

PROFESSIONAL PILOT

OUR
45th
YEAR

SEPTEMBER 2011

PHI and ADS-B in the Gulf

One of the world's largest offshore oil industry and EMS operators, PHI flies a wide variety of helicopters and is a major user of ADS-B. Senior personnel shown with Sikorsky S76C++ and S92 at LFT (Lafayette LA) are (L-R) Dir Avionics Rickey Labit, Dir Mx Tony Gonzalez, Dir Ops Pat Attaway, Chief Pilot Mike Hurst, Check Airman Rich Roy, Line Training Capt & Line Pilot Garry Lee with ADS-B equipment.

PHI

Powerplant Support



Long-range bizjets

Choices are many and prices are high—and with ranges that cover the planet, body clocks take time to recover.

By Mike Venables
Contributing Writer

Dassault Falcon 7X is an example of the growing category of bizjets with 5000-nm-plus range. Flight durations can exceed 12 hrs, causing significant disruption to circadian rhythms.

Scaled Composites' GlobalFlyer was a very long-range aircraft indeed with its distance record of 22,390 nm. The record was claimed in 2006 following a flight that started at Kennedy Space Center in Florida and ended at BOH (Bournemouth, England) after circling the globe and crossing the Atlantic twice.

GlobalFlyer was not designed to be fast—the flight averaged a groundspeed of 291 kts including tailwinds—although the endurance of both the aircraft and the pilot, Steve Fossett, at 76 hrs 45 min, was impressive. However, the payload capacity (other than fuel) was meager and creature comforts were nonexistent. The flight landed with 200 lbs of fuel remaining. Hardly NBAA reserves!

While it is a challenge to create an ultralong-range aircraft, it is an even greater challenge to create a long-range aircraft that will fly a long distance at a reasonable speed with an acceptable payload. A number of long-range business jets are on the market and more are coming. Establishing an arbitrary minimum range of 5000 nm, a recent survey of business aircraft

revealed the qualifiers shown in the table on this page. As can be seen, while the speeds and payloads are acceptable, the durations start at slightly less than 12 hrs and top out at over 16!

Human factors

As difficult as it is to design and build these aircraft, it is far more difficult (read "impossible") to design and create a long-range pilot. Despite the public perception of the steely-eyed jet pilot, we are all subject to fatigue and the influence of

our circadian rhythms. A circadian rhythm is an internally driven cycle, of roughly 24 hrs, in biochemical, physiological or behavioral processes. Circadian rhythms have been widely observed in plants, animals, fungi and some bacteria. Although circadian rhythms are built-in and self-sustained, they are adjusted to the environment by external cues called zeitgebers (from the German for "time giver" or "synchronizer"), of which the primary one is daylight. Other zeitgebers are temperature, social interactions, exercise and eating/drinking patterns.

Long-range business aircraft

Aircraft	Range (nm)	Av speed (kts)	Duration	FBW	EIS
Global 5000	5381	463	11 hrs 37 min	No	In svc
Falcon 7X	5655	454	12 hrs 27 min	Yes	In svc
Gulfstream G500	5788	453	12 hrs 47 min	No	In svc
Global Express XRS/Global 6000	6111	464	13 hrs 10 min	No	In svc
ACJ319	6000	442	13 hrs 53 min	Yes	In svc
BBJ	6229	442	14 hrs 06 min	No	In svc
Gulfstream G650*	7000	488	14 hrs 21 min	Yes	2012
Gulfstream G550	6698	454	14 hrs 45 min	No	In svc
Global 7000*	7300	488	14 hrs 58 min	Not ann	2016
Global 8000*	7900	488	16 hrs 11 min	Not ann	2017

*Preliminary

According to Bombardier Chief Pilot (Widebody Aircraft) Yann Lemason, his demo flight department policy requires a 3rd pilot if the duty day exceeds 16 hrs (about a 12-hr flight).

