Flight engineer Ralph Chaffin on the flight deck of a 737 at Boeing Field in Seattle. The airplane will be thoroughly tested before it is delivered to the customer. Chaffin has worked in flight test with a variety of commercial aircraft, tankers, trainers and transports.

Flight test teams shake out Boeing aircraft performance to make sure that the vehicles operate perfectly under any conditions.

Where the Rubber Meets the Ramp

By William Cole

They are the calm voices who let military test pilots know when they are reaching the edge of the envelope. They are the technical experts on the flight decks of commercial jetliner test flights who continuously operate and test the aircraft's critical systems. They are the crew members who don flight suits to fly with transport test pilots practicing assault landings. They are the "pilots" who control autonomous helicopters from a ground-based station in the Mojave Desert.

Meet some of the flight test engineers who shake out Boeing aircraft performance to make sure that the vehicles operate perfectly under any condition.

Drama in the mission control room

It was a tense moment for the 50 engineers concentrating on a bank of monitors in the mission control room at Edwards Air Force Base in Southern California.

Signals from Boeing's X-32B concept demonstration aircraft for the Joint Strike Fighter program were indicating that all three critical navigation systems, which help to stabilize the aircraft, were "red," or not responding.

continued on page 6

continued from page 5

"That could be bad news, or very bad news," says Bill "Jaco" Jaconetti, then flight test conductor for the experimental aircraft. "It could mean that the aircraft simply had reduced stability. Or it could mean it was out of control."

Jaconetti and his team had to find some answers quickly. They immediately broke out their emergency procedures to get to the root cause of the problem. But soon they were relieved to hear from the test pilot that the aircraft appeared to be flying normally. Not taking any chances, the team aborted the mission and brought the aircraft in early.

Mercifully, such incidents are so rare that they stand out in a flight test engineer's memory. On the ground and in the air, Boeing military and commercial engineering teams put their products through a punishing array of tests. From the time the engines start to the time they shut down, a stream of data from the aircraft and the pilot is used to monitor the aircraft, says Jaconetti. During a flight test, his team has five focus areas: the overall health of the aircraft, its engine parameters, its avionics systems, the state of its fuel and its instrumentation.

"Our goal is to shake out new systems and parts, to put every aircraft through every situation that the end user could possibly experience," says Jaconetti, one of a select group of engineers who have traveled the world to make sure that Boeing aircraft deliver as promised. "We push the aircraft to its limits; we take it to the edge of the envelope. I serve as a filter between the team and test pilot, providing only necessary information. Our challenge is to make real-time calls. We have to think quickly and accurately enough to recognize a system's limit, to knock it off at exactly the right time. One misjudgment and you could break something."

