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Safety

A Corporate Safety Publication

Down & out

Rapid Descent

Wrong Direction

Deadly Omissions

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Contents

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Midair over the Amazon

By Mark Lacagnina

Controversial Brazilian report cites loss of situational awareness by pilots and controllers.

The airplanes converged nearly head-on, striking their left wings first. The business jet lost most of its left winglet and the tips of the left horizontal stabilizer and elevator, but it remained controllable and was landed without injury to the seven people aboard. The airliner initially lost about a third of its wing and then broke up during a spiral dive into the Amazon rain forest; all 148 passengers and six crewmembers were killed.

The 282-page final report by the Brazilian Aeronautical Accident Inverstigation and Prevention Center – the Centro de Investigacao e Prevencao de Acidentes Aeronautcos (CENIPA) – concludes that loss of situational awareness by the Embraer Legacy 600 pilots and by the air traffic controllers handling the flights were among several factors that led to the business jet proceeding out of radar and radio contact — and with a nonfunctioning transponder and traffic collision avoidance system (TCAS) — at a flight level that placed it in conflict with the Boeing 737-800.

The report's findings and conclusions have been questioned by organizations that include the U.S. National Transportation Safety Board (NTSB), a party to the investigation. NTSB said, for example, that although the report acknowledges air traffic control (ATC) safety deficiencies, it does not provide sufficient analysis of the deficiencies or include them in conclusions about the cause of the accident.

The collision occurred in visual meteorological conditions at Flight Level (FL) 370 (approximately 37,000 ft) the evening of Sept. 29, 2006. Both airplanes were nearly brand-new. The Legacy, N600XL, had been purchased by ExcelAire Services, a U.S.-based charter and aircraft management company, and was en route from the Embraer factory at Sao Jose dos Campos to Fort Lauderdale, Florida, U.S., with an overnight technical stop at Manaus, Brazil. The 737, PR-GTD, had entered service with Gol Transportes Aereos the month before the accident and was on a scheduled flight from Manaus to Rio de Janeiro, with a technical stop at Brasilia.

Partial Clearance

The report said that because of their haste to de-part — to avoid flying over the Amazon at night—the Legacy flight crew did not have adequate knowledge of the flight plan that had been prepared for them by Embraer personnel.

been prepared for them by Embraer personnel. It also concluded that transmission of an incomplete departure clearance by the ground controller at the Sao Jose dos Campos airport "favored the understanding by the pilots that they had to maintain FL 370 all the way to Manaus."

The Brasilia Area Control Center (ACC) had given the ground controller a clearance that specified three flight levels: FL 370 on Airway UW2 to the Brasilia VHF omnidirectional radio (VOR), FL 360 from the VOR to an intersection on Airway UZ6, and FL 380 thereafter. When the ground controller relayed the clearance to the Legacy pilots, he included only the initial flight level, saying, in part, "clearance to Eduardo Gomes [the Manaus airport]. Flight Level three seven zero."

"As a result, the pilots understood that FL 370 was cleared up to Manaus," the report said. "In an interview ... the pilots of N600XL confirmed this understanding."

The Legacy departed at 1751 coordinated universal time (1451 local time). The airplane was on Airway UW2, which has a centerline track of 006 degrees, and 52 nm (96 km) south of the VOR about one hour later when it was handed off by the Brasilia ACC Sector 5 controller to the Sector 7 controller. The Sector 5 controller did not tell the Sector 7 controller or the pilots that a change from FL 370 to FL 360 was to be made before the airplane crossed the VOR and began navigating on the 335-degree centerline track of UZ6.

Noting that the Brasilia VOR is well within Sector 5 airspace, NTSB said that the hand-off was made "unusually early" and that it was the Sector 5 controller's responsibility to instruct the crew to descend to FL 360. "Alternatively, he should have either changed the data [shown on the ATC radar displays] to accurately reflect the clearance [i.e., the assigned altitude] or advised the Sector 7 controller of the actual clearance." The report said that the Sector 7 controller assumed that the crew already had been instructed to descend to FL 360 even though the copilot reported that they were maintaining FL 370 when they established radio communication with him. After the controller told the crew that the airplane was in radar contact and the copilot acknowledged the information, there was no further communication between the crew and ATC until after the collision.

'Bad System Design'

NTSB said that a change on the controllers radar display when the airplane neared the VOR at 1855 likely contributed to the controllers misunderstanding of the assigned flight level. The aircraft data blocks on Brazilian ATC radar displays show two flight levels, side by side and separated by a symbol. On the left is the Mode C flight level transmitted by the aircraft's transponder; next to it is the "cleared flight

All 154 people aboard the 737 were killed when the airplane broke upduring descent and crashed in the rain forest.

level" that has been issued, and entered in the data block, by a controller. Normally, the symbol "=" appears between the two flight levels. However, the cleared flight level automatically changes to the "requested flight level" about two minutes before the aircraft crosses a navigation fix at which a level change should be made. Thus, when the Legacy neared the Brasilia VOR, the flight level information displayed in its data block changed from "370=370" to "370=360." Nevertheless, the controller did not notice that the airplane was "flying at a flight level that was different from the flight level requested in the active flight plan," the report said.

Noting that the report did not fault the flight level display itself, NTSB said that "a design in which two distinctly different pieces of information — that is, requested altitude and cleared altitude — appear identical on the display is clearly a latent error." A similar opinion was expressed by the International Federation of Air Traffic Controllers' Associations, which called the flight-level-display feature "non-error-tolerant ... and a bad system design" that was not adequately addressed by the report.

Squawk Stopped

Seven minutes after the airplane crossed the VOR — its transponder stopped replying to ATC radar interrogations. The report said that neither the pilots nor the controller noticed this, and that cockpit voice recorder data indicated that the attention of both pilots was focused on conducting performance calculations for the landing and takeoff at Manaus. "With adequate planning, this task should "have been finished on the ground before departure," the report said, noting that the pilots had found after they were under way that the preflight paperwork assembled by Embraer included a notice to airmen about a reduction of the available runway length at the Manaus airport. Investigators were unable to determine conclusively how the transponder had been switched to the standby mode, which requires pressing the transponder/TCAS button — one of 12 buttons on the sides of a radio management unit (RMU) twice within 20 seconds. The report said that the most likely explanation is that the pilot inadvertently switched the transponder to standby while using other RMU features for the performance calculations.

Among other possibilities considered was that a laptop computer accidentally struck the transponder/TCAS button on one of the RMUs when it was passed between the pilots. However, it was determined that the control yoke would have prevented this.

Another possibility is that the button was accidentally struck when the pilot placed a foot on the footrest at the bottom of the panel. However, "the footrest has a metal plate, called a foot protector, designed to keep the foot away from delicate instruments which could be damaged if contacted inadvertently," the report said.

NTSB said that misuse of the footrest is another possibility. "In certain forward seat positions, there appeared [during observation flights] to be a very comfortable resting position that involved resting the feet on top of the footrest guards rather than inside the designated footrest areas," the board said. "This ... located the captains right foot in the area of the RMU so it could make unintended contact without the captains awareness."

Warnings Undetected

While briefing his relief controller at 1918, the Sector 7 controller said that the Legacy was maintaining FL 360. At this point, the flight level display in the data block would have changed from "370=360" to "370Z360," to indicate that the airplane was being tracked by primary radar with an altitude sweep. This system is intended to be used only for military aircraft in emergency or air-defense situations. However, the "Z" also is automatically displayed when a civil aircraft stops replying to radar interrogations.

"Although the system presented the prescribed indications for the loss of the N600XL transponder, they did not draw the attention of the controller to the need for changing the flight level," the report said. It also said that during the 57 minutes preceding the collision, the Legacy pilots failed to notice a transponder "STANDBY" indication on the RMUs and a "TCAS OFF" indication on the primary flight displays.

At 1926 — 34 minutes after the last radio communication — the Sector 7 relief controller made the first of seven calls to the Legacy, which had by then flown beyond the area covered by the last assigned radio frequency. The controllers calls were made simultaneously on six radio frequencies. However, NTSB said that he "never attempted to try a relay through other flight crews, the emergency frequency or any other means to treat the flight under lost-communication procedures.” The board said that the controller also failed to inform the Amazonic ACC, which was handling the 737, about the loss of radio and radar contact with the Legacy.

At 1948, the copilot began using the five Sector 7 frequencies shown on his navigation chart in an attempt to re-establish radio communication with ATC; he made 19 calls. However, only one of the frequencies shown on the chart actually was usable. Two of the frequencies had not been selected at the controllers console, one was erroneous, and one had not been “connected” to the center’s audio equipment, the report said.

The copilot heard part of the controllers last transmission at 1956. He requested that the controller repeat the message, but his call was not heard. The collision occurred one second later.

The Legacy rolled left and began to descend, but the crew was able to regain control. They used the emergency frequency, 121.5 MHz, to relay a message to Amazonic ACC through the crew of a Polar Air Cargo aircraft that they were declaring an emergency because of flight control difficulties and would conduct an emergency landing at the military airport in Cachimbo, about 100 nm (185 km) ahead.

“After landing, the N600XL crew reported that their airplane had collided in flight with an unknown object,” the report said. “The wreckage of the [737] was found the next day -. - in a region of thick forest in the county of Peixoto de Azevedo, Mato Grosso State.”

Misplaced Blame?

Among the reports conclusions was that the Legacy crew had not been trained adequately and had not prepared properly for the delivery flight, and that their limited experience with the airplane and its avionics equipment was a likely factor in the inadvertent deactivation of the transponder and TCAS.

NTSB said that the facts do not support these conclusions. “The crew flew the route precisely as cleared and complied with all ATC instructions,” it said. “Although the transponder outage was likely because of an inadvertent action, no evidence in the factual record indicates that a lack of familiarity with the avionics is related to the outage.”

