All In The Family

FOR 26 YEARS — IN THREE GENERATIONS OF GENERAL DYNAMICS-BUILT AIRCRAFT — THE 125TH FIGHTER INTERCEPTOR GROUP HAS PERFORMED THE AIR DEFENSE MISSION (Page 27)
IN THIS ISSUE . . .

FEATURE
PEACE DELTA
The Fighting Falcon in Venezuela.

PROGRAM NEWS
EYES OF THE STRIKE FORCE
The tactical reconnaissance mission gets a much-needed facelift.

THE F-111 GOES DIGITAL
A proposal for digital flight controls for the F-111.

SPECIAL SERIES
SEMPER VIPER!
Part 4 — the F-16's cockpit.

ONE PROBABLE . . . CONFIRMED
Robert Stanford-Tuck and the Battle of Britain.

SAFETY
BINGO!
Is your switchology up to date?

MAINTENANCE
THE SOFTWARE INVASION
Like it or not, software is here to stay.

MANUFACTURING
ROBOTICS
Building airplanes the modern way.

EVENTS
JACKSONVILLE GETS F-16s
Florida ANG unit has air defense role.

PUREST OF THE PURE
8,500 hours of single-seat, single-engine fighter time.

WHO'S REALLY THE OLDEST F-16 PILOT?

F-16 RELIABILITY IS PRaised

F-16s DOMINATE 'LONG RIFLE' COMPETITION

THAI AIR COMMANDER GETS ORIENTATION RIDE

INDONESIA BUYS 12 F-16s

FIGHTING FALCONS PARTICIPATE IN MALAYSIAN EXERCISE

GREEN MOUNTAIN BOYS
Vermont Air Guard unit transitions into F-16.

EGYPT TAKES DELIVERY OF FIRST F-16C

MANAGEMENT
Herb Rogers ........................................... Vice President and General Manager, Fort Worth Division
Rolf Kueger ........................................... Vice President/Logistics
Tim Roels ............................................. Director/Product Support
Don Tye .............................................. Manager/Field Product Support

EDITORIAL STAFF
Frank Badder ......................................... Editor
Bob Cunningham .................................... Art Director
Don Steger ........................................... Design/Layout
Dub Ballow ......................................... Cartoonist
Ben Juarez .......................................... Illustrations

ABOUT THE COVER
F-16s of the Venezuelan Air Force sport a distinctive paint scheme. This South American country is proud of its aviation heritage. An article about their F-16 program begins on page two. (General Dynamics photo by Gary Tolbert)
"It was a matter of working hard, studying hard, training people . . . and now here we are, operating with pride as full members of the F-16 community."

— Lt. Col. Juan Paredes Niño
Venezuelan Air Force

Peace DELTA

By FRANK C. BADDR
Editor, Code One

The F-16 Fighting Falcon is truly an international airplane, currently being flown by ten air forces throughout the world. But apart from the United States, where the popular fighter is manufactured, the F-16 is virtually absent in the Americas. Only one other country on this side of the globe owns F-16s. That country is Venezuela.

Located atop the South American continent, Venezuela is less than a three-hour ride — by commercial airliner — from Miami. Partly because of this close proximity to the USA, and partly because of an even closer and long-standing friendship between the two democracies, Venezuela has long been a recipient of American aviation technology.

"We have acquired, in the last 30 years, a tremendous amount of American-built airplanes," said Lt. Col. Juan Paredes Niño, Commander of Grupo 16, Fuerza Aerea Venezolana, or FAV (the Venezuelan Air Force). "The influence of the American aircraft industry has penetrated this country in a very important way. After World War II, we received almost all the aircraft in our inventory from the United States."

But the Europeans managed to break this virtual monopoly in the early '70s, when Venezuela and the United States hit a snag during negotiations over the proposed purchase of F-4 fighters.

"There was a little bit of disagreement between our governments concerning our need for airplanes like the F-4. That circumstance brought the French industry into our country . . . the Mirage. An excellent airplane," Paredes said, "but our initial selection was the F-4."

Lt. Col. Paredes Niño
This French-built Caudron G. III performed a fly-by during ceremonies at El Libertador Air Base when the Venezuelan Air Force welcomed its first F-16 Fighting Falcon. The Caudron was the first airplane in the Venezuelan Air Force, delivered there in December 1920.
However, Paredes said the Venezuelan government decided to break with tradition and purchase the French-built airplane, "because of disagreements in the wording of the contract."

The FAV ultimately purchased two versions of the Mirage — the Mirage III and the Mirage V — to fill different mission roles.

"In the early 80s," Paredes said, "the FAV established a need to modernize its inventory. We were looking for a multi-role airplane that would be affordable. The airplane had to be able to accomplish, by itself, the missions that we were accomplishing with two different airplanes at that point. Our staff began an evaluation of the many different types of airplanes available in the market at that time. I remember that those in the evaluation were the Mirage 50, the Kfir, the Toronado, and the F-16. There were some other candidates, but it was felt that none of them could fulfill the multi-role specifications the FAV was looking for."

Paredes said the evaluation included technical studies of performance and life-cycle cost, available options, and long-term supportability.

"The FAV was really looking for a multi-role aircraft, able to stay in our inventory for 20 to 25 years," Paredes said.

The extensive evaluation process called for flight testing of all candidate aircraft "in their country of origin," Paredes said. "We sent a group of pilots to Europe, Israel, and the United States to fly those airplanes and to make a final report of their observations."

When all the evaluations were complete, the FAV initially decided that the F-16 was "the aircraft that we wanted — the best one to fill our needs," Paredes said. Trouble, however, loomed on the horizon.

"The U.S. government was officially offering us the F-16/79," Paredes said, "and that almost destroyed the whole program because the .79 engine didn't fill many of our specific requirements — especially in the long-time maintainability and range, just to mention two areas. There were many other disadvantages to having the airplane with the .79 engine instead of the F100. Fortunately, there were more conversations, agreements, and evaluations between ourselves and the U.S. government concerning our defense needs in this area of the Caribbean, and finally the F100 engine was approved for our airplanes."

When that agreement was reached, the wheels were put in motion for training of personnel, preparation of installations, and aircraft delivery schedules.

Paredes said he had always been a supporter of the F-16, despite having been a Mirage squadron commander at the time of the competition.

"The information we had on the aircraft — the commercial information plus some other specialized technical data — gave us the impression that the F-16 was definitely a first-class fighter. And I personally saw the F-16 in 1981 at the Le Bourget airshow in France. I was very, very impressed with the aircraft's performance that day. It's unbelievable what the aircraft is able to do. From the beginning, I was one of the persons in the FAV that was in favor of the F-16."

"Of course, there was still a lot of support for the Mirage. Change is always resisted among the community of humans. And we were very happy with the Mirage. It's an excellent airplane also. But in evaluating the improvement we could expect in the Mirage — going from the Mirage III and Mirage V we had then to the Mirage 50, and comparing that with the F-16 — our conclusion was that the F-16 was definitely more capable of filling our needs."

"We wanted a multi-role fighter. We had two different types of Mirage fighters. The Mirage III is an interceptor, and the Mirage V is an interdiction or air-to-ground airplane. And in the F-16 we could have — in a
single airplane — both capabilities," Paredes said.

Maneuverability, simplicity of maintenance, and cost versus life-cycle projections were other reasons for the F-16’s selection, Paredes said, but one other very important feature came into play, according to the Colonel.

"The Mirage 50," he said, "is an improvement over the III and V... but it is not a latest-generation aircraft. The equivalent to the F-16 in France, as you well know, is the Mirage 2000. And in 1981 the Mirage 2000 was not in production for foreign countries. They were just starting production for the French Air Force."

Also of importance to the F-16’s selection by the FAV was the Fort Worth fighter’s existence in the USAF inventory, which Paredes said gives "a guarantee of support, not only from the mechanical point of view, but also from the logistics point of view. And there are so many other customers for the F-16 around the world. It’s really such an international airplane that you could have possibilities for agreements with so many other countries for technical exchange data or technical support. There are many, many options with the F-16 when you start looking around and see how many customers there are for the airplane right now."

At this article’s publication date, F-16s had been in the FAV’s force structure for nearly three years — time enough to have identified any major incorporation problems. But Paredes said there are none.

"We can’t talk about problems really. There are some areas that you have to modify or equip in a different way in order to accept a fighter of this technology. But there were no problems incorporating the F-16 into our force structure. It is designed in such a simple way, such a modular way, that there are really no problems in bringing the airplane into your inventory. You have to modify certain shops, you have to modernize certain things, you have to prepare certain areas. You’ll have some specific areas that you never had before, like the hydrazine shop. But you can’t consider these as problems."

Paredes also lauded the F-16’s reliability/maintainability record since being a part of the FAV inventory.

"Initially, everything is a little bit more difficult with any new project, but the F-16 was even better than we expected. We have some aircraft availability rates that are really surprising. Higher than we were expecting. In our case, it is even higher than the USAF’s standard. But we received brand new airplanes, so we’re waiting to see if, when they get older, they go to a more normal availability level."

Col. Orlando Sayago

In a separate interview with Col. Orlando Sayago, Chief of the Electronic Services Center, the F-16’s maintainability — especially with regard to the Avionics Intermediate Shop/Line Replaceable Unit concept — was the main topic of conversation.

"Before we got the AIS test stations," Col. Sayago said, "the kind of maintenance we had here was a kind of analogous test. With this new concept (AIS/ERU), we’re getting into a new maintenance support, performed with automatic test equipment. This is the first time we’ve had this kind of equipment."

To prepare for the new technology, Sayago sent technicians to General Dynamics Fort Worth Division. Meanwhile, the test stations arrived in country, accompanied by four General Dynamics engineers.

"We had problems in the beginning," Sayago admitted, "but we fixed all the problems and we have none now. Our technicians are getting the training, they are getting more confidence in the equipment, and they are improving their ability. With time, they are becoming more qualified in their technical capabilities. Right now we are prepared for an extension of two of the General Dynamics technicians. We want two of them to be here for at least one more year, to give more training, to train new people, and to support the F-16. Our goal is to be self-sufficient in this kind of maintenance."

Back at the fighter group level, Lt. Col. Paredes said his people have already attained self-sufficiency.

"We are still working for that self-sufficiency in some higher stages of maintenance," Paredes said, "but here at Group 16 we could say that essentially we have a self-sufficient unit operating with only Venezuelan personnel right now."
The Venezuelans are proud of their self-sufficiency in maintaining the technologically advanced F-16. Their degree of contractor support is no more than would be found at an average U.S. Air Base.