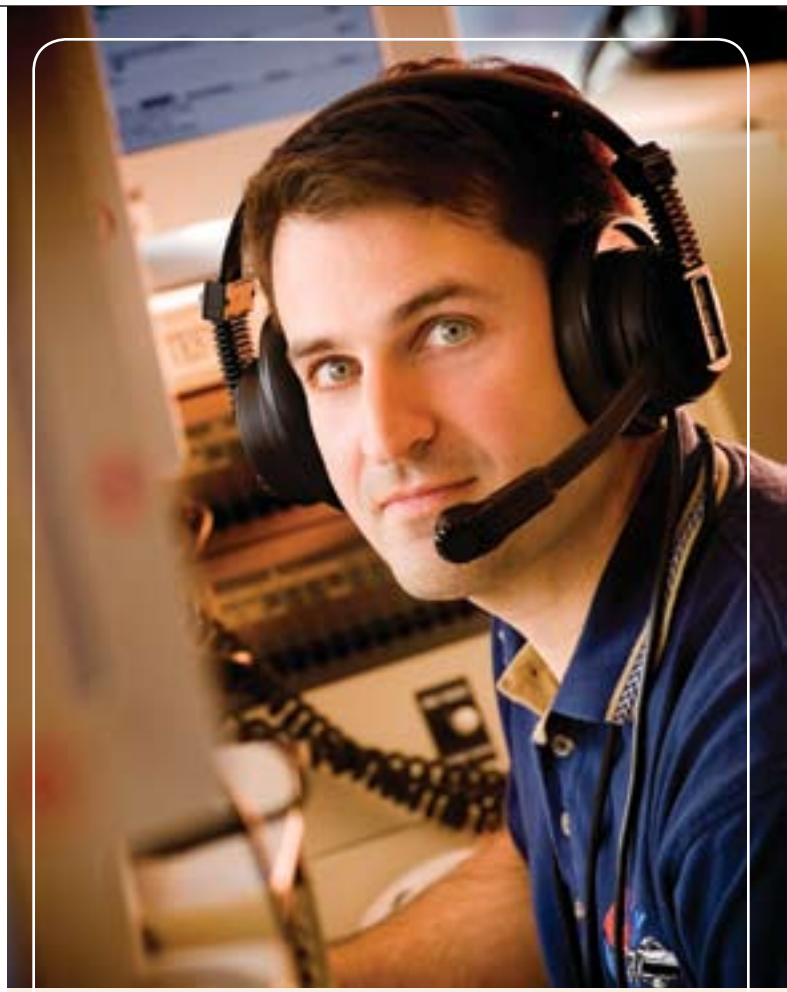
"Our goal is to shake out new systems and parts, to put every aircraft through every situation that the end user could possibly experience." – Bill Jaconetti.

Now on a special assignment as the integrator for the Integrated Defense Systems Test and Evaluation function, Jaconetti was previously flight test technical lead on the F-15SG (Singapore) development program, flight test conductor for the F-15 and F/A-18E/F development programs as well as for the X-32. He and his team of 30 engineers, aircrew, and maintenance people successfully execute dozens of flight-test missions each year.

Jaconetti grew up near O'Hare airport in Chicago. An airplane flew over his house every 45 seconds every day of his boyhood. Far from being annoyed by it, Jaconetti developed a fascination for the aircraft. He decided that engineering was his destiny. After earning a bachelor's degree in aeronautical engineering, he began a search for his dream career.

He remembers every word of the voicemail offering him a job interview at Boeing: "We have an F/A-18 Super Hornet. You are going to be responsible for everything that happens to that aircraft. Call if you are interested."

He did, naturally. "I wound up with one of the best jobs at Boeing," he says.



Bill Jaconetti is described by F-15 chief test pilot Joe Felock as a "flight-test engineer extraordinaire." From the control room on the flight ramp in St. Louis, Jaconetti and his team routinely pushed aircraft to their limits.

Madelene Vega: Flight-testing the big bird

Edwards Air Force Base sits in the baking Mojave Desert in Southern California.

However, it is paradise for pilots and flight test engineers.

Named after Capt. Glen Edwards, a young U.S. Air Force pilot who died aboard the YB-49 jet-powered flying wing in 1948, Edwards occupies 44 square miles and contains two powdery lake beds, ideal for emergency landings.

It was at Edwards that Chuck Yeager broke the sound barrier in the X-1, and where every Air Force test vehicle from the SR-71 Blackbird to the F-22 Raptor is put through its paces.

"I knew when I was five years old in Puerto Rico that I wanted to fly," says Madelene Vega, a flight engineer on the C-17 program at Edwards Air Force Base in Southern California. "I knew how to fly a plane before I knew how to drive a car."

Today it's where the space shuttle sometimes lands and where stealth aircraft climb into the sky. It's also where F-15s can be seen doing hairy "tail slides" – climbing vertically until running out of airspeed then dropping backwards, momentarily out of control.

And it's where Boeing flight test engineer and test conductor Madelene Vega dons her Boeing-blue flight suit several times a week to board a C-17 Globemaster III transport. She, a three-person flight crew (two pilots and a loadmaster) and sometimes a few supporting engineers, then take off for four-hour missions that usually take them over Edwards air space, Long Beach, Calif., and the Pacific Ocean.