The pilot, 42, had 9,388 flight hours, including 5.5 hours in the Legacy. The copilot, 34, had 6,400 flight hours, including 3.5 hours in type and nearly 400 flight hours as pilot-in-command of Embraer regional jets, which are similar to the Legacy.

‘Missed Opportunity’

The final report on the midair collision failed to provide ”clear conclusions” about known problems in the Brazilian air traffic control (ATC) system and how they contributed to the accident,: said a position statement issued in January by the International Federation of Air Traffic Controllers’ Associations (IFATCA).

“Whereas the inquiries in regard to the events in the cockpit of the Legacy private jet seem to .have received a lot of attention and were done with rather detailed care by CENIPA [the Brazilian Aeronautical Accident Investigation and Prevention Center], the same cannot be said for investigations on the ATC side,” said the federation, which represents more than 50,000 controllers in 130 countries.

For example, IFATCA noted a “non-error-tolerant” ATC software feature that occasionally changes the flight level shown on the controller’s radar display, with no input by the controller. The federation called this a “bad system design” that created a trap for the pilots and controllers involved in the collision. The accident report discusses this feature-but includes no recommendation about it.

“IFATCA thinks the identified shortcomings in the CENIPA report are a missed opportunity for the Brazilian aviation authorities to restore trust and safety in the national aviation system. This final accident report could have served as the starting point for an extensive and desperately needed healing process. ...This has unfortunately not occurred, as CENIPA—an integral part of the same Brazilian Air Force that is responsible, for the provision of air traffic control—-has chosen to put the main responsibility for the midair collision of 2006 on the front-line operator only. This CENIPA decision appears driven by a reluctance to expose staff and departments situated in its own organization.”

Brazilian investigators considered the possibility that the Legacy's transponder might have been deactivated when the captain's foot, when placed on the footrest shown by the arrow, inadvertently touched the radio management unit above and to the right of the footrest.

The report also concluded that the pilots were distracted by the performance calculations and lost situational awareness. "Although they were maintaining the last flight level authorized by [ATC], they spent almost an hour flying at a nonstandard flight level for the heading being flown and did not ask for any confirmation from ATC," it said.

The controllers were faulted for failing to provide proper traffic separation. "The air traffic control units involved ...did not correct the flight level and did not perform the prescribed procedures for altitude verification when they stopped receiving essential information from [the Legacy's] transponder," the report said. "The controllers assumed that the traffic was at a different flight level without even being in two-way radio contact with N600XL for confirmation."

NTSB said that its analysis of the facts led to the conclusion that the probable causes of the accident were "ATC clearances which directed [the pilots of both airplanes] to operate in opposite directions on the same airway at the same altitude. ... The loss of effective air traffic control [resulted from] a combination of numerous individual and institutional ATC factors which reflected systemic shortcomings."

A separate investigation was conducted by the Brazilian Federal Police and resulted in criminal charges against the Legacy pilots and several of the controllers.

Courtest FSF AeroSafety World

HUMOR

Some People Just Never Listen

ATC to Flight 123: "Slow to 300 knots please." After several moments, it was apparent the crew had not complied with the first speed reduction and was overtaking the plane ahead of them.

ATC to Flight 123: "Slow to 280 knots." This was soon followed by a request for 250 knots from ATC when the crew still had not slowed the airplane.

Finally, the now-frustrated controller ordered, "Gentlemen, the number is 250. Either slow to it or turn to it!"

DEADLY Omissions

Human memory fails in predictable patterns that can be avoided by paying close attention to SOPs when distractions occur.

By Alan dean & Shawn Pruchnicki

In August 1987, a McDonnell Douglas DC-9 flight crew taxiing to Runway 03C at Detroit Metropolitan Wayne County Airport (DTW) failed to conduct the taxi checklist.

Consequently, the flaps were never set for takeoff, causing the lift-deficient aircraft to crash immediately after takeoff. As a result, 156 souls perished when the aerodynamically stalled aircraft crashed in a parking lot just off the end of the runway.

Nearly 21 years later; in January 2008, a Bombardier CRJ200 crew committed that identical checklist omission at another major U.S. Midwest airport. However, instead of the omission culminating in a fatal accident, a "config flaps" aural warning sounded and the takeoff was safely aborted.

In the case of the DTW DC-9, the aural warning never sounded. And, although the reason for the failure of the warning system was never determined, it is important to understand that the system's failure is the only variable that separates the DC-9 crash from the CRJ aborted takeoff. Aside from this single difference, these two events are human factors equivalents of identical twins.

Alarmingly, these types of events may be more common than realized. Preliminary investigation of the August 2008 Spanair McDonnell Douglas MD-82 takeoff accident in Madrid, Spain, found that the aircraft's flaps were in the retracted position. A recent study of the U.S. National Aeronautics and Space Administration's Aviation Safety Reporting System data base revealed numerous reports of airline crews failing to properly configure flaps for takeoff. Seeking to understand the human factors commonalities of these types of incidents, we assembled summaries of the DC-9 and CRJ events.

Boarding of the DC-9 had been delayed by weather for nearly one hour. After passengers were boarded, the before starting engines checklist was accomplished and the aircraft departed from the gate. Ground control responded to the first officer's (FO's) taxi request with routing to a different runway than originally anticipated. The controller also advised the crew that the automatic terminal information service (ATIS) recording had been updated to include a warning that low-level wind shear advisories were in effect due to convective activity in the area.

As the captain (CA) initiated taxi, the FO obtained the new ATIS information and recalculated takeoff performance numbers. While the FO was "head down," visually focused inside the cockpit, the CA passed by an assigned taxiway. Ground control redirected them, and the taxi resumed with some miscellaneous conversation regarding the earlier weather delay. This delay was significant because the crew's next flight was to an airport with an arrival curfew.

Seven minutes after leaving the gate, the DC-9 crew cleared to taxi into position and hold on the runway. Although the CA failed to call for the before takeoff checklist, the FO verbalized all associated items prior to receiving a takeoff clearance. As the CA commenced the takeoff roll, the FO was initially unable to engage the autothrottle system. This issue was resolved as the aircraft rapidly approached 100 kt. Next, the cockpit voice recorder (CVR) captured the FO verbalizing "V1," then "rotate," closely following by the sounds of the stick shaker and subsequent ground impact.

The CRJ crew had completed the before taxi checklist after passenger boarding and requested permission to taxi. As the CA called "flaps 20, taxi checklist," he initiated a right turn as instructed by the controller but quickly realized that this would send them in the wrong direction. Stopping the aircraft, he interrupted the FO's checklist routine in order to seek clarification. Once that issue was resolved, they maneuvered along a congested ramp towered their assigned runway. As soon as they reached the runway, the tower controller cleared the crew for immediate takeoff. The line-up checklist was called for and the FO read it, concluding with, "Takeoff config okay…line-up check complete". Aircraft control was then transferred to the FO, who began advancing the thrust levers. The "config flaps" aural warning immediately sounded, and at approximately 30 kt the CA aborted the takeoff.

External Pressure

From the narratives, it is apparent that both crews experienced external pressures to expedite their departures. For the delayed DC-9s crew, it was an airport arrival curfew, while the CRI crew felt rushed when they were cleared for immediate takeoff.

Both crews likewise encountered distractions as soon as they departed from their gates. For the DC-9 crew, as the taxi began it became necessary to obtain updated ATIS information and confirm performance data for the unexpected runway change. The CRJ crew received erroneous taxi instructions which needed clarification. It is important to note that both crews' distractions came at the exact point when the flaps would normally be extended for takeoff according to the taxi checklist.

But to simply say these flights were plagued with errors resulting from rushing and distractions is too simplistic. Many more insidious threats were lurking on each flight deck; threats and human limitations which went untrapped — that is, undetected and unmanaged — ultimately causing both crews to skip entire checklists. Some of those threats included experience/ repetition, memory problems, expectation bias and checklist discipline.

Experience and Repetition Threats

So, how do experienced pilots omit en-tire checklists? Clearly, experience has many benefits, but experience can also undermine even the most seasoned experts when they are conducting repetitive tasks such as running a checklist.
The first critical concept is that, as experience is gained, repetitious tasks such as conducting checklists become cognitively ingrained as simple flow patterns. Consequently, a pilot can automatically move from checklist item "A" to item "B" to item "C" with mini-mal mental engagement.

The second important concept is that each subsequent checklist item (A, B, C..,) is mentally cued to be accomplished by the perception that the preceding item has been completed.

And third, initiation of a repetitious task such as a checklist must be prompted by a cue. This initiating cue can come from a verbal command ("flaps 20, taxi checklist"), a condition (engine fire) or even an environmental indicator (proximity to the runway). And here is where the threat lies. Interruptions, distractions and deviations from standard operating procedures (SOPs) can break mental flow patterns, create false memories and even mask or eliminate initiating cues. As demonstrated by the flap-setting omission by both flight crews, the end result may be a significant failure that goes untrapped.

In the DC-9 and CRJ scenarios, each crew encountered immediate interruptions as they began to taxi. This is significant because taxi initiation and proximity to the gate are typical conditional and environmental cues prompting pilots to execute the taxi checklist. In effect, the interruptions of having to obtain ATIS information and clarify taxi instructions masked those cues, leading to omission of the checklist which called for flap extension. Then, as the aircraft continued toward their departure runways, the crews continued to move even farther away from the environment which could have reminded them to perform the taxi checklist.

Furthermore, as each crew approached the runway, new cues were encountered prompting them to execute other checklists. For the CRJ crew, nearing the runway was an environmental cue to run the before takeoff checklist. By now the crew was mentally so far from the earlier taxi check that there was little hope that the omitted checklist would be remembered.