Col. Sayago said the AIS test stations reduce the amount of hands-on work required of technicians, but limit maintenance support to the intermediate level.

"With analogous test we had, in most cases, depot-level capability. Right now we are having conversations with General Dynamics and with Westinghouse to get some depot-level capabilities."

But Sayago is justifiably proud of his organization's PMEL capabilities. An acronym for Precision Measurement Equipment Laboratory, PMEL is where calibrations are done on precision equipment used to calibrate other equipment. It is the lifeblood of effective aircraft maintenance programs, and Sayago has developed one of the finest PMEL facilities to be found anywhere.

"Our PMEL was established in 1972. At that time, it was a very good program. Later on, with the acquisition of the F-16, we found that our PMEL was behind what a good PMEL should be. With this new program, the F-16 program, we increased our capabilities. Right now we have a PMEL type two at the same level as any PMEL in the USAF. And we also have PMEL four, which is specifically for the F-16.

"We feel that our PMEL is the best in the South American area. We have trained 18 technicians so far, and we have five more in the States getting trained. These technicians receive basic PMEL training plus some of the specific training in boresight, electronics, etc., oriented to the F-16 program.

"We're very proud of our PMEL," Sayago said, "because we have new equipment, standards, and training that we didn't have before. As a matter of fact, we've had visitors from Argentina, Peru, and Ecuador, and they are very interested in having some kind of technological interchange with the FAV in this specific field, the PMEL field."

The Venezuelans are sincerely appreciative of the F-16 program and what it has meant to the modernization of their Air Force.

"The F-16," Paredes said, "has revolutionized our Air Force, because the aircraft was bought with all the support, all the training and technical data, all the equipment that you need to operate the aircraft. The package that we bought has resulted in the development of some other areas of our Air Force to a higher level of maintenance than they had before, because many of the things that we bought with the F-16 package are usable on other systems — like in the case of our PMEL.

"The F-16 has really brought a new era into our air force. We're very proud of what we've been able to do up to now, with the support of the USAF and General Dynamics. If you could do a retrospective, you'd see how even our buildings, our facilities, and our technicians have changed in this time.

"We are the only air force in South America that is operating the F-16, which gives us a reason to be very proud. We belong, actually, with a community that includes the United States and many of the most developed and important air forces around the world. Our technicians and our pilots have been able to receive and operate the F-16 without any problems. It was a matter of working hard, studying hard, training people... and now here we are, operating with pride as full members of the F-16 community."
THE TACTICAL RECONNAISSANCE MISSION GETS A MUCH-NEEDED FACELIFT.

Eyes Of The STRIKE FORCE

By SCOTT SCHOFIELD  Project Lead, F-16 Recce PVI Simulation

ABOUT THE AUTHOR: Scott Schofield is the F-16 Recce Simulation Pilot/Vehicle Interface Project Lead. He is a 1977 graduate of the U.S. Air Force Academy, and has over 2,000 hours of flight time with over 900 hours in the RF-4C. He is currently an RF-4C pilot, assigned to the 192nd Tactical Reconnaissance Squadron, Nevada Air National Guard, Reno, Nevada.

For decades, the unofficial motto of tactical reconnaissance squadrons has been “alone, unarmed, and unafraid.” But if the F-16 Recce (currently undergoing flight evaluation) is selected as the future recce platform, then that old motto may have to be shortened to simply “unafraid.”

A proposed successor to the aging RF-4C, the F-16 Recce would incorporate the latest in sensor technology to give recce a real standoff capability. In addition, the F-16 Recce will be able to defend itself, and it will retain the Fighting Falcon’s impressive air combat maneuvering capability.

But that’s not the whole story. Beyond enhancements to survivability, General Dynamics technology has also improved the recce mission through a data link system that can drastically cut the time it takes to provide commanders in the field with vital intelligence information.

Recent conflicts in the Falklands, Grenada, Lebanon, and Libya have reinforced the need for improvements to recce capabilities, and the U.S. Air Force has responded to that need through the Advanced Tactical Air Reconnaissance System (ATARS) program. ATARS seeks to upgrade the RF-4C in the short term while simultaneously developing a follow-on recce (FOTr) system and an unmanned air reconnaissance vehicle. Common to all three ATARS systems will be an electro-optical (EO) suite to replace the current film system on the RF-4Cs, thus eliminating the requirement for time-consuming film processing.

The need for timely intelligence to help clear the “fog of war” will not change. The recce mission will remain vital to total force effectiveness. In the past, however, the problem has been an inability to provide intelligence in a timely manner. The current tactical reconnaissance system requires too much time to collect, interpret, and communicate the information. With a survivable platform, advanced EO and infrared (IR) sensors, and data-link capability, the F-16 Recce will significantly improve mission effectiveness.

To be successful, today’s unarmed RF-4C must avoid the threat, acquire the target on film and then transport the information back to a suitable airfield. That means the aircraft must land where the film can be downloaded. Photo personnel must then process, develop, and exploit the film, transmit a report to the appropriate agencies, and send actual photos when required. The problem is that the cycle from request to receipt of intelligence is painfully long and vulnerable. From the time the film is processed and evaluated, it typically takes about four-and-a-half hours before the information is received by a Corps-level unit — which makes
information on mobile threats almost useless. However, when EO and IR sensors are coupled with data-link capability, the middle man can be removed. The crew can transmit the data directly to the requestor and central command authorities for exploitation.

Mission basics remain the same for the recce pilot of tomorrow — low-level, high-speed ingress against targets that may be mobile or fixed, but not always at a known position. It's dangerous to search for targets in a high-threat environment, but that's the basic mission: to verify the existence and location of the target, mark it, visually identify or record it, and relay that intelligence by the most expedient manner. Today's RF-4C crew has no timely system for inflight intelligence relay, aside from their radio — a doubtful option in a sophisticated communication-jamming environment. And with few exceptions, the RF-4C must directly overfly the target to get imagery. Pave Tack pods provide a standoff capability, but there are few of them available, and their drag effects severely limit speed, range, and maneuverability.

To most fighter pilots it sounds ludicrous to send a manned platform behind enemy lines... and not attack the targets. But there are reasons. With the proper stand-off sensors, the F-16 Recce is more survivable in the target area, and the enemy might not even know he's being "painted" by an intelligence-gathering aircraft. The intelligence thus gained will reduce the risk to a full strike force, or increase the effectiveness of artillery — and either of these options would increase the probability of complete target destruction. Critical prestrike intelligence and post-strike bomb damage assessment could be obtained day or night. Flying the sensors into position to get the target seldom requires a "pop" as in most air-to-ground strikes. Therefore, the recce is usually able to fly the mission without climbing above 200 to 300 feet, depending on the target and on the coverage required. And the intelligence gained would be available to the user within minutes.

That's what the F-16 Recce can do for the combat commander — reduce the risk and increase the effectiveness of future attacks. For you fighter types, timely recce means your target location has been recently verified, and "one picture is worth a thousand words" to help you identify the target. Fewer surprises in the target area means better situational awareness.

By now you may be saying, "OK, I can understand where improved recce capability might be needed, but aren't there enough satellites and drones to do that job?" Each system — satellite, remotely piloted vehicle, or manned recce — has strengths and weaknesses. Satellites, for example, don't have the tactical flexibility to always be in the right place at the right time, and even a little weather is a major limitation. Drones eliminate the risk to humans, but are not always the right machine for the job. Range, sensor payload, and flexibility are severely limited in today's drones. No sir, at times there's simply no substitute for the human decision factor in the target area. While the mosaic of unmanned systems is getting more impressive each year, no single system is capable of accomplishing all the recce tasks. Manned tactical recce remains a real need, and it is being made more survivable and more responsive to user needs.

In modifying the F-16 for the recce mission, few hardware changes are required to the cockpit or the aircraft. The recce pod is mounted to the fuselage at the centerline station. A pylon is not used. The F-16 Recce will be capable of employing reconnaissance systems in all tactical environments.

In December 1984 General Dynamics was contracted to design and evaluate a recce-missionized cockpit for the F-16. Hardware changes were minimal. The recce-unique functions were primarily integrated through software changes. Basic F-16 Block 30B functions were not altered. Simulation was used to accomplish this task. First, part task simulations evaluated specific parts of the overall design
prior to complete cockpit integration. Next, the still-evolving cockpit design was evaluated in a full-mission simulation using complete combat profiles, including threats, multiple targets, and night, under-the-weather scenarios. Simultaneously, flight tests of the recce demonstration pod were conducted at Edwards AFB.

The cockpit design is now in formal evaluation. Pilots and weapon systems officers (both F-16 and RF-4C types) from the USAF and the Air National Guard are being used to evaluate the cockpit. Their experience level and background varies. Aircrews include instructors from the ANG Recce Weapons School and USAF’s Fighter Weapons School.

The formal evaluation will culminate in a report to the USAF describing cockpit design, aircrew workload findings, required mechanization changes, and problem areas that may be encountered during full scale development and production.

The original contract called for simulation in the F-16D (two-seat) cockpit. The USAF subsequently requested the addition of single-seat sorties to provide direction for possible single-seat development. These single-seat simulation scenarios are identical to the two-seat missions.

The F-16 Recce simulator has independent display capability on the multifunction displays (MFDs) and data entry displays in the front and rear cockpit. With the exception of a recce power panel in the rear cockpit, all sensors and recce formats are controlled "hands-on" (stick and throttle) or on the MFDs, thus giving the pilot/WSO the advantage of a hands-on, head-up cockpit to improve situational awareness. Hardware changes from the baseline F-16D are minimal, reducing the cost of cockpit modification while maintaining commonality with other F-16C/D aircraft. The rear cockpit throttle and side stick may be decoupled by the WSO to prevent interference with pilot inputs. The decoupled throttle may then be positioned to individual preference.

Simulator capabilities include inflight viewing, image recording, and recall of recorded imagery for edit and data link. The crew can review recorded targets and edit the imagery prior to inflight data link to selectable stations.

When the final recce pod design is completed and approved, it will contain cameras, the video management system, reconnaissance interface units, and the data link system. The nose of the pod is a turret that can accommodate a tri-lens camera. The turret position can be changed inflight to either a forward oblique or a vertical line-of-sight. The pod's aft section has a retractable data-link antenna. Pod temperature and window defog are maintained by an internal environmental control system. The crew can change line of sight and field of view either inflight or on the ground.

