ASRS Directline

Fall 1991

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The Aviation Safety Reporting System
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Welcome to *ASRS Directline*, a quarterly safety digest by the analysts of NASA's Aviation Safety Reporting System. Our inaugural issue (Spring 1991) was well received, and with this issue we begin regular quarterly publication. *Directline* is intended to meet the needs of operators and flight crews of complex aircraft, and of ATC personnel who are looking for insight into more effective interaction with these operators. As with most safety information, we believe those in general aviation will find that *Directline's* information is applicable and beneficial to their operations as well.

Articles contained in *Directline* are based on ASRS reports containing issues that have been identified as significant by ASRS analysts. Distribution is directed to managers and management personnel, safety officers, and training and publications departments. Because our job and our interest is aviation safety, we encourage editorial use, reproduction, and distribution of *Directline* articles—we merely ask that you give credit to the ASRS and to the authors.

Here are the articles in this second issue of *ASRS Directline*.

That rounds out this issue of *ASRS Directline*. To make suggestions for future issues, or just to tell us what you think about this safety newsletter, fill out and send in the Comments sheet at the end of this newsletter. (There's an order form for ASRS Publications and the *CALLBACK* subscription too.) We look forward to hearing from you.

— Charles Drew, *ASRS Directline* Editor

International Altimetry

by Perry Thomas

The use of **Hecto Pascal** or **Millibars** by some countries has, on occasion, caused experienced international flight crews (who are accustomed to inches of mercury) to misset their aircraft altimeters.

Europe

"[A] three-man, wide-body type aircraft flight crew experienced in European operations" was engaged in a difficult (9 degrees drift over water in heavy rain) VOR–DME approach to an MDA of 420 feet. The transition altitude had been 4,000 feet so the experienced, but weary, flight crew was late receiving ATIS, reducing the time available for completing their landing data. QNH was given as nine-nine-one.

The first officer was flying the approach and the captain called 1,000 feet MSL in descent. Shortly thereafter, the second officer called *"300 feet radar altitude—go around!"* A missed approach was flown and the *"captain questioned the tower about altimeter setting…29.91 …this was confirmed. A second voice, however, corrected that statement to 991* ***millibars****"* [emphasis added].

The aircraft's altimeters were reset from 29.91 to 991 millibars—**a 640 foot difference**. The flight crew later calculated they had come within 160 feet of hitting the water.
(See the altimeter graphics on page 4.)

Was this merely an isolated incident? Here is a second occurrence from the other side of the world.

The Orient

It was the end of a long overwater flight. *"Approach control gave the altimeter as 998 hectopascal. I read back 29.98. [The] approach controller repeated his original statement. Forgetting that our altimeters have settings for millibars and hectopascal (which I had only used once in my career, and that was 6 months ago), I asked where the conversion chart was. 'Old hand' captain told me that approach [control] meant 29.98. Assuming that he knew what he was doing, I believed him. We were a bit low on a ragged approach and I knew we were awfully close to some of the hills that dot the area…but it was not until we landed and our altimeters read 500 feet low that I realized what had happened."*

Quotes from Other ASRS Reports

"Never having used mb before, the significance of 971 mb wasn't apparent to me until I read the equivalent Hg 28.68."

"Dealing in millibars did not make an impression…[because of] the very low [atmospheric] pressure."

The *"copilot who had copied the ATIS gave me 29.97 when I asked for QNH. Gusty winds and [the controllers] thick…accent weren't helping things. [Obstructions] seemed unusually close to our altitude. [The] copilot had assumed 9-9-7 to be 29.97. "* (500 feet low.)

"[Given] altimeter of niner-seven-eight hPa. The hPa was somewhat muted. We set 29.78 [inches]." (900 feet low.)

Factors

Several human and procedural factors appear to increase the possibility of misset altimeters in international operations.

Fatigue

International flights from the United States are generally of long duration through several time zones. The element of fatigue in long distance flights is inescapable.