"Every flight is different," says Vega. An accomplished engineer fluent in Italian, Spanish, and Portuguese, she has worked on flight-test projects in Italy, Germany and Brazil for three aerospace companies. Sometimes she flies on the C-17 to Charleston Air Force Base, S.C., where the team practices assault landings. "We are in effect pioneers, testing an aircraft for the first time," she says. "It's very exciting."

But it's also hard work, and there's not much time to enjoy the ride. Vega's responsibilities include monitoring test parameters, acting as cockpit safety monitor, communicating necessary information to the flight crew and, most important, documenting the test results.

"My job is to keep the flow of the mission going," she says. "I make decisions about the order of each test. The C-17 is an amazing, very complex airplane with constantly changing flight control laws. You have to remain focused all the time. It's challenging." Nevertheless, there is camaraderie among the onboard team. "I learn so much from my crews and supporting fliers," says Vega.

Edwards is where Madelene Vega dons her Boeing-blue flight suit several times a week to board a C-17 for exhaustive flight tests.

Before each flight, she plans the mission, drawing up test-profile sequencing that will take the aircraft to its limits. She creates the flight cards, which detail the parameters of each test and serve as a guide to the flight crew. She conducts aircrew briefings and debriefings. She also has to interpret and define test requirements according to military air vehicle specifications.

"I knew when I was five years old in Puerto Rico that I wanted to fly," she says. "Science fiction in general and particularly the movie 'Star Wars' had a strong effect on me. I used to pretend that I could fly to the moon when I was a kid. My dad was an engineer. I was always asking him questions like, 'Why is a fire truck red?' (Answer: In the 1930s, when most cars were black, red stood out.) I was hooked when my parents gave me flying lessons for my 16th birthday. I learned how to fly an airplane before I learned how to drive a car."

Since then, Vega has developed a pedigree career history. She was an engineer at McDonnell Douglas in Long Beach for more than 10 years, working her way through every commercial airplane program at the company. Then, after three years overseas, she returned to Boeing and the C-17.

"You have to love airplanes to do this job," she says. "I never take this for granted. I want to continue expanding my knowledge of aircraft systems and testing. I'm doing something that not many people get to do. It's my life."

continued on page 8

Ralph Chaffin sometimes flies twice a day. No two airplanes are the same, he says. Each customer requires a slightly different configuration.

continued from page 7

Ralph Chaffin: One of Boeing Field's best

As he walks across the crowded tarmac at Boeing Field, Seattle, veteran flight engineer Ralph Chaffin almost always gets a wave and a smile from pilots, air crews, production engineers, maintenance folks, mechanics – and, most importantly, from Boeing's airline customers.

Today, he'll be doing an exhaustive preflight check on a 737. Then he'll join the crew to fly out over the Pacific Ocean, back over Washington, do a touch-and-go at Moses Lake, Wash., and head back to Boeing Field.

The vehicle could just as easily be a widebody, or in a couple of years, a 787 Dreamliner. He's qualified to coordinate flying quality tests for all new-production 737 Next Generation (-600/-700/-800/-900ER) models, 747-400, 767 and 777 airplanes. When he disembarks from a test flight, he receives the same warm reception.

"When you've been doing this for a while, you develop a bond with the people you work with," says Chaffin, flight engineer and systems operator for Production Flight Test at Boeing Commercial Airplanes. "We work closely together as a team. Over time, you develop trust." But trust, he cautions, is something you have to earn.

A strong aircraft systems background is clearly essential for a flight test professional, he says. And Chaffin certainly knows his airplanes. He has flown in every conceivable variation of commercial jets, tankers, trainers and transports since the 1970s for Boeing, other aerospace companies, and the U.S. Navy. He supported the E-3/AWACS aircraft flight testing and accumulated more than 6,000 hours as a C-130 flight engineer and TA-4J/US-2B military flight crew member in the navy. He not only has a degree in professional aeronautics; he's a licensed FAA turbojet flight engineer and an FAA airframe and powerplant mechanic.