In addition to the basic recce pod, a LANTIRN navigation pod (NVP) with a FLIR is being simulated. The actual pod will be pylon-mounted on the forward left side of the engine air inlet. It contains a navigation FLIR and terrain-following radar that permits low-level, terrain-following operations in a manual or automatic mode. From the NVP's FLIR, the pilot gets HUD imagery to permit low-level navigation at night. The terrain-following radar projects terrain indications on the MFDs and also provides obstacle warnings.

A steerable FLIR is separate from the navigation FLIR. The steerable FLIR has a wide-angle (40-by-40 degree) field-of-view sensor to record target imagery at night. It can be manually controlled, slewed to the radar cursors, or slewed to the inertial navigation set. Combined with the infrared line scanner's oblique capability, the steerable FLIR will give the F-16 Recce a significant night stand-off capability.

Simulation results have been excellent. Full mission simulation of all these capabilities is complete. The proposed cockpit design was evaluated in an F-16D simulator with a high-resolution visual scene depicting a strikingly realistic Eastern European scenario.

For part-task simulations (completed in March), the crew flew a simple, point-to-point, low-level navigation mission. The test controller reviewed test parameters prior to flight and assisted the crew throughout the profile. Part-task simulations evaluated specific parts of the cockpit without the complete cockpit mechanization. Test results allowed General Dynamics to make changes prior to complete cockpit integration for the full-mission simulation.

For full-mission simulations (completed in August), the crews flew multiple practice sorties prior to the data runs. Assistance was available during practice runs only. On data runs, the crew flew the mission as they would on a combat sortie. Four East German targets were assigned. Each mission required about 240 miles of low level and lasted about 50 minutes from takeoff to landing back at Bamburg Air Base, West Germany. FLIR video was displayed on the HUD for the night profiles.

Formal evaluation procedures are identical to the full-mission simulation. The cockpit, however, will contain those change requirements identified during the full-mission simulation. The purpose of this last phase is to evaluate the final product and obtain data for the final report to the USAF.

The formal evaluation will be completed in December 1986, and the final report will be sent to the USAF in mid-January 1987. Flight test and simulation results, thus far, indicate a great advance in tactical reconnaissance capabilities...good news for commanders, aircrews, and soldiers alike.

NEXT: The F-16 Recce flight test. Look for a glimpse of the reconnaissance pod demonstration in the next issue of Code One.
A PROPOSED NEW FLIGHT CONTROL SYSTEM
WILL BE SAFER, CHEAPER, AND MORE RELIABLE.

By ROBERT F. REAMS
Program Manager,
F-111 Digital Flight Control System

The USAF's world-wide fleet of F-111 aircraft will be made safer, more reliable, easier to maintain, and cheaper to operate if a digital flight control system (DFCS), being proposed by the USAF's Aeronautical Systems Division, is contracted for development. The ASD fielded a "request for proposal" on the DFCS earlier this year, and General Dynamics Fort Worth Division — builder of the F-111 — is hoping to win a contract award for refurbishment of the aging flight control system.

This modernization program is but another step in the USAF's "F-111 weapon system master plan" aimed at maintaining the F-111 as a key element in the deterrent arsenal of America and her allies.

From a safety standpoint, it is estimated that — over the remaining service life of the F-111 fleet — the DFCS would reduce by eight the number of aircraft lost due to catastrophic flight control system failures. (That, in itself, represents a significant reduction in life cycle costs.)

IMPROVED SAFETY WITH DFCS

CURRENTLY, A SINGLE FAILURE IN THE FCS COULD RESULT IN AN UNCOMMANDED MANEUVER

SINGLE FAILURE  SINGLE FAILURE
WITH THE DIGITAL FLIGHT CONTROL SYSTEM, A SINGLE FAILURE RESULTS ONLY IN A WARNING LIGHT ...
costs.) The F-111’s current flight control system was hi-tech stuff when it was introduced in the 60s. In a terrain-following flight mode, however, a single failure can be fatal.

But DFCS redundancies allow system failures without introducing the crew to the Almighty. With DFCS, single failures merely result in a warning light. Key to the DFCS will be a fault-tolerant, digital computer designed to apply corrective action to electrical power fluctuations that currently can cause erratic flight control response or loss of control. The DFCS will also include improved logic implementation and direct paths to specific, critical systems.

Reliability figures have not endeared the F-111 to those who have to fly or maintain her. Remember, please, that we’re talking about an airplane that was first fielded more than twenty years ago. It incorporated startling new technologies that responded very well to emerging threat defensive capabilities. But, quite frankly, it stayed broke a lot.

Enter the DFCS... and an 18-fold increase in system reliability. That’s what the Fort Worth Division will deliver. Our DFCS computer will undergo an in-service warranty performance test that allows no more than eight failures per 8,460 flight hours on operational F-111 aircraft. The loss of a critical function necessitating flight abort will occur no more than once in 67,500 three-hour sorties.

Maintainability is also better with the DFCS. Maintenance manhours per flight hour will be reduced by 94 percent, mainly by replacing six relatively high-failure-rate line replaceable units (LRUs) with a single, low-failure-rate LRU. The DFCS computer will incorporate 100 percent fault isolation to the component level by either automatic or manual means. During ground checkout it will automatically step through a comprehensive test sequence — and monitor the results — in under two minutes. And it will store in-flight failure data.

It is projected that the program will pay for itself in less than seven years through reductions in maintenance, less need for spares, and fewer aborted or incomplete missions. And don’t forget those eight “saved” aircraft.

In General Dynamics’ approach to DFCS development, the existing modes and functions of the current, analog flight control system will be implemented, and the handling qualities will be maintained, as well as the cockpit controls and displays required to operate the existing system. However, the functional capabilities of many of the retained modes and functions will be enhanced, and many new capabilities will be added. Autopilot performance on all aircraft models will be improved to at least the same level as the FB-111A (which has improved transient response and performance characteristics). One new feature (for low-altitude protection) is an aural ground proximity warning for manual operation below 10,000 feet.

If awarded the contract for DFCS development, the Fort Worth Division will proceed in two phases — full scale development (FSD) and production.

FSD will cover design, hardware procurement, installation design, software development, system integration, and installation/flight testing of the modified system in an FB-111A, an F-111F, and an EF-111A. FSD would begin in January 1987 and run through October 1990.

Production will entail six “kit-proofings” — one for each major F-111 mission design series. Four of these kit proofings will be conducted at the Sacramento Air Logistics Center and two at British Aerospace Corporation in the United Kingdom. As kit integrity is verified, retrofit kits will be produced, the remaining aircraft modified, group B spares provided, technical orders formalized, and trainers modified. Production would begin in February 1990 and be completed in October 1994.
SEMPER VIPER!

By JOE BILL DRYDEN
Experimental Test Pilot
EDITOR’S NOTE: This is the fourth in a series of articles in which experimental test pilot Joe Bill Dryden describes what’s “different” about the F-16 Fighting Falcon, compared to other fighter aircraft. In Part one, Joe Bill described the F-16’s flight control system. Part two involved aerodynamics and “cues” to departures/deep stalls. Part three concluded the discussion on departures and, in this issue, Joe Bill talks about the F-16’s cockpit.

I can remember around 1972, when I first began getting involved with the Lightweight Fighter Program, that it was difficult to visualize just what they had in mind when I was reading about the cockpit layout for the F-16. When I tried to picture what it would feel like on someone’s wing during a night weather approach to about two hundred and a half, I was not too sure I would like what I visualized. However, within my first ten seconds in the cockpit I couldn’t believe we didn’t do this a hundred years ago! It’s great!

I did realize that there would have to be changes in the way I approached some flying aspects that I’d been using in the F-100, F-104, F-4, etc. First of all, the increased seat-back angle made for a far more comfortable cockpit. It was difficult to “gracefully” enter, but once in the seat it felt super. The rudder pedals only moved a half inch, so I could put them where they felt comfortable. In airplanes like the F-4 I was always concerned with being able to get full rudder pedal throw (and a lot of it), so I was forced to fly with the pedals practically under my chin. I was not forced to reach for the stick in the F-16; instead, it fell nicely to hand just over the arm-and-wrist rest. As the YF-16 progressed more and more toward an operational configuration, there were numerous small changes in the stick and armrest/wristrest geometry. The first stick did not move at all, but rather depended strictly on the amount of force you were using to determine the desired pitch or roll rate. It was possible to fly the airplane very well with this fixed stick, but it was decided it would be still better if there was a small amount of motion added. The stick still “moves” only three-sixteenths of an inch aft, three-thirtyseconds left and right, and next to nothing forward. Although this is a very small amount, it is sufficient to give you the tactile cue of making an input. It also lets you know when you’re up against the limiter — something that was difficult to do with the old fixed stick.

Why essentially no movement forward? We found that under negative g you tend to move up and forward in the seat enough to increase the amount of forward stick more than you want to. As a result, it was decided to provide for minimal forward stick movement. The small amount of movement in the other axis seems to be just about the right amount. This stick movement was another area where people not completely familiar with the aircraft made a lot of erroneous inputs about how much movement was really needed. Stop and think about it. If you have much more movement in the pull direction, you quickly reach the point that you’re pushing on the bottom of the stick while pulling on the top. That assumes you have your arm on the rest and are not trying to fly the airplane by moving your whole arm. Instead you should be using only hand and/or wrist movement. So, like the mistakes people made in evaluating the F-16 from an aerodynamic standpoint, people were making bogus decisions because they had not taken the time to completely understand the F-16.

Once I started flying the F-16, I noticed right away that I had a whole new set of muscles in the front of my neck and upper chest. In thinking about this a little further, it should be obvious that the difference in the seat-back angle requires you to exert some physical effort to keep your head from being forced backward under elevated g loads. Even though you’re leaning back in the seat, the natural human tendency is to carry the head still aligned with the local vertical. This is much like watching television at home in your easy chair; unless you’re asleep, your head is not back against the head rest. The airplanes you’ve previously flown wanted to force your head forward under the same g level. This slight discomfort with the newfound muscles quick passes — just like any other new physical endeavor.

