarters where both gently curve upwards along the chord-angle of the respective aircraft's fin and through the rear half of the fin (different aircraft have their tails raked or swept-back at different angles). Both bright green and dark green stripes have a "chromed *color*" (colored mirror) finish, meaning that you can and will see the reflection of anything on them both, especially yourself. This livery is far different from the livery for aircraft of the parent organization, Elite Aviators that AeroScience is a subsidiary of Aircraft of Elite Aviators are painted in Gloss Black –all over, and have a "Chromed Silver" stripe atop a trio of "Chromed Yellow (or Gold)" stripes. All stripes have gaps in-between them so they stand out and like their AeroScience counterparts, these stripes run to the rear in the same climbing then gently upward curving direction, along the chord angle of the tailfin and through the rear half of the fin.

The walk-around for the AeroScience AS440 Flamingo differs slightly from the walk-arounds of other jets in that its external anatomy has different and sensitive areas that need visual (before system) inspection. The major area in question is the rear portion of the wingroot extension, which happens to be hollow; so as to accommodate the inboard-most trailing edge section of the wing. This part of the wing gets sandwiched by the upper and lower panels of the rear wingroot extension as the wing slides into the slot shaped recess reserved for it, during swing-wing configurations that facilitate transitions between high-speed/low lift-low-drag and low-speed/high lift-high drag flight regimes. We'll get to this section near the end of our walk-around inspection. Like other aircraft, the walk-around starts from the Flamingo's front port (left) side, in the vicinity of the main exit and where forward-most part of the wingroot extension joins the fuselage. This part -it should be noted- is the last rather than the first part to be visually inspected. So, we start by looking at the main doorline; this is the AeroScience term for the gap defining the seam between the main door or main exit and the fuselage surrounding it (At AeroScience we call it doorline because when viewed from afar, it looks like the line which makes up the rectangular shape of the door; where one would expect the door to open and close). We look out for cracks, fractures, warped and out-of-line conditions of the Flamingo's skin in this area. With nothing of the sort found, the main door check is successfully concluded. Next we move forward to the cockpit windows area and check the windows for the same kind of issues on the main door (window frames in this case) in addition to checking the windows themselves for cracks, scratches, reduced transparency (a.k.a. increased opacity) and any unusual appearance of the bolts in the window frame. This is important because the Flamingo is a supersonic flyer and we must be sure that those windows and their frames are ready to be struck by the continuous, wall-like, laminar flow of air...ramming it at supersonic speeds. This is also important because unlike the retired Anglo-French Concorde which had retractable visors (steeply raked-back, windows or windscreen/windshield...whichever you prefer to call it) to protect the main forward windows, the Flamingo's have no such protection, save the reinforced structural design of its window frames and toughened structure of the advanced glass composite material that makes up each of its window panes.

On passing their visual inspection (cockpit windows), we look downwards to the probes or sensors protruding from the side of the fuselage like tiny forward-facing whiskers on the cheek of the aircraft (hope you don't mind my youthful analogy...you'll come across it again). Among them is the Pitot tube pair, hollow, electrically heated (to prevent ice build-up from blocking its orifice) sensors, one of which provides speed data during subsonic flight, while the other provides for supersonic flight. As the aircraft flies forward, the air flowing into them gets measured in a way that allows the Air Data Computer to figure out how fast the aircraft is going. Simply put, the Pitot tube pair form the external part of the aircraft's speedometer system. The next probe is the Alpha Vane. Also electrically heated to keep ice off it (so it doesn't give inaccurate data), this probe detects -by feeling airflow strength on its topside and underside, and thus lets us know when the aircraft is flying at or near steep angles that could compromise its ability to stay airborne. Simply put, the Alpha Vane is our stall warning system. The last sensor in this group which is not a probe is known as the Static Port. It's a hole that lies flush on the side; if you can mentally picture a whale with a blowhole on its cheek instead of the top of its head, then you are on the same page with me on this sensor. The Static Port functions like a human's Eustachian tube...accessing current atmospheric pressure to help the other sensors to correctly provide air performance data to the air data computers and the crew. It must never be covered at any time that the aircraft is being operated (in the air or on the ground). During maintenance sessions such as external cleaning, where chemical agents (cleaners, ice-melters, paints, etc.) or physical agents (jets of water or air for cleaning), it's vital to cover however, so that internal components (as sensitive as our ear drums et al...Analogy again) don't get compromised. After maintenance, the covered Port must be uncovered otherwise once airborne, air-generated performance data will become so inaccurate that the various performance computers will literally get confused and start arguing with one another over air data discrepancies. This chaos will eventual erode the crew's situational awareness enough to result in a very messy conclusion to the flight.

After the sensors inspection, we move to the front to inspect nose cone for knicks, dents and damage to the lightning protection strips lining it. The nose cone is hollow and houses the Doppler weather radar. We look further downward to the nose gear (front landing gear). We look into the nose wheel well with flashlights or turn on the wheel well lamps (which light up for three minutes before self-extinguishing, to go gentle on the batteries). Here we check to see that there is no evidence of fluid leaks or wall-spray of fluids. We check hydraulic and electrical lines for anomalies that should forbid operation of the aircraft. With the nose gear looking okay, let’s take a moment to observe something that helps the Flamingo capitalize on lift. Stepping back from the nose gear and looking at the aircraft head-on, you'll notice that the cross-sectional shape of the fuselage is a somewhat "trapezium-shaped" with rounded edges and the wider surface being at the bottom with its contour being more curve downwards. The idea was to create a polygonic, teardrop-shaped, "lifting body" airframe, cross-sectional shape that generates at least fifteen percent of the aircraft's overall generated lift. It posed a challenge for the design of the main door and its folding steps, but it worked out in the end. The result is the wingroot extensions and wings (even with their variable geometry) blending in beautifully and seamlessly into the lower edges of the rounded-edge, trapezium shaped fuselage cross-section...not too differently from that of certain combat jets.

If our departure requires a push-back, then we need to ensure that a bypass pin is inserted in place on the external part of the hydraulic power steering system (of the nosegear assembly) so that the aircraft's Hydraulic-A System exempts the steering system from the hydraulic pressure it’s providing. This allows the push-back truck to push the aircraft back into a turn without having to struggle or fight the system's "wheels-straight" hydraulic pressure that tries to keep the wheels facing forward since no one is applying turn commands on the boss of the steering tiller from inside. Other things we check are that the Scissors Gears of the nose gear doors aren't popped out (otherwise those doors will never close during gear retraction. We also check that the nose strut (the shock absorber) isn't fully compressed; that at least half of its shiny cylinder is visible and dry from any kind of moisture let alone fluid. I normally carry small strips of white tissue paper which I lightly wrap around the shiny cylinder and rub with to check for any fluid residue. If ok, we look further down at the tires; checking the chine of each tire and ensuring that the ground-contact section of the each (of the two-wheel nose gear system) has no bulge that suggests under inflation. To their sides, the wheel bolts also need checking by eyes and hands for looseness, we can’t be too careful these days. If all is ok, we migrate to the aircraft's front starboard (right) side where we do the same checks we did for the front port side; windows and probes but no door.

Next area is the starboard wingroot extension. This fairing is the blending transition between wing and fuselage. It has been shaped such that it generates 5% to another 10% (depending on speed) of the total lift that the aircraft generates. It also houses the xenon gas discharge, landing lights, runway turnoff lights and the components of the swing-wing architecture that lets the aircraft fly at subsonic and supersonic speeds, while having space at its rear to accommodate part of the wing when it is fully swept-back for "speed-of-heat" (supersonic) flights. It’s interesting to note that for an aerodynamic advantage, the movement plane on which the swing-wing does its “swinging” is actually not aligned with the horizon. Rather, it’s slanted at a two-degree angle, so that when the wing is swept forward, it is slightly higher than when it is swept to the rear (in the “speed-of-heat” configuration. This allows the wing to have a subtle, inherent angle-of-attack (AoA), which is highly advantageous in terms of the Flamingo striking a straight-and-level poise (attitude) in flight. We check to see that the hinge fairing at the meeting point of the wing and the wingroot extension is clean and flush-smooth; that all of the wing's five slats (wing's leading-edge lift devices) are aligned whether in the extended or retracted positions and that the lamps and lens of the navigation strobe lights and wing/position lights are all intact. This inspection has us walking from the wingroot out to the wingtip and around to the back of the wing. Now we're checking the aileron, its trim tab, its static discharge wicks and the outboard section of the wing's fowler flap (trailing edge lift device).

Because of my unrestrained imagination and enthusiasm for preventive safety, I always have handy, a portable folding ladder that allows me to see the topside of the wing from behind it, and to back-up the ladder just in case of its absence, I also have my handmade, collapsible periscope (the telescoping type). Its lens, swiveling viewer and focus knobs allow me a crisp, magnified view of wing surfaces and at night, the rectangular, battery-powered LED lamp bezel around the top lens lets me see the wing surface well in the dark. On the wing's topside, I check the spoiler flaps (also called the speed brakes) to ensure they are aligned and flush with the wing’s upper surface, as well as each other whether raised or lowered. Then there are the stall-delaying retractable (electromagnetically) vortex generator fins, and over-wing sucker ports; at subsonic speeds they delay the onset of stalls by sucking excess turbulent air that forms on the wing's topside and allowing remnants of laminar airflow to continue rearwards. The vortex generators pop out from the leading-edge slats in a similar fashion to a cat’s claws, to help turn some of the laminar airflow over the wing to become small, controlled, turbulent vortices. These help create extra lift at a certain range of high Angles-of-Attack (AoA). The sucker-ports simply allow AeroScience to push back or delay the onset of a wing stall by sucking burbling the turbulent airflows that normally result from airflow separation between the bottom and top surface of the wing. This means that the Flamingo’s original pitch angle at which its wing stall would normally occur has been increased by almost six degrees.

Now we've arrived at the rear part of the wingroot extension. The part of the wing gets sandwiched by the upper and lower panels of the rear wingroot extension as the wing slides into the slot shaped recess reserved for it, which I mentioned earlier on. The Flamingo, like certain military aircraft (i.e. F-14 Tomcat, F-111 Aardvark and B-1 Lancer) have what is known as "variable geometry wing" architecture; civilians know it better as "swing-wings". The aircraft's wings can be swept forward to the likes of 20° - 30° angles for low speed tasks like taking off and landing where generous amounts of lift can be maintained. These wings can be swept halfway back for low to intermediate speed cruises to reduce fuel burn and drag. For the supersonic speeds that these aircraft achieve, their wings are swept back fully so that the aircraft assumes a dart-like shape with reduced frontal area cross-section. This allows for high speed, low drag flights.

What we are looking for is the slot or gap that the inboard section of the flaps recedes into when the wings are swept back. We want to ensure that this gap is clear of any debris that can interfere with wing retraction. As the Flamingo is a new aircraft; ahead of market entry, I'm promoting a culture or tradition among pilots whereby they always park the aircraft with its wings swept fully back. This keeps the slot occupied from possible entry of debris. On the topside of this area there is a broad spoiler flap (for both sides that is) which acts as the speed brake for supersonic and transonic (back and intermediate wing sweep angles) speeds, when the main spoilers are too far out of their normal forward angle to be effective. These wingroot spoilers also deploy during landings but not during flights when the wings are swept forward (too avoid excessive loss of lift at slower speeds). Let’s move on to the rear of the aircraft. If you stand in the gap between the wing and the horizontal stabilizer and look up you will see the engine nacelle. We check the elevator on the stabilizer, its trim tab and its all-plane, pitch trim rail slot…the entire stabilizer moves as part of the pitch trim component that the trim tabs are a part of. Next we check the outflow valve shutters of the cabin pressurization system. It should be closed since the aircraft is unpowered at the moment.

The engine nacelle is longer than usual because each engine has an afterburner for supersonic speed power. We check to see that the slide-back, target-type thrust reversers are fully stowed. The presence of an afterburner in the engine called for nacelle design which includes an exhaust nozzle (what you may regard as the tail pipe) that retracts forward and into the nacelle while spreading open to increase its diameter. This allows the reignited exhaust an unhindered flow out the back, making it an unfavorable place to mount the reverser. AeroScience engineers designed the reverser buckets to be mounted ahead of the afterburner nozzle on a rack that slides them well aft of the nozzle where they are free to pop out an into the deployed position. The gap between the wing and stabilizer also provides the structure-free clearance for the deflected thrust from the deployed reversers, and because the aircraft is moving forward, this deflected thrust or blast will not ricochet off the ground (possibly with debris) and up to the wing's underside. But that could happen when thrust reverse is used at near-standstill speeds or backing out of a parking spot and is the reason why thrust reverse usage is discouraged on all jet aircraft except during landing roll-outs.