He says that communication, flexibility and stamina are perhaps the essential qualities for a person in his job.

"You have to be absolutely precise and clear when you are describing a condition to a pilot or another team member," he says. "You have to be able to adapt to rapidly developing situations. You must be prepared to fly at any time. During a flight test, you must be able to perform what we call 'crew resource management.' That means that you have to know exactly what to tell the crew and when. It calls for some swift decisions. What do the wrong numbers for the engine or the pressure controller mean? And do I need to tell the crew about them?"

The captain, he says, will almost always be concerned with the flying qualities of the airplane. The first officer concentrates on communications and navigation. The systems officer monitors the electrical, hydraulic and pneumatic systems.

"There's so much going on during a flight test that to the casual observer it might look like chaos," he says. "I prefer to think of it as a choreographed dance, with each move having a purpose. But as the coordinator, you have to see through the clutter and establish some priorities."

He and other system operators/flight engineers at BCA actually have a dual role. On the ground, they conduct detailed first-flight preflight tests. They do start, taxi and post-flight evaluation of all aircraft. But they also do in-flight checks on all production aircraft, sitting upfront in the observer seat between the pilot and co-pilot. That sometimes means flying twice a day. They are in essence serving as flight systems officers. Flight engineers regularly flew as members of regular flight deck crews before the computerized systems of modern airplanes reduced the number of people needed in the cockpit from three to two.

"We probably flight-test 35 planes a month," says Chaffin. "Every one of them is slightly different from the other. Each customer has a different configuration."

No matter what the challenges, Chaffin considers himself blessed. "I look forward to every single day at work," he says. "It's fantastic, and I never get tired of it. How many people get to do the job they dreamed of doing as children?"

David Milanes: Piloting from the ground

There's quite a gale blowing at the Southern California Logistics Airport, a former U.S. Air Force base in Victorville, Calif., which is home of the A160 Hummingbird UAV flight test program. Located in the Mojave Desert, 2,875 feet above sea level and 95 miles north of Los Angeles, Victorville is often buf-

feted by blustery weather. The prevailing winds, blowing in from the Pacific Ocean to the south, normally keep the air free of smog.

Today, the wind is gusting to 30 mph, not enough to cause a ground test cancellation. But it's enough to make the A160 flight test team slightly relieved that A160 aircraft A001RB is not scheduled to go up. The aircraft is tethered to the flight ramp, where it will undergo only ground tests.

Dave Milanes, lead aircraft test engineer and ground-based pilot for the autonomous helicopter, is inside the ground control station. He and two members of his ground-test team, Andrew Abramson, an electrical engineer, and Matt Theis, an aerospace engineer, are busy looking at incoming data from the A160, which has its engine running. Abramson is checking voltage levels of the electrical system and vibration data. Theis is monitoring the overall health of the aircraft and comparing trends with previous tests.

"We were essentially making sure that it was safe to fly," says Milanes. "But we were also testing a new engine controller that we had been working on."

> "When things arise you have to make very quick decisions and they have to be right."
> – David Milanes.