One often-heard item concerning this new seat-back angle is that some people feel they can’t look toward six o’clock as easily as with their previous airplanes. Once again, pay some attention to the fact that this is a different airplane. With a conventional cockpit you’re sitting erect or leaning slightly forward in the seat. The human makeup is such that the head rotates fairly well about the vertical axis. Therefore, it’s fairly easy to rotate the head and eyes far enough left or right to see over your shoulder. You get comfortable with such a motion because you’re familiar with it. These very same people who are complaining seem to forget that they’re usually doing nothing but looking at aircraft structure once they get cranked around. Looking at six o’clock in the F-16 requires a little different technique. Instead of simply turning your head, try this (don’t even think about leaning forward): use the “towel racks” to push or pull
yourself left or right as far as you can go (both directions will work, and with a little practice you'll quickly learn which direction is better at that particular moment). Now, lean your head toward your shoulder in the same direction you're leaning your body. With a little practice you can get to where you can support your head with your shoulder while you're pulling g. Now rotate your head about the now-leaning vertical axis and you'll be able to look nearly right down the back of the airplane. And better yet, those clever devils have not put any aircraft structure in your way. The only possible interference now is from the top of the seat. Amazing!

I've not heard many pilot complaints about the lack of a canopy bow in the F-16. I get the impression that everyone is impressed with the markedly improved visibility that results.

The physics involved or the tradeoffs required, a lot of attention was suddenly focused on the F-16's bird-strike "problem." As a result, the canopy thickness went from three-eighths inch on the prototypes, to one-half inch on the full-scale development airplanes — and finally to three-quarter inch on the production version. Therefore, the possibility of reflections ricocheting around inside the transparency (and then into your eyes) increased markedly. It's also interesting to note that this additional canopy thickness cost you 22 pounds of additional weight per one-eighth inch increase.

While I have mentioned bird strikes, let me digress for a minute on that subject. It's important to realize what we're talking about, when the subject comes up for discussion.

"For a minute I thought I'd forgotten something. I finally realized that I could see like in no other Air Force airplane I'd ever flown."

That is certainly the most lasting impression I had on the initial takeoff I made in the airplane. For a minute I thought I'd forgotten something. I finally realized that I could see like in no other Air Force airplane I'd ever flown.

However, I have heard some complaints about reflections in the canopy at night. You must remember that the original design of the F-16 revolved around the role of lightweight air-to-air fighter. However, this quickly changed to one of multi-role fighter. The possibility of the aircraft spending much more time in the arena where it might encounter birds was one change. Without fully understand-

First of all, the failure mode with a bird strike in the F-16 is rarely one of penetration (i.e., the bird does not usually come through the canopy). Instead, the impact puts a big depression in the canopy. This depression (dent, if you prefer) then progresses back along the canopy in a traveling wave, giving rise to the possibility that it (the wave) will rap you on top of the head hard enough to incapacitate you. The "sweet" spot required for this to happen is hardly six inches by six inches, roughly centered on the HUD. Anything outside this area does not create enough of a dent to hit you as this traveling wave passes by your head. I feel the odds
against just such a hit are astronomical, but it was not my decision to make. So, what you now have is a canopy that will take a four-pound bird in this area at something in excess of 350 knots. This capability assumes that you are sitting at "design eye." If it looks like the mission is going to require that you fly at high speeds, in an area where you know there are a lot of birds, you should make note that you can get an increased safety margin simply by lowering your seat below "design eye." It is also very interesting to note that the F-16 is one of only a few airplanes that has been so thoroughly scrutinized in this area.

There are several other airplanes (I won't mention any here, but you would recognize them instantly if I did) where the failure mode is one of penetration. And the airspeed that

chops at 600 knots in any tactical airplane — in which case all bets are off.

Anyway, we were talking about reflections. Because of several reasons beyond the control of both test and operational pilots, we have to live with a canopy whose thickness is very conducive to reflections. Also the canopy geometry, which gives us such excellent visibility in the daytime, is hard to light from the inside without some annoying reflections. We have to recognize they exist and learn to live with them. There are a couple of things you should consider. First of all, learn to fly with the lights as dim as possible. Although not yet designated as the primary flight instrument within TAC (as it is with the Navy F-18 community), perhaps the time has come to consider using the HUD to fly with at night (or in the daytime for that matter). Through some judicious use of the night filter (in conjunction with the day, night, and/or auto bright switch in concert with the brightness knob) you can get the HUD where you can see it perfectly without any annoying reflections. With the panel and console lights very dim (to almost off, which the HUD will allow) you can virtually eliminate any annoying reflections. In fact, that's exactly what we've been doing lately — eliminating reflections. After spending a lot of time and money in apparent dead ends (electroluminescent strip lighting, many different filters, different bezel lights on the various gauges, etc.) we came up with the following solution: we added a master switch for the interior lights in much the same manner as the external lights. We use the present rheostats to set up the various panel lights to where we can see everything comfortably. Then, with a hands-on switch, we turn everything off (the warning lights are rigged to stay dim) and fly using the HUD until we need to check something. Then it's "click" on, do our check, and "click" off. It works great!

There is still the problem of having to contend with the REO (radar electro-optic) display, but we are working on a filter to help here (and it looks like we've come up with one that works well). With some practice on your part, you can come up with the right combination of brightness, symbology, and contrast settings that will allow you to use the REO at night and still not flood the cockpit with green light. There will still be those areas — such as night weather approaches, either single-ship or on the wing — where it could be a bother. In such cases you can turn it down enough (even off) to where it shouldn't interfere. Experiment a little and you'll see it's not too hard to come up with some personal settings that will allow you to see outside through the small amount of reflections that remain.

One final area before we leave the canopy is the refraction and internal reflections of such things as runway lights. I have seen these and do not like them either. I wish I could remove them entirely, but I can't (with the present thickness). But don't despair! I have never seen a circumstance in which it was not obvious which lights were the real ones and which were the pretenders. If you realize that the phenomenon exists, there is no reason to "bite" on the wrong picture.

I mentioned using the HUD. It seems like there's a lot of misunderstanding about what it is that you now have in front of you. What it is, is everything you had "heads down" — except now it's all in one place. And better yet, you can still look at the real world while you're looking at instruments. In the next issue of Code One, I'll discuss — in detail — the capabilities of this marvelous instrument, and hopefully dispel some of the myths surrounding it.

CODE ONE/15
EDITOR'S NOTE: Robert Stanford-Tuck began a career with the British Merchant Marine Service in 1935, but after two years at sea he decided — on a whim — to join the Royal Air Force. He completed flight training at Uxbridge and was posted to 65 Squadron at Hornchurch where the first of many incidents that earned him the name “Lucky Tuck” occurred. While flying on a formation training flight, another aircraft collided with Tuck’s in mid-air. Tuck parachuted to safety, but the other pilot was killed.

He saw his first action of WWII with 92 squadron over the beaches at Dunkirk, where he shot down five German aircraft in his first two days of combat. He subsequently became one of the RAF’s top scoring aces and an outstanding leader. Often decorated, Tuck shot down 30 enemy aircraft and rose to the rank of Wing Commander before being shot down in January 1942. This is the third article by Bob Cunningham in a series of interviews with some of the world’s top aces.
the Interview...

CUNNINGHAM: Wing Commander Tuck, you joined the RAF in 1935, fought through the Battle of Britain, and went on to become one of the RAF’s best-known Aces. How many combat victories do you have?

TUCK: Well, up until four years ago, I was credited with 29 victories, but four years ago the aircraft recovery teams we have that go around England, because there’s a lot of them still just below the deck, recovered one 25 feet down and it turned out to be a Messerschmidt 109. And I knew nothing about this, but the Ministry of Defense then got on to me and they said, “It’s one that you claimed as a probable,” because in my combat report I said it just flicked instantaneously out of the way as I fired at it. I said I don’t think I hit it hard enough, but I could claim it as a probable. So I had 29, without this one I claimed as a probable. But, this one that they dug up established beyond all doubt, due to the position and everything about it, that it was mine. I had nothing to do with it except when they found out, they checked an entry in my log book about this probable, and they said, “Right. You have got 30 now.” And his name, the pilot’s name, was Leutnant Kneitel. He was 30 years old and he was adjutant of the Richthofen Squadron.

“Thank you very much indeed. It now sits in our squadron museum. We’d like to make you an honorary member of the squadron.” Which was a happy ending to a rather sad event.

CUNNINGHAM: Your first victory was scored while providing air cover for the evacuation of Dunkirk. What type of aircraft were you flying then?

TUCK: I was flying a Spitfire Mark II.

CUNNINGHAM: What type of aircraft was your first victory over?

TUCK: A Messerschmidt 109E.

CUNNINGHAM: Did you ever do combat with the Me 110?

TUCK: Oh yes, I shot down several one-one-ohs, one-tens.

CUNNINGHAM: Was it as difficult an opponent as the 109 or the ...

TUCK: No. Certainly not. It was not as maneuverable and not as fast, but it was a very unpleasant aircraft to encounter because it had very heavy firepower in the nose. It was a twin-engine aircraft and had this very heavy firepower concentrated in the nose and if it was behind you, it was really letting go with a lot of ammunition. The moral was, don’t let one get behind you. Always have them up front and shoot them.

CUNNINGHAM: It had a rear-gunner also.

TUCK: Yes, it did. Indeed it did. Yes. I always found the German rear-gunners in both bombers and one-one-ohs were very accurate, very determined, and they would fire until the last minute before you could wipe them out. I had very high respect for the German rear-gunners.
CUNNINGHAM: Was that the day the Germans called "Adler Tag," or "Eagle Day?"

TUCK: I think it might have been, yes. I'm not quite certain, but I think it was. It was our biggest day, the day of the heaviest combat all day long.

CUNNINGHAM: I see. Was that sort of the high-water mark of the Battle of Britain?

TUCK: It was the peak. After that, it trailed off. But that was the peak day. And then it trailed off a little bit, and then suddenly it stopped. And they converted to night bombing, as you remember.

CUNNINGHAM: Is there any one combat that stands out in your memory?

TUCK: Yes. I have one which is quite extraordinary. It's something I wish I could undo, really, like many things that happened in the war. I was up on a drizzly evening over South Wales, and I was stalking a German bomber, a Ju.88, that I had spotted. He had probably seen me also because he was dodging in and out of the clouds. Then suddenly he popped out into the moonlight and I had just time to get in one burst — from a distance — before I lost him again. But I did hit him and saw him jettison his bombs and turn tail for home. My fuel was getting low, so I gave it up as a bad job and returned to base, reported it, then dismissed the whole affair from mind. Well, next morning early I got a telephone call from my father. I could tell immediately from his tone it was something bad, and he told me then that my sister's young husband had been killed the night before. Now, of course, this was quite a shock and particularly so because we didn't thought of him as being in any real danger. He was a private in the Queen's Westminster's at St. Donat's in South Wales. He was awaiting transfer to an officer training unit. There were no details then, and I thought perhaps it was some freak training accident. I went on off on patrol, still trying to absorb the fact of John's death. His name was John Spark, and they'd only been married about a year. Then I began to think about the bomber I'd hit that evening — over South Wales — and suddenly I had a dreadful premonition …

CUNNINGHAM: That it was your bomber?