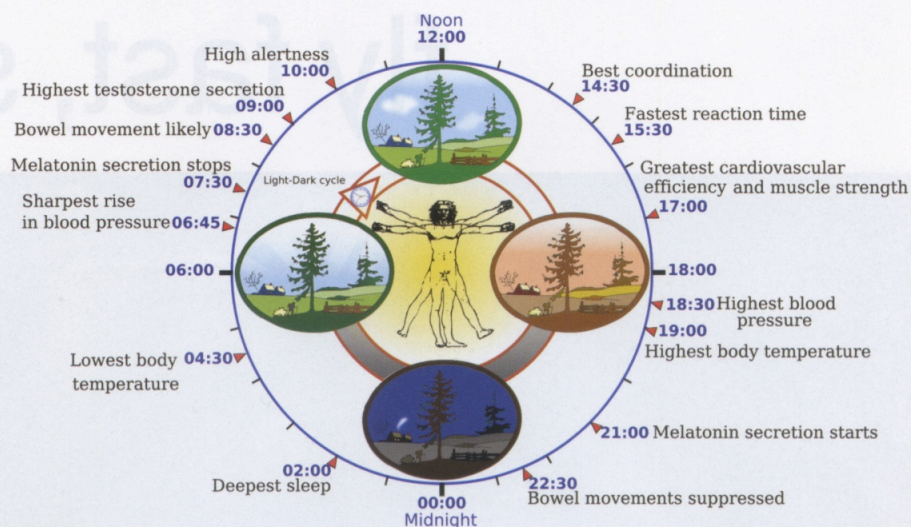
Let's assume that such a flight stayed in the same time zone (say from Atlantic Canada to Chile). If we refer to the figure on this page, we can see that secretion of melatonin (the sleep-inducing compound) stops at 7:30 am, making an 8:30 am departure reasonable. This results in an arrival at 8:30 pm—also reasonable. The problem is that, if the flight extends beyond 9:00 pm, melatonin secretion starts again. The crew will be starting the approach as their bodies are getting ready for sleep. Hence the logic to adding the 3rd pilot on longer flights. The pilots can take a rest in rotation so that at least 2 of the 3 pilots are rested—or should be—for the final phase of the flight.

Unfortunately, most flights do not stay in a single time zone, nor do they leave at 8:30 am for an evening arrival (a daytime flight). An 8:00 pm departure from New York results in an 11:00 pm arrival in Taipei, Taiwan (15 hrs at Mach 0.85). Maintaining crew alertness throughout the very long night flight means minimizing the impact of the normal circadian rhythm.

Crew self-help actions

Pilots can do some things to help themselves when it comes to minimizing the effects of these rapid time zone crossings. These include eating lightly and keeping hydrated throughout the flight. On shorter flights, catnaps of 20–40 min—a “NASA snooze”—can revitalize a fatigued brain. Getting out of the cockpit for a walk helps to reinvigorate blood circulation, key to restoring clear thinking—one of the *zeitgebers*.

Yann reports that Bombardier Demo Flight Ops also has a policy of running continuous system reviews and examining “what if?” scenarios to keep the pilots engaged and alert. Electronic flight bags—both Class 2 types and iPads—provide easy access to documentation for these reviews. Prior to flight, a variety of software tools are also available to aid scheduling to reduce fatigue.



Circadian rhythm affects all our bodily functions (including brain function) throughout the day.

Crew rest area

As most, if not all, of these long-range aircraft have custom interiors, owners can contribute significantly to reduction of fatigue effects by adding a crew rest compartment. It must be isolated from the rest of the cabin so that the resting crewmember can sleep soundly. This means that it must be soundproof or remote from high-activity areas. It should allow the occupant to eliminate light (100% effective windowshades and no cracks around the door) and to control the temperature independently of the rest of the aircraft, as cooler temperatures are required for deep sleep—another *zeitgeber*. Needless to say, it must have a lie-flat bed.

While an appropriate crew rest area takes away from space that would otherwise be available to the owner and his/her fellow passengers, these features create an environment that leads to a more refreshed crew and should therefore be seen as safety features. As mentioned above, good hydration is vital. Therefore, a lavatory that the crew can access without disturbing the passengers is also a godsend as it allows free access at any time, regardless of what the passengers are doing. Placing the flight attendant station and galley close to the flightdeck further enhances fatigue-busting interaction.

Cockpit design features

Aircraft manufacturers themselves play the biggest part in creating an environment that battles fatigue. To start with, the flightdeck should be roomy and easy to enter and exit, since cramped quarters stimulate the release of body chemicals that only exacerbate fatigue. Yann notes that careful design can assist by creating the illusion of even more room. (See photo on p 68.)

To the greatest extent possible the flightdeck should be isolated from noise and vibration, since even the most comfortable headset becomes a source of irritation on very long flights. There should be good circulation to keep the air fresh without drafts and hot or cold spots.

Reclining pilot seats enhance the effectiveness of NASA snoozes. For a long-range aircraft the jump seat requires additional consideration. It should be comfortable and allow the 3rd pilot to sit either between the first 2 pilots (normal location) or off-center so that the other pilots can enter or exit without the 3rd pilot having to get up.

According to Airbus Corporate Jets Marketing Dir David Velupillai, fly-by-wire systems help to reduce fatigue by increasing the aircraft's stability, while advanced navigation and autopilot systems, such as autoland, reduce the pilot workload further, particularly at the end of a long flight. Runway overrun protection (ROPS) is another help-



Bombardier Global 7000/8000 cockpit concept, already roomy, uses design elements to create the illusion of even more space.

ful tool to reduce stress and workload. Airbus has decided to make its patented ROPS available to all aircraft manufacturers.

Display and area lighting flicker can induce distracting headaches. Bright area lighting can reduce fatigue during the period that the body considers to be the “wee” hours by fooling it into wakefulness—another zeitgeber.

According to Gulfstream Senior Mgr Social Media and External Communications Heidi Fedak, the company spent a lot of time ensuring that its PlaneView display system was uncluttered with a streamlined color palette to minimize distractions.

Boeing Business Jets (BBJ) Pres Steve Taylor, a long-time pilot, says, “In my experience, the thing that is most helpful to crews flying ultra-long-range missions is simple, intuitive systems. [What] crews really need are airplanes that do what you expect them to do. A fatigued crew has a much more difficult time dealing with ‘What’s it doing now?’ issues than a fresh crew does.” At BBJ, says Taylor, “We have a philosophy that gee-whiz items really have to earn their way onto our flightdeck because new technology can occasionally add complexity.”

A number of pilots have commented on the ability of SVS and/or EVS to ease terminal area operations at an unfamiliar destination. Some larger metropolitan areas have marginal visibilities even on the best days. In addition, EVS provides operational credit, reducing the chances of a diversion—a stressful situation that will further extend the duty day.

Cabin design features

A lower cabin altitude can reduce fatigue and other borderline hypoxia symptoms such as distracting headaches and night vision degrada-

tion. Most purpose-built bizjets can maintain a sea-level cabin up to 30,000 or 31,000 ft. This translates to low cabin altitudes all the way up to FL510, which allows more direct, and therefore less stressful, routings. While the bizliners can’t maintain the equivalent pressure differentials, their lower ceilings (FL410) also yield fairly low cabin altitudes. Maintaining good cabin humidity also reduces stress on the occupants.

All existing and planned long-range business jets offer enough space to build at least a 3-zone cabin. With proper dividers, this provides those who want to rest with adequate isolation so that the others won’t disturb them. For those who want to work or be entertained, technology advances continue to improve the connectivity options. In-seat displays allow a variety of activities without one person imposing their choices on those nearby.

Light and environmental control are important for the passengers, too. Those who want to work or play need adequate light while those who want to rest need the dark and cooler temperatures so individual lighting and multizone climate controls are a must. Improved sound and vibration isolation further reduce fatigue.

According to Bombardier Senior Customer Care Coordinator Debra Francz, the task of helping the passengers with all the technology falls on the flight attendant. He or she must be able to help passengers with the multifunctional seats, the cabin management system, the entertainment system and the connectivity systems. This includes knowing how to connect a BlackBerry or an iPhone to the onboard network and how to work the available medical monitoring systems in an emergency.

While most of these systems are not unique to long-range aircraft, they are more critical on longer flights, particularly in those areas where the local infrastructure is not compatible with the home-based systems. Given the increased workload on these long flights, some operators are adding a 2nd flight attendant.

Preparation

Reducing fatigue is a responsibility shared by crews, scheduling departments, owners and manufacturers. The pilots and flight attendants must prepare themselves for individual flights by getting a good rest prior to departure and staying hydrated during the flight. They should be taking strolls through the cabin, engaging in regular tasks with their crewmates and resting.

While there are many common factors and guidelines, individuals have their own variations and each person should learn how best to prepare for long flights at unusual departure times. Flight departments should take circadian rhythms into account when scheduling flights and use a software tool to avoid times of maximum fatigue. Adequate time should be allowed for rest prior to the return flight or a relief crew should be prepositioned to take over.

Further, the human side needs to be considered, since separation from family and familiar surroundings adds to the stress of the actual trip. Owners need to provide proper crew rest facilities as well as systems to allow the passengers to rest effectively. The entire cabin layout should support these goals, too.

Finally, aircraft manufacturers must design these aircraft carefully from nose to tail to minimize fatigue and maximize crew efficiency. The well-known slogan could be adapted to read, “The best safety device in any aircraft is a well rested crew.” ✈



Mike Venables is an aviation consultant and freelance writer. The principal at TriLink Technologies Group, Venables has been involved in the aerospace industry

for more than 40 years, including aero engine, airframe, avionics and simulator manufacturers.