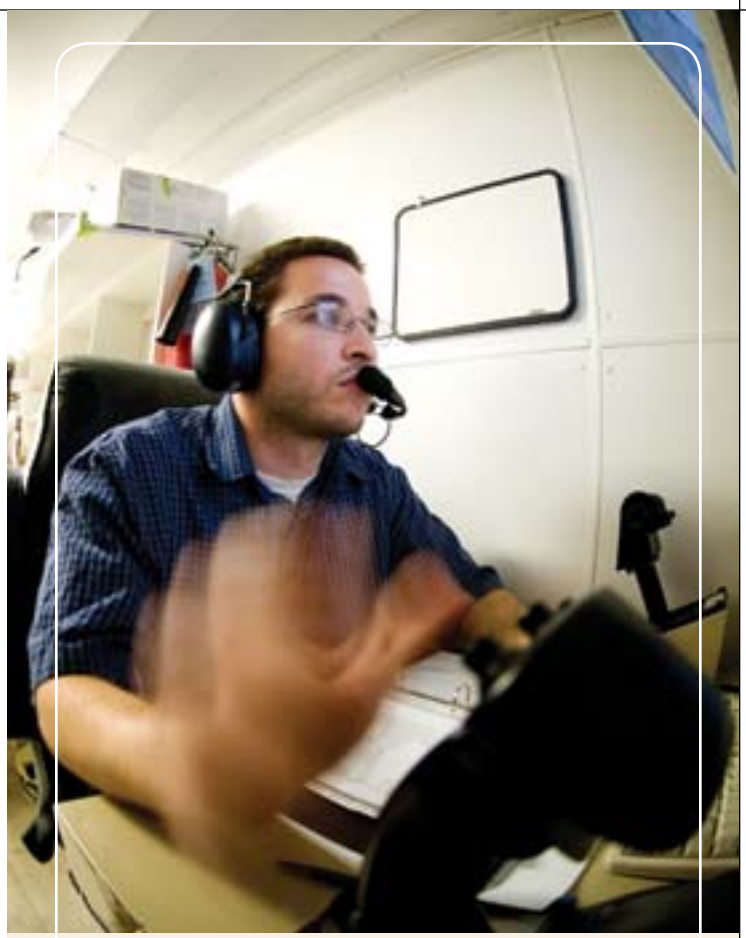
Boeing Advanced Systems is developing the A160 under a contract with the Defense Advanced Research Projects Agency (DARPA). Development, manufacturing and assembly of the A160 takes place at the Boeing Concept Exploration facility in Irvine, Calif. The aircraft is designed to fly with endurance up to 20 hours, longer than any other unmanned helicopter. It can fly at an estimated top speed of 140 knots at ceilings up to 30,000 feet, with a high hover capability up to 15,000 feet. Intended missions for A160 include reconnaissance, surveillance, target acquisition, communications relay, and precision resupply.

The computer control stations on the ground are where a pilot and a co-pilot monitor the aircraft's autonomous flight and can step in to give certain directions to the vehicle's onboard computer. In fact, the first flight of A001RB – the 5th A160 built to date – will probably be flown by Mary Jayne Adriaans, the A160 test director, who is responsible for all A160s in test. During the actual flight, a video camera mounted on the front of the aircraft will give the team a pilot's-eye view from the helicopter.

"It's not like flying a radio-controlled model airplane," Milanes explains. "The A160 is piloted by its computer, which we program in advance. When we use the stick, we are telling the flight computer how fast to make the aircraft fly, how fast to spin the rotor, and other such commands. It would be a little like a passenger aboard a regular helicopter instructing the pilot to fly at 80 knots, say, or to slow down to 20 knots. But in an emergency, there are actions we can take to bring the aircraft safely to ground."

What kind of engineer does it take to manage the testing of such a vehicle?

"You have to know the system inside and out," says Milanes, an MIT graduate with a degree in aeronautics and astronautics. He took the job straight from college in August 2003.



A160 flight-test engineer David Milanes conducts a ground test for A001RB – the 5th A160 built to date – from a control station in Victorville, Calif., home of the A160 flight-test program.

"When things arise, you have to make very quick decisions, and they have to be right. If you make the wrong decision, it can have dire consequences. This is not like driving a car that you can just stop in the middle of the road. You have to be able to think ahead, anticipate what can go wrong, and be ready to take the appropriate action."

Milanes always knew he wanted to be in aerospace. But it was an MIT recruiting flier for a job opening at Frontier Systems Inc., the original developers of the A160, that caught his eye.

"This is a special class of aerospace," he says. "I wouldn't have been here if I hadn't seen the flyer and applied for the job. It's exciting. You are on the cutting edge of a technology that one day will be operating in the field. This is not your everyday job. It's enjoyable; it's very easy to be highly motivated. It's fun working on the ship, and it's fun being surrounded by great co-workers." ■