Workload on Approach

Transition from standard altimeter setting flight levels (QNE) to sea level altimeter setting altitudes (QNH) are generally much lower than in the United States. Obtaining altimeter settings and landing data closer to the approach segment complicates the task of preparing data for landing at the very time the flight crew may be most fatigued.

Language Difficulties

Rapid delivery of clearances coupled with unfamiliar accents, and contraction of hPa (hectopascal) or mb (millibars) increase the potential for error. This also must be true of flights arriving in the United States from other countries. Other flight crews communicating in their native tongues contribute to a lack of awareness of what other traffic is doing.

Communication Procedure

Only *one* person receiving the approach and landing data, and passing that information to the rest of the crew means that a misconception or misunderstanding is less likely to be detected until too late.

Cockpit Management

There is often inadequate crew briefing for approach and landing with no mention of how the altimeter setting will be expressed—that is, Hg, mb, or hPa. Flight crews also may not adequately review approach charts for information. Some airlines do not provide the second officer with approach plates; unless he or she makes an extra effort to look at one of the pilot's charts, the altimeter setting standard may be unknown.

Experience Level and Currency

At least one airline experiences a constant turnover in the international group as senior pilots retire and other crew members bid off international schedules to upgrade to captain or first officer. Many of the international reports submitted to ASRS mention that at least one flight crew member is new to the operation. Airline training is usually reported as being adequate, but some of the training for international operations may not be used or need to be recalled for months after the training is received.

The Question of Q's

We all tend to forget things we either have not used in a while, or we don't use very often. For those of us who need a memory refresher, here are three important "Q" altimeter settings:

QNE: The standard altimeter setting of 29.92 inches of mercury (the contraction is Hg.), or 1013.25 hectopascal (hPa for short), or 1013.25 millibars (use mb). See the sidebar on the next page titled "**What's a Pascal?**" to find out why hPa and mb are the same.

- ON THE GROUND—a variable elevation reading that is above or below actual elevation (unless the station pressure happens to equal 29.92 Hg).
- IN THE AIR—positive separation by pressure level, but at varying actual or true altitudes.

QNH: Height above sea level when corrections are applied for local atmospheric pressure that is above or below the standard altimeter setting of 29.92 Hg. QNH is the altimeter setting provided in the ATIS information and by ATC.

- ON THE GROUND—the actual elevation above sea level when the aircraft is on the ground.
- IN THE AIR—the true height above sea level (without consideration of temperature).

QFE: An altimeter setting that is corrected for actual height above sea level and local pressure variations

- ON THE GROUND—**zero** elevation when the aircraft is on ground. Thus, for an aircraft at the gate at Denver (actual airport elevation above sea level–5333 feet), the aircraft altimeters would read **zero** if set to QFE.
- IN THE AIR—the height above ground (without consideration of temperature).

The "Q" codes referred to here may be found in the Tables and Codes section of the Jeppesen Sanderson airways manuals.

International Altimetry *continued…*

Recommendations

- Review approach charts prior to the descent, approach and landing phase. Each flight crew member should pay particular attention to whether altimeter settings will be given in inches (Hg), millibars (mb), or hectopascal (hPa).
- Use precise radio phraseology; confirm with ATC any radio communication that is not fully understood. Radio phraseology considered standard in one country may not be accepted or understood in another.
- Keep more than one flight crew member in the communications loop—including ATC clearances and ATIS messages.
- Practice good cockpit management technique. Include in the approach briefing how the altimeter setting will be expressed.
- Observe proper crew coordination. Flight crews need to cross check each other for accurate communication and procedure. Question anything that does not seem right.

Some of the aspects involved, such as fatigue, will be more difficult to overcome. Implementing sterile cockpit procedures, avoiding distractions during periods of high cockpit workload, and getting adequate crew rest and nourishment will help to avoid those famous last words…**I ASSUMED**.