Memory Threat

There is another elusive human factors threat associated with repetitive tasks that can harmfully influence human memory. Specifically, when presented with cues which are frequently associated with conducting a particular task — such as entering the runway cues the line-up checklist — the brain can actually plant false memories of events that never occurred. This phenomenon is especially prevalent after interruptions.

For example, it is highly likely the CRJ crew intended to perform the taxi check-list after sorting out their taxi instructions. In fact, the CA originally called for the checklist as the aircraft began to move. But then he immediately interrupted the FO from initiating the checklist to clarify the taxi routing. In interruption scenarios like this, the mind can create false memories based on previous experiences. So, later, when running the before takeoff checklist, the errant crew may have falsely "remembered" completing the taxi checklist. That false memory was created out of the hundreds of other flights in which a checklist would have been completed at that point in the taxi.

This concept is known as source memory confusion. Humans are especially susceptible to source memory confusion when interrupted or rushed, variables which existed for both the CRJ and DC-9 crews.

Another human weakness related to memory is that, generally, humans are not good at remembering to perform tasks which have been deferred for future execution. Known as prospective memory failure, a deferred task is often forgotten until an overt indication — for example, a "config flaps" aural warning — alerts us to our omission. A simple example is when a controller requests a pilot to advise him when "proceeding direct" following a course deviation for weather. This deferred task often is forgotten until the pilot is queried by air traffic control, "Are you direct now?"

Obviously, both FOs made a decision to delay extending the flaps; clearly, the deferred task was not remembered. The CRJ crew received an overt indication of their omission when the "config flaps" aural warning sounded; the DC-9 crew was less fortunate.

Expectation Bias Threat

Another threat that lurked on both the CRJ and DC-9 flight decks is known as expectation bias. In simple terms, expectation bias is "seeing" what you expect to see even when it is not there. In the case of the CRJ departure, the final item on the line-up checklist is verifying that the "T/O CONFIG OK" advisory message is posted on the electronic display. Among other things, the message confirms that flap settings are appropriate for takeoff. Even though it was not posted, the FO revealed in a post-incident debrief that he "thought" he saw the message.

Understanding such an aberration is difficult, but one explanation provides a plausible answer. Experience conditioned the FO because he always saw "T/O CONFIG OK" displayed when taking the active runway. With an established 100 percent success rate of always seeing the message, expectation bias may have led him to believe that it was present. Perhaps a casual glance at the electronic display was adequate for expectation bias to take place — the FO "saw" the message he was expecting to see.

Checklist Discipline Threat

Aircraft and procedures are designed with multiple layers of defenses to prevent errors from developing into accidents. The DC-9 CVR recording concludes with the sound of the stick shaker, another layer of defense. Under normal circumstances, a crew receiving a stick shaker warning would decrease pitch and increase thrust to rectify a slow speed encounter. However, not realizing the aircraft's insufficient lifting capabilities, the DC-9 CA increased the pitch angle, assuming the reason for the stick shaker was a wind shear encounter. His decision in a time-critical environment was not unfounded, as the ATIS noted that low-level wind shear advisories were in effect. However, post-accident investigation revealed no wind shear involvement.

So, although the aircraft's stall warning system functioned properly, the captains misperception of a wind shear event negated the aircraft's built-in defenses. This outcome highlights the extreme importance of the layer of defense existing just prior to the aircraft's defenses — the human layer. It also exposes how human error and limitations can readily defeat multiple, robust layers of defense.

And, like aircraft defensive systems, human defensive systems function through sophisticated algorithms. On the flight deck, one of those algorithms is the checklist.

From the narrative, it is apparent that the DC-9 CA never requested the taxi or before takeoff checklists in accordance with SOPs. By not following standard checklist protocols, the CA became reliant upon the FO to ensure that necessary procedures were accomplished. Because of this SOP deviation, it is conceivable that the FO was task-saturated, having to obtain the new ATIS information, confirm takeoff data, perform his normal functions and anticipate checklists the CA failed to request.

Additionally, the CAs reliance on the FO to conduct checklists on his own accord negates a critical two-pronged safety factor associated with checklist design. When correctly applied, the proper method is for a pilot to call for a checklist based upon the flight phase and which pilot is flying the aircraft. As a backup, if the designated pilot fails to call for a checklist, the other pilot should issue a challenge. By transfer-ring checklist initiation to one pilot, that critical safety backup is nullified.

A CA can transfer responsibility for check-list initiation passively or actively. He or she can actively promote the transfer by telling the FO to "run the checklists at your leisure" Alternatively, the CA can passively transfer checklist responsibility by allowing an overly assertive FO to simply run checklists without being commanded. Either way, the practice is not acceptable because it greatly undermines a critical layer of defense. Both pilots must retain their shared responsibility to ensure that checklists are completed.

Cognitive Saturation

Maintaining a "sterile cockpit" merits discussion here as well. The human brain has amazing capabilities. But, like a computer, each task accomplished and each variable assessed places cognitive demands on the brain. When these demands exceed an individual's capacity, newly presented information may not be perceived or understood.

This situation is referred to as cognitive saturation and its occurrence prevents the accomplishment of further tasks. Even the act of ignoring nonpertinent conversation requires mental effort, which may compromise safety. For example, while listening to a CA speak about his weekend plans, an FO may fall victim to source memory confusion, causing him to incorrectly believe he's completed a checklist.

Some argue that light conversation serves to facilitate crew bonding. While this is true, the timing of such conversation must respect cognitive limitations and the safety advantages of adhering to sterile-cockpit regulations.

Mitigation Strategies

These threats represent inherent weaknesses associated with the flight deck environment and the professionals who strive to perform flawlessly within it. Unfortunately, a minor slip or deviation from SOPs can put crew and passengers in harms way. Individually, some violations are seemingly inconsequential — an incomplete taxi briefing, or a minor violation of the sterile cockpit rule. But when combined with other lost layers of protection, sometimes unknown to the crew, the margin of safety can rapidly erode, causing the flight to slip closer to an accident.

When presented with threats, professional pilots want to know how to counter them. The following mitigation strategies outline proven techniques to overcome normal human limitations that may erode safety margins:

- Recognize that interruptions can alter human behavior and seriously erode safety margins. Interruptions are threats and should be regarded as accident precursors Treat any interruption with caution.
- Overcome prospective memory failure by clearly informing your flying partner if interruptions or operational necessity dictate delaying a checklist. When doing so, also verbalize a specific plan detailing when the delayed task will be accomplished. This can enable the other crewmember to confirm that the task will be performed.
- Understand that memory is heavily influenced by cues. A memory aid recognized by both crewmembers can serve as a reminder to perform a delayed task.

continued on page 12....

Wrong Direction

Faulty IRU Leads Aircraft Astray
Boeing 737-300. No damage. No injuries

Investigators were unable to determine why on-board navigation displays showed the 737 correctly tracking east toward Makassar, on the southwest coast of Sulawesi, Indonesia, when the aircraft actually was on a curving course to the south. The flight crew did not notice the error until they saw a mountain while descending over what should have been the Java Sea.

The Feb. 11, 2006, incident was caused by a malfunctioning inertial reference unit (IRU) and concluded with an uneventful landing at Tambolaka Airport on Sumba, an island about 255 nm (472 km) south of Makassar, according to the final report published recently by the Indonesian National Transportation Safety Committee.

The pilot-in-command (PIC) was an inspector for Indonesia's civil aviation authority and occasionally flew for the operator to maintain proficiency in the 737-300. While preparing for the scheduled flight to Makassar from Jakarta at 2300 coordinated universal time (0600 local time), he found that the no. 2 IRU, a major component of the 737's inertial reference system (IRS), had failed. "The failed IRU was replaced by line maintenance engineers with a serviceable unit," the report said. "They tested and aligned the IRUs on the ground and found them to be functioning normally."

The PIC told investigators that he completed the alignment of the IRUs and initialized the IRS before departing from Jakarta at 2320. There were 146 passengers, six crewmembers and three flight attendant trainees aboard the aircraft.

The aircraft's flight management computer (FMC) normally receives data from the no. 1 IRU but automatically switches to the no. 2 IRU if a fault is detected. "The PIC reported that the takeoff, climb and heading changes on track were normal," the report said. "At 0025, the FMC changed, uncommanded, to [the no. 2] IRU, and the aircraft commenced a slow right turn. The PIC reported that he saw the caution 'IRS NAV ONLY' appear on the FMC, but the copilot cleared the message" The message indicated that the FMC was receiving only IRU data; the aircraft apparently was out of range of ground-based navigational aids.

Flight data recorder (FDR) data showed that the aircraft increasingly diverged south of the planned and programmed track. "The PIC reported that the divergence was not noticed because cockpit instruments showed [the aircraft] tracking toward Makassar," the report said. "This was confirmed by FDR data. ... The reason for the aircraft diverging to the right when the FMC showed that it was maintaining the flight-plan track could not be determined using the available data."

The course deviation was not noticed by air traffic controllers. The report said that the controllers had not received training on a recently in-stalled air traffic control (ATC) radar system, had not correctly programmed the new radar systems route-adherence-monitoring function, lacked "appropriate coordination [and] had a degraded awareness of their areas of responsibility."

The 737s transponder signal became weak as the aircraft flew south, and at 0041 the ATC radar track defaulted to the flight-plan track; thus, the 737 was depicted on the controllers' displays as following the correct path to Makassar. During this time, the PIC — the pilot flying — administered oral quizzes separately to two flight attendant trainees; the quizzes lasted 20 minutes and 15 minutes, respectively. The report said that the PIC was not authorized to conduct the checks and that they diverted his attention from flying the aircraft.