Below the aircraft for inspection is the port main landing gear. We have to stoop low, almost crawling to it to check it out; we're looking for the same things we looked for on the nose gear with our flashlights or using the 3-minute illumination of the well lights. Because of supersonic flights, we had to include main wheel doors because we were worried about the effects of extreme cold at 60,000ft to 65,000ft on the exposed sidewalls of the tires. Then there are also the shockwaves that could form on those sidewalls if they were exposed to act as a seal for the wheel well (as is done on doorless wells of some aircraft including the Boeing 737). We felt it was safer to have the seamless, flush panel of a wheel well door keeping the airflow as smooth and laminar as possible. Having checked this we look up to the tail fin, which is also called vertical stabilizer. We check its two-piece rudder (upper taller part is hydraulically powered, while lower shorter part is electrically powered) plus its trim tab. By now we are at the rear port side of the aircraft -done with the empennage (all three stabilizers) to inspect the rear of the port wingroot extension as we did on the starboard side. Next we check the port main landing gear as we did with the others before checking the length of the port wing's rear and forward sections, lights and port wingroot extension. We are back to our starting position of the walk-around.

In terms of fuel capacity (figures withheld), the unfortunate penalty for adopting the variable-geometry wing design is that wing tank space is severely limited. For this reason, the wing tanks and wingroot tanks are smaller than those on similarly sized aircraft; in fact we at AeroScience prefer to regard them as right/left auxiliary tanks. To compensate for the shortage, the main tank or center tank has been enlarged greatly. Fuel supply on the Flamingo follows this order: Both Right and Left Auxiliary tanks supply fuel to their respective engines first. On emptying, the main (center) tank seamlessly takes over. The APU takes its fuel from the main tank.

Preflight on the Inside

On entering the "cold-and-dark" state (unpowered systems, hence dark displays and instruments) of the flight deck one immediately fathoms my radically exotic departure from conventional flight deck design. Normally everyone would like to do something in as different a way as possible; that irresistible urge to carve a trend-setting niche is what fuels my imagination to follow unusual routes towards achieving the same goal that others take the more common route to get to. I've gotten tired of seeing the same thing in cockpit layouts and instrument display form-factors; I want to see and to do something different that hasn't been tried before. At the same time, I want to arrive at the universal goal of the whole mission. It is for this reason that I adopted the radical cockpit instrumentation layout I explained in the beginning. Once seated, we scan all panel areas starting from the overhead panel to ensure switches and controls are in their proper positions. We use the Panel Scan section of the printed manuals kept onboard to achieve this. Once done, we turn on the main battery, then we turn on both Inertial Reference System (IRS) units to get a battery-powered headstart on the lengthy alignment cycle. If Ground Power is available we quickly transfer our power supply to it so as to spare the battery, if there's no Ground Power, then we quickly turn on both fore and aft fuel pumps in the Main (center) tank and start the APU. When the APU settles into its run, it informs us via its panel that it’s ready to take the load of our electrical needs; thus we engage both Right and Left APU GEN switches so that the battery can be take a break.

I designed the overhead panel to be an electrical/data interface for the modular, Line-Replaceable-Units that each separate control on the panel is. This means the fuel panel, air panel; electric panel, etc. are all individual, portably flat, subpanels that are connected via a single power-data connector to their respective, code-labeled, slots via power-screwdriver points on their face, each. Next we turn on the avionics array so that the remaining instruments come to life while their respective networks and computers boot-up. The IRSs still aren't ready yet so we'll setup the MCP for takeoff; dialing in the active runway's heading on both CRS panels, dialing in an assumed altitude constraint of 10,000ft on the ALT panel, dialing in an initial vertical speed of at least 3,500ft/min (4,000ft or more if obstacle clearance is an issue), an initial climb speed of V2+15kts or the universal limit of 250 knots...these values we're putting it are all subject to change because ATC sometimes issues instructions that affect the values put in. Now it’s time to tell others in the area that we have electrical power running by turning on the Wing Lights (a.k.a. Position lights), the red one on the port wingtip and the green one on the starboard wingtip.

Next on our list is setting up our radios and getting weather and runway info. During my design of the Flamingo I got over-excited and one of the radical decisions I made was the installation of a third but modified COM3 radio that has Active and Standby sections for wideband HF, VHF, UHF and SATCOM (yes…it has a band selector as well as frequency selector). I like such redundancies because you never know when they'll come in handy. This means I can tune 6 stations at a time, listen to 3 at a time (simultaneously) and talk to only 1 at a time. On the edge of each Active frequency window, I had our developers include a prominently bright, multicolored line that serves as an audio spectrum analyzer. This way one can visually ascertain which radio one is hearing chatter on by comparing the color light patterns against the chatter; there's even a "Suspend" button on each COM radio so that if chatter on all 3 is on, you can single out the radio with chatter-of-interest. When using radios I like to stay organized so I always strap a lapboard to my right thigh and clip a writing pad on it. This is where I write down how I want to manage my departure frequencies. For example:

RADIO	ACTIVE	STANDBY
COM 1	Approach	Center
COM 2	Ground	Tower
COM 3	ATIS	Emergency
NAV 1	Runway in use	Alternate runway
NAV 2	Alternate runway	Runway in use

On my lapboard the frequencies would appear in place, in brackets beside their descriptions. This has proven useful to my First Officer on past flights; it just boosts situational awareness on radio management. Dialing into the ATIS gives us the runway and weather info we need for takeoff performance setup (in FMC) and confirmation of the runway heading we dialed in both CRS panels. We also set runway heading into the HDG panel and that concludes the MCP setup. Back to the overhead panel, we need to enable the ventilation system, so we turn on the APU Bleed Air as well as setting both Air Packs to "High". I like my cockpit left-temperature set to 24°C, the cockpit's right side temperature can be set differently, then there is the temperature setting for the cabin, these all share a common subpanel, right next to the subpanel of Bleed Air subpanel. Now it's time to set the pressurization panel with values for cruise altitude of 65,000ft for this flight; a corresponding value of 6,000ft (cabin altitude) and the elevation of the destination airport. Now let's get other overhead items ready; turn on window heaters, probe heaters, arming of the emergency power and lights, galley power, inflight entertainment system, the selection of either right or left (not both) Ignitors since this is the first flight of the day...all is set and we can finally setup the FMS because by now both IRSs are aligned. I had no choice but to do a full alignment because the aircraft was in the hangar when its IRSs were last powered-off. This means its Last Known Position will be different from its current position on the apron, where the aircraft was towed out to.

The Flamingo is so radically different from all other civil aircraft that I thought it would be nice if I kept the CDU as simple as possible in appearance and behaviour even though its actually faster in terms of CPU, has more memory (1-Gigabyte for now), so as not to intimidate pilots new to the aircraft. I chose to make its page architecture identical to the ones on Boeing 737NGs, with differences being the addition of more page menu items to cater for user convenience and the fact that the Flamingo is a supersonic flyer. With all systems set, we can now enter our route into the FMS so it knows where we want to go to as well as providing us with a performance advisory options; pace alternatives (slow, fast, etc.), weight influences on performance, etc. We've decided that this first (test) flight be an evaluation on the Flamingo's maximum range at its slowest supersonic speed; the fastest speed that it can travel furthest on with a full tank and just two occupants on board…with no baggage. The other test flights on the calendar are outlined below without dates (focus being on performance profiles):

1. <u>Maximum supersonic range</u> is the greatest distance the aircraft can travel at the slowest supersonic speed, which allows the aircraft to stay in front of the forward-most shockwave (drag-rich area) it generates. This speed is usually above Mach 1.0 (i.e. Mach 1.15). The engines will operate in supercruise mode, just below the output level that the afterburners would be involved in. This is known as **LRSC** or Long Range Supersonic Cruise mode.
2. <u>Maximum range possible</u> is the slowest speed at optimum altitude as determined by FMS); this is known as **LRC** or Long Range Cruise mode. In this profile, no afterburning or supercruising will be involved. Design forecasts have indicated the Flamingo's LRC speed being Mach 0.95
3. <u>Maximum speed possible</u> is the fastest speed the aircraft can fly at without breaking apart. It's also known as the **V_{NE}/M_{MO}** or Never Exceed speed/Maximum Operating Mach number. We'll also get to know its range (at different weights) when flying flat out at this speed with its afterburners fully lit throughout the flight. This is known as **MSC** or Maximum Supersonic Cruise mode.
4. <u>Minimum speeds possible</u> will see the aircraft being tested for minimum "unstuck" speeds (lowest speed at which aircraft will leave the ground after being "rotated" during a takeoff run), minimum speeds for flight with flaps extended; flaps not extended; minimum speeds for cruise at key altitudes in flaps/no-flaps, un-swept, intermediate-swept and fully-swept wings. The idea is to validate wind tunnel test results and to calibrate the performance database of the **Speed and Flight Envelope Protection** (SAFEP) system, which protects the aircraft from unsafe flight regimes as well as whoever (those "half-baked" pilots) might be careless enough to lead the aircraft into such a regime.

We chose the first test flight to be based on the slowest supersonic speed that the most distance possible can be covered on a full tank, when there are only two occupants and no baggage on board. The second test flight will be this same performance profile but with eight passengers and the typical baggage load-out of eight business travelers, the third test flight will be the same but at maximum takeoff weight and concluded with a maximum weight landing. There will be a lot more test flights that aren't mentioned among these capital flight tests. Back to where we are, time to enter our route. I've chosen to fly from our factory at the Al-Ahsa airport (OEAH), Saudi Arabia. I didn't mention earlier that AeroScience is based in Saudi Arabia; it's actually the first indigenous Arab aircraft manufacturer (albeit being conceived of and initiated by myself, a non-Arab). AeroScience was founded when I presented the concept to a Saudi sponsor and an Emirati sponsor; together we became the co-founders of AeroScience. The head office is based in Dubai, United Arab Emirates while the factory is based at Al-Ahsa Airport, which is on the southwest outskirts of the Saudi Arabian city of Al-Hufuf.

Now let's get into the FMS. The FMS architecture (FMC+CDU+User=FMS) used in the Flamingo may appear to some pilots as being too simplified for such an advanced airplane as the Flamingo. Three CDUs or Control Display Units are installed; one for each pilot and the third at the rear of the pedestal. All three run in synchronous mode, meaning that whatever is done on one unit appears as being done on the other two. Essentially it's like having three windows on a room; you can go through any to access the room; any change you make in the room can be seen from any of the windows. The FMC or Flight Management Computer is actually one single unit that is accessed from (any of) these three CDUs. This is to keep situational awareness as high as possible all the times. Operation is simplified with a wizard-like guide indicating which way to go in terms of chapter/page sequences (indicated by prompts at bottom of display, just above the scratchpad). Before I go into details, I will present a map of some of the Flamingo's FMS system of Chapters and Pages that a pilot will have to sequence through. It'll help you to understand the inputs I'll be making on this first flight.

OPERATIONS MENU

FLIGHT chapter		*GROUND* chapter	
IDENT page 1 of 1		INDEX page 1 of 1	
– AIRCRAFT MODEL	ENGINE RATING –	← FMCS	DFCS →
– NAV DATA	ACTIVE DATES –	← A/T	IRS →
– OS VERSION		← EFIS	FMC UPLOAD →
← INDEX	POSITION →	← INDEX	FMC DOWNLOAD →

POSITION page 1 of 1		FMCS page 1 of 1	
	LAST POSITION –	← INFLT FAULT	PERF FACTOR →
– REF AIRPORT	CURRENT POSITION –	← CDU TEST	IRS MONITOR →
– GATE		← SENSORS	DISCRETES →
	SET IRS POS –		FIXED OUTPUTS →
– GMT MNTH/DAY		← INDEX	
← INDEX	ROUTE →		

ROUTE page 1 of 2		DFCS page 1 of 2	
– ORIGIN	DESTINATION –	← LINE (status)	LRU INTRFACE →
– CO ROUTE	FLIGHT NO. –	← INFLIGHT FAULTS	LAND VERIFY →
– RUNWAY	GENERATE ROUTE –		
– VIA	TO –		
		← INDEX	
← ALTN DEST	PERFORMANCE →		

PERFORMANCE page 1 of 2		A/T page 1 of 2	
– GW/CRZ CG	OPT ALT/CRZ ALT –	← CURRENT STATUS	LRU INTRFACE →
– FUEL	CRZ/WIND –	← INFLIGHT FAULTS	INTERACTIVE →
– ZFW	ISA DEV –	← ENGINES/RATINGS	
– RESERVES	ToC OAT –		
– COST INDEX	TRANS ALT –	← INDEX	
← INDEX	N1 LIMIT →		

N1% LIMIT page 1 of 2		IRS INDEX	
– SEL/OAT	*Thrust rating (L & R)*	← IRS LEFT	IRS RIGHT →
← TO (RATING)	CLB →	← IRS LEFT & RIGHT	
← TO-1 (DERATE)	CLB-1 →		
← TO-2 (DERATE)	CLB-2 →	← INDEX	
← INDEX	TAKEOFF →		

TAKEOFF page **2 of 2**	
– RW WIND	RW COND →
– RW SLOPE/HDG	
– SEL/OAT	*(RED) N1% Thrust (L&R)*
	THR REDUCTION –
← INDEX	

(Status Type) CLIMB page **1 of 1**	
– CRZ ALT	AT *(Cmt Wpt)*
– TGT SPD *(SPD/MCH)*	TO *(Nxt Wpt-Time/Dst)*
– SPD RSTRNT	CLB-1 N1% *(Cmt Thrst)*
← MAX RATE	MAX ANGLE →
← ENG OUT	RTA →

(Status Type) CRUISE page **1 of 1**	
– CRZ ALT OPT/MAX	STEP –
– TGT SPD	TO ToD *Time/Dst* –
TURB N1% *(L&R %)*	ACTUAL WIND *CRS°/SPD* –
– FUEL AT DEST	
← ENG OUT	RTA →
← LRC	LRSC →
← MSC	ESC →

APPROACH page **1 of 1**		
– GROSS WT	WING ANGLE	VREF –
– GO-AROUND N1%	60°	MCH 2.00 –
	45°	MCH 0.97 –
APT RWY (LENGTH)	20°	MCH 0.80 –
ILS-RWY (FRQ & ID)		
FRONT CRS°	FLAP ANGLE	VREF –
WIND CORRECTION (KT)	15°	140KT –
	27°	130KT –
–	38°	126KT –
← INDEX		

INDEX – INIT/REF page **1 of 1**	
← IDENT	NAV DATA →
← POSITION	FIX →
← PERFORMANCE	
← TAKEOFF	
← APPROACH	
← OFFSET	NAV STATUS →

OPERATIONS menu

This is the first chapter that appears when power is supplied to the system. It has just two chapters under it, serving as the entry menu. The two chapters are FLIGHT and GROUND (maintenance). Since we are flying out, I'll press the Line Select Key adjacent to the screen item titled "FLIGHT". This takes us to the first page in the FLIGHT chapter titled "IDENT". At the IDENT page, we visually verify that the aircraft's specs (engine model, navigation database, time/date, etc.) are all correct before moving on to the next page. Choosing the GROUND option is best left for the mechanics as it's the channel they use for doing things updating the navigation database, telling the aircraft about any kind of alterations made to any of its components, etc. it's not the place for us to operate in unless we are having a technical get-together with the mechanics. In the future we will omit the appearance of this page when the system is powered on. It can still be accessed by pressing a certain combination of keys.

IDENT page

As a logical guide for the crew operating it, the Flamingo's FMS keeps the crew informed on the status of their previous inputs by using the lower-most Line Select Keys (LSKs) which appear beneath a bold line, separating these lower-most LSKs from those above. Whatever item appears beside the right lower-most LSK, is the item that the crew is expected and permitted (by the FMS) to attend to. If the item that appears beside the left LSK happens to be the item titled "**INDEX**", then it means the previous page has been filled-in/treated satisfactorily by the crew and that there are no outstanding pages or item that still need to be attended/filled-in by the crew. If on the other hand, an item other than "**INDEX**" appears the lower-most left LSK (at AeroScience we refer to these lower-most LSK items as "below-the-line" LSK items) it means some the indicated page has not been completed. As an added aid to remind the crew, AeroScience has programmed such a prompt to flash in the "bright-dim-bright-dim" manner until it is revisited by the crew for completion. We will later incorporate color-coded fonts to further heighten situational awareness on this feature, as an upgrade.

POSITION page

Having verified the contents of the IDENT page, we can see that the right-side, below-the-line LSK is prompting us to move into the POSITION page where we can tell (or remind) the Flamingo where exactly it is positioned geographically, so that it can start to keep a record of wherever it eventually goes to at all times. Among several things, we will enter the Reference Airport; where it is and where its position monitoring will start from (it should be understood that REF AIRPORT can in rare cases be different from the airport where a trip route is to start from). Today our REF AIRPORT will be Al-Ahsa airport, home to the AeroScience factory; we therefore enter the ICAO Identifier code for Al-Ahsa which is **OEAH** by typing the code into the scratchpad and pressing the LSK for the item REF AIRPORT. This “pastes” our typed entry from the scratchpad to the REF AIRPORT line. If the factory has a system of gates for aircraft to park at, we enter the gate number beside its LSK. At the moment, AeroScience does not use the gate system, just ramp parking slots, so we can leave the GATE line empty (FMS will not “complain” about this). The item LAST POSITION bears the last recorded coordinates (position) that the Flamingo stood on when it’s Inertial Reference System (IRS) was powered-down. This happened to be one of the factory’s hangars. Our maiden flight involved the Flamingo being towed out of the hangar and onto the ramp, before it was powered on via Ground Power and later APU Power. This means the current position is different from the last.

Since we gave the IRS a headstart (via battery power) to align as we entered the cockpit, we should use the different value (coordinates that appear on the LSK item **CURRENT POSITION**. All you do is press its LSK to “copy” the current coordinates to the scratchpad, and then press the LSK for “**SET IRS POSITION**” which bears the boxes “ □ □ □ **.** □ ” etc. (Whenever you see those boxes on an FMS page, it means you MUST provide the relevant info otherwise progress can’t be made in the preflight process) this is an easier alternative to transferring info from one spot in the FMS to another spot, compared to typing the whole longitude/latitude value manually. Immediately, the Pscholographic Display of the Integrated Flight Display (combination of Primary Flight Display and Navigation Display) adjusts the colored terrain map with international borders, by shifting the map so that the location (our current coordinates/position) slides under the centered aircraft icon (representing us). Now the Flamingo knows where it is and can now account for its position wherever it goes…so let’s tell it where it’s going to go today, by going to the ROUTE page; since the prompt ROUTE now appears on the right hand below-the-line LSK.

ROUTE page

On this page we discover that the FMS has intuitively copied our chosen REF AIRPORT of Al-Ahsa (its code of OEAH actually) into the scratchpad as we entered this page. The next thing to do is to enter OEAH into the line for ORIGIN since we are at Al-Ahsa and will be leaving from there; once again, we do this by pressing the LSK beside the item ORIGIN to paste OEAH from the scratchpad to the ORIGIN space. Immediately, the IFD shows a cyan-colored (blue) circle icon representing an airport appearing next to the IFD-centered aircraft symbol which represents us. Next we type in the ICAO Identifier for our destination airport DNAA, which stands for Nnamdi Azikiwe International in Abuja, Nigeria. This causes the map on the IFD to automatically zoom out sufficiently, while panning towards the location of Abuja, Nigeria so that we can see both origin and destination airport icons cyan-colored (blue) circles with their codes besides them in cyan-colored (blue) as well. The prolific input/output redundancies of the Flamingo’s FMS architecture allows so much flexibility that if the crew desires, a route can be drawn automatically by selecting the LSK of GENERATE ROUTE or manually, by either entering/typing it into the ROUTE page, or by actually “drawing” it using the Cursor Control System (TCS). To manually create a route by drawing it, you place you index finger which is wearing the finger-worn device on the origin airport icon and click the side of your index finger using your thumb. This causes a flyout menu to appear. Listed in this flyout are options which include the item “Generate OEAH-DNAA route”. Clicking on this causes a sub-flyout to appear with options of:

1. Direct-to (GPS) route
2. V-Way (Victor airways) route
3. J-Way (Jet airways) route
4. VOR route
5. NDBs route
6. Combination
7. RNAV route

You select the composition of the route between Al-Ahsa and Abuja you prefer and the FMC will generate the shortest possible route based on route composition you have chosen. This can be done from the CDU if so desired because pressing the LSK for GENERATE ROUTE takes you to a page that has the same LSK menu as the IFD’s airport icon flyout menu on this feature. If you have so much time (and fuel or ground power) at your disposal, you could create your route the long way by first selecting Direct-to (via IFD icon flyout menus or CDU page) so that FMS draws a single, legless (no segments or waypoints in-between), great-circle route, magenta course line between Al-Ahsa and Abuja. The next thing you do is in the IFD’s pschologram of the route; you click-and-drag by pointing on the magenta course line near the OEAH icon while keeping the click button pressed, and “drag-and-release” the magenta course line to any waypoint (intersection, VOR, NDB, etc) situated near the running length of the magenta course line, you need to zoom-in to see available waypoints though. It will “snap-on” to that waypoint and in the CDU, you will see it appear in the TO section while the VIA section automatically gets filled in with a “DIRECT” annunciation. This happens if you don’t “drag-and-release the magenta course line onto a Victor-airway or Jet-airway; doing that would have the VIA field being filled with the related Victor-airway or Jet-airway (V-way or J-way) you “released” the course line onto. One nice feature in many FMSs today is that if you select two waypoints that have a V-way or J-way between them, selecting the end-waypoint for that V/J-way automatically prompts the FMS to add all/any waypoint(s) present, in-between the start-waypoint and end-waypoint of the V/J-way in question. The same applies to the Flamingo’s FMS. For our trip from Al-Ahsa to Abuja, I decided to create the route manually, well ahead of the flight (next page):

Flight Plan (route) for FMC

Waypoint category	Via	To	Waypoint type
SID	–	AHSA4	Intersection
Transition	–	KURSI	Intersection
Route	–	GOLNO	Intersection
	–	RUBAN	Intersection
	–	**RIY** (114.50z)	VOR/DME
	–	DURMA	Intersection
	G782	**RGB** (115.50z)	VOR/DME
	G782	TUKVU	Intersection
	G782	**DFN** (117.50z)	VOR/DME
	–	SENGO	Intersection
	–	EPLOM	Intersection
	–	IMLER	Intersection
	–	2032E	Intersection
	–	**DOG** (112.30z)	VOR/DME
	–	1930E	Intersection
	–	NIMIR	Intersection
	–	1725E	Intersection
	–	KINTU	Intersection
	–	1418E	Intersection
	–	1316E	Intersection
	–	TJ009	Intersection
	–	SIGAL	Intersection
	–	POSIB	Intersection
	–	IKTAM	Intersection
	H223	**JOS** (113.10z)	VOR/DME
	–	BORNA	Intersection
Transition	–	ABJ23	Intersection
STAR	–	ABJ21	Intersection

SID = Standard **I**nstrument **D**eparture

STAR = Standard **T**erminal **AR**rival
or (**S**tandard **T**erminal **Ar**rival **R**oute)

In an upcoming update for the OS of the Flamingo's FMS, we will include a ROUTE page menu item titled REVERSE ROUTE. This feature will allow a used route to be flipped around so that it becomes a return route. It should be noted however that, any SIDs and STARs in the route will be omitted by FMS as they will naturally not apply, since they are meant to guide one to/from the airport, to/from the main route itself (pilots will have to insert SIDs and STARs themselves, based on what they airport establishes as appropriate for their respective traffic patterns).

PERFORMANCE page

Now that we and the Flamingo know and agree that we are going to Abuja, as well as which way to follow to get there, let's do the same thing regarding the pace we will be moving along our chosen route. The most economical performance profile is a product of several variables arrived at via calculations by the FMS; simply put, FMS will ask/require you to provide it with certain information. When you provide such, it will in turn advise you on what to do, when to do and how to do in terms of the following:

1. An economically optimum altitude to fly at (calculated by FMS).
2. An economical rate-of-climb to that economical altitude (calculated by FMS).
3. Cruise speed (chosen by the pilot, and maintained by FMS).
4. The best place near the end of the route to start the most economic descent into Abuja.

We start first by entering the Flamingo's weights; if you know it's gross weight then you type it in manually, followed by the weight of the fuel (don't worry, aircraft of nowadays know the quantity if you enter the weight of the fuel and vice versa). If you don't know the gross weight or just want to do it the easy way, simply remind the Flamingo (like all other jets) of its empty weight, also known here as the zero-fuel-weight or ZFW. Type the ZFW into the scratchpad and "paste" into the left side of the FMS display beside LSK-3L (third Line Select Key on left side), by pressing LSK-3L. The FMS will immediately see that it is heavier than its empty weight and calculate the difference for FUEL weight (and consequently fuel quantity) as well as its total weight or gross weight (GW). It will also ascertain where on board all, some or most of this weight is situated (or distributed) so that it can calculate and tell you where its center-of-gravity (CG) is. This is extremely important for the following two reasons:

1. It will advise you on the value to set the pitch trim to so that during takeoff, you get an accurate feel of the primary flight control (Twistick) when you raise the nose to get off the ground. Not getting the pitch trim set correctly will result in your muscles being strained on providing extra forward or rearward pressure on the Twistick to get the right takeoff/nose-up angle. If you get the setting very wrong, you may either strike the tail on the ground during takeoff or worse, not be able to takeoff at all…meaning you use up all the runway while remaining on it and overshooting it to collide with whatever lies beyond the runway…an extremely messy scenario!
2. During cruises, aircraft of nowadays "feel" their center-of-gravity while monitoring changes in their weight and weight distribution, this helps them (when their autopilots are active) to maintain the correct (fuel-efficient) "posture" so to say when flying; the correct "posture" or attitude is managed by correctly adjusting the pitch trim setting.

Once you type in the Zero-Fuel-Weight (ZFW), modern jets including the Flamingo automatically fill in the remaining weight items with the corresponding weight values and pitch trim setting value (we will see this value later). FMS also shows us the recommended cruise altitude to fly at for maximum fuel economy (as well as the Flamingo's maximum possible) altitude in the OPT ALT/CRZ ALT area of this page. If we know the details of wind speed and direction for our recommended altitude, we can enter it otherwise we can leave it until we get up there, where we can see it on our Flight Display System, and enter it manually. The more info you give FMS (when it asks), the more economic it can make your trip through its advisories to you. Based on our full tank weight entry, our occupant weight entry –just the two of us and no baggage weight, FMS has recommended a weight and speed-related cruise altitude of FL650 or sixty-five thousand feet (above sea level). We conclude by filling in the fields on page one and two of PERFORMANCE, with details of weather conditions at Al-Ahsa airport (wind speed and direction, temperature, runway dryness/wetness and texture).

N1% LIMIT page

The next page in the setup sequence is the N1% LIMIT page. This is an interesting page because it's from here that we instruct the Flamingo on how much power it really needs to get off the ground and climb to the sixty-five thousand feet cruise altitude. The first important issue here is the current weather at our factory, where we are taking off from. As early as it is this morning, the temperature of this desert town has already climbed to twenty-five degrees Celsius. The issue here is that the warmer the air is, the less dense it is, and the less dense air is, the harder it is for any aircraft engine to perform its duty of propelling the aircraft to a takeoff on the same runway – which by the way has a specific length that is constant. For certain other regions of the world, you will find that even though the air is cool, it still isn't dense enough for certain aircraft to take off, due to insufficient runway length for the aircraft's given weight. This is very typical of high-elevation airports; airports in mountainous regions as high as five thousand to ten thousand feet in height.

We can takeoff using maximum thrust, but because there are only two of us on board with no baggage and a generously long runway, we won't need all that power; we can literally "fool" (lie to; deceive) the FMS into thinking that its warmer outside than it actually is. This is done by typing in a higher temperature than the current Outside Air Temperature (OAT) at the LSK item titled SEL/OAT. This tells the FMS that it's warmer outside (than it actually is); I'm typing in a temperature value of thirty-eight degrees Celsius. FMS knows that when it's warmer outside, the engines will have a reduction in power output and even take longer to rev-up.

The idea is to deceive FMS because it already knows that our overall weight is so light and the runway is so long that we actually don't need so much power to take off. The benefit of using this method –known to pilots as the "Assumed Temperature" method for takeoff power, is that you reduce the workload of your engines and extend their service life significantly, while minimizing maintenance costs and spacing maintenance intervals further apart. The "Assumed Temperature" method is one way of deriving "De-rated or Reduced Takeoff power", in an effort to go gentle on the engines when possible. Another method is simply selecting any of the FMS pre-calculated Takeoff Derate options on page one of N1% LIMIT section, however the Assumed Temperature lets you vary how much you can greatly reduce the takeoff power safely thereby minimizing fuel burn and inter-turbine temperatures (thermal stresses in hot section of engines), but you have to be careful so that you don't under-power the aircraft.

I've typed in an outside air temperature of thirty-eight degrees Celsius into the SEL/OAT line and FMS has replied by indicating that instead of requiring some eighty-seven percent of N1 output for takeoff power, we can safely get airborne using just seventy percent of N1 power. Finally, I should explain to you what N1% actually means. Jet engines have multiple fan and turbine stages, the first fan stage which you see outside when you stare at the front of the engine, is called the "N1 Fan". It is attached to a spool or shaft which runs to the last turbine stage of the engine…the one you see when you stare through the tail pipe of the engine at the rear end. It's also important to know that the blades at the front half of the engine are known as "Fans (or fan for singular)" because they draw fresh air in. The blades in the rear half are known as "Turbines (or turbine for singular)" because the hot, burning gases from combustion generate a "blowing force" to turn these rear-place turbine blades. This means that the front fan (a low pressure fan) or N1 fan is attached via spool or shaft to the rear turbine (low pressure turbine) or N1 turbine. After the N1 fan is the N2 fan, it is an intermediate pressure compressor and is attached via spool (or shaft) to the N2 turbine, which is situated in front (further inside) of the N1 turbine. This means that the spool (or shaft) or the N1 fan and turbine is enclosed within the hollow spool (or shaft) of the N2 fan and turbine. Take a look at the following diagrams on the next page to get a rough idea of what I'm on about:

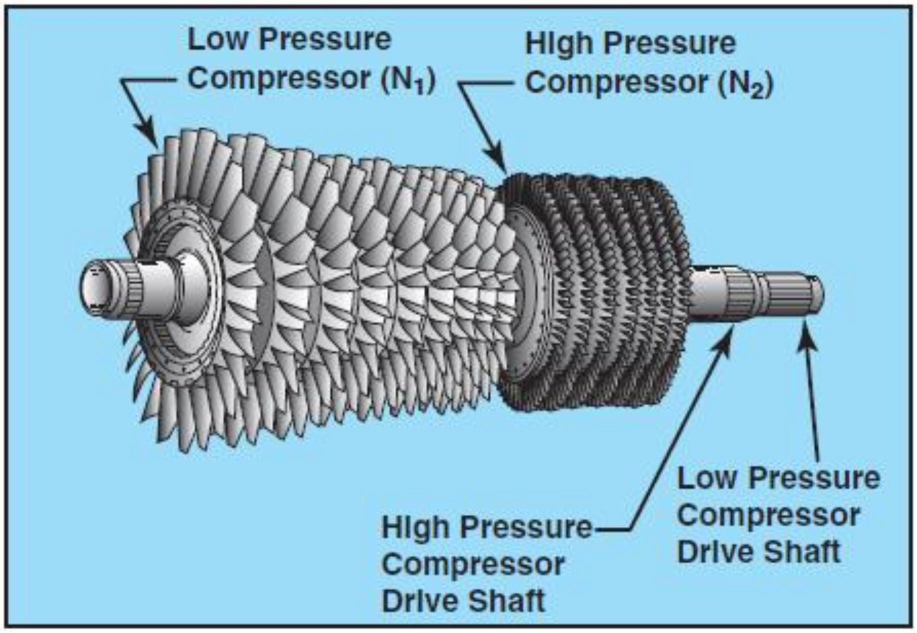


Figure 1. Dual-spool axial-flow compressor.

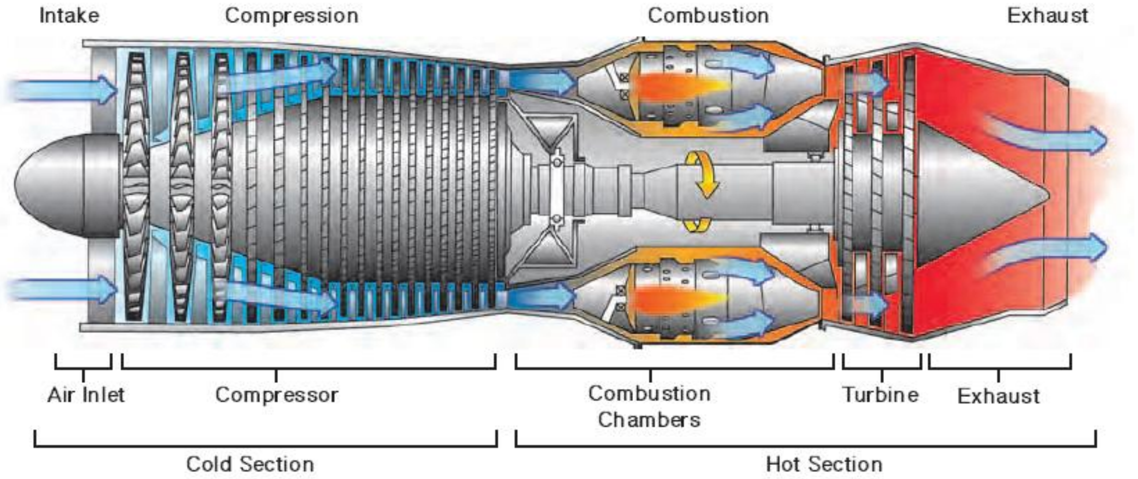


Figure 2. Components of a typical jet engine.

TAKEOFF page

After setting up our takeoff thrust and thrust derate values, I go to the bottom of the page to select the prompt to move to the next page, the TAKEOFF page. This is where we setup the proper wing configuration for our weight and weather related departure. A flap setting should be selected that will enable the Flamingo to takeoff before it uses up the runway's length. Our weight, today's weather and our thrust setting means we can use the least amount of flaps which is seven degrees (angle) of flaps, so I type in the value of seven degrees in the LSK line titled FLAPS. FMS automatically calculates my takeoff V-speeds based on my weight, today's weather and thrust setting. There are three V-speeds every pilot must know (by his/her calculation or by FMS calculations) in order to carry out a safe takeoff, they are:

1. **V1** = Decision Speed. The speed at which you no longer have the option of aborting the takeoff because you are going too fast and have too little runway space left to come to a safe stop. If your speed during takeoff attempt has not reached V1, then it is safe to slam the brakes on if a problem springs up, and you will be able to stop the aircraft before running out of runway space.
2. **VR** = Rotate Speed. Depending on weight, weather and runway length, this speed can sometimes be the same with V1 or sometimes, be a little higher than V1. The certain thing is that once you reach VR, you can (and it certainly will be time to) “rotate” the nose of the aircraft upwards by pulling back gently on the Primary Flight Control; side-mounted Twistick for the Flamingo, Sidestick for Airbus jets, center-mounted Joysticks for combat aircraft and Yokes for all other aircraft.
3. **V2** = Safety Takeoff Speed. Once you rotate the nose up sufficiently, any aircraft is bound to get off the ground. A few seconds after liftoff you will have accelerated to the V2 speed –the speed at which you need to be at (and maintain or exceed) if you should lose at least one of your engines. On most flights –which thankfully don’t involve the loss of an engine, the landing gear or undercarriage, are traditionally retracted at or a little bit beyond this speed so that the aircraft can accelerate quicker (extended landing gear or undercarriage do slow down aircraft because of the airflow disruption they cause).

Also on this page, we will see the FMS-calculated center-of-gravity (CG) and the corresponding (also calculated) Trim setting that I need to apply for a neat takeoff…I mentioned this earlier if you can remember. On page two of the TAKEOFF section, I can if I have the info, enter runway wind direction and speed (for FMS to further refine its calculations), runway condition; dry, wet, anti-skid, etc. Once this is done, you will notice at the bottom of the page that there is no prompt to move to another page. This is because you have come to the end of the essential FMS setup for the flight and that you are ready for departure detail.

Taxi Clearance

Now that preflight checks and preps are completed, I’m going to setup the radios as follows:

1. **COM1** = 126.70 MHz, the frequency of Bahrain Center. Whenever we intend to depart as according to the flight plan we filed with them, we contact them to let them know we are ready for departure, and they clear us for departure detail.
2. **COM2** = 122.80 MHz, the frequency for Al-Ahsa Airport’s Air Traffic Control (tower). They will clear us to taxi from our parking position to the runway while ensuring we don’t bump into anyone or anything on the ground.

3. **COM3** = Satellite Communications (SATCOM) link to the AeroScience department of flight operations. They are our support team in case of any challenges, and we must have a permanent channel for staying in touch.
4. **NAV1** = 110.90 MHz, the frequency of Al-Ahsa Airport's Runway-34. The runway's abbreviation (ICAO code actually) is IHSA and its compass (magnetic) heading is 343-degrees…this I dial into the HDG control on the Mode Control Panel (MCP). This ensures that the Flamingo is tuned into the signal of the runway's Instrument Landing System (ILS). It's a facility that visually guides pilots and/or autopilots to the runway for accurate and safe landings even in zero-visibility. I'm tuning Navigation Radio One to this signal as a convenient precaution.
5. **NAV2** = 116.60 MHz, the frequency of the Al-Ahsa VOR station. It's a ground based navigation aid which either forms part of an aircraft's route when flying overhead from one place to another, through our area. It also serves as a reference aid for non-precision approaches (not involving the use of ILS). VOR means **Very high frequency Omni-directional Radio range**. It's capable of helping a tuned-in aircraft to even know its distance as it approaches or recedes away from the installation.
6. **NAV3** = I'm not tuning this radio to any signal yet. I had it installed as standard equipment on the Flamingo just to maximize functional redundancies on the navigation front. A third Nav radio is extremely uncommon on any aircraft and serves as a reminder of how radical and unconventional I am in design and development. I could slave it to the GPS system but even that unit is comfortable as it is, functionally.

My radios are set, and I've spoken with Bahrain Center and Al-Ahsa traffic control; we're cleared to power-up and roll out to the runway using the A34 taxiway which leads to runway-34.

Start-Up

I'll start by setting the air conditioning switches from HIGH to AUTO. For quick cooling on the ground, HIGH has to be used because aircon packs find it hard to cool when the aircraft is standing still. Aircraft air conditioners lack compressors in order to avoid the excess weight. Instead they use a system or array of heat-exchangers; these are a series of radiator-like devices which air flows through to pack out the hot air from onboard and dump outside through convection. The result is cooling which is channeled back into the aircraft. You'll soon know why I set them to AUTO. The Auxiliary Power Unit or APU (that little jet-powered generator) I mentioned earlier has been supplying electrical power and compressed air since we got on board. Now I need most of its compressed air to spin-up the engines to life (engine start). To start the engines, I go to the overhead panel and look for the ENGINE START subpanel. I move both ENGINE 1 and ENGINE 2 switches from AUTO to START. The compressed air supplied by the APU is so potent (high pressure) that there is enough for a dual supply of thirty-PSI; each engine needs a minimum of thirty-PSI of air pressure to successfully spin into a self-sustaining start/run. As I move both switches from AUTO to START, the AIR (BLEED) SOURCE subpanel automatically starves the air conditioning units of air (courtesy of my setting their switches from HIGH to AUTO…remember?) in order to divert all the compressed air to the engine starter units (blowers actually). The central display which shows feedback from the GCAS or General Crew Alerting System, displays the engine start sequence graphically and textually.

The linear scrolling gauges of both engine's indicators show a spinning-up process. I immediately go to the throttle quadrant (where the throttle levers are) and set the fuel let-in switches from CUTOFF to RUN/IDLE. This arms FADEC (Full Authority Digital Engine Control) with permission to manage the engine start process independently. Both engines keep spinning up (increasing rpm) until they reach their N1 speed of twenty percent, the speed required for sustained ignition to commence. You can hear and perhaps even feel the distinctive "poof" sound as the FADEC-managed introduction of fuel is ignited in both engines simultaneously. On the engine gauges, you can also see the EGT (Exhaust Gas Temperature) gauge also showing a rise in temperature. As both engines reach an N1 of fifty percent (and increasing), FADEC disengages both starters and re-diverts compressed air back to the aircon units. FADEC continues to "escort" via fuel flow control, both engines to their respective idle-run speeds, where after it declares a message of ENGINE START COMPLETE on the display. Our engines are ready for the propulsive business of the day. Back on the radio, I inform Al-Ahsa tower that I'm ready to roll and turn on the taxi lights. To get the Flamingo moving, you simply release the parking brakes and that's it; the thrust from the idling engines is more than enough to get the bird rolling along, of course you have to be ready on the brakes to restrain it when taxiing. Analogically, it's the same with driving a car with automatic transmission (gearbox); once you start its engine and shift its gear lever from P (park) to D (drive), you have to be ready on the brakes as it will creep forward. Such is the tremendous power-to-weight ratio of the Flamingo, even when its engines are idling. Since we are parked on the ramp, there are no obstructions in front of us, leaving us free to roll out. As I start to steer the Flamingo along taxiway A34, the FMS notices and displays on the GCAS, the TAXI CHECKLIST. This is a list of things I need to attend to while taxiing and since I know this aircraft like the back of my hand (I designed it), I can handle it all single-handedly (no need for a co-pilot even though the Flamingo is meant to be flown by a two-man crew). On the next page is the list showing the following:

1. Wings/Flaps:
    - Switch to AUTO
2. Flaps:
    - 7º
3. TCAS:
    - TA/RA/RE
    - ABOVE
4. Cabin Pressure:
    - Set to FLIGHT
5. Engine Start:
    - Set to FLT
6. Heating
    - Pitot ON
    - Window ON
7. Lights
    - Taxi ON
    - Strobe ON
8. LNAV
    - ARM
9. Transponder
    - ON

Basically, anything that needs to be done before or during taxiing, which hasn’t been done yet will appear in this checklist. I deliberately ignored a few things and they have appeared as reminders. As I take the necessary action for each item, it will disappear from the list. Once the last item in the list is dealt with, the Flamingo will present the next list which is the TAKEOFF checklist.

Steering the Flamingo on the ground is easy; turns are made by twisting the Twistick in the relevant direction as is done on the joysticks for certain computer games. Now that we're heading to the runway, it’s time for me to show off what makes my Flamingo different from every other flying vehicle out there. One of the "to-do" items on the TAXI CHECKLIST that you saw requiring crew action is the WINGS/FLAPS item. It says the system needs to be turned on; looking down at the pedestal you'll see an open switch-guard with a switch inside, standing vertically in its OFF position. It is turned on by flipping the switch to the right, past the ON position to the AUTO position. This gives the Flamingo the ability to "self-configure (or auto-configure)" its wings according to the protective demands of the SAFEP (Speed And Flight Envelope Protection) system. If you look out the window to the rear, or look at the 3D diagram of the Flamingo shown on the FLT CNTRL page of the GCAS, you will see that the wings are swept in the supersonic position...fully back. This like I said earlier, is to become a tradition for parking the Flamingo so the recess where its wing trailing edges are stowed, are kept free of obstructive debris.

The other way of turning on the system is simply by closing (downwards) the switch-guard so that its inner lid-side presses the flip-switch all the way into the ON position...as I'm doing now. You can see that as the system comes alive, it disappears from the list, leaving the FLAPS-7 item as a sub-item. You can also see, hear and maybe even feel the Flamingo automatically swinging out (electro-hydraulically) its wings to the FORWARD sweep angle. The system is ON but not yet armed for auto-configuration; that will happen when I pull the Wings/Flaps lever back from the UP detent to the FLAPS-7 detent...this is what arms it to reconfigure itself when required. You'll soon see it in action. Now that we are well away from the ground personnel area, I'll clear the remaining "to-do" items on the list, they are as follows (with an explanation of why):

- TCAS set to TA/RA/RE:
    - ➢ TA stands for "Traffic Advisory"; the Flamingo's traffic radar sees and tracks (like other aircraft) other aircraft nearby and tells you which one(s) is/are getting too close to pose a risk of collision with you. It simply alerts you.
    - ➢ RA stands for "Resolution Advisory"; the Flamingo (like other aircraft) tells you which way to go -up or down- and by what amount, to safely evade any intruding aircraft that is on a collision course with you. Here it tells you exactly what to do and when.
    - ➢ RE stands for "Resolution Execution"; the Flamingo UNLIKE any and all other aircraft (except maybe the Airbus A380), will -if its autopilot is engaged at the time- automatically evade any aircraft that is too close/on a collision course with you. It will steer itself away from the proximate threat; in the process it will likely abandon the route it is flying to do so and will steer itself back on course only when it has evaded the conflicting traffic (intruding aircraft).
- CABIN PRESSURIZATION set to FLT: The cabin air pressure is still equal to the air pressure at Al-Ahsa airport. I'm setting it to FLT or "flight" mode so that the Flamingo quickly fills its interior with air at the appropriate pressure that will enable us to breathe while at high altitude. All aircraft operating above twelve thousand feet must have internal pressurization capability.
- SPOILERS arm: the lever for the speed brakes is to be pulled back a little so it’s aligned with the ARMED mark along its shiftgate. This allows the Flamingo to deploy or raise the Spoiler Flaps if we decide to abort or "reject" the takeoff for one critical reason or the other, and when our speed is at or above sixty knots.
- AUTOBRAKES arm to RTO: I'm arming the wheel or service brakes to the RTO setting, which is for "Rejected Take Off". If our takeoff speed is at or above sixty knots and for some critical reason, we have to abort the takeoff, the wheel brakes (and the armed Spoiler Flaps I mentioned above) will all activate immediately when I pull the throttle levers back to the IDLE position to cut engine power. The Flamingo will apply maximum, anti-skid braking action along with full Spoiler Flap deployment to bring itself to a safe and quick standstill.

Now that I've cleared the TAXI and TAKEOFF CHECKLIST, we can safely get airborne. The Flamingo has full authority over its wings, flaps, landing gear (yes it also extends and retracts its wheels), and even the "above/all/below" directions that its traffic radar focuses in, I'm getting clearance from Al-Ahsa tower as I steer onto the unoccupied runway...and re-engage the parking brakes while we wait for clearance. Because this is the first flight of the Flamingo, we might have to wait on the runway for a minute or three; the design and engineering teams have crammed this prototype Flamingo with arrays of instruments and sensors to monitor its performance, behaviour and handling, from taxiing through takeoff, cruise, landing and parking. We will not have any interaction with such equipment as none of it is under my operating jurisdiction; my job is just to fly us to Abuja so that the equipment can do their job. The deliverables of this flight include performance data for a very normal flight/trip profile; all the teams want to know what kind of performance variables will be generated by the Flamingo during a flawless flight cycle. Not only will the data be compared with its counterpart generated during the computer-aided design stage and wind tunnel tests, but it will also be compared with the data of future test flights (especially those focusing on "low" and "high" performance extremes and various flight regimes.

Takeoff

The tower has cleared us for takeoff; this means that all our ground teams, lab teams and telemetry teams are happy (satisfied) with the performance of their equipment setup on board and that we can get going. This is the moment of truth...we are about to make a special edition of history with the first ever supersonic flight of a civilian aircraft, since the last supersonic flight of the last Anglo-French Concorde, before it was finally confined to the annals of aviation history.

To enact the reduced power setting of “Flexible Thrust, you look at the base of the throttle shiftgates, you will find a tiny spring-centered slide switch there; the left side of each is titled FLX for “Flexible Thrust (to activate the Assumed Temperature, reduced thrust mode)”, while the right side is titled TO/GA for “Take Off/Go Around (maximum thrust without yellow-lining the engines, let alone red-lining them)”. I release the parking brake and push the throttle levers forward a bit until the N1 gauges show sixty percent, and as the Flamingo starts accelerating and I notice the engine response-pointers align with the throttle lever's command position pointers. This is when I slide the switch to the left for FLX mode. This commands FADEC to apply "The Flexible Thrust" power that applies thrust worth N1 of seventy percent (based on the assumed outside temperature of thirty-eight degrees Celsius that I entered on the N1% LIMIT page in the FMS earlier). Even with such reduced power, we're still able to accelerate fast enough so that you can feel yourself being pinned gently but firmly into your seatback; the Flamingo is to General Aviation aircraft, what an AMG-Mercedes or Brabus-Mercedes is to passenger cars...a rocket-propelled grenade that goes without exploding later (unless a nasty collision or impact occurs)!

As we accelerate to sixty knots the Flamingo's synthetic voice (yes the Flamingo talks to you when giving certain types of feedback) gives the aural message "sixty knots" and a second later, it says "throttle hold" while it's FDS shows the same textual annunciation of a boxed THROTTLE HOLD. Because we are not in a hurry to climb and cruise at maximum speed, neither myself nor FADEC will invoke the use of the afterburners that are part of the engines. If you remember during setup, the trip performance profile for this flight is that of "Long Range Supersonic". AeroScience wants to know how far the Flamingo can travel using the least amount of power needed for supersonic flight. Instead of using afterburners, the engines will run in "supercruise" mode, a thrust mode that produces more thrust than the partial afterburning mode of the Anglo-French Concorde, but less thrust than the fuel-guzzling, flame-throwing afterburning mode of many combat jet engines. We will be cruising at the Flamingo's slowest supersonic speed of Mach 1.15; this speed keeps it well ahead of the drag-infested supersonic start-speed of the Mach 1.00 to Mach 1.09 range.

As the Flamingo calls out (while showing same on its FDS) the "V1" speed and a second later the "VR" speed (which means "rotate speed"; "V" for speed and "R" for rotate), I gently pull back on my side-mounted Twistick until the Flamingo's nose rises to an angle of five degrees. The Flamingo is such a lift-rich, aerodynamically efficient airplane that as early as three degrees of nose-up angle, its weight is taken off its landing gear suspension. And if you hold it at three degrees, it will still get off the ground gracefully. We are airborne as you just felt the "thud" sensation of the wheel struts extend to their respective "stops", and our vertical speed indicator has started showing a positive rate-of-climb while the altimeter shows the corresponding increase in altitude. You can also feel the G-force pulling you down into your seat-bottom. The Flamingo now voices out "Positive Rate" to confirm to us that it is happy with the start of our climb out of Al-Ahsa.

Climb

Seconds later the Flamingo calls out "V2", our "safety takeoff speed" and then it calls out "gear up". Don't bother about retracting the landing gear, the Flamingo will do so itself. The SAFEP has authority not just over the throttles (auto-throttle/auto-thrust), the Wings/Flaps and Spoilers, but also the landing gear...anything it needs to manage its ability of safely remaining airborne. As it packs those wheels into their wells, you can see and perhaps feel the Flamingo accelerate some more despite no further increase in power or drop in nose angle. Whenever an aircraft's landing gear is lowered, they act as airbrakes, just like the flaps and spoilers, so you want to pull them in soon after takeoff to help the aircraft accelerate promptly. At an altitude of five hundred feet the Flamingo signals to us that its FMS-autopilot is ready to handle any and all of the right and left turns that our route is made. It signals us by flashing in "white" colored light, the LNAV (Lateral

NAVigation...the right/left-turn aspect of a route) button on its MCP. As I press the LNAV button, its light changes to a steady bright green to indicate that now has control of all/any turns that will be made en-route. The only steering control I have left is that of up/down...but not for long. As we reach an altitude of one thousand feet, the Flamingo signals that we can hand over to it the up/down-turns of the route. This is known as Vertical NAVigation (VNAV); as the VNAV button flashes "white", I press it and its light becomes a steady "green" and now the FMS has full authority (control) of the Flamingo.

As we reach a speed of two hundred and forty knots, the Flaps lever shifts itself from FLAPS-7 to FLAPS-UP before we exceed the speed limit of the flaps structural integrity. We obviously don't need the extra lift it generates because drag is also generated when flaps are out. Until we reach an altitude of ten thousand feet, the Flamingo and every other aircraft in the world with pressurized cabins, are programmed to obey the international speed limit of two hundred and fifty knots. This global speed limit was imposed so that all aircraft windscreens/windshields can withstand multiple bird strikes (collision with flocks of birds) without cracking or breaking. Before we get to that altitude we will reach the first waypoint in our route. It's the intersection of our route's **S**tandard **I**nstrument **D**eparture or SID. An SID is an airport and airspace authority-established route that aircraft follow out of a busy airport. It helps to separate outbound flights from inbound flights; which follow **S**tandard **T**erminal **AR**rival (STAR) routes. The first waypoint which makes up our small SID an intersection called "AHSA4" and it's where we turn left to fly along the Transition of our SID. A Transition is a small route segment that joins the SID route to the main trip route; it helps blend-in the SID route with the main route so that abrupt turns and changes in direction are not encountered. There are transitions that join the main route and the STAR route as well. Our waypoint for our SID's departure transition is called "KURSI".

The three-dimensional view of our route, the topographical presentation of the Saudi Arabian terrain below us, all other aircraft flying nearby is breathtakingly immersive; the way the Synthetic Vision image database adjusts itself when the Flamingo climbs, dives or makes a turn is simply an extreme marvel of graphics and optics engineering. The pscholographic projection of all the performance, navigation, weather, and traffic/terrain symbology is so crisp, while the animation is as sublime as it is seamless. I'd like to say that there are one or two details that AeroScience is yet to settle down on. For instance, after takeoff the switches for LANDING/TAKEOFF LIGHTS were still in the ON position, yet the lamps actually turned off as soon as the landing gears retracted automatically. This detail is being scrutinized as a possible source of confusion for future flight crew. My proposed design remedy (hopefully to be incorporated as a design update/fix later, is that switch (es) for these lamps –including the TAXI LIGHTS, evolve into a spring-loaded switch which is centered in-between the detents of ON and OFF positions, with of course, a backlamp to light-on or light-off as an indication of whether the lamp is being turned on/off by the crew or by auto-gear deployment/retraction. This way if you turn them on and the Flamingo auto-retracts its landing gear after takeoff, you won't get confused as the ON backlamp will extinguish as the gear's entry into its well turns off the lamp. My design remedy helps further in that if you want to turn the TAKEOFF/LANDING LIGHTS while cruising, you simply slide the switch to the ON position and release it so it "clicks" back to the center position while the ON indicator becomes illuminated by its backlamp.

As we climb to ten thousand feet, the CLIMB CHECKLIST appears shortly after the TAKEOFF CHECKLIST is cleared out. At this point, Al-Ahsa Traffic hands us back over to Bahrain Center. They are now in charge of our egress from our base of operations and I am hoping that they will take advantage of the sparse level of air traffic and clear us for an uninterrupted, unstepped and direct climb to sixty-five thousand feet, otherwise known to pilots as flight-level six fifty or flight level six-five-zero. With our current weight, the Flamingo shoots into the big blue at four thousand five hundred feet per minute even while its engines are dishing out just seventyty percent N1. This is the ECON thrust/vertical speed (another term that means rate-of-climb) profile for initial climbs. We have just crossed ten thousand feet and the Flamingo is no longer under the international obligation to keep its speed at two hundred and fifty knots or less, so the FMS moves the speed bug up to the three hundred and forty knot mark, while the FADEC obliges not by adding power, but by lowering the nose for a less steeper climb angle so that the vertical speed drops from the steep four thousand five hundred feet per minute to three thousand feet per minute.

Our acceleration now picks up rapidly as the speed scale's speed-trend-vector arrow grows taller while pointing up. As early as twelve thousand feet we hit the speed of three hundred and forty knots and the Flamingo's FMS, FADEC and SAFEP computers work together to maintain the speed…they "talk" to one another digitally and agree to continue adjusting (maintain three hundred and forty knots) airspeed not by making changes to the throttles, but by adjusting climb angle via vertical speed. So once again we are climbing a bit steeper; now at three thousand seven hundred feet per minute. This airspeed will not be exceeded because SAFEP is "telling" FADEC and FMS that our "**V_{NE}**" or "Never-Exceed speed" range starts from three hundred and fifty knots. This is displayed as shaded red-to-yellow ticker band that runs along the inner side of the linear, scrolling speed gauge which is the Airspeed Indicator and SAFEP Advisory scale. As you move up the yellow-to-red warning ticker band, it gets less yellower and more redder to express how seriously you will be in trouble if you somehow make the Flamingo fly in that speed range (overspeeding…which will result in the aircraft breaking up into many pieces because the air has suddenly become too dense for it to fly through).

The good news is that even if you somehow manage to tell the Flamingo –via FMS– to exceed that speed, it will ignore your command and warn you via the GCAS that the speed you want to move up to is in the "$\mathbf{V_{NE}}$" range. If you push the throttle levers forward at this point, SAFEP will tell FADEC to pull the levers back, and if you push-and-hold the levers forward, FADEC will overpower your hands when it "fights" you to pull the levers back. Your muscles simply can't oppose the extreme torque generated by the electromagnetic servo that FADEC uses to move the throttle levers along their respective shiftgates. Another reason why SAFEP is protecting the Flamingo's structural integrity via "$\mathbf{V_{NE}}$" is because when I chose the ECON climb thrust profile, SAFEP decided that it was best to leave the wings in the (fully swept) forward position. If we suddenly decide to be in a hurry and choose in FMS, a faster climb profile, FADEC will add the required power from the engines while SAFEP self-sweeps the wing rearward by self-shifting the Wings/Flaps Lever from the WNGS-15 (fifteen degree angle of wing sweep…or forward) to the more aerodynamically efficient detent of WNGS-45 (forty-five degree angle of wing sweep…or intermediate). We will see this self-sweeping wing action by the time we cross the transition altitude of eighteen thousand feet, when the systems switch from measuring airspeed in knots to measuring in Mach.

We've just passed seventeen thousand feet, I'd like to draw your attention to the Speed Indicator (I'd rather not call it an Airspeed Indicator because it measures not only Airspeed, but Mach as well). If you look at it closely you'll notice its dual-calibration; the scale that measures our speed in Knots appears on the right of the scrolling gauge, close to the scrolling tick marks and its figures appear in boldface font. Just next to these Knots figures, on the left half of the scale are the Mach figures. They appear dim and in a smaller italic font size, but also scroll downwards with the Knots figures since we are accelerating. As soon as we pass the Transition altitude of eighteen thousand feet, the Flamingo will switch from measuring speed in Knots to measuring speed in Mach. On the Speed Indicator, the Knots figures will become dim and smaller in font size and become italicized, while the Mach figures will grow larger and boldfaced while becoming de-italicized. That's one of two signs that the Flamingo has performed the Transition altitude, calibration reversion. The other sign is that the secondary altimeter which is always set to measure at the standard atmospheric of one thousand and thirteen milibars (equal to the optional measurement of twenty-nine point nine two inches of mercury), now becomes the active altimeter while the crew-adjustable primary altimeter goes into standby mode.