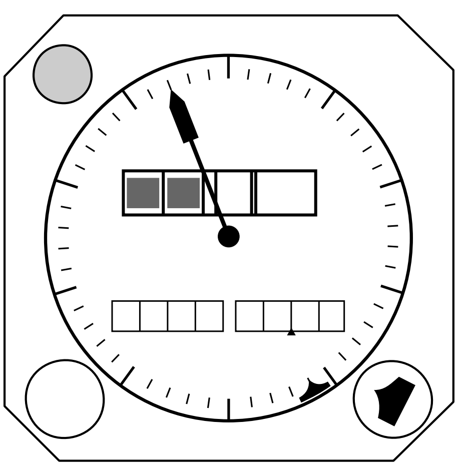
What's a Pascal?

The term "hectopascal" is derived partly from the name of a 17th century philosopher and mathematician, and partly from the Greek.

Blaise Pascal was born in 1623 in France. A youthful genius in mathematics, at age 21 he developed and built the first digital computer. Pascal's Law of Pressure was developed in 1647 and is the principle that created hydraulic lifts, and eventually the hydraulic brakes in our automobiles. Using Evangelista Torricelli's work on the principle of the barometer, Pascal developed his own method of measuring barometric pressure.

Hecto is an irregular contraction of the Greek word for hundred from the metric system of measurement—hence hectopascal, often abbreviated to HP or hPa. In common usage, one hPa equals one millibar.

What the flight crew saw…

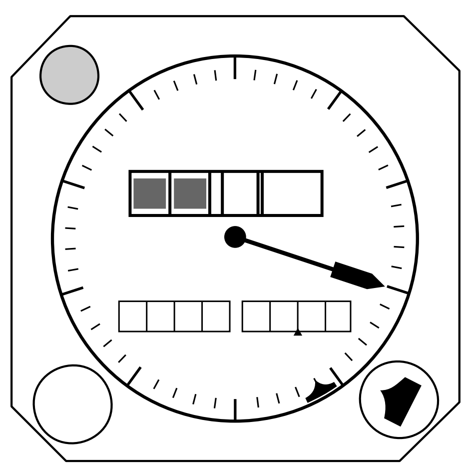


with the altimeter misset to 29.91".

The non-precision approach had an MDA of 420'. The graphic on the left is what the flight crew saw with a misset altimeter.

The graphic on the right shows that they were actually 120' below MDA at the point of the go-around. When executing a non-precision approach, it is common practice to use a higher rate of descent than for an ILS, thus by the time that the aircraft's descent rate was arrested, they had descended as low as 160' above the surface.

But at a setting of 991 hectopascal,



they were 120 feet below the MDA!

One Zero Ways to Bust an Altitude
…*Or Was That Eleven Ways?*

by Don George

Here I am, the PIC (Passenger In Coach) on a coast-to-coast wide-body, cruising along at flight level 350. I'm in Seat 25B (one of the cheap seats), feeling fairly comfortable after recovering from an earlier 1/2 incident which involved the guy in 24B suddenly tilting his seat to the full recline position and spearing me with my very own tray table. In any decent football league, that would have been a 15-yard penalty, but I didn't even get an "excuse me."

No cracked ribs, so I try to relax, but I can't because now I'm already worrying about the fact that we will have to descend in a couple of hours, and I know from reading a lot of ASRS reports that our chances of getting down through 11,000 and 10,000 feet without an incident are pretty remote. I conjure up in my mind a scenario which runs like this…

Controller will say, *"…descend and cross three zero miles west of Gulch VOR at one-one-thousand, reduce to two five zero knots, report leaving flight level two zero zero, Podunk altimeter three zero zero five."* With all those zeros now implanted into the flight crew's heads, one of them will read back *"Descend to one-zero-thousand"* along with the other values, and the controller will fail to note the wrong altitude in the readback.

Shortly thereafter, we will change over to Approach Control and report *"…out of one eight thousand for one-zero-thousand."* Again a busy controller will miss the incorrect altitude.

As we start to level off, the controller sees our altitude readout, questions us, and tells us to climb back up to one-one-thousand, where we belong. At the same time, there are a couple of departure aircraft heading in our direction, also at 10,000 feet. We evade them by making some steep turns and climbing rapidly. Not much harm done except a few spilled drinks, and the possible creation of some future paperwork.

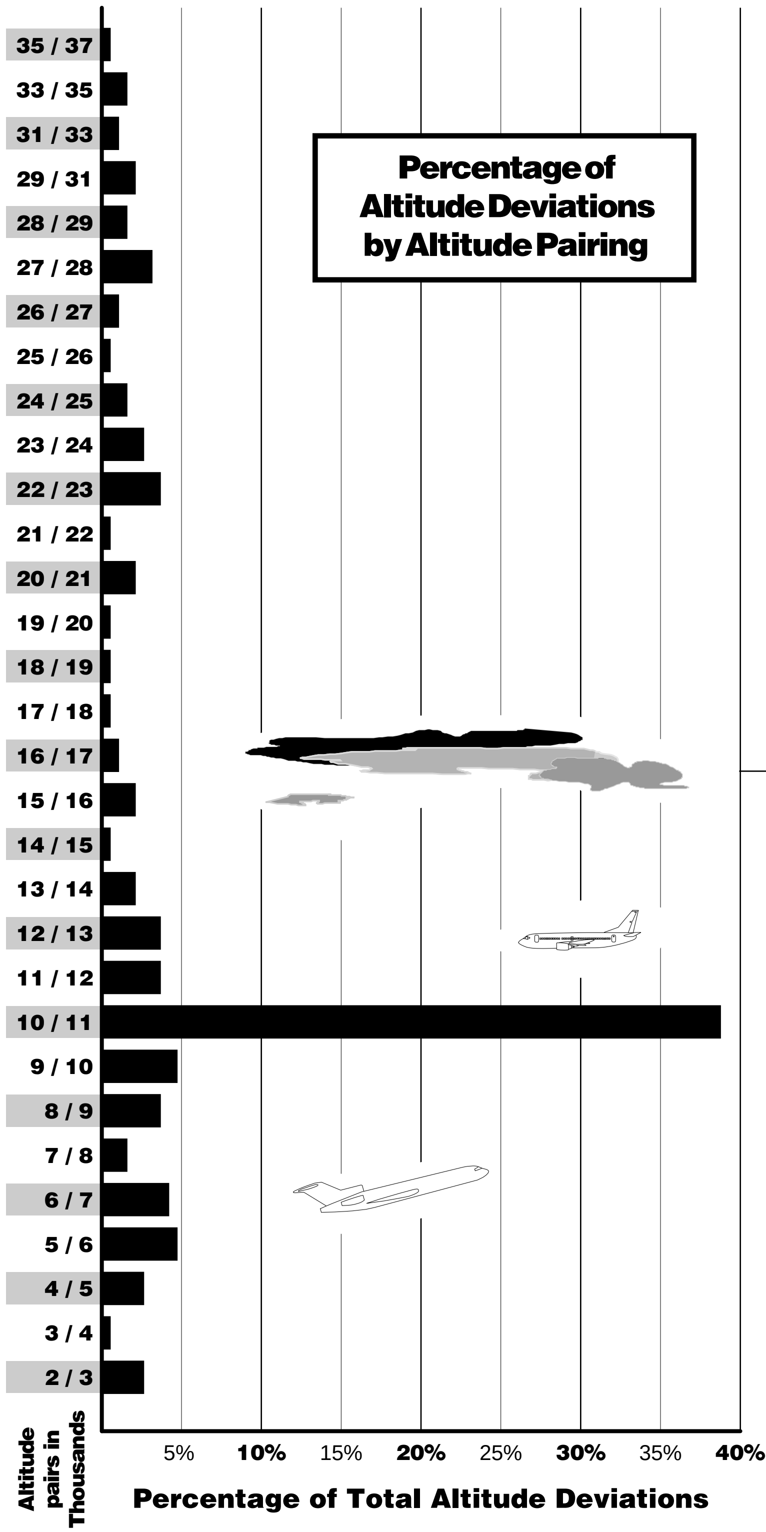
Pretty soon, I hear the announcement for flight attendants to prepare for landing. This is the favorite part of the trip for me because it means that the guy in 24B must put his seat back into the upright position, and it also indicates that we have gotten down through 11,000 and 10,000 feet without hitting another aircraft. Both of these occurrences allow me to breathe a lot easier!!!

Okay…so I made up all this stuff about the guy in 24B, and the dogfights with other aircraft, but it all could have really happened, because seriously, there is a real life 10K/11K problem, and I wanted to get your attention so that we could talk about it.

Why do a lot of altitude deviations occur at 10,000 and 11,000 feet?

Contributing Factors

In the preparation of this article, I reviewed hundreds of ASRS reports which involved a mix-up with these two altitudes. The reports reveal several causal factors which show up in nearly all of the incidents. I'll review those factors here; however, bear in mind that the incidents do not usually occur as a result of a single causal factor. They almost always reflect a combination of two or more of the following factors.



Similar Sounding Phrases

Pilots misunderstand the clearance, and controllers misunderstand the readback due to the similar sounding phrases of one-zero-thousand and one-one-thousand.

> *"I believe it is very easy to confuse one-one-thousand with one-zero-thousand, and vice-versa."*

> *"I don't know if the controller said 10,000 but intended to say 11,000 or if he said 11,000 and I thought he said 10,000."*

Readback/Hearback

Controllers fail to note incorrect altitude in pilot readbacks. The old hearback bugaboo…

> *"Voice tape reading showed that the clearance was to 11,000 feet, but readback by [the] captain of 10,000 feet went uncorrected."*

> *"Controller said 'Oh, I should have checked your readback.' "*

Analysis of the ASRS database indicates that there are far more clearance misinterpretations involving the altitude pair of ten/eleven thousand feet than any other altitude combination—**fully 38 percent** of the sample data set. The next largest category accounted for less than 5 percent of the total deviations in this data set.

The sample data set on which this finding is based is composed of 191 ASRS reports describing incidents with the following characteristics: (1) an assigned altitude was overshot or undershot, (2) a misinterpreted clearance contributed to the occurrence, (3) the event occurred between 1987 and 1990, and (4) the deviating aircraft attained an altitude 1000 feet, (or 2000 feet above FL 290) above or below its assigned altitude. The search was confined to ASRS Full-Form records since only these contain all of the necessary data elements.

The adjacent figure is based on an analysis of these data. Each category relates to a pair of altitudes that were confused with another, leading to an altitude overshoot or undershoot on either climb or descent.

Too Many Numbers

Controllers include several (sometimes, too many) numbers in the same radio transmission.

> *"The controlling agency, in rapid manner, told us to turn to 310 degrees, slow to 210 knots, and I understood him to say 'maintain 10.' "*

> *"Very often controllers issue four to five instructions in the same breath, such as 'turn left 330 degrees, maintain 2000 feet till established, cleared for ILS 30 approach, contact tower 119.4 at the outer marker, and maintain 160 knots until five mile final.' "*

Similar Numbers

Altitude crossing points stated in miles may be similar to the altitude to which the flight is cleared.

> *"Were we cleared to 10,000 feet 11 miles west of ARMEL, or 11,000 feet 10 miles, or 10,000 feet 10 miles, or 11,000 feet 11 miles?"*

> *"Center cleared us to cross 10 DME NE PVD 11 thousand, 250 knots. I read back 11 miles NE PVD 10 thousand, 250 knots. At 10,100 feet I questioned center, and they said 10 north east at 11 thousand, 250 knots. We climbed back up to 11,000 feet."*

250 Knots at 10 Thousand

Pilots tend to associate a 250 knot speed restriction with a 10,000 foot altitude assignment, since civil aircraft are normally restricted to a speed of 250 knots or less below 10,000 feet.

> *"A clearance for 250 knots generally makes a pilot think about 10,000 feet due to the association of 250 knots below 10 thousand."*

> *"We think the 250 knot restriction could have led us to assume 10,000 feet because the majority of locations use 10,000 feet/250 knot crossings in their STAR's [Standard Terminal Arrival Routes]."*

Spring Loaded

Pilots may anticipate receiving a certain clearance, but get something just a little different. Perhaps the last SID or STAR they executed had speed and altitude crossing restrictions that were similar, but not exactly the same as the one they are currently flying.

> Noted an air carrier pilot who initiated a premature descent to 10,000 feet from 11,000 feet: *"I may have anticipated being given 10,000 feet after seeing [an air carrier aircraft] pass below me."*

Failing to Question the Unusual

Pilots may, or may not, be familiar with normal ATC procedures in a particular area, and in either case, neglect to question an abnormal altitude assignment.

> *"Next time in and out of DEN we will be aware that the inbound aircraft are normally at 11,000 feet and departure aircraft normally restricted to 10,000 feet."*

> *"The usual clearance for this arrival is 11,000, but we both followed my error blindly to 10,000 feet."*

The *Ten* Mindset

Pilots and controllers get what is referred to as a "number ten mindset" after hearing a lot of zeros. It seems like one-zero-thousand then becomes the altitude assignment.

> *"I **do** think the number of tens in the clearance was a contributing factor."*

> *"Flight crew read back 'one-one-thousand', but somehow had mindset of one-zero-thousand."*

Reduced Monitoring

Cockpit duties and distractions result in only one flight crew member monitoring the ATC frequency. Similarly, controller workload and frequency congestion are factors which affect the ability of controllers to closely monitor pilot readbacks.

> *"This type of situation has occurred with this crew member 3 or 4 times since flying two man crew aircraft when one crew member is busy reviewing approach plate and procedures and is distracted from hearing conversation between [the] other crew member and controller."*

Cockpit Management

Cockpit management and flight crew coordination may be less than optimum, and crew members fail to adequately monitor each other in such tasks as altitude alert setting or readback of clearances.

> *"Center cleared our flight from 17,000 feet to 11,000 feet MSL. This was acknowledged by me, however the first officer understood 10,000 feet and placed that altitude in the selector."*

> *"I will have to watch the music closer while the other guy is playing the piano."*

Radio Technique

Very often controllers and/or pilots fail to use proper techniques. I consider this to be the "big one" when it comes to causative factors. Yes sir, old number one-one (that's eleven) is a really critical factor.

> *"The controller was busy, a lot of traffic. Contributing factors: Fast talking, bad radios, long clearances, a lot of numbers—given too fast to comprehend or write down."*

> *"I don't know who was correct, but I know that I was incorrect in not requesting a confirmation of the clearance, since some doubt existed."*

Confusing Phraseology

Controllers and pilots are frequently misunderstood due to their use of improper phraseology.

> *"We had understood and read back 'descending to 10,000.' Phraseology contributed to this incident."*

> *"To correct future problems like this, the altitude should be given in the form of 'ten thousand' or 'eleven thousand', instead of saying 'one-zero', or 'one-one-thousand.' There is too much of a chance of error. We are used to hearing ten, or eleven, or twelve in everyday life."*

So...What are you going to do about it?

Here are a few starter suggestions.

Corrective Measures

Saying it Twice—Differently

Controllers and pilots are encouraged to use both single digit and group form phraseology in order to reinforce altitude assignments whenever there is the possibility of misunderstanding. Consider the following examples.

Controller transmission*: "(Ident) descend and maintain one-zero-thousand, that's* ***ten*** *(with emphasis) thousand."*

Pilot transmission*: "Roger (callsign), leaving one-seven-thousand for one-one-thousand, that's* ***eleven*** *(with emphasis) thousand."*

Note: Recent Air Traffic Procedure 7110.65 Handbook change allows controllers to use this phraseology to reinforce an altitude assignment. Many "old" pilots have used the technique for a long time and find that it helps.

Radio Technique

Take a good hard look at your radio communication techniques. Do you check to make sure the frequency is clear before transmitting? Do you activate transmitter **before** starting to speak? Do you use full and correct callsign? Do you use an acