THE PULSE

Online travel planning is booming in Europe as in America. The market for bookings is expected to triple between 2000 and 2002 to $10.9 billion. Airlines control the largest stake: 28 percent of the industry.

SOURCE: PHOCUSWRIGHT

The Dragonfly Suit

Supersonic fighters exert powerful gravitational forces that can cause pilots to black out. Now a breakthrough in protective gear may be at hand.

BY CHRISTOPHER DICKEY AND STEFAN THEIL

AMERICAN F-16 FIGHTER planes and Soviet-built MiG-29s will scream through the skies of Nevada next month in a furious series of supersonic dogfights. It won't be the first time. In previous Red Flag exercises in the skies above Nellis Air Force Base, America's top guns have almost always had the technological edge. This time when the planes go into the wild high-speed twists and turns of close combat, things may be different. It's not that the MiGs have gotten better, or that the German Luftwaffe pilots who will be flying them are any more skilled than the Americans. The difference will be purely sartorial: the German pilots will be wearing better outfits.

"It's like magic," says one envious American pilot who's tested the new suits. They could also be, quite literally, lifesavers. Pilots say they are better than traditional gear in counteracting the dangerous gravitational forces that handicap them in supersonic combat and sometimes cause them to black out during training. But bureaucratic forces could keep NATO pilots from getting them. The problem: the new suits were developed by a Swiss inventor. They are also radically different from technology in which the Pentagon and Europe's military bureaucracies have invested hundreds of millions of dollars. Will powerful NATO air forces opt for a Swiss solution to the vexing problem of gravity's effects on the pilots' bodies?

Humans are an aircraft's most fragile component. As a plane plunges and rolls, passengers feel a sudden multiplication of gravity, or G's, from the centrifugal forces. It's like a neck-snapping theme-park ride. But the most rip-roaring state-of-the-art roller coaster ever made, generating maybe twice the force of normal gravity, never comes close to what riding a fighter plane feels like. The dangers posed by high-G forces first became evident in the 1930s with the development of the Germans' Stuka dive bomber, and the effects have become more pronounced and dangerous with every new generation of faster, more agile hardware. As a plane maneuvers at high speed, banking into tight turns, centrifugal force causes blood to flow from the pilot's brain to his seat and feet, and he blacks out. The condition is called G-LOC (for gravity-induced loss of consciousness). If the G's rise fairly slowly, say half a G per second, the symptoms come on slowly and predictably: impaired vision, then blackout at about four G's. After recovery, the pilot often feels euphoric and disoriented for a while. If he's lucky, the blackout is temporary. If not, he's dead. In the newest generation of combat aircraft, the G's multiply so fast there's no time for warning symptoms. When American F-22s or Eurofighters maneuver as radically as they were designed to do, they can generate 10 G's—10 times the Earth's gravitational pull—in about half a second.

What's to protect the pilot against the tremendous force of ultramodern fighters? An "anti-G suit" that hasn't changed much

The new suits, like the old (left), aim to prevent G-LOC

FROM TOP: NO CREDIT; CORBIS BETTMANN

since World War II. When the G's begin to build, an elaborate system of pneumatic valves and pumps fills the pilot's suit with air, squeezing his lower body enough to keep the blood up in his head. In films of these suits in action, pilots look as if they're being crushed by rubber bladders. "Flying in a normal suit is painful," says Luftwaffe Maj. Georg Pepperl. To illustrate, he holds out his forearms to show dozens of swellings where the old suits have ruptured his blood vessels. "G measles," he says.

Modern high-performance craft also have special breathing masks that pump pressurized air into a pilot's lungs. These require the pilot to follow an arduous breathing routine called an Anti-Gravity-Strain Maneuver, or AGSM. "You have to stay on top of it," says Col. Hank Morrow of the Texas Air National Guard, who has been flying F-16s for 19 years. "You have to grunt and breathe and strain." The experience is exhausting for the flier. Combat efficiency drops off dramatically because he has to endure both the G's and the G suit. It becomes difficult to control the craft and virtually impossible to talk. Worse, these conventional pneumatic suits only barely keep up with rapid build-up of G's. Over the last two decades, several F-16 crashes and near crashes have been attributed to G-LOC. The Pentagon usually faults the pilots for failing to perform their AGSM properly.

Andreas Reinhard, a 45-year-old former pilot in the Swiss Air Force, has spent 13 years and millions of dollars in venture capital developing a G suit that operates in a completely different way. He calls it the Libelle, the German word for dragonfly, because it's based on the same principles that protect a dragonfly's innards from the 30-G accelerations the insect generates in flight. A dragonfly's vital organs are encased in liquid. When blood rushes to one side of its body, so does the liquid, providing a counterpressure. Even in the days of the Stuka, engineers realized that a pilot immersed in liquid like a baby in a womb would be well protected, if only there were a way to do it. There wasn't. The practical problems of this proto-fetal approach seemed insurmountable. Pneumatics won the day.

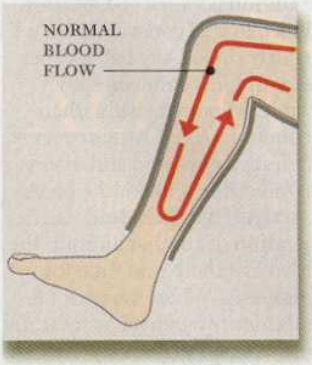
Reinhard had the idea of using newly developed fibers and fabrics to achieve the same effect as shifting liquid, but without having to encase the pilot in a womb. Using himself as a test pilot, he sloshed around in a rubber suit filled with 6.5 gallons of water. Over the years his prototypes grew more refined. The latest contains one third of a gallon in sealed tubes that run from neck to ankle. In practice it doesn't look much different from the normal cloth jumpsuits military pilots wear in helicopters and other low-performance aircraft. But as the G's mount, water in the Libelle rushes to the seat and ankles, swelling the tubes there and pulling the nonstretch fabric taut. There is no connection to any machinery or computers in the plane.