Bahrain Center has cleared us to proceed direct to Flight Level Six Fifty (sixty-five thousand feet) and since the performance of the Flamingo exempts it from the step-climbs of heavier jetliners, we'll just keep going up albeit gradual reductions in vertical speed as we head higher into thinner air. I'm turning off the APU as we no longer need it; I left it on up to this altitude as a precautionary tradition so that I can have immediate Bleed Air (compressed air) and electrical power in case we experience the loss of an engine that would require an in-flight restart or, the loss of any or both of the engine-driven Integrated Drive Turbo Generators (source of electric power from engines). One of the changes I've suggested to our team is to edit the performance programming so that as soon as the Flamingo clears ten thousand feet during a climb, SAFEP will self-sweep the wings from WNGS-15 to WNGS-45 so that the difference between its current speed as it accelerates beyond three hundred knots will be so great that not only will "**V_{NE}**" be pushed farther away up the speed scale, but that an increase in fuel economy will be realized. The idea is that the more swept back your wings are, the less drag you will produce; the easier it will be for you to "slice-while-skate" through the air as your reduced frontal-area drag coefficient (frontal area cross-section) becomes a benefit of the wings shifting to a steeper, rearwards angle. Now at twenty thousand feet or Flight Level Two Hundred, the SAFEP folds the wings back to WNGS-45 as you can see the Wings/Flaps lever self-shift up the shiftgate. If your current speed is too fast or slow for the wing-sweep angle or flap setting, a kink will appear in the shiftgate to block movement of the lever in the direction you want to movie it; another hallmark of SAFEP.

As we climb higher, our vertical speed is traded off (reduced to three thousand feet per minute) in order to maintain speed without adding power, and our speed increases more and more. At Flight Level Three Hundred (thirty thousand feet) the air is so thin that FMS has to increase the throttles to eighty-five percent in order to keep accelerating to the FMS-target speed of Mach 0.95 while climbing at three thousand feet per minute. At Flight Level Four Hundred, vertical speed is reduced to two thousand feet per minute and our acceleration brings us closer to the speed of sound (supersonic flight or Mach 1.0), we can see that SAFEP has just folded or swept the wings all the way back, as the Wings/Flaps lever finally self-traverses the shiftgate to the forward-most position of WNGS-60. On the GCAS display, I point with my "gloved index finger", wearing the Cursor Control System (TCS) to the rear-view pose of the aircraft symbol and "drag-and-turn" it so that we are viewing the aircraft from above. You can see how dramatically the Flamingo's shape has changed from a normal looking aircraft to a dart-shaped, combat jet-like shape. Very soon we will reach and exceed the speed of sound, even while climbing. Such is the tremendous power, agility and grace of the AeroScience AS440 Flamingo!

At Flight Level Five Hundred, the Flamingo further lowers its rate-of-climb to one thousand five hundred feet a minute, long after accelerating beyond the speed of Mach 1.0; we are now flying supersonic and the only telltale sign signifying it is the speed gauge, there is no special sensation to feel or anything. If it were possible for you to somehow fly outside beside the Flamingo at this speed, you would notice how gravely silent it is outside around the Flamingo. This is because whatever noise is being generated by the Flamingo is absolutely left far behind it. To a bystander, the Flamingo would just fly by silently and a few seconds later, the bystander would here all and any sounds (i.e. engines) being generated by it. At Flight Level Six Hundred, the Flamingo gradually reduces its rate-of-climb to five hundred feet per minute; its engines have been pushing us along in their “supercruise” mode. By now fuel economy has exceeded by a small margin, our calculated (and simulated) expectations, those turbofans are now sipping fuel at an impressively frugal rate of four hundred and ten pounds per hour…and its going to reduce a bit more since we haven’t reached our FMS-target altitude of sixty-five thousand feet yet.

Cruise

Our climb from Al-Ahsa’s runway-34 to Flight Level Six Fifty has taken just forty-five minutes, with the flight time to Abuja being an estimated four hours flat, especially if there is little or no inbound traffic into Nnamdi Azikiwe International Airport, Abuja. It’s those traffic-generated, pesky vectors from Nigeria’s Airspace team known as “Kano Center” and Abuja's “Approach Team” that may vector us around if many other aircraft are coming in at the same time, which will extend our flight time. I could really do without that, not that we will be short on fuel or something. I just love direct, stepless ascents and continuous (stepless) descent approaches; it is the epitome of efficient (financially, temporally, etc) flying. As we cruise along, there is really very little to do except talk about the flight and the equipment, listen to the radio chatter between aircraft and the airspaces they fly through with one another…oh, and acknowledge radio handovers from one Center to another, while retuning the radios accordingly. We won’t hear much or say much with the people at AeroScience because they are busy monitoring the Flamingo’s progress via SATCOM radio links, the data telemetry of the ACARS (Aircraft Communications Addressing and Reporting System), the Tri-Channel, solid-state, Blackbox which houses the Flight Data Recorder/Flight Voice Recorder/Flight Video Recorder. This custom made Blackbox has multiple banks of solid-state memory modules which all combine to store eight Terabytes of prolific data, while at the same time streaming the same generated/stored data live via satellite to the AeroScience lab servers. Multiple cameras mounted inside and outside include panoramic color video feeds and black-and-white Infrared video feeds for the Enhanced Vision System (EVS). Other than all this, we might as well just relax and see how well the Flamingo’s galley has handled our in-flight chow.

Now that we are cruising hands-free, let me show-off some of the stuff that makes the Flamingo different from all other aircraft. I want to show you some things on the Integrated Flight Display (IFD). The Electronic Flight Instrumentation System of EFIS on other aircraft is a dedicated panel with switches that allows you to show/hide certain information relating to Navigation. On the Flamingo, there is bezel of icons that line up the outer edges of each (of the three) PDS. These icons appear in 2D since they line the outer edges of the PDS. The arrangement of icons is by grouping. The icons you see on the bezel are called “Master Icons” because they represent certain other related icons, under them. These other icons in turn are known as “Slave Icons”. To select a “Slave Icon” you have to know which “Master Icon” it appears under…a fairly easy task, as Slave Icons are related to their respective Master Icons. For instance, say you want to show all VORs in the vicinity. You would have to select the EFIS icon on the bezel so that its flyout-list appears, showing all the Slave Icons under it. On other aircraft, the EFIS panels have among their buttons a VOR button which when pressed, displays all VOR stations in the vicinity. On the Flamingo, selecting the EFIS icon on the bezel with the finger-worn TCS device causes the list of EFIS icons to appear. You will find among these icons, the VOR icon, which you then select so that VOR stations appear on your map. One of the four sides of the icons bezel is reserved for “favorite” icons…selectable icons the user deems as being frequently used; akin to a speed dial. You can show or hide as many details on the map as you desire; the most important thing is that you find which type and amount of data suits your ability to maintain the highest level of situational awareness. Some pilots perform best with a highly decluttered display while others prefer their info displays jam-packed with info as their brains just have a way of sifting through it all and assimilating what is important at the moment, without being bogged down with an info overload. The items of interest in the bezel include the following groups and subgroups in this descriptive order:

ICON BEZEL OF INTEGRATED FLIGHT DISPLAY (IFD)					
EFIS Group		MAP Group		VIEW Group	
Info	Show/Hide Info	Info	Mode (reticle)	Info	Camera View
ARPT	Airports	**NORTH**	North-ahead	**N-Gear**	Nose-gear (fore)
VOR	VOR stations	**TRACK**	Track-ahead	**M-Gears**	Main-gears (fore)
NDB	NDB stations	**HSI arc**	Horizontal situation	**Ovrhd**	See front from tail
INT	Intersections	**HSI full**	Horizontal situation	**Undrnth**	See gears from aft
TRFC	Nearby aircraft	**VSI arc**	Vertical situation	**L-side**	From left wing
TURB	Turbulence	**VSI full**	Vertical situation	**R-side**	From right wing
WXR	Weather radar	**VOR-PNT**	VOR pointers	**Syn-Syt**	3D Synthetic sight
CNST	Constraints	**NDB-PNT**	NDB pointers	**Nyt-Syt**	Infrared night-sight
V-ways	Victor airways	**APRCH**	Approach (Loc/GS)		
J-ways	Jet airways	**PLAN**	Route checking		
RSTR	Restricted airspace	**MAP**	Normal nav view		
BORD	Geo-politi borders				
ARSP	Airspace types				
COMS	Comms areas/freq.				

DCLT	Declutter map				
TERR	Terrain				
CHRT	Nav charts available				

The image on the IFD (PFD and ND) as a whole can be manipulated in terms of viewing it from other angles/perspectives, as I mentioned earlier. For instance, the default view is "slightly high from behind". This lets you see the immediate airspace in front, on both sides and behind the Flamingo…in 3D. If you want to view the displayed info from above as is done on the 2D displays of today's (other) aircraft, all you have to do is place your TCS-dressed finger (index finger with the finger-worn device) on the slide-scroll icon that runs most of the length of the right border of the PDS's IFD. It looks just like the zoom scale control on the Google Earth application for PCs. Next you "drag" the centered slider to the UP mark so as to cause the entire display to gradually rotate from the horizontal plane to the vertical plane. It will look a little bit 2D-ish because you can still see icons at different depths. If you want to monitor your navigational progress from the side, you point then "drag" on the slide-scroll icon that runs most of the length of the bottom border of the IFD. Dragging it left or right will present you with a corresponding rotation of the whole display in the respective direction that you drag in. You'll also notice that the tiny aircraft symbol representing the Flamingo in the ND is not a "stick-figure" diagram like it is on Airbus jets, or the "triangle" diagram found on Boeing jet NDs, in the Flamingo it's a diagram of the Flamingo itself. If you zoom into the aircraft symbol using the slide-scroll icon that runs most of the length of the left border of the IFD, you'll discover it to be another highly detailed copy of the airplane diagram seen in the GCAS display. It will show landing gear status, wings/flaps status, etc. There really is no need to see the aircraft symbol in detail as the zoom level restricts you from other associated data; better use the GCAS airplane synoptic symbol to keep abreast with the Flamingo's status.

ICON BEZEL OF GENERAL CREW ALERTING SYSTEM (GCAS)	
Info	**Show/Hide Info**
ENG	Engines (status)
APU	Aux. Power Unit (status)
BLEED	Bleed Air (source, pressure, temperature, anti-ice)
COND	Conditioned Air (distribution, temperature, Air Packs)
PRESS	Pressurization (cabin, cargo, psi, relief valves)
DOORS	Doors (passenger, cargo, safety-arming)
ELEC	Electrical (volts, amps, channels)
WHEELS	Undercarriage (tire pressure, brake temperature)

HYD	Hydraulics
FUEL	Fuel/Tank (quantity, pressure, flow)
FLT.CTL	Flight Controls (wings, flaps, position)
CAM	Camera system (Nyt-Syt, body views)

Descent

Our “Top-of-Descent (ToD)” is an FMS-generated conditional waypoint (that crew can’t modify) that tells us when and where the Flamingo will automatically start its descent into Abuja. There is a difference in how the FMS initiates its VNAV-guided auto-descent. Boeing aircraft normally auto-descend provided the crew dials in on the Mode Control Panel’s ALT (altitude control) knob any of the lower altitudes in the vertical profile of the route being flown, BEFORE the Boeing aircraft REACHES the ToD (which in Boeing aircraft is indicated as “T/D”). On Airbus aircraft, I have not noticed (on any of my Airbus flights) the aircraft auto-descending on reaching the Top-of-Descent waypoint. However, the icon clearly appears on the Nav Display as an arrow that starts with a horizontal tail that bends down diagonally to its diagonally-downward pointing arrowhead. So far –on Airbus aircraft, I have dialed down altitudes on the MCP well before reaching the ToD arrow only to notice the Airbus aircraft passing the ToD without diving into a path-guided descent. On those few occasions I had to press the MCP “Expedite” button to dive at a steeper angle so as to re-intercept the proper descent profile (route), before pressing the ALT knob to invoke the path-guided VNAV descent. I later confirmed from an Airbus pilot that Airbus aircraft indeed do not descend automatically on reaching their respective ToD when cruising in VNAV-mode. Now what I do on Airbus aircraft is to simply dial down on the MCP, to my next selectable, lower altitude well before I reach the ToD. The Airbus (like its Boeing rival) keeps flying level…as I approach the ToD; I keep zooming in on the Nav Display’s map scale to get a clearer picture of precisely when I will reach the ToD. As I reach the ToD (when my aircraft symbol touches the ToD symbol), I press in the dial knob for altitude selection to command the Airbus to initiate the VNAV descent. From this point on, it will manage the dive along the descent profile, that’s how different it is on Airbus aircraft, compared to Boeing aircraft.