TUCK: Exactly. And it was. When I got down I immediately called intelligence to inquire about all enemy activity over South Wales the previous day. And the awful word came back that there had been none at all — except for one stick of four bombs that fell at Porthcawl. 'Probably from the Ju.88 you reported,' they said. I asked if there were any casualties and they told me there was only one — a private at the army camp at St. Donat's Castle. So there it was. I had caused the death of my sister's husband. And as you can imagine, I kept this to myself for a long time.

CUNNINGHAM: But she knows now.

TUCK: No. But it was an awful thing to have happen.

CUNNINGHAM: Let's switch subjects here. At one time during the Battle of Britain you were very short of fighter aircraft, weren't you?

TUCK: Oh yes. We were. But even more important than that was we were running very short of pilots, cause our casualties were very heavy. But of course, the Germans were, too. But they had more of them than we did. We were running
short of both aircraft and pilots, but the aircraft shortage was overcome by Lord Beaverbrook, who was minister of aircraft production, known as the “Beaver.” The Beaver got in and sorted out the production program very quickly. He was a wonderful fella. So our shortage-of-aircraft problem in the Battle of Britain was settled sooner than the shortage of pilots because you can’t train them that fast.

But, good maintainability and a high readiness rate are also very important factors in the struggle for air superiority. Our ground crews were absolutely wonderful throughout that battle. They worked day and night repairing damage and servicing and changing the way they have to in intense conditions like that because we were using the aircraft extremely hard the whole time — from ground level up to 25- and 30-thousand feet and back down — and they were being very heavily used. And the maintenance problem was very acute. Some wonderful riggers and mechanics had to work double shifts, but they all came up to it.

CUNNINGHAM: You mentioned the Spitfire had higher performance than the Hurricane. What, in your opinion, are the characteristics of a good fighter aircraft?

TUCK: Well, naturally you want it reasonably small. A big, heavy, cumbersome fighter I've never thought was much good. It's a big target for any opposition you could meet. It's a large target and I don't like it being that size. I don't think it's necessary. If you can make a small, strong, powerful aircraft ... but it must be very strong, highly maneuverable; good rate of climb, all these types of things. I never liked these great big ... I've flown Spitfires for, I suppose, a thousand hours, and just before Pearl Harbor was bombed we seemed to know lease-lend was coming in for fighters that we wanted. And so my commander sent me over to the United States to fly by arrangement with the manufacturers, all of the new aircraft. Which I did. I flew them all. But one small point ... I'd got over a thousand hours on the Spitfire and it was very small, very dainty, very maneuverable. Your cockpit fitted you like a glove and your instruments and everything were right at hand immediately. But it was small, fast, and strong. And good armament, we thought.

But I went to Farmingdale, Long Island, and met Alexander P. DeSivory there out there — fine chap he was, too — was a great friend of mine then — he arranged it with the chief test pilot. He took me through everything and I sat in the cockpit of the P-47. That's the Thunderbolt that did such marvelous work throughout the war. Thousands and thousands of them were produced. A very rugged aircraft it was. But it was very large in comparison with my dainty little Spitfire. First time I sat in the cockpit and the chief test pilot was showing me all the taps and things I said, "Good gosh! Look at the size of this cockpit!" He said, "Yeah, it's good to have plenty of space," and I said, "Yes, it's all right. I suppose it is. What happens, well, I'll break my bloomin' neck if I fall off the seat." But it was a big — I have always liked them small, fast, strong, and maneuverable. And good armament.

CUNNINGHAM: Did you ever fly a twin-engined fighter such as the Whirlwind?

TUCK: Yes, I flew the Whirlwind. And of course I flew DeHavilland Mosquitos also, but not in combat. I never used them in combat, but I flew them for the hell of it, because I liked them.

CUNNINGHAM: For combat, which would you prefer — the single or twin-engined fighters?

TUCK: Single.

CUNNINGHAM: You were shot down while strafing ground targets in France . . .

TUCK: Yes, finally, in 1942. I commanded the Biggin Hill Wing of five Spitfire squadrons in '41 and '42. And then early in '42 I was doing a low-level attack with one other fighter, just using cannon on an alcohol distillery and a flak battery just inland from Boulogne. The light flak got me right through the sump and everything like that, and I crashed and was taken prisoner. It probably served me right that they got me — for shooting up a distillery, you know!

CUNNINGHAM: War brings out the worst in people.

TUCK: Yes, but that was the end of it for awhile.

CUNNINGHAM: You put some shots into the flak battery that shot you down didn't you? How were you treated when they captured you?

TUCK: Yes. I knew that the Spit had bought it and I was going down. I made one last pass at the flak truck — because they were still shooting at me — and I hit it good just before going in. It was a pretty rough landing and I got out with a nasty bump on the head and a bleeding nose. And the Germans came up and grabbed me and pushed and shoved me back to the wreck of the flak truck. I thought they were going to show me what I'd done to their comrades and then string me up or something of that sort. But when we got there — the thing was still smoking and bodies laying around — they began to laugh and point to the guns, and they were telling me "Good shot, Engiee!" You see, by some fluke one of my shells had gone directly down the barrel of one of their guns and exploded. And they thought that was funny. And a good thing it was that they did!

CUNNINGHAM: And after that you met General Adol Galland . . .

TUCK: Before I was taken off to prison in Germany, Galland and his pilots of the Luftwaffe fighter squadrons based at St. Omer gave a dinner for me. He was, and is, quite a grand gentleman. He was an Oberstleutnant [Lieutenant Colonel] at that time, but later commanded the entire German fighter corps. We had a very nice evening, and I was amazed at the feeling of comradeship we seemed to have. But then, of course, they had to send me off to prison.

Before sending Tuck off to prison, Galland told him, "I'm glad you're not badly injured, and that now you will not have to risk your life any more." After the war, they met again and have since become very close friends.

Tuck's luck seemed to desert him for awhile, and he remained a prisoner until January of 1945. Then he and a Polish pilot escaped and walked to the Russian lines, and finally to Odessa where Tuck and his comrade smuggled themselves and the wife of another Polish pilot (who was fighting in Britain) aboard a British merchantman bound for Southampton. After an absence of more than three years, "Lucky Tuck" made his way back home again!
Lead heard two's bingo call and glanced at his totalizer. It displayed 1300 pounds — 200 pounds below the bingo he had set prior to takeoff. Yet there was no “FUEL” warning in the HUD. Why? Lead checked the fuel quantity select knob. It was in reservoir. That wasn't where he wanted it, but he had evidently left it there after an earlier fuel check. He placed the knob to normal and, sure enough, “FUEL” began flashing in the HUD.
This hypothetical scenario illustrates the fact that pilots need to be aware of their F-16's particular bingo fuel warning mechanization... because this warning mechanization varies, depending on aircraft block version, modifications, etc. And it could be embarrassing to write up the aircraft for an improper bingo fuel warning when that's how the jet really works.

Originally, the bingo fuel warning was provided when total fuel (external plus internal) decreased to less than the bingo value. The fire control computer (FCC) compared total fuel (provided by the fuel quantity control unit) to the bingo fuel value (entered by the pilot). After two Class A mishaps involving trapped external fuel, it was decided to base the bingo fuel warning on fuselage fuel (internal fuel minus wing fuel). This change involved both hardware and software. The hardware portion was a modified fuel imbalance control unit and the associated wiring to provide fuselage fuel information to the FCC.

The software portion originally involved instructions for the FCC to use the fuselage fuel input for comparison (instead of the total fuel input). This mechanization worked as designed as long as the fuel quantity select knob was in normal. When the knob was placed out of normal, however, the fuselage fuel input to the FCC was a constant 5900 pounds, and no bingo fuel warning was available for entered bingo's less than that value. To correct this, the FCC software was revised to compare the total fuel input with the fuselage fuel input and to use the lesser of the two as the basis for triggering the bingo fuel warning. Thus, the goal of having the bingo fuel warning based on fuselage fuel was achieved — with the fuel quantity select knob in normal. Out of normal, the basis for the warning essentially reverted to one based on total fuel for all entered bingo fuel values below 5900 pounds.

If you'll recall the scenario at the beginning of this article, lead didn't get a bingo fuel warning until he selected normal. This is a real possibility for some USAF and EP AF pilots. Although the preceding discussion on mechanization evolution was written in the past tense, it hasn't all happened yet. The present mix of hardware and software combinations is difficult to put into words. Hopefully, the following table will give you a clue as to what you've got now and what you can expect in the future.

The important point to remember about the new mechanization is that the bingo fuel warning will only be based on fuselage fuel if the fuel quantity select knob is in normal!

<table>
<thead>
<tr>
<th>Air Force</th>
<th>F-16 Model</th>
<th>Fuel QTY SEL Knob in NORM</th>
<th>Fuel QTY SEL Knob out of NORM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Bingo Based On Fuselage Fuel</td>
<td>Bingo Based On Total Fuel</td>
</tr>
<tr>
<td>USAF &amp; EPAF</td>
<td>A/B</td>
<td>Aircraft with 1</td>
<td>Blk 1, 5, 10 aircraft without 1</td>
</tr>
<tr>
<td>EAF</td>
<td>A/B</td>
<td>Aircraft with 2</td>
<td>All aircraft</td>
</tr>
<tr>
<td>IAF</td>
<td>A/B</td>
<td>Aircraft with 2</td>
<td>All aircraft</td>
</tr>
<tr>
<td>SAF</td>
<td>C/D</td>
<td>Aircraft with 3</td>
<td>All aircraft</td>
</tr>
<tr>
<td>FAV</td>
<td>A/B</td>
<td>All aircraft</td>
<td>All aircraft</td>
</tr>
<tr>
<td>PAV</td>
<td>A/B</td>
<td>All aircraft</td>
<td>All aircraft</td>
</tr>
<tr>
<td>ROKAF</td>
<td>C/D</td>
<td>None</td>
<td>All aircraft</td>
</tr>
<tr>
<td>EAF</td>
<td>C/D</td>
<td>None</td>
<td>All aircraft</td>
</tr>
<tr>
<td>IAF</td>
<td>C/D</td>
<td>None</td>
<td>All aircraft</td>
</tr>
</tbody>
</table>

* Revised software not scheduled.
** All have hardware, software not scheduled.