The report also noted that "while in the cockpit, [the second flight attendant trainee] noticed that the sun was from the left side of the PIC seat, about 10 o'clock to the nose of the aircraft" and that "the PIC subsequently covered the left cockpit window with paper." The position of the sun indicated that the aircraft was heading south-southeast. "That should have been an indicator to the pilots that they had diverged significantly from the flight-planned track even though the navigation displays were indicating that they were tracking as planned to [Makassar]," the report said.

Believing they were 115 nm (213 km) from Makassar, as indicated by their electronic flight instruments, the crew received clearance from ATC to begin the descent from 33,000 ft. "When approaching 28,000 feet, the PIC saw a mountain on the right side of their track," the report said. "That topography was not expected because the flight to Makassar does not pass a mountain. The pilots then opened a map to find their position. ... The pilots then referred to the standby compass and found that the aircraft's heading was 230 degrees."

The report said that the pilots consulted the quick reference handbook (QRH) but were unsuccessful in resolving the navigation problem because they did not complete all the actions prescribed by the QRH.

The crew solicited help from ATC and from pilots of other aircraft to identify geographical features in the area but were unable to fix their position. At 0214, the PIC told the copilot that one hour of fuel remained and that they might have to prepare for a ditching. The copilot then said, "There is a runway down there." The PIC decided to land at the unidentified airport.

"For the next 12 minutes while descending, the crew attempted to verify their position," the report said. "The PIC told the senior flight attendant that they would shortly be landing somewhere on Sulawesi island." After landing on the 1,920-m (6,300-ft) runway at 0240, the pilots found that they were on Sumba.

Investigators determined that both IRUs had malfunctioned during the flight. "The IRUs, when used by the flight management system, pro-vided erroneous global position location to the FMC and flight instruments," the report said.

The investigation found evidence of repeated, unresolved IRU malfunctions in the operator's 737 fleet, including 18 in the two months preceding the incident. Nearly a year after the incident, the pilots of one of the operator's 737-400s were distracted by an IRU malfunction when the autopilot disengaged while en route to Sulawesi in bad weather. They became spatially disoriented and were not able to recover from the subsequent upset; all 102 people aboard were killed.

Courtest FSF AeroSafety World

...continued from page 10

- If interrupted while performing a checklist, re-run the entire checklist. Doing so greatly reduces the probability of succumbing to source memory confusion.
- To overcome expectation bias, use the say-look-touch confirmation technique, For example, when confirming proper flap settings while conducting a checklist, say what the setting should be, look at the flap position indicator and touch the flap handle. By incorporating multiple sensory inputs, a higher level of task attentiveness is achieved.
- Slow down. Rushing is a primary initiator of human factors related failures, including those associated with repetitive tasks.
- Checklists should be specifically called for by the appropriate pilot in accordance with SOPs. Doing so ensures that the check-and-balance philosophy built into them remains, intact. It also enhances situational awareness, as both pilots can remain apprised of the aircraft's status. Do not advocate the idea of executing checklists "at your leisure."

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IATA Incident Review Meeting

The purpose of IATA IRM is to share incidents and accidents by all airlines/ manufactures, the lessons learnt and safety initiatives undertaken by each organization. This is very unique forum where serious incidents are shared by all airlines.

Safety must remain a priority for all IATA airlines even in difficult economic times when it can become very easy for struggling companies to drop the safety ball. The IATA Operations Committee (OPC) and IATA Safety Group (SG) continue to support the IATA strategy and priority on safety, The information gathered at the IRM helps to provide input to that strategy and it allows airlines to learn valuable lessons from the incidents experienced by others and to build on industry best practices.

Overview of all 2008 Accidents

- The total number of accidents is higher for 2008, in comparison to 2007
- 30% of all accidents involved crew members fatigue
  - Versus 35% in 2007
- 20% of all accidents involved Western-built Jet Hull Losses
  - Versus 20% in 2007
- 21% of all accidents were fatal
  - Versus 20% in 2007
- There were fewer fatalities in 2008
  - 190 fewer fatalities versus 2007

Main Issues from Incident Review Meeting

During each IRM meeting, member airlines discuss incidents, accidents or any occurrence with the potential risk of causing an accident. IATA and the member airlines classify accidents as per the following categories, presented below. The following section presents the issues discussed at the IRM regarding some of these accident categories, as well as the recommendations noted during the meeting. The occurrences presented at the IRM either resulted in these types of accidents (e.g., CFIT) or had the potential risk of resulting in them.

Ground Damage

Issues:

- Airlines presented analysis of ground damage occurrences, broken down by events during the following:
  - Ground servicing
  - Pushback
  - Initial taxi-out / breakaway
  - Taxi
  - Docking / final stop
  - Training crew for ground movements
  - Cases presented also included flight deck fires on ground
- Clearance of ground crew and tugs
- Undetected tail area damage during pushback

Recommendations:

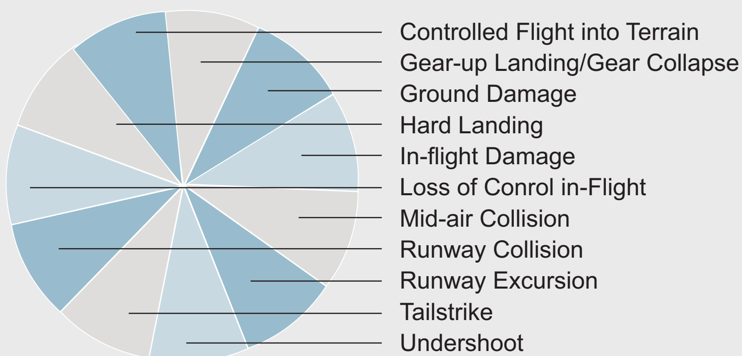
- IATA will continue to lead the industry focus on the reduction of ground damage events, through initiatives such as the IATA Safety Audit for Ground Operations (ISAGO)
- Airlines should refer to standardized procedures for use in operator checklists to ensure the tug is clear
- Effective CCTV of all aircraft activity on ramp, during ground movements, on takeoff and landing, to aid in investigating occurrences

Loss of Control In-flight

Issues:

- During the IRM, members discussed incidents involving recurring technical malfunctions:
  - Schedule delays
  - Non-standard ADI displays and pilot

Accident Categories



- Complexity of NOTAMs
- Stall in flight
- Flight crew disorientation during go-around

Recommendations:

- IATA has included a new segment addressing Safety in Maintenance Operations, under its Six-point Safety Strategy
- Industry should continue to focus on modernizing NOTAMs
- ATC should be aware of effects of a late runway change on flight crew workload and stabilized approach awareness
- Airlines should train upset recovery, including disorientation
- Airlines should address stall recovery training and awareness
- Airlines should explore the possibility of a self-evaluation pilot pitch rate tool of pitch rate on take-off (already implemented at some carriers)
- Airlines should develop a go-around scenario for training, which encompassed the effects of longitudinal acceleration
- IATA STEADES will conduct a survey on airline training for stall recovery following stickshaker activation and stalls with the A/P ON
- IATA STEADES will conduct further analysis on maintenance-related events

Controlled Flight into Terrain

Issues:

- Flights in protected area on approach
- Flight crew situational awareness issues and monitoring by ATC

Recommendations:

- Airlines should move to RNAV approach with constant descent angle
- Minimum Safety Terrain Warning (MSAW)
- When experiencing difficulties, airlines could discuss particular approaches with their authorities so that they are designed to support flight crew operations (capture levels)

	2008	2007
Total Accidents	109	100
IATA Members	33	35
Western-built Jet Hull Lossess	22	20
Fatal	23	20
Fatalities	502	692

- Flight crew awareness: some carriers recommend the use of display as well as the use of charts by flight crews during the flight, not just for the approach
- Airlines should recommend that flight crews use the terrain mode on display. Some carriers have a policy, which states that on descent, the PF has terrain ON and the PNF has weather ON
- IATA STEADES will conduct an analysis of EGPWS warnings and ATC's role in these events

Runway Collision

Issues:

- The members discussed the intervention of ATC during take-off (e.g., cases where ATC calls STOP during the take-off roll)
- Incidents linked to work in progress at the aerodrome (e.g., take-off and landing on runways with displaced threshold or runway end, due to construction)

Recommendations:

- ATC should provide flight crews with information (rather than issue an instruction)so the crew can make the decision whether or not to abort the take-off
- If ATC calls for a STOP, the call must have a call sign
- Suitable policy and training should be provided to ATC
- ATC should notify flight crews regarding reduced runway length
- IATA will conduct a STEADES analysis of incidents relating to take-off or landing on runways with displaced threshold / runway end due to work in progress

Down and Out

There is no checklist for incapacitation, a rare but serious threat.

By Mark Lacagnina

The risk of a pilot becoming incapacitated in flight is very low, recent studies show, but an incident early last year – and other in the past – exemplify another point made in the studies: In the rare event that incapacitation does occur, a flight can be seriously threatened.

In its report on the incident, the Irish Air Accident Investigation Unit (AAIU) said there were signs that something was not right with the first officer when he reported late for duty at Toronto's Pearson International Airport the morning of Jan 28, 2008. the commander said that the first officer appeared to be "quite harried" when he arrived on the flight deck of the Boeing 767-300. the commander assured the first officer that all the preflight preparations for the flight to London Heathrow Airport had been completed and encouraged him to "settle down."

The commander became increasingly concerned about the first officer's behavior after the flight got under way. The first officer left the flight deck several times and did not follow standard procedure when he returned.

'In conversation, he remarked several times that he was very tired," the report said. "With the workload now light in cruise, the commander suggested that [he] take a controlled rest break on the flight deck. The commander was concerned not only for the well-being of his first officer but of the possibility of having to carry out a CAT III autoland approach at Heathrow due to low weather [conditions]. He considered it prudent to let his colleague rest now and be fully alert for the descent and approach at the destination."