On the Flamingo however, it’s a different story. The same logic that guides the Flamingo (along with Boeing, Airbus and other aircraft) during their climb on the vertical profile up to the Top-of-Climb (ToC) waypoint, is the same logic that guides the Flamingo from cruise profile to descent profile…you simply engage VNAV and that’s it, the Flamingo’s FMS knows when/where to end the climb with a level-off into the cruise profile, and later, when/where to start the descent from cruise to descent profile. There’s absolutely no need for any additional human decision (crew input) to invoke at the start of an FMS-managed descent. So on reaching our ToD waypoint, the

Flamingo simply throttles back its engines and performs a subtle “vertical fly-by” curve in its flightpath (the same way they do during LNAV turns on curved flight paths with regards to the apex-waypoint of the route segment) from a horizontal path to a diagonally downwards path. Normally other aircraft overshoot the ToD waypoint to start their descent while throttling back their engines to flight-idle, to avoid overspeeding on the unfolding dive. Again, you can enjoy the view of the Flamingo either in a horizontal, vertical or oblique 3D presentation of the Nav Display, to see the Flamingo as it route-transitions from cruise to descent mode. I’m going to “drag-turn” the pscholographic Nav Display so you can see our descent from an angular 3D perspective. Notice how FADEC modulates the thrust while FMS does similar with the pitch in order to keep us on the descent path. If we were to encounter a strong tailwind now, instead of deviating above the descent path with an FMS request to apply speedbrakes as on other aircraft, the Flamingo will practically auto-apply its speedbrakes in order to stay on the descent path. Our ToD was somewhere not far from the Maiduguri VOR station (MIU) whose frequency is 113.70 MHz, that might seem such a long way to Abuja, but believe me it’s because we are descending from a lofty sixty-five thousand feet at a dive angle that ensures that the Flamingo’s engines run near or at idle for at least ninety percent of the way (start of descent to landing)…it’s all about comfort combined with fuel economy. With our initial descent being made at the supersonic speed of Mach 1.15, even with engines at idle (basically a gravity-propelled dive at a semi-steep angle), it takes only a few minutes before we pass the intersection titled BORNA.

Our descent from Flight Level six fifty (sixty-five thousand feet) at a speed of Mach 1.15 will continue until Flight Level four hundred (forty thousand feet), from where the Flamingo will reduce the steepness of its dive angle (via raising its nose or pitch up) a bit so that it slows down to a speed of Mach 1.05. The idea is to use the increasing density (as we descend to lower altitudes) of the atmosphere as an airbraking tool to slow down before the Flamingo's FMS and SAFEP are compelled to auto-deploy the spoilers (speedbrakes) for a slowdown. This machine is awesomely smart thanks to the software's "program parameter redundancy" architecture; this is a method of having a vast constellation of conditional/argumentative, programming, scripting and algorithms set parallel so that the array of flight augmentation computers (three primary and two secondary) can have a wide choice of event-alternatives to choose from based on computations.

Just before our descent started, we were handed over from N′Djamena Center (Chad's airspace team) to Kano Center (Nigeria's airspace team); they use TRACON (Total RAdar COverage Nigeria) to monitor aircraft flying overhead. Our next waypoint is the Jos VOR station titled JOS and Kano Center has assured us of clearances for a direct, stepless descent to Abuja Approach's area. Later on at Flight Level three hundred (thirty thousand feet), the Flamingo slowed down using nose-up pitch to its transonic speed of Mach 0.95. Continuing down at Mach 1+ in such dense air would require more engine power, and fuel burn is what the Flamingo's programming will avoid as long as we leave its VNAV speed profile in "ECON" descent mode. We will keep diving at Mach 0.95 until twenty thousand feet when it will be time for the Flamingo to spread out its wings from swept-back (WNGS-60) to intermediate (WNGS-45) while speedbraking itself down to three hundred and forty knots at the Transition altitude of eighteen thousand feet. Kano Center has just cleared us to continue our stepless, direct descent to twelve thousand feet and is handing us over to Abuja Approach. The Flamingo has throttled back again to slow down to the next FMS weight and altitude-related speed of three hundred and twenty knots and is self-swinging its wings again, forward to the WNGS-20 detent. It's actually preparing to comply with the fast approaching speed limit of two hundred and fifty knots imposed on flights at the altitude of ten thousand feet and below. I'm turning on the APU now so we will have both standby power and bleed air (in case an emergency in-flight, air-start of the engines is required...standard operating procedure).

Approach

It's time for us to expect vectors from Abuja Approach into the area controlled by Abuja Tower (terminal Air Traffic Control). Abuja Approach team has three channels or frequencies that you can reach them on namely 119.800MHz, 121.700MHz, and 127.900MHz. There's really no hands-on-control needed for the landing because during FMS setup back at Base, all parameters of the approach were ascertained between me and FMS. So right now, it knows what to do and how to do it. All I need to do is keep communicating with the Abuja people over the radio. The Navigation radios have always been under the retuning command of the FMS, so as we get closer to Nnamdi Azikiwe International airport we notice both Nav radios auto-tune to the 109.300MHz frequency of Runway-22's Instrument Landing System (ILS). On the Integrated Flight Display (IFD), the deviation indicators for the Localizer and Glideslope signals (of the airport's ILS) now appear...waiting for us to fly near the signal areas, so they can guide us in. runway-22 is identified by the ICAO code **IAB** and it has a length of three thousand six hundred and eleven meters, this makes it more than three and a half kilometers long, while its magnetic compass heading is two hundred and eighteen degrees…almost aligned in the southwest direction.

Abuja Tower (on frequency 118.600MHz) has just given us an express clearance to lineup with runway-22 direct. This means the last part of our route; the STAR that I programmed into FMS doesn't need to be altered. I can let the Flamingo continue on the last route leg segment; it requires something like a gentle left turn (about thirty degrees in heading change). This is the point where I have to make just two crew inputs; the first being to press the VOR/LOC (VOR/Localizer) button on the MCP, to "tell; permit; activate" the Flamingo that it's time to "grab-and-home-in" on the ILS Localizer signal. The Localizer deviation indicator has come alive and thanks to the Flamingo's VNAV descent to a final altitude of five thousand feet, we are under and to the left of both runway-22 ILS signals. The VOR/LOC button is lit in "white" indicating that Flamingo can "feel" the signal nearby and is arming itself to "grab-and-home-in" on the signal. The active button also disengages the LNAV guidance of the FMS and seconds later, the Flamingo turns left to lineup with the still far away runway. You can see the Localizer deviation indicator drift from the right end of the scale to the center as the Flamingo banks into a left turn. We are now tracking the centerline of the runway while slowing down to one hundred and fifty knots.

Minutes later the Flamingo completes the extension of its flaps to FULL and the Glideslope indicator comes "alive" signaling that capture will occur in some seconds. Now I'm performing the second crew input by pressing the APP (Approach) button to "tell; permit; activate" the Flamingo that it′s time to land using the airports facilities that the Flamingo can perceive via its Nav database and tuned Nav radios. As the APP button lights up "white" to indicate that it′s aware the Glideslope signal is nearby, it arms itself for capture. As we fly into the signal, the APP button light changes from "white" to "green" (the same way the VOR/LOC button did) meaning capture of the signal has occurred. I'm now going to invoke a dual-channel, Category-3 (full) Autoland by pressing the second master autopilot button titled A/P2. Whenever the Flamingo is near or on an ILS signal for approach, pressing the other autopilot button causes it to "join" the previous one instead of cancelling it for reversion or handover. Now I have both A/P1 and A/P2 on and they are green. Having flown into the Glideslope (GS) while on the Localizer (LOC), the Flamingo suddenly dives again, this time along the three degree angle that the GS signal radiates upward on. On the windscreen/windshield HUGS, we can see the dynamic symbology of approach-mode data showing us which way to go, all the way down to the runway. On the IFD, you can see the colored rendering of Abuja's terrain moving by and just up ahead you can make out the runway and the dotted line running along the ground leading to the runway; the dotted line actually represents the last part of the FMS route which is still visible above at the representative four thousand feet height.

On our way down to two thousand feet, the Flamingo lowers its landing gear and slows down to our final speed of one hundred and fifteen knots (when filled with people and baggage, the minimum approach speed is at least one hundred and twenty knots). Fully self-configured to land, the flight guidance system in "autoland" mode arms the FLARE mode and retrims for a five degree pitch to help us slow down to one twenty-five knots. Abuja tower has cleared us to land and we simply sit back and let the Flamingo proceed down. Remember those landing lights that went off during gear retraction during takeoff? Well I didn't turn their switches to OFF; they went off because the gears were being pulled in. Now that they are coming out and the switches are still in the ON position, they will self-illuminate as the gears rumble down into their respective locked positions. The Flamingo's aural voice system suddenly says in its clear, bold synthetic voice "one thousand feet". Next it calls out "eight hundred feet", later it calls out "five hundred feet" and continues counting down. After calling out "three hundred feet" it next says "two hundred...minimums-minimums", then "one hundred". Now it calls out our height "ninety, eighty, seventy, sixty, fifty, forty, thirty, twenty, ten, retarding" and right after that, we feel the nose rise from five to ten degrees as the Flamingo flares itself and its main landing gear touchdown on Nnamdi Azikiwe International's runway-22. FADEC immediately cuts the throttle to idle while both autopilots disengage after they de-rotate the Flamingo for nose gear touchdown. The armed spoilers have deployed while the autobrakes I earlier armed to position "2" have started slowing us down. The Brake-to-Exit or BTE feature won't work here at Abuja because there is no GPS-coupled electronic airport chart for it to give me runway exit options to choose from. I want us to catch the first exit so I'm activating the thrust reversers (has to be done manually as Flamingo has no control over it) since I've noticed that FADEC removed the protective kinks blocking the lever's gates.

Arrival

As we slow down rapidly, the Flamingo calls out "sixty knots", this is any competent pilot's que to quickly de-select thrust reverse application. This is because thrust reverse is not only ineffective in deceleration at such docile speeds, but also you run the risk of the vectored thrust kicking up debris on the runway that could easily get ingested by the high-revving (due to thrust reverse action) engines. So I quickly disengage and stow the reversers while the autobrakes slow us down further. By now, the deployed spoiler flaps have long become ineffective as the airflow around them has diminished to an impotent breeze. Grabbing the Twistick lightly, I steer us off the runway and into the second exit on the left of runway-22. On the radio, Abuja Tower is now handing us over to Abuja Ground. I'm now satisfied with the braking action and decide to disengage by stepping on the brake pedals. This triggers off the magneto release of the AUTOBRAKE switch which I slid to the "2" position, so that it returns to the OFF position. To retract the spoilers, you either move the throttles forward a bit (apply thrust) or just move the spoiler lever all the way to the forward stop of its shiftgate.

Using the potency of idle thrust and manual braking, I taxi to the parking space as directed by Abuja Ground, while turning off the landing lights, transponder, weather radar, TCAS, and setting the cabin pressurization from FLIGHT to GROUND mode. I also retract the flaps and fold the wings backward to the supersonic position of WNGS-60. I've also turned on the taxi lights. As I park and set the parking brakes on, I can't help but reminisce at the trip that we just completed;

four hours flat, from liftoff to touchdown as the flight clock is showing. Going through the respective checklists, I divert our electrical needs from the Integrated Drive Turbo Generators of each engine, to the generator of APU. I'm also transferring our bleed air supply from the Engine Air Bleed system (provided by the mid-stage engine compressors) to the APU's Bleed Air system. This frees me to shut down the engines by moving each one's fuel cutoff lever from RUN to CUTOFF, and the engines lose their fuel supply and their ability to continue running any further. Now it's time to fill both my pilot's logbook and the aircraft's logbook before powering down all the systems, according to the checklist. After that, I'll deactivate the aircraft to the storage state popularly known as "cold-and-dark" state. Let's step outside for debriefing as this marks the completion of the first Flight of the Flamingo.

Conclusion

Such was our flawless arrival that one would be tempted to ask why we didn't automate the remaining un-automated and seemingly "automatable" aspects of command-and-control of the Flamingo. Truth is the current state-of-the-art technology for command-and-control of an aircraft may not go beyond what we have achieved so soon. The industry will get there eventually. For now our radical achievements are what we have to go on, any further breakthrough will come from additional, brain-wracking innovations that current materials, processes and funding can support. The return flight from Abuja to the AeroScience facility is going to be very different from this just completed flight. See you at debriefing.

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