Note:

7 Block 15S FCC software (P05) plus hardware (ECP 0676).
- Applies to only eleven USAF models (all Misawa AB).
- P05 software available.

2 FCC software plus retrofit of ECP 0676 hardware.
- EAF software update is planned as part of OCU.
- IAF software update is unknown.

3 Block 30B FCC software (FP06) plus ECP 0676 hardware.
- Most C/Ds have hardware.
- Software update Dec. 86.
LIKE IT OR NOT, SOFTWARE IS HERE TO STAY, AND THOSE NOT WILLING TO ACCEPT ITS EMERGING ROLE WILL LIKELY BE TRAMPLED BY THE BILLIONS OF DATA BITS STAMPEDING THEIR WAY.

Likers, OFP, CPLI, checksum, fixed point, floating point, cues, stacks ... on and on goes the strange new terminology of the software development world. Software affects virtually every major avionic system — either currently in use or under development — in the Air Force inventory. Like it or not, software is here to stay, and those not willing to accept its emerging role will likely be trampled by the billions of data bits stampeding their way.

"So," you are probably asking yourself, "just what exactly is software?" Simply stated, software is a computer program — a series of instructions that tells the computer what tasks to perform and when to perform them. Without software, a computer is sort of like the brain of a newborn child. Before it will be effective as anything but a paperweight, it must have external stimulus. Like a human brain, the computer can only perform those tasks that its memory allows.

When software is applied to an aircraft system, it's like adding an extra crew member to perform that particular mission task. Hardware (computers) and software (instructions for computers) are integrated into aircraft avionic systems to lighten crew workload.

"Integrated avionics" describes an overall system in which everything works together — what affects one part of the system could affect the entire system. "Avionics" is a term that
telling all the other onboard computers what to do and when to do it. But in order for the mission computer to act as a bus controller, it must have an operational flight program (OFP) — which, of course, is the dreaded software ... millions of data bits dutifully doing the programmer’s bidding. The mission computer’s OFP consists of approximately 52,000 lines of program code. If run off on a standard line printer, this code would create a stack of paper 18 inches high. The mission computer must communicate, control, and monitor all integrated systems on the FB-111 AMP. Each system is “serviced” several times per second. The mission computer also keeps track of all self-test functions and reports all malfunctions to the crew via the multifunction display (MFD).

When a bug (software problem) bites the OFP, the solution is far more complicated than simply changing a few instructions. Any OFP change can directly or indirectly affect the entire integrated system. So when OFP changes are required, the system integration engineers embark on the very long and tedious task of testing for any possible effect the changes might have on other system elements — while additionally ensuring that the revised system still does what it was designed to do.

Consider what happens when a crew member commands the MFD to switch from a navigation mode to a bombing mode. The MFD is the primary interface between the crew and the multiplexed avionic system. It serves as a computer keyboard and display, allowing the crew to control and monitor avionic configurations. The desired mode is selected by pushing a button on the MFD, which then sends a message to another computer called the programmable display generator (PDG). The PDG’s OFP accepts the request and processes it to the mission computer over the multiplexed bus. The mission computer’s OFP looks at the request to ensure its validity. (Let’s say, for instance, that you’re in a steering mode in your FB-111 and you suddenly feel a need — for whatever reason — to drop bombs on one of your destination points. Well, the OFP won’t let you do it because in software language a “destination” cannot also be a “target.” The WSO will have to do some in-flight reprogramming before you can pick a bomb off at this point.) This validity check is performed by running several program modules within the mission computer’s OFP. These program modules check the request as to mode compatibility and, if valid, send the required data to all systems appropriate to the new mode. After processing the request, the mission computer will send data, via the multiplexed bus, instructing the PDG to display the new mode on the MFD.

And all this activity takes place in a matter of milliseconds.

The example given is just a simple operation, but things can become much more complicated; like when other onboard systems — such as the inertial navigation units, Doppler radar, attack radar system, etc. — are simultaneously reporting data while the aircraft is flying at 450 knots, 200 feet off the deck. A minor OFP change in this environment is potentially fatal. It could affect virtually everything tied to the multiplexed bus. For this reason, the mission computer’s software must be thoroughly tested. All possible combinations of events must be checked and verified by the system integration engineers to ensure safe and effective system operation.

Software development is an awesome and tedious task, requiring close interface between software and hardware engineers to insure compatibility. Once the initial design is completed, validation testing is begun. This testing can involve anything from software development test stations to actual flight tests. Integration engineers check to see that all involved systems are working together properly and, when changes are made, that the new system remains within design specifications. Virtually millions of events — affecting the entire integrated avionic system — take place within the OFP. Despite the complexities, however, software engineers have substantially increased the combat capabilities of modern aircraft. Software is the name of the game in current and future avionic system design because it reduces cockpit task saturation, enabling combat crews to do the job on the modern battlefield ... and survive.  

---

CODE ONE/23
FROM THE SIMPLE, SINGLE-TASK MANIPULATORS OF A DOZEN YEARS AGO, ROBOTS HAVE EVOLVED INTO HIGHLY COMPLEX MACHINES WITH AN ALMOST UNLIMITED POTENTIAL.

For nearly half a century, General Dynamics has been fulfilling U.S. Air Force requirements for quality military aircraft. This is a demanding job that is made even harder by a requirement to continuously upgrade our product to counter every emerging threat capability. From a production standpoint, that requirement means constant pressure to improve and refine our manufacturing processes. But these quality improvements must additionally be cost effective ... because military aircraft are bought with your tax dollars.

We therefore feel a very real obligation to build the finest fighter aircraft possible, using the most advanced methods available. We do not take lightly our responsibility to improve our product while lowering its cost. This philosophy guarantees our survival in a highly competitive industry, just as our products guarantee the survival of free nations in a hostile world. This sense of obligation has driven us to develop and implement the innovative technologies described in this article and in future issues of Code One magazine.

—CHARLIE WHITE
Vice President of Production
The manufacturing industry has experienced a series of revolutions in the production arena since the Industrial Age began over a century ago. But in the past 15 years, manufacturing technology has progressed further than in all the previous years combined. And robotics has emerged as a potent force in manufacturing. From the simple, single-task manipulators of a dozen years ago, robots have evolved into highly complex, computer-programmable machines with an almost unlimited potential for production applications.

Within the aerospace industry, General Dynamics has been a leader in the application of robotic technologies to the manufacturing process. Robots are often exciting, as in the case of our vertical fin skin robot. This large, complex machine is quite impressive as it goes about its task of drilling 1100 precise holes in the F-16's vertical fin skins. Some robotic applications, however, are less visible, and the work they do is far less exciting—but their value in improved product quality, reliability, and lowered cost is substantial.

A case in point is the contact/filler insertion robot. This machine automatically inserts blank contacts/fillers into electrical connectors (similar to cannon plugs). Not too thrilling, huh? Nevertheless, this robot is six times faster and much more reliable than the old, manual method, and it will save nearly a million tax dollars by 1993.

To help you realize the importance of this robot's job, consider that the F-16 is a "fly-by-wire" aircraft. There are no mechanical push-pull rods, bellcranks, pulleys, or cables to link the control stick with the flight surfaces. Instead, when the pilot moves the stick, his input is translated into an electronic impulse that travels through a wire bundle to servos at the moveable wing surfaces. That's how the F-16 came to be nicknamed the "electric jet."

The airplane's cavities are filled not with mechanical hardware but with wire bundles. And these bundles each terminate at a plug that must mate with another plug. These plugs can have as many as 152 holes, and each hole either has to accommodate an electrical contact from its mating plug or have a "blank" contact inserted into it. Most of the F-16's wire bundle connectors intentionally have several unused holes in order to provide for future system expansion as new technologies and capabilities are developed. To protect these unused cavities until they are needed, blank contacts are inserted into them, and then the blanks are covered with fillers to give an environmental shield in accordance with USAF specifications and standards; thus the term "contact/filler."

The fabrication of electrical harnesses is one of the most expensive operations in the aerospace industry. And, until recently, one of the most labor-intensive tasks in that fabrication process was the insertion of blank contacts/fillers into connector cavities. A human operator receives a harness subassembly and selects the connector plug chart for the specific connector to be assembled. The operator ensures that the connector, contacts, and fillers correspond to the shop order. The connector plug chart is then checked to determine which contact cavity is to be filled first.

The operator locates the contact cavity, selects the proper contact, inserts it, then selects and inserts the proper filler. This process is repeated until all blank contact/filler cavities have been filled. Obviously, this process is extremely time-consuming, fatiguing, and can easily lead to operator error when alertness is at least as maximum. A faster, more accurate method was needed. The solution was a robotic system, developed by General Dynamics and funded in part by the USAF-sponsored Technology Modernization Program (see Code One, Spring 1986).

An Automatix robot with its own computer and control system, and a Moorfeed vibratory feed bowl bank were purchased and mated to a General Dynamics-designed "end effector" — the working end of the robot. This is the part that performs the task-specific functions (in this case, the contact insertion). General Dynamics also designed an air-assisted contact/filler delivery system and the fixture to hold the connector in place while the contacts are inserted into
A computer-linked visual inspection camera and light table were added to insure that the connectors are in the correct configuration.

The resulting system is capable of handling two connector socket sizes, two pin sizes, and four filler sizes which account for 85 percent of those electrical contacts and fillers that formerly required manual insertion. The contacts and fillers are vibrated out of the feed bowls and air-blown through tubes to the end effector. An air cylinder extends, pushes the contact into the correct cavity, and retracts. A filler is then inserted in the same manner. Moving from cavity to cavity, the end effector repeats the insertion process while being monitored by sensors to insures that the pins and fillers are correctly placed.

All information necessary to the robot (the exact location of the holes in the connectors, gauge size of the contacts, types of parts, pins, and sockets) is accessed from an Electrical Harness Data System computer. Information concerning each connector configuration is stored by harness number and reference designator in a database. This is the first off-line programmed robotic assembly system implemented at the Fort Worth Division.

The result of all this is lowered production costs, improved quality, improved production reliability, and an attendant improvement in operational reliability of the finished airplane.

As previously mentioned, General Dynamics also uses a robot to drill holes in graphite/epoxy vertical fin skins. This robot’s daddy signaled the aerospace industry’s first use of a robot in the manufacturing process. It happened right here at the Fort Worth Division in January 1979 when a Cincinnati Milacron hydraulic robot was brought on line to drill vertical fin skins. It was a hard-working machine capable of fast, safe, and uniform operation. From 1979 through July 1984, it drilled 550 holes per skin in approximately 2,600 composite skins. And it eliminated a tedious, multi-setup, manual drilling operation accomplished with a hand-held, cable-supported, 35-pound drill that was both highly fatiguing and potentially hazardous due to the continuous generation of graphite composite dust. The hydraulic robot was equipped with a vacuum system that removed the dust as it was generated, thus totally eliminating the hazard.

Over the years, however, the hydraulic robot became more and more expensive to maintain. Robotic technology was evolving rapidly, replacement parts for older robotic systems were becoming difficult to locate, and the maintenance requirements of the hydraulic robot were increasing. Also, the robot part program required constant “tuning up” as the machine became older. Due to design limitations, intermittent binding occurred during insertion of the drill into the template bushing which guides the tool into the part.

Clearly, the time had come to upgrade the robotic system. Electric robots were now available that were more reliable, more “repeatable,” and easier to maintain than the hydraulically powered models.

In October 1984, a clean, quiet, electric robot with updated controls was brought on line. Immediately, better quality holes resulted. The “old” hydraulic robot was removed from service and shipped to General Dynamics Land Systems Division in Detroit, where it is being used for robotics familiarization.

The new Cincinnati Milacron electric robot uses a quick-change adapter to grasp six different end effectors, designed by General Dynamics engineers. These specially designed end effectors incorporate a combination of pneumatics and hydraulics that allow control of the feed rate. The new design also has an automatic centering capability that provides compensation for "drift" in the articulated robot arm. When the robot has positioned the drilling tool near the part, an automatic extender moves the drill forward into the template bushing. In the past, an extend feature was used to locate on each individual end effector. Now, however, a single extend feature has been designed onto the quick-change adaptor, permanently located at the end of the robot arm. Along with other improvements, this innovation has cut end effector costs by 40 percent.

In the future, the electric robot will also handle routing, countersinking, and counterboring. These new tasks, combined with an automated material handling and part-positioning system, will save an estimated 4,300 man-hours per year.

A total of 14 advanced technology robots are currently performing a variety of tasks at General Dynamics Fort Worth Division. Expanding and upgrading this robot workforce is an ongoing process that will doubtless result in additional savings and improved reliability throughout the life of the F-16 program — and beyond.
Jacksonville Gets F-16

FLORIDA AIR NATIONAL GUARD UNIT IS THE FIRST TO RECEIVE F-16 AIRCRAFT IN A DEDICATED NORTH AMERICAN CONTINENTAL AIR DEFENSE ROLE.

By JOE STOUT
Public Affairs

The Florida Air National Guard's 125th FighterInterceptor Group began replacing its Convair-built F-106s with Fort Worth-built F-16s in formal ceremonies in September at the unit's Jacksonville International Airport base.

The unit is the first to receive F-16A aircraft in a dedicated North American Continental Air Defense role. The unit will receive 18 F-16s to replace 22 F-106s that it has been flying since 1974.

The unit flew another General Dynamics aircraft, the Convair F-102, for 14 years before it received its F-106s. That makes 26 years — and counting — in General Dynamics aircraft. The F-102, F-106, and F-16 are all single-seat, single-engine fighters, each designed to supply their era with superior air combat capability.

The ceremony was highlighted with an F-16 air show and an Air Defense scramble demonstration by two F-106 Delta Darts.

Col. Dean T. Biggerstaff, 125th Group Commander, opened the ceremony with a description of the crucial Air Defense mission. He said the unit keeps two airplanes on alert at all times, ready to scramble within five minutes to intercept and identify unknown aircraft that are detected on radar monitored by the USAF's 23rd Air Division Command at Tyndall AFB, Florida. The 23rd Air Division monitors radar in the nation's Southeastern coastal region on a 24-hour basis.

Colonel Biggerstaff said the 125th FIG has been performing the Air Defense mission — with two aircraft on constant, five-minute alert — since 1956. To demonstrate, a scramble horn was sounded and two Delta Darts were taxied from a hangar where they are kept ready at all times. As the aircraft took off in the simulated Air Defense response, Col. Biggerstaff explained that two additional F-106s remained in the hangar on alert status, ready in case of a "real" scramble order.

Brig. Gen. James M. Rhodes, Commander of the 23rd Air Division, said the selection of the 125th Group as the first Air Defense F-16 unit bears testimony to the weight of the group's responsibility and to its outstanding performance in fulfilling its mission.

"The unit has an enviable record in its long years, in many millions of hours of alert," he said, adding, "I'm very proud to see the arrival of the F-16 Fighting Falcon. It is truly an amazing fighter. It has been a long-standing goal of the Air Force and the Air National Guard to increase the capability of the Air Defense (forces)."

Maj. Gen. Robert F. Ensslin, Jr., Adjutant General of Florida, called the F-16, "the finest
fighter aircraft in the world. The unit is prepared to continue its outstanding performance in yet another first-line U.S. Air Force machine.

An F-16 flight demonstration was performed by the USAF's east coast demonstration pilot, Capt. Smokey Bauman of the 363rd Tactical Fighter Wing, Shaw AFB, South Carolina. Following the demonstration, Bauman's F-16 and another flown by Capt. Steve Ritter (the 125th FIG's first qualified F-16 pilot) joined two F-106s for a symbolic flyover of old and new aircraft in another ceremony highlight. Col. Biggerstaff, referring to this flying display and to a row of F-106s on the tarmac, said, "This is probably the last opportunity we will ever have to see this. Everyone at Jacksonville has enjoyed working with the F-106, which has been a workhorse for the Air Defense Command and an outstanding airplane, as well as a very safe airplane."


Air National Guard officials have said that three additional Air Defense units in the United States will begin flying F-16A aircraft in 1987 and 1988. An Air Force competition currently is underway for procurement of between 270 and 300 Air Defense fighters, with a decision expected in November. General Dynamics Fort Worth Division has submitted two proposals in the competition.

Col. Dean T. Biggerstaff, 125th FIG Commander

**Who's Really the oldest F-16 Pilot?**

In the last issue of Code One, we asked if anyone would care to dispute Lt. Col. George Inabinet's claim to be the oldest active F-16 pilot. He's the DCM for the 169th TFG, South Carolina ANG.

Guess what? Somebody did. Three somebodies, as a matter of fact — and we were told about two others who were apparently too modest to volunteer the information themselves (there could be many others in this category).

At 52, George figured he might have the title. But alas, it was not to be. Our first call came from right here in Fort Worth — from Phil Oestricher, Director of Flight Test and the first man ever to fly the Fighting Falcon. Phil is 55. Then there's Lt. Col. Robert Cassaro with the 162nd TFG, an Arizona ANG unit at Tucson. He has almost two years on George.

From Europe, we hear that Lt. Col. Herman Eijlers of the Royal Netherlands Air Force is still flying F-16s at age 55.

But perhaps most embarrassing to George is the fact that two men from his own organization can top him. The Group Commander, Col. Frank Rogers, is older by six months; and South Carolina ANG Chief of Staff, Brig. Gen. Stan Hood, is an F-16 pilot... at age 57! Now here may be the real title holder!

But Lt. Col. Joe Khare, full-time commander of the 169th TFG, took up for his DCM.

"It's just that George feels like the oldest," Khare explained.

**Purest of the Pure?**

Here's another one for you trivia fans. Col. Dean T. Biggerstaff, commander of the Florida Air National Guard's 125th Fighter Interceptor Group, will probably be setting records every time he lifts the fire in his F-16 Fighting Falcon. This seasoned veteran already has something like 6,000 hours in General Dynamics-built, single-engine, single-seat fighter aircraft. We figure that's got to be a record. And, if you count his F-86 time, he's got 8,500 total hours of single-engine, single-seat fighter time. That may or may not be a record, but it's got to be close!

Biggerstaff has been with the 125th FIG since the mid 50s. He was there in the early 60s when the unit converted to the Convair (now General Dynamics San Diego Division) F-102. He was there when they switched to the Convair F-106.

And he's still there — now commanding the first of what will become several ANG units flying the F-16 Fighting Falcon in a dedicated air defense role.
more mechanized cockpits, and enhanced electronic countermeasure systems, to name a few recent engineering changes. Production rates not only are keeping pace but increasing. General Dynamics is presently delivering 13 to 15 aircraft per month, and output will almost double by the middle of next year.

When AFSC Commander Gen. Lawrence A. Skantze asked whether

- High composite yields translate into a relatively low level of review board actions, indicating not only high production reliability but the ability of General Dynamics to manage complex weapon system enhancements.
- High composite yields also translate into a scrap, rework, and repair average for the F-16 C/D of 39 cents per labor hour, compared with $1.26 for the aerospace industry.

MAJ. GEN. MONROE T. SMITH
Air Force Systems Command

F-16 Reliability Is Praised

By JAMES W. JONES
Staff Writer, NEWSREVIEW

EDITOR’S NOTE: The following article appeared in the August 1, 1986 issue of NEWSREVIEW, a periodical published by the Air Force Systems Command. It is being reprinted here by permission.

A n Air Force general who fixed F-84s as a crew chief more than 30 years ago is elated at how long today’s F-16 multirole fighter can fly between repairs.

When he worked on F-84Es as a staff sergeant more than 30 years ago, Maj. Gen. Monroe T. Smith said, “one flight was the norm, and then it had to be fixed.” Contrasting that with the F-16, the general said “it’s truly amazing for an aircraft to fly six times and come back OK with no fixing required before the next mission.”

A 35-year Air Force veteran, Gen. Smith serves as Deputy Chief of Staff for Product Assurance and Acquisition Logistics, Air Force Systems Command. His office monitors the health of weapon system programs to ensure the Air Force is getting the best for the money.

A complex aircraft to begin with, today’s F-16 is being manufactured with enhanced computer memories, the Air Force might be sacrificing quality for delivery schedule in the F-16 program. Gen. Smith sent some of his people to find out. They selected a representative block of 20 F-16C/D models, maintenance history not considered, and tracked them from factory floor to the user organization — the 363rd Tactical Fighter Wing, Shaw Air Force Base, S.C.

Among other things, the product assurance team found that the 20 F-16s had a 96.3 percent mission capable rate as of June 18. Over the last 16 months, F-16C/D models — USAF-wide — scored a 90.6 percent mission capable rate, compared with 81.5 percent for the F-4E, which the F-16 is replacing.

Other team findings:
- F-16C/Ds fly more than four hours between repairs, compared with about an hour and a quarter for the F-4E.
- Less than 10 maintenance man-hours are required for each F-16C/D flight hour, compared with about 30 for the F-4E.
- Composite yields for F-16 fabrication parts at General Dynamics — that is, the average first-time inspection pass rate for parts produced — are among the highest in the aerospace industry.
- Of the 20 F-16s involved in the study, seven had zero defects upon receipt at Shaw AFB, and the other 13 averaged only 2.3 defects per aircraft.
- The Air Force has established an F-16 user requirement of no more than 12.65 maintenance man-hours per flight hour. Since December 1985, that figure has been running less than 10 for the 20 F-16s at Shaw.

“A and B models are good aircraft,” General Smith said, “but we’ve learned a lot from them. The Cs and Ds have even better reliability and maintainability.”

One measure of F-16 reliability is the mean time between maintenance actions. For C/D models, that figure is 33 percent better than for A/B models. And one measure of maintainability is how many man-hours per flight hour it takes to keep the aircraft flying. For C/D models, that’s eight manhours, compared with 12 for A/Bs.

“Our push for a quality F-16 started a long time before we started saying that R&M (reliability and maintainability) is important,” General Smith said, adding that the typical lead time from design to production for a weapon system like the F-16 is about 10 years. “We’ve been working R&M real hard as a command.”

CODE ONE/29
F-16s Dominate 'LONG RIFLE' Competition

The F-16 Fighting Falcon once again proved its superiority in the air-to-ground role by capturing the top five team positions in a one-day gunnery competition between 13 active duty fighter wings from 9th and 12th Air Forces.

Dubbed "Long Rifle," the competition marked the first in a planned series of events to be staged every six months. The first Long Rifle took place at England AFB, Louisiana. Future events will alternate between various locations within 9th and 12th Air Forces.

As a gunnery competition, Long Rifle is somewhat unique in that team members from competing units are selected by random lottery just two days before the event is to occur. According to an official USAF news release, this team selection process ensures "a competition that simulates closely what a tactical fighter wing might do in war. Rather than highly polished and specially trained competitors, the event included a cross-section of average pilots doing their best."

And best of the best was Capt. Vanness Irvine of the 58th Tactical Training Wing, Luke AFB, Arizona. Irvine was declared Top Gun after winning three of the competition's five scored events. He racked up 708 of a possible 800 points on his way to the title. Irvine's superior individual effort also paid off for his team, as the 58th TFW placed first in team standings.

Missions were flown in four-ship formations — non-stop from respective home bases. In-flight refueling was employed, and the aircraft recovered at England AFB, Louisiana. The tactical portion consisted of low-level navigation legs, followed by five weapon delivery profiles on two separate ranges. Scoring was based solely on weapons delivery, using a "no alibi" criteria.

Twelfth Air Force teams earned 8,645 points of a possible 17,000 to defeat 9th Air Force in the first, semi-annual Long Rifle. TAC Commander General Robert D. Russ presented an award to commemorate the feat. Other awards were presented by Lt. Gen. William L. Kirk, 9th Air Force Commander, and Brig. Gen. Donald R. Snyder, 12th Air Force Vice Commander.

The next Long Rifle will occur at an as-yet-unannounced location within 12th Air Force.

Thai Air Commander Gets Orientation Ride

The F-16's capabilities were displayed at another aerial demonstration four days later at U Tapao Royal Thai Naval Base in Bangkok, where it was observed by General Arthit Kamlang-ek, Supreme Commander of the Royal Thai Defense Forces, and by William Brown, U.S. Ambassador to Thailand.

Eight F-16s from the 35th Tactical Fighter Squadron, 8th TFW had deployed to Thailand from Kunsan Air Base, Korea, to participate in Cobra Gold, a 20-day joint exercise with the Royal Thai Defense Forces. The 4000-mile deployment spanned the China Sea and was aided by aerial refueling from a KC-10 tanker.

Leading the flight was the 35th TFS's squadron commander, Lt. Col. Michael D. Fore. The 8th TFW was represented by the Vice Commander, Col. Frank Garza, and by the Director of Operations, Col. Anthony Tolin.

During the exercise, 220 sorties were flown, of which 182 terminated Code 1. High point of the operation was a joint services naval assault with F-16s providing top cover for U.S. Marines and U.S. Army personnel, landing from U.S. Naval vessels standing offshore.
The Republic of Indonesia has signed a Letter of Agreement to purchase 12 multi-role F-16 aircraft. They are the sixteenth Air Force/Navy to purchase the Fighting Falcon and will take delivery of their first aircraft in August 1989. At the request of the Indonesian Air Force, the program has been designated “Peace Bima Sena.”

The Letter of Agreement specifies delivery of A/B model aircraft, equipped with the Operational Capabilities Upgrade package. The LOA also includes a complete Automated Logistics Management System that will complement the advanced aircraft by ensuring immediate, parallel updates to their logistics management capability. GDSC will manage the installation, training, and implementation of the system, coordinating with the program manager to ensure it is available and ready to support the program well in advance of the first aircraft arrival. Further selected Indonesian Air Force personnel will receive their systems training at the Product Support Training Center in Fort Worth, Texas. Pilot training will be provided by the USAF.

R.M. (Bob) Drewry has been designated as the Indonesian Program Manager. He has managed the Venezuelan program for the last five years. (An article on the Venezuelan Air Force appears in this issue of Code One.)

The Fighting Falcon was introduced to the skies over Malaysia in August when six F-16s of the 432nd TFW, Misawa Air Base, Japan, deployed to Butterworth Air Base, Malaysia, to participate in Commando West 10, a joint USAF/RMAF air-to-air exercise.

The USAF F-16s (five As and a B) flew non-stop from Misawa, using a KC-10 tanker for air refueling. The flight took more than nine hours. Extra pilots and ground crew members were transported in a C-141 aircraft to the exercise site, located in northwestern Malaysia, approximately 60 miles south of the Thai border.

RMAF 12 Squadron hosted the USAF visitors. Both 11 Squadron and 12 Squadron flew F-5s out of Butterworth Air Base in dissimilar air combat training exercises against the F-16s. Also participating were 6 Squadron (flying A-4s) and Number 3 Fighter Training Center (flying Aermacchi MB-339s). These units are assigned to Kuantan Air Base, near Kuala Lumpur, Malaysia’s capital city.

USAF pilots of the 13th TFS were led by their Squadron Commander, Lt. Col. Gary Bendlin. Also participating was 432nd TFW Vice Commander, Col. Ev Pratt.

In 82 sorties, the F-16s suffered no aborts and no sorties lost to maintenance or weather. Several RMAF pilots received F-16B rides, including the Chief, RMAF, Lt. Gen. Ngah; and the Commander, Air Defense Command, Brig. Gen. Ghani.
Egypt Takes Delivery of First F-16C

The Air Force of the Arab Republic of Egypt took delivery of its first F-16C multimission fighter in a recent ceremony at Fort Worth. Egypt is the first foreign nation to join the United States in having both F-16A/B and F-16C/D aircraft in its defensive inventory.

Acceptance papers for the single-seat Fighting Falcon were signed by Air Marshal Mohamed Abdul Hamid Helmi, Commander of the Egyptian Air Force.

Deliveries under Egypt’s initial order for 40 F-16A/B aircraft were completed in 1983. An additional 39 aircraft are to be delivered under the follow-on contract.

“The first Egyptian F-16C delivery represents the truly dedicated effort of both Americans and Egyptians,” Air Marshal Helmi said. “The F-16C is a significant addition to the existing F-16s in Egypt, which have been serving successfully since 1982.

“This event represents a major milestone in Egyptian-American friendship. On behalf of the Egyptian Air Force, I would like to thank the USAF, General Dynamics and every subcontractor company that participates in the manufacture of the F-16. Let’s all hope that this aircraft will see only peace in Egypt,” the Air Marshal said.

Maj. Gen. Bradley C. Hosmer, Assistant Deputy Chief of Staff for Programs and Resources, speaking on behalf of USAF Headquarters, noted, “The program serves as an excellent example of the dedicated cooperation between the U.S. government and the Arab Republic of Egypt in our mutual goal of peace in the Middle East.”


Maj. Gen. Eaglet also lauded the high mission-capable rates that F-16C/D aircraft have been achieving since they were introduced into the USAF inventory. “The men and women of General Dynamics can have justifiable pride in having produced such a remarkable weapon system,” he said.

James R. Mellor, General Dynamics Executive Vice President — Marine, Land Systems, and International — said, “This aircraft, coupled with the talent and drive of the Egyptian Air Force, makes an unbeatable combination.”

In addition to Air Marshal Helmi, Raouf Ghoneim, Deputy Chief of Mission for the Egyptian Embassy in Washington, D.C., and Dr. Fouad Youssef, Consulate from Houston, represented the Egyptian government at the ceremony.

“This delivery is an expression of the importance that our country places on the relationships between the United States and Egypt,” said Herbert F. Rogers, Vice President and Fort Worth General Manager, who was master of ceremonies. “We at General Dynamics are extremely proud to be a part of that relationship.”
NO! USE ONLY THOSE CLEANING AGENTS AUTHORIZED IAW TO, 1-1-1 OR T.O. 1F-16A-23 AND CHECK TH' NUMBERS OF TH' STUFF PRINTED ON TH' DRUM.-ARE TH' NUMBERS CORRECT?

UNAUTHORIZED CLEANING AGENTS OFTEN CONTAIN CORROSIVE ELEMENTS!

IT SEEPS INTO JOINTS, ETC., THEN TH' WATER EVAPORATES, LEAVING A CORROSIVE RESIDUE. IN TH' FINE PRINT ON ONE ALLEGED 'SUPER SOAP' TH' USER WAS ACTUALLY TOLD THAT IN STRONGER SOLUTIONS IT WOULD "REMOVE PAINT AND CARBON IN A VAT STRIPPING OPERATION."
Egypt Takes Delivery of F-16C