'Confused and Disoriented'

The aircraft was midway across the North Atlantic when "it soon became apparent that the first officer was quite ill," the report said, noting that his speech began to have a "rambling and disjointed nature." After another extended rest break, his behavior became "belligerent and uncooperative." After calling the lead flight attendant to the flight deck, the commander told the first officer that if he did not begin to cooperate, he would be considered incapacitated and dealt with accordingly.

The first officer did not respond, so the commander told the lead flight attendant to 'secure the first officer away from the controls" and enlist the aid of other cabin crewmembers to remove his from the flight deck, the report said. One crewmember sustained a wrist injury while doing so. Two physicians among the 146 passengers attended the first officer, who was described as confused and disoriented.

After communicating via data-link with company dispatch personnel in Toronto, the commander declared a medical emergency and told air traffic control that he was diverting the flight to Shannon, Ireland, which had good weather conditions.

Before beginning the descent, the commander asked the lead flight attendant to check the passenger list, to see if any company pilots were aboard. "No line pilots were on board, but one of the flight attendants held a commercial pilot's license with a multi-engine rating and a noncurrent instrument rating," the report said. The commander summoned her to the flight deck.

"The flight attendant provided useful assistance to the commander, who remarked in a statement to the investigation that she was 'not out of place' while occupying the right-hand seat," the report said.

After an uneventful landing, the flight was met by physicians who assisted the first officer and assessed his medical condition. The first officer then was transported to a local hospital. "[He] remained under hospital care for 11 days, where a gradual improvement in his condition was made," the report said. "On 8 February, he was flown home [by air ambulance] to Canada, where his care continued."

The report provided no details about the first officer's medical condition and did not specify his age.

Serious Incident

The AAIU commended the commander and flight attendants. "Incapacitation of a member of a flight crew is a serious incident," the report said. "The commander, realizing he was faced with a difficult and serious situation, used tact and understanding, and kept control of the situation at all times. The situation was dealt with in a professional manner, employing the principles of crew resource management"

The report cited a Transport Canada technical publication (TP) that provides guidance on recognizing and dealing with pilot incapacitation. Differentiating between sudden, serious and subtle incapacitation, the TP says that the leading causes of sudden pilot incapacitation are gastrointestinal problems such as stomach cramps, nausea and diarrhea.

"Heart problems and fainting are the main causes of serious incapacitation," the TP says. "Complaints of chest pain (often confused with indigestion), weakness, palpitation or nausea should be taken seriously. Pallor [paleness], unusual sweating, repeated yawning or shortness of breath should all trigger suspicion."

Common causes of subtle pilot glycemia (low blood sugar), extreme fatigue, alcohol, drugs and "other toxic substances," the TP says. Subtle incapacitation also can be triggered by a stroke or brain tumor.

Symptoms of subtle incapacitation are likely to be noticed during periods of high stress or workload. "The victim may not respond to stimulus, may make illogical decisions or may appear to be manipulating controls in an ineffective or hazardous manner," the TP says. It recommends that, if the victim does not respond normally to two consecutive challenges or one significant warning, such as when an aircraft is flown below decision height without the required visual references, the other pilot should take the following actions:

- "Do whatever is necessary to maintain control of the aircraft."
- "If you need to restrain the victim, do only what is needed to deal with an immediate threat to control. You will have time [later] to further secure the victim"
- "Climb to and maintain a safe altitude."
- "If you are on an approach which has destabilized, initiate a missed approach following standard procedures. You may not have access to a checklist, so take extra care to accomplish essential tasks."
- "Keep your thoughts organized. Saying your actions out loud may help you stay focused. If the best aircraft is autopilot-equipped, engage the autopilot at an operationally safe altitude to lessen your workload."

The TP says that other crewmembers or passengers should be enlisted to secure the incapacitated pilot — by moving his or her seat to the full-aft position and tightening the shoulder harness — or to remove the pilot from the seat.

Single-Pilot Fatalities

A study by the Australian Transport Safely Bureau (ATSB) in 2007 focused on 98 pilot-incapacitation events that occurred from 1975 through March 2006.3 Noting that these events comprised 0.6 percent of all occurrences in the ATSB accident/incident database during the period, the report said, "The results of this study demonstrate that the risk of a pilot suffering from an in flight medical condition or incapacitation event is low."

Nevertheless) the report said that pilot incapacitation "represents a serious potential threat to flight safety." The pilot-incapacitation events included 10 fatal accidents, in which 24 people were killed, and six nonfatal accidents.

All the fatal accidents involved single-pilot flight operations, including four conducted by charter or business pilots. Eight fatalities occurred when a Beech Super King Air 200 crashed in September 2000. ATSB determined that the cabin likely depressurized while the airplane was climbing to while the airplane was climbing to 25,000 ft for a charter flight of about 1.5 hours' duration; the King Air continued flying for about 3.5 hours after passing the destination.

Overall, the greatest cause of pilot incapacitation was acute gastrointestinal illness, typically from food poisoning, in 21 cases, followed by exposure to smoke or toxic fumes, in 12 cases. Nine pilots lost consciousness for unspecified reasons. Eight suffered heart attacks, five of which were fatal. Five pilots suffered symptoms of infectious diseases, mostly viral infections, although one case involved malaria. Five others were incapacitated by trauma resulting from bird strikes, a windshield shattered by hail and an injury during an emergency ground evacuation. Four pilots suffered respiratory symptoms of acute pneumonia and severe emphysema.

Noting the prevalence of gastrointestinal illness, the report said, “It is important that crew meals are prepared to the highest possible hygiene standards and that pilots receive different crew meals to help reduce the overall risk.”

Pilots also should be careful of what they eat and drink before flying and during layovers. “Contaminated food and water consumed in these periods may then produce an acute gastrointestinal illness some hours later,” the report said.

While heart attack was involved in only eight of the 98 pilot-incapacitation events, it accounted for half of the fatal accidents and the deaths of seven passengers. The report said that “cardiovascular disease still ranks as the single biggest cause for medical disqualification of pilots” and that cardiac events may be under-reported “especially in difficult postmortem circumstances” following accidents.

The study results show that “there is a low chance of a medical condition or incapacitation event adversely affecting the outcome of a flight,” the report said. “The medical certification system appears to be working well. However, it remains important that this system continues to evolve with, and be based on, the changes and developments in scientific research and medical practice.”

Insidious and Dangerous

A 2004 study by the U.S. Federal Aviation Administration (FAA) focused on 47 flights during a six-year period ending in 1998 in which pilots became incapacitated or impaired — that is, able to perform only limited flight duties’ The report on the study said that the rate of in-flight pilot incapacitations/impairments was 0.058 per 100,000 flight hours.

The report said that safety was seriously threatened in seven events:

- A Boeing 737 first officer suffering a seizure related to alcohol withdrawal “suddenly screamed, extended his arms up rigidly, pushed full right rudder and slumped over the yoke during an approach,” the report said. “The captain regained control after flight attendants pulled the first officer off the controls.”
- A Douglas DC-9 first officer’s foot lodged against a rudder pedal when he stiffened during a heart attack. “The captain had to apply full opposite rudder to control the aircraft until the foot could be
- A Boeing 727 freighter captain and flight engineer temporarily lost consciousness after the flight engineer inadvertently depressurized the cabin at 33,000 ft. The first officer donned his oxygen mask and performed an emergency descent.
- While taxiing after landing, the “captain stiffened so violently during an epileptic seizure” that he suffered a broken shoulder and back, and applied sufficient pressure on the right rudder pedal and wheel brake to cause the airplane to suddenly turn and stop.

RAPID DESCENT

A series of unfortunate events leads a 737 captain to dive to the wrong conclusion.

Boeing 737 was scheduled to depart from Nauru Island for Apia in Western Samoa at 0330 local time. The initial track was 113 degrees magnetic from the NDB. Planned cruise altitude was 33,000ft, trip distance was 1485nm and flight time was 3.5 hours nearly every minute of it over water.

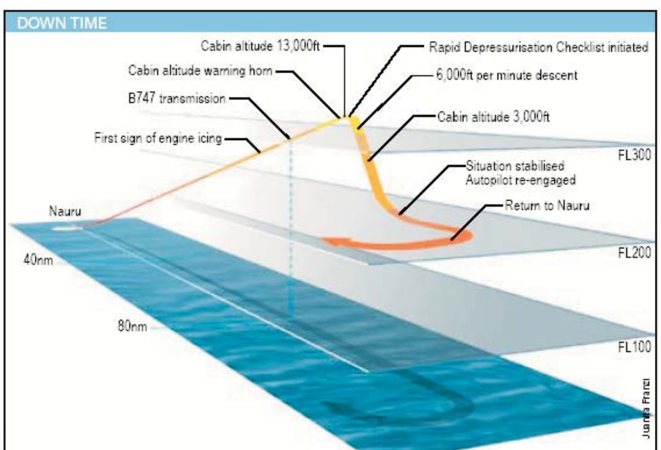
Climbing through 25,000ft, we experienced some early signs of engine icing and promptly switched the engine anti-ice system on. Moments later, we were surprised to hear an “all stations” broadcast from a Boeing 747; the jet was crossing our radial, climbing through our planned altitude and 40nm in front of us. We were outside controlled airspace and – worryingly the local flight service unit had not notified us of the 747’s presence.

We exchanged position information with the 747 and were just passing FL320 when a warning horn sounded in the cockpit. At first, I thought the alert, which sounded like the warning beeps of a reversing truck, was an over-speed signal. It took us a full 25 seconds to twig that the problem was to do with the cabin pressurisation system. Neither of us had noticed a discernable pressure change, but the gauge was indicating 13,000ft and climbing, when it should have been steady at 8,000ft.