Last month 10 officers from the Luftwaffe's 73d Fighter Wing who will be flying the MiGs at Nellis began training in the suit in Europe's most sophisticated centrifuge, at Königsbrück Air Medical Institute near Dresden. "Under the strain of high G's, the pilot wins who can stand the strain the longest," says Major Pepperl. Military pilots aren't known for their gushing enthusiasm, but Pepperl was frankly amazed by his first experience with the Libelle. "With the new suit you can go for a longer time," he says. "It's like sex with Viagra." Capt. Swen Jacob simulated a dogfight in the centrifuge, chasing an American F-16 on a computer monitor inside a tiny cockpit that spun wildly around with each simulated turn, all the while whirling in a high-velocity circle. On a video in the control room, doctors and officers watched as the gravitational pull got higher and higher, drawing the skin down the face of the 32-year-old pilot as if he'd instantly aged 50 years. At 8.5 G, long past the point where an unprotected pilot would pass out, he was still talking freely to the officers, as if he were taking a spin in a Cessna. His pulse showed none of the extreme peaks the centrifuge operators were used to seeing.

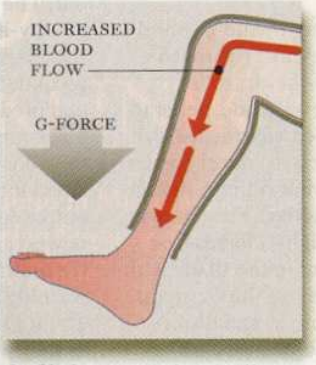
Colonel Morrow was part of an American team testing the Libelle at Virginia's Edwards Air Force Base last summer. In

Fighting the Big G

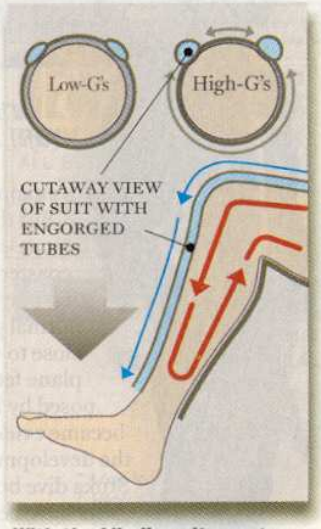
A pilot needs to withstand high gravitational or G-force to maneuver supersonic fighter planes. How the Libelle suit helps:



In normal gravity (1 G), blood flows evenly. But as the pilot performs high-speed maneuvers, he is subjected to eight to 10 G's.



As G's increase, they pull blood toward the pilot's feet, causing him to become lightheaded and eventually black out



With the Libelle suit, gravity pulls water down through the tubes, expanding them and constricting the fabric. Blood can't rush to the feet.

SOURCE: AUTOFLUG LIBELLE. GRAPHIC BY TOM LYNN. RESEARCH AND TEXT BY BRETT TAYLOR—NEWSWEEK

case the Libelle didn't work, a backup pilot in a standard-issue pneumatic G suit rode in the same plane. As it turned out, he was the one who suffered. "I took off, up to about 15,000 to 20,000 feet, and started doing nine-G turns to the bottom of the area," Morrow remembers. "The poor guy in the back seat was about to die." Another bonus: because the suit isn't hooked up to compressors, the equipment can be removed, making the planes lighter and still more agile.

After glowing reports from its medical institute and the pilots' evaluations, the Luftwaffe is expected to approve the Libelle for use in solo flights as soon as this month, which means it would be ready to roll for the MiGs in Red Flag. Reinhard's people are racing to put final touches on the tailoring, like the pockets and penholders pilots say they need.

But the real challenge ahead may well be politics and bureaucracy. The big market for the Libelle is equipping pilots for the hundreds of new top-of-the- line Eurofighters soon to be rolled out. British Aerospace, which has authority over pilots' equipment, would have to hand over the contract to Reinhard's high-tech tailors. So enthusiastic is the Luftwaffe that it has said it wants to switch equipment if further tests, including Red Flag, are successful. Members of the four-nation consortium that is building the Eurofighter, including British military officials, will meet at Königsbrück in June to watch more wild rides on the centrifuge.

The United States is interested as well, especially after last year's tests at Edwards. But Reinhard's company estimates the Pentagon has spent at least $100 million so far developing Combat Edge, a pneumatic system that is supposed to be able to handle up to 10 G's. The U.S. Air Force has scheduled a formal evaluation for the third quarter of this year. What does all this mean to the taxpayer? Reinhard won't say how much each suit will cost. Even though Libelles are relatively cheap to make (no electronics, no pneumatic equipment, no microprocessors required), he's got 13 years of private funding to pay back. So each Libelle will probably cost many tens of thousands of dollars. To the pilots who've used it, there's little question that it's worth the price. "After I flew in it," says Morrow, "I said [to Reinhard], 'I'd like to give you a check for one, so I can take it back with me'." Reinhard just smiled and put the suit back in its tightly secured case, guarding it like the secret weapon it is. ■

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