From here, it was a comedy of errors on my part. While donning my oxygen mask, I managed to knock my spectacles onto the floor. There was a delay of a few seconds as we both fumbled in the dim light to locate the tiny volume control knobs to activate the oxygen mask intercom system. With the intercom switched on, I recited the rapid depressurisation checklist, which included directing the first officer to fully close the main outflow valve switch on the panel above his head. It’s impossible to read the position of the outflow indicator needle from the left seat, so I was relying on the first officer to monitor it.

I made a public address to inform the passengers of the impending emergency descent, then closed the throttles, extended the speed brake, and put the aircraft into a steep dive.

Over-pressure condition: At this point, it is worth noting that there were a couple of other issues on my mind. For one, I was aware that there was an elderly woman on board who had never flown before. Would she be able to fit the oxygen mask over her head and what



Situation stabilised: After the warning horn sounded, the B737 flight crew initiated a rapid descent, dropping 10,000ft in a minute. Once the situation had stabilised, the flight crew returned to Nauru, rather than continue to Samoa with a pressurisation problem.

ANALYSIS

MURPHY'S LAW *John Laming & staff writers*

This pilot certainly struck an unusual set of circumstances. You can't help thinking that if the original maintenance information had been available to the crew before departure, the captain would have known of the problem with the pressurisation controller and been less inclined to act hastily at the first sign of an unscheduled pressurisation change.

The combination of several distracting events close together – engine icing, unannounced traffic and the activation of the cabin altitude warning horn, all within the space of a few minutes during a night climb in instrument meteorological conditions (IMC) – no doubt contributed to the confusion in the cockpit.

While the pilot's immediate concern for his passengers' welfare is understandable, the first sounding of the cabin altitude warning called for a cold, calm appraisal of the situation. As the captain concedes, if all the facts of the situation had been considered, a rapid descent would not have been executed.

Some operators require flight crews to monitor cabin pressurisation every 5,000ft in the climb. This is a sensible precaution and it might have helped the crew in this case detect and resolve the problem earlier.

Checklist check-up: The Boeing after take-off checklist does require a check of the pressurisation system once the flaps are retracted, though the author doesn't say if this check was conducted. If it was, we can assume that the problem was not evident at that stage.

The pilots were correct to don their oxygen masks as soon as they realised there was a problem with the cabin pressurisation system. The fact the pilot dropped his glasses in the process was unfortunate and clearly added more stress to an already problematic situation.

At this point, the captain initiated the rapid depressurisation checklist, which calls for the first officer to close the outflow valve switch. This is aimed at reducing the flow of air from the cabin in the event of major structural damage or a window blowout. However, if the pressurisation fault is relatively benign, as in this incident, full closure of the outflow valve results in an immediate build up of pressure in the cabin. In this case, the increased pressure resulted in considerable discomfort, in the form of ear pain, for the crew and passengers. Once it became clear that the cabin pressurisation was under control, the captain made the correct decision to return to the departure airport rather than continue the flight with an unknown pressurisation defect.

The pilot makes a good point about simulator training. There is a tendency for simulator instructors to focus on rapid depressurisation events. Appropriate consideration should also be given to unscheduled depressurisation changes and their diagnosis.

Finally, it's worth noting that there was a short period where the pilots were unable to identify the reason for the warning horn, which in the 737 serves a dual purpose as a cabin altitude and takeoff configuration warning.

effect would a possible shortage of oxygen have on her health? I also had my doubts about the inexperienced cabin crew and their ability to assist passengers with their oxygen masks. With that in mind, I was keen to get to a lower altitude as soon as possible.

We were descending at 6,000ft per minute. I concentrated on flying the descent while the first officer looked after the pressurisation panel. My ears were beginning to hurt and without my glasses it was difficult to focus on the instruments. I handed over control to the first officer while I groped on the floor for my glasses, finally retrieving them from near the base of the control column.

The cabin altitude needle, now indicating 3,000ft, had dropped 10,000ft in a minute. Unable to relieve the pressure in my ears, I was experiencing severe and distracting pain. The closure of the out-flow valve from its normal, slightly-open position to the fully closed position had resulted in an over-pressure condition. The first officer was doing a sterling job and I managed to turn my attention (and newly restored vision) to the pressurisation panel.

At 20,000ft, with the cabin altitude under control, I re-engaged the autopilot while we assessed the situation. After some discussion we concluded that it would be foolish to continue on to Samoa with a dodgy pressurisation system. I decided to return to base at Nauru. Apart from a few sore ears, the passengers were in good shape.

An engineer changed the pressurisation controller, and we flew to Samoa without further problems.

It transpired the crew who had flown the aircraft before us had reported fluctuating cabin rates of climb and written up the defect after landing. An engineer had replaced the offending pressurisation controller and signed the defect report, which happened to be on the very last page of the maintenance sheet. He left a new maintenance book in the cockpit for us to use then knocked off for the night. We only saw the new document, which, of course, contained no defects.

Clearly there was no need for the rapid descent. I should have directed the first officer to the unscheduled pressurisation change checklist, rather than the rapid depressurisation checklist. This would have allowed a more leisurely series of actions to regain cabin pressure. If that failed, a decision could then be made to execute a rapid descent.

At the time the urge to descend quickly was strong. Lack of oxygen appeared to pose a threat to my elderly passenger (and others) and I was not entirely confident that the flight attendants could manage the situation. In the real-world event I rushed into the emergency descent – perhaps unconsciously primed by previous simulator training – rather than keeping a cool head and sitting on my hands until the problem was properly diagnosed.

Courtest Flight Safety Australia

...continued from page 17

- An Airbus A300 captain suffering a cerebral infarction (blood-flow blockage) did not call for landing gear extension during approach and “simply nodded agreement when the first officer questioned him about it.” While taxiing to the gate, he applied full takeoff power twice before the first officer shut down the engines and called for assistance.

- A McDonnell Douglas MD-88 captain wearing monovision contact lenses — which correct for near vision in one eye and distant vision in the other eye — perceived the airplane to be higher than it was during an overwater approach in rain and fog. “This resulted in a steeper-than-normal final approach, causing the aircraft to strike the approach lights,” the report said. Three passengers sustained minor injuries during the subsequent evacuation.

- The captain and first officer were impaired by fatigue when a Douglas DC-8 freighter stalled during an approach and struck terrain. All three flight crewmembers were seriously injured in the crash.

The latter two events, the only accidents among the 47 flights, both involved pilot impairment, which the report characterized as insidious. “When a dramatic incapacitating event such as a heart attack or epileptic seizure occurs, it is often obvious and can be dealt with by the unaffected crewmember,” the report said. “In the two impairments that ended in aircraft accidents, the pilots were probably not aware there was a problem. ... It may be that subtle impairment of a pilot is more dangerous than obvious medical incapacitation.”

Courtest FSF AeroSafety World

CARRY ON ABOUT CABIN BAGGAGE

More about cabin baggage than you ever wanted to know.

By Sue Rice & Granted Howard
Cabin Safety Auditors - CASA

Passengers want to carry more and more baggage on aircraft. They've paid for their flight, and they feel entitled to take on board what they want to keep handy – or secure. However, the size and weight of carry-on baggage is limited in the interests of safety.

That's because if a flight encounters turbulence – or has an accident – serious damage can result from cabin baggage hurling through the cabin. The more unsecured baggage, the greater the risk.

Safety regulations allow operators to limit the size of carry-on baggage so that the danger from oversized and overweight luggage is reduced. The operator's policies for carryon baggage have the backing of law. Unfortunately the rules don't stop confrontation between cabin crew and passengers.

> **The sports star stared furiously at the poor flight attendant, yelling, "No way, I've got take this IN!"**

Sometimes it can get ugly.

A while ago, a well-known tennis player was boarding an airliner for a flight to a major tournament. He was carrying a large tennis bag stuffed with tennis gear. At over a metre long, it was well outside company size limits. One of the cabin crew stopped him at the door of the aerobridge as he was having his boarding pass checked. She told him – quite firmly – that his bag was outside allowable limits.

The tennis star reacted as if it was match point and the flight attendant had just called his winning serve "Out". The sports star stared furiously at the poor flight attendant, yelling, "No way, I've got to take this IN!" She responded, "No, it's not going in. It's over the size limit. It will have to go in the hold". His loud, "Do you know who I am?" could be heard from inside the aircraft.

A stalemate developed. She wouldn't let him on the aircraft with the oversized bag, and he wouldn't budge. The argument was holding up the flight, and pressure to resolve the dispute was getting acute. So the harried flight attendant got him to agree to abide by the "umpire's" decision – she would seek advice from the purser.

When she came back, there was a determined spring in her step. She informed the red-faced sports star, "the purser says 'no means no' – it doesn't fit the size testing module, so it's no; it will have to go in the hold". She tried to calm him down by saying she would ask the ground staff to take special care. His bag would be in perfect condition at the destination baggage carousel. She took the tennis bag to the ground staff and it was secured in the hold.

He was not happy with the result, and stormed down the aerobridge, frustrated and angry, loudly complaining about his treatment. At his seat he opened the overhead locker, and – as luck would have it – found it empty. "It will fit here," he yelled, pointing to the empty locker. And he demanded that the purser bring him his bag.

By this stage everyone was looking at the performance. But the purser had his measure. She eyeballed him and said calmly, “We will not be closing the aircraft doors and taking off until you sit down.” He did, remaining quiet for the rest of the flight, refusing food or drink.

The cabin crew’s response is a lesson to all. The purser backed up her flight attendant. And the flight attendant made clear who was in charge, without getting into an argument.

You should always approach conflict situations calmly and objectively. While it can sometimes be useful to say that you understand the person’s problem, you should not attempt to explain the situation in detail, but simply state the safety requirement. If the situation is not then resolved, refer the matter to the pilot-in-command, who has the power to issue a legal direction.

Passengers must comply with directions from the pilot-in-command. This power derives from several Civil Aviation Regulations (1988): Passengers must comply with directions given by the pilot in command who has wide-ranging powers under the civil aviation safety regulations. These powers include the ability to have a person removed from the aircraft or place a person under restraint.

Injury: Disputes over carry-on baggage can involve just about anyone. Sometimes they involve injury. One cabin attendant recalls a brush with a business class passenger that left the attendant with a badly bruised foot.

The passenger was a photographer, carrying a modestly-sized metal box that was over the weight limit. The passenger found his seat and turned to the cabin attendant saying, “Take care of this”. But before the attendant could react, the passenger dropped the box – right onto the attendant’s foot. In the end the captain had to come out to speak to the passenger about transferring the overweight baggage to the hold. The passenger was adamant that this would not happen, and threatened to “sue the airline for everything it’s got”. The captain explained that if the camera box was not stowed in the hold, then the passenger and his

CHECKING UP ON CHECK-IN

January 2006 – the height of the tourist season, and a specialist group of CASA cabin safety inspectors conducted spot checks in Brisbane, Sydney, Melbourne, Canberra and Perth looking at how Australian registered airlines are handling carry-on baggage.

The 12-person team of cabin safety specialists and flying operations inspectors used a checklist they had developed to work out whether handling of carry on baggage was effective. Over 30 scheduled flights were checked. The checklist included:

- Does the operator monitor the baggage allowance size, number and weight limits in line with its policies?
- Does the operator manage cabin baggage which exceeds the baggage allowance size, number and weight limits?
- Do the operator’s cabin attendants and ground personnel coordinate and manage cabin baggage that exceeds the baggage limits?

As part of normal cabin enroute surveillance, additional checks include:

- Before closure of the boarding door, are cabin attendants required to verify that each article of cabin baggage was stowed in accordance with the company’s operations manual?
- Were all cabin compartment placard restrictions met (for example, “no stowage” signs, “weight”, “soft articles” signs, etc.)?
- Was any carry-on baggage that was removed from the cabin and placed in a cargo compartment properly accounted for in calculating aircraft weight and balance?
- Was all cargo in the passenger cabin properly restrained and packaged in accordance with loading instructions?
- Was carry-on baggage or cargo stowed so that it could not slide and obstruct the path to exits and aisles?
- Were the cabin baggage controls from the company’s operations manual and other written policies and instructions followed?

baggage would not be flying. The camera box was stowed in the hold.

Cabin baggage can hurt you – especially if it is overweight. To avoid back problems you should always follow occupational health and safety guidelines when lifting cabin baggage. This means you should:

- Place your feet apart for good balance.
- Bend your knees.
- Hold the object as close to your body as possible.

- Lift smoothly and slowly.
- Pivot with your feet; don't twist the back.
- Push, rather than pull a load.
- Share the load, work with a partner.

Know your own strengths and limitations. Use proper lifting and bending techniques.

Self check-in: A nationwide review of airline check-in practices by CASA in January found more care needs to be taken with self check-in and quick check-in facilities at major airports.

Operational surveillance was carried out at five major domestic airports targeting cabin baggage. The objectives were:

- To assess the effectiveness of the operator's procedures in meeting compliance requirements
- To discover if the operator follows its procedures, controls, process measurements and interfaces for carry on baggage control
- To establish whether communications channels were effective in telling staff about any changes in the operator's procedures for carry on baggage control.

The surveillance program found that passengers who make use of streamlined check-in facilities need to be reminded that they still need to follow carry-on baggage and dangerous goods restrictions and guidelines.

An expected expansion in self-check in via the internet or at kiosks at airports will put pressure on compliance with carry-on baggage limits. Nearly half of all airports surveyed in 2005 by air transport IT provider, SITA, reported that they had deployed self-service kiosks. This is expected to rise to 70 per cent in the next two years.

Self check-in allows passengers to determine whether their carry-on bags are within size and weight guidelines. While cabin baggage-size test units were generally available at self-service kiosks, the audit team found that scales to weigh baggage were generally unavailable, a problem CASA has brought to the attention of operators.

Overall, the spot surveillance program found that operators whose management systems support active monitoring of cabin baggage had satisfactory control of cabin baggage before the boarding stage. Only a few incidents of over-limit baggage were observed.

As most cabin crew know, passengers' desire to carry on more baggage tends to peak at certain times. At Christmas, holiday makers carry precious presents that must be kept close. Many are odd shapes that are difficult to stow. Friday nights and Sunday nights can also be a problem because business travellers carry a lot of cabin baggage so that they can avoid waiting at the baggage carousel for luggage. It is at these peak times that extra care needs to be taken. Cabin crew are legally required to enforce the operator's carry-on baggage limits. This is far more effective if the oversized or overweight baggage is caught early. Preferably the offending baggage should be stopped and put into the hold at check in – or at least at the aerobridge.

Sue Rice and Grant Howard are cabin safety auditors for CASA.

Managing Safety

From the Inside Out

BY
NICHOLAS A. SABATINI

When Jerry Lederer started Flight Safety Foundation in 1947, U.S. air carriers averaged a major accident every 16 days, for a fatality rate that approached 2,000 fatalities per 100 million people flown. Today, that rate is down dramatically to an average of 2.5 fatalities per 100 million people flown. While the overall rate is higher on a global scale, the strong safety record in most regions of the world is a remarkable achievement.

Yet, we can never rest. With aviation's vital importance, we must build on this achievement. The U.S. Federal Aviation Administration (FAA) is taking a two-pronged approach to manage risks and keep improving safety. To begin, the FAA is managing risk from the "inside out." The FAAs Aviation Safety Organization has been undergoing a rigorous self-examination — looking at how it is organized, at processes, and at internal measures and accountability. At the same time, the FAA must focus outward on the entities and individuals that it regulates.

In his book, Managing the Risks of Organizational Accidents, James Reason discusses the importance of such an inside-out approach. He says you must manage risks from inside because an organization, such as the FAA, could unwittingly contribute to an unsafe condition or unsafe practices.

Organizational risk is not new in aviation. It was present at Kitty Hawk with Orville and Wilbur Wright and machinist Charlie Taylor. It was present in the 1940s with accidents every 16 days. Yet, organizational risk was largely undetected because it was overshadowed by greater risks — such as engine failure, controlled flight into terrain, loss of control, and approach and landing accidents. Now that we have fundamentally addressed those common causes, we need to identify and address other vulnerabilities, including organizational risk, which now may pose greater concern. Metaphorically, organizational risk is taller due to the flatness of the surrounding terrain.

As a regulator, the FAA requires regulated organizations to operate with a safety management system (SMS) and to have a safety culture. It is essential that the FAA hold itself to the same high standards to which it holds industry. The FAAs Aviation Safety Organization — with its nearly 7,000 employees and many more designees who act on behalf of the FAA administrator — is moving to an SMS.

The organization developed an SMS doctrine in concert with industry and is moving ahead with an implementation plan for an integrated system safely approach across the organization.

SMS is built on the foundation of a quality management system (QMS), which the Aviation Safety Organization implemented through ISO 9001 standards in 2006. QMS addresses processes — their standardization and consistency — as well as continuous improvement. It is essential to add safety management to assure that risk management is incorporated into key processes. Yet, both QMS and SMS are processes executed by humans. For safety's sake, processes must exist in a safety culture. Getting the culture right is more important than the systems used. This is what is most important about managing from the inside out.

What about the second prong — the regulators essential external focus? What can we do to manage risk more effectively across civil aviation? With an air carrier fatality rate of 2.5 per 100 million people flown, some might think the accident rate has reached such a low level that we should no longer expect sudden and sustained breakthroughs in future rates.

I disagree. The aviation community is on the threshold of the next level in aviation safety. This will be possible by managing risk far more effectively. The way to do this is through gather-

-ing and sharing key safety data, using sophisticated data analysis to identify precursors and detect emerging risks, and prioritizing and measuring mitigations.

Today, with the Aviation Safety Information Analysis and Sharing (ASIAS) initiative, the FAA is gathering crucial safety information from a number of data sources. Furthermore, with sophisticated analysis tools, we are detecting trends, identifying precursors and assessing — and addressing — risks.

Here's an example of how data analysis and sharing can make a big safety difference. In 2007, several airlines reported that their digital recorder data, or flight operational quality assurance data, showed that they were getting warnings from their terrain awareness and warning systems (TAWS) at several airports with adjacent mountainous terrain in Northern California.

That was one data point: the finding that several airlines received TAWS warnings in the same area. ASIAS analysts reviewed multiple data sources to get a clearer and fuller picture of the problem. They analyzed minimum vectoring altitudes (MVAs), plotted TAWS warning locations in relationship to these MVAs and I overlaid radar track data from arriving flights to reveal a relationship. Then, they overlaid the terrain database combining, or fusing, it with the MVA and TAWS data.

With all of this, the analysts were able to see a causal relationship that could not be seen from any one data source. The experts call what they did "fusion." The single data point — the TAWS warnings — was just that: a single piece of information. But fusing the data sources, including the MVAs, radar track data and more, provided a larger picture, a more complete understanding of the issues, and enabled the FAA Air Traffic Organization and Aviation Safety Organization to work together based on solid objective information.

From those TAWS warnings in Northern California airspace, thanks to data gathering, sharing and analysis, FAA is making flying safer — in the way it designs MVAs, how it vectors traffic, the design of TAWS software and much more.

With ASIAS, we are making a game-changing move from gathering data after accidents, in what has been termed a "forensics" approach, to preempting accidents. The more complete data, coupled with advanced analysis, help us find emerging threats and identify precursors — precursors that could be buried in terabytes of safety data. This gives us advance warning and a tremendous advantage in preemptively managing risk.

Years ago, Jerry Lederer said, "Risks are ever-present, must be identified, analyzed, evaluated and controlled." In today's interconnected world — with far greater demand and vastly increased complexity — Lederer's guidance is more prescient than ever. The aviation community must manage risk. It is imperative that we manage risk together.

Courtest FSF AeroSafety World

How slow can you go?

HUMOR

It seems that it was a very busy day and a "good ol' boy" American (Texas-sounding) AF C-130 reserve pilot was in the instrument pattern for landing at Rhein-Main. The conversation went something like this…

Tower: "AF1733, You're on an eight mile final for 27R. You have a UH-1 three miles ahead of you on final; reduce speed to 130 knots."

AF1733: "Rog-O, Frankfurt. We're bringin' this big bird back to one-hundred and thirty knots fur ya."

Tower (a few minutes later): "AF33, helicopter traffic at 90 knots now one-and-a-half miles ahead of you; reduce speed further to 110 knots."

AF1733: "AF thirty-three reinin' this here bird back further to 110 knots"

Tower: "AF33, you are three miles to touchdown, helicopter traffic now one mile ahead of you; reduce speed to 90 knots"

AF1733 (sounding a little miffed): "Sir, do you know what the stall speed of this here C-130 is?!"

Tower (without the slightest hesitation): "No, but if you ask your co-pilot, he can probably tell you."

Fumes event

On 23 November 2007, a Boeing Company 767-338, registered VH-OGG, departed Sydney, NSW at 1426 Eastern Daylight-saving Time for Melbourne, Vic. The flight was a scheduled passenger service and on board were two flight crew, seven cabin crew and 255 passengers.

At about 12455, a passenger reported to a flight attendant that he could smell fumes coming from a gasper air vent above his seat. The passenger later reported that the fumes smelled like jet exhaust. The passenger became unconscious, and was administered oxygen and regained consciousness within a few seconds. A second passenger in the area also reported feeling nauseous at the time. The flight crew declared a state of urgency to air traffic control and began performing the 'Smoke or Fumes – Air Conditioning Melbourne Airport at 1529.

No other passengers or crew reported any adverse effects from the event. The two affected passengers had travelled extensively by air with no previous adverse effects from the event. The two affected passengers had travelled extensively by air with no previous adverse reactions and the investigation could not determine whether the passengers' symptoms were as a result of fumes in the aircraft cabin, or some other unidentified medical conditions.

The investigation identified a non-contributory safety issue related to the adherence to curing times following application of corrosion inhibiting compounds in the aircraft's cargo bays on 22 November. The operator's procedures for the application of the compound did not completely and unambiguously specify the curing time required to prevent fumes. In addition, the maintenance records for the application of the compound did not show any requirement for a curing time to be met. As a result, there was no assurance that sufficient time would be allowed.

The operator reported that it will revise maintenance manuals covering the application of corrosion inhibiting compounds to clarify the corrosion inhibiting compounds curing times.

Navigation event

On 11 January 2007, at about 0718 ED-ST and Airbus A320 aircraft, registered ZK-OJB, departed at Sydney Airport, NSW for Auckland, New Zealand and was assigned a radar heading by Air Traffi c Control (ATC).

The controller noticed that the aircraft turned onto an incorrect heading and informed the flight crew. A check of the aircraft's compasses by the flight crew found that they were reading approximately 40 degrees incorrectly, and that a GPS PRIMARY LOST message had appeared on the aircraft's multi-purpose control and display unit and navigational display. The flight crew advised ATC that the compass was unserviceable and that they were experiencing navigational difficulties. In addition, they believed that the aircraft's Instrument Landing System was affected.

The flight crew elected to return to Sydney and ATC provided radar vectoring in order to allow for a reduction in the aircraft's fuel load and, as a result, for a landing below the aircraft's maximum landing weight. The aircraft remained in visual meteorological conditions and was radar vectored for a visual approach and landing.

When the aircraft returned to the departure gate, the flight crew noticed that the inertial reference system (IRS) had been aligned to the incorrect longitude. The operator's investigation into the incident found that the IRS was aligned by maintenance staff prior to the crew boarding the aircraft. The incorrect alignment of the IRS was not noticed during a number of subsequent checks prior to departure.

The maintenance action to align the aircraft's (IRS), although not mandated, was in accordance with the operator's documented procedures. The reason for the input of incorrect position data in the IRS could not be determined.

The investigation was unable to determine why the incorrect positional data remained undetected by the flight crew, despite the four separate pre-take-off procedural defences.

As a result of this incident, the operator developed a training program for all company pilots that was designed to improve discussion and guidance in relation to threat and error management issues. VFR.

On Health

HOW I QUIT

"I smoked two packs a day from the time I was 16. It was a security blanket for me. But I began to feel bad about myself because I was such an addict—always thinking about the next smoke. I knew it was making me sick—sinus infections, sore throats, a cough. Mornings, it felt like a weight was on my chest.

So I quit. Cold turkey. For two weeks I felt sad. Moody. Cranky. I couldn't concentrate. I snapped at people.

Then it all stopped. I was OK.

But I felt I needed something. So I carried hard candies in my pocket to pop in my mouth. Whenever I had a yen for a smoke, I reminded myself of all the things I hated about smoking.

The biggest reward was that my self-esteem became so much better. Now I don't need a cigarette to make everything OK.

- Patricia

LETTER TO ANN LANDERS

Dear Ann:

I am 50 and I'm overweight. I've had high blood pressure for the last five years. In that time, I've seen two gynecologists and two internists. All noticed that I had hypertension. The last doctor decided to treat it with daily medication.

Although all of these doctors were "concerned," not one of them—including the doctor who prescribed the medication—bothered to tell me that the simple act of losing 10 pounds could significantly lower my blood pressure.

Why would four doctors fail to tell an overweight patient with high blood pressure that she should lose weight? I had to find this out on my own, reading articles. Well, I lost 10 pounds and my blood pressure is now normal—without medications and without their side effects.

Please alert your readers to this "sin of omission."

THE 13 VITAMINS

There are 13 true vitamins: A, C, D, E, K, plus 8 B vitamins (B1 or thiamin, B2 or riboflavin, B3 or niacin, folic acid, pantothenic acid, biotin, B6, and B12.

If you look at the internet, you'll find marketers who have "invented" some bogus ones: vitamins, F, O, P, T, U, and B17, with claims to cure whatever ails you.

ANGER & BLOOD PRESSURE

If you get angry easily, you might want to consider an anger management course for your health's sake. A study in Health Psychology found that men who had coronary heart disease and scored high on scales measuring anger and hostility significantly lower their blood pressure after taking an 8-week anger management course.

CALCIUM TWICE A DAY

If you are taking more than 500 milligrams of calcium supplements a day, take half in the morning and half later in the day to improve the rate of absorption. Also, calcium supplements are absorbed better if taken with a meal.

CHARCOAL

Charcoal should never be burned inside your home, car, tent or camper—even if you think there is adequate ventilation. Carbon monoxide fumes have no odor and they can kill without warning.

Beware of bringing a grill with smoldering charcoal inside. Wait until charcoal is completely extinguished.

CAN'T PUNCH OUT AGGRESSION

Some people think that they can work out their aggression on a punching bag. But a recent study published in the Journal of Personality and Social Psychology challenges that notion. When 360 college students tried dispelling their pent-up feelings on a punching bag, they found their aggression increased.

COTTAGE CHEESE

Cottage cheese has only 25% to 50% of the calcium of milk as the curdling process results in the transition of calcium into the whey which is drained off.

THE PERFECT CURL

The curl is the basic exercise for developing the biceps. It seems so simple to do, but John Graham, an exercise physiologist in Allentown, PA, says most don't do it right. Here's his technique for the perfect curl (using dumbbells):

1. Start with light dumbbells (each one at 10% of your weight). Stand straight, feet in line with your shoulders. Press your elbows against your rib cage. Palms should face straight out; your shoulders, elbows and wrists aligned. (If you have back problems, do this while seated.)

2. Keeping your back straight and your elbows pressed against your rib cage, slowly begin curling the right dumbbell up. Don't twist the dumbbell as you curl it. "If you rotate, you are using more momentum than muscle," says Graham. (If you can't lift the dumbbell past the midpoint without moving your elbow or leaning back, it's too heavy.)

3. Raise the dumbbell s-l-o-w-l-y moving slightly above your chest without letting your elbow move forward. Then squeeze your biceps muscle. It should take 4 seconds to reach the top. Look straight ahead as you curl; do not look down as it will hunch your shoulders forward, making the curl less effective.

4. S-l-o-w-l-y lower the dumbbell all the way, taking a full 4 seconds to do it. Then repeat this process with the left hand. Do not begin the left hand until the right hand has fully completed the curl and returned to its starting position. When you can do 3 sets of 13 repetitions, go to the next heavier weight.

NOT ALL FAT BAD

Not all fat is bad. In fact, some of it is good. Monounsaturated fat (monos)—found in olive oil—has been shown to lower blood cholesterol and perhaps reduce the risk of breast cancer and high blood pressure. But olive oil isn't the only source of this beneficial fat. Here are some others:

Food	Monos (gm)
Olive oil	(2 Tbsp) 20
Canola oil	(2 Tbsp) 16
Dry roasted pecans	(2 Tbsp) 11
Dried pistachios	(2 Tbsp) 9
Toasted almonds	(2 Tbsp) 9
Chunky peanut butter	(2 Tbsp) 7
Dry roasted cashews	(2 Tbsp) 5
Dry roasted peanuts	(2 Tbsp) 4

Courtest Aviation Medical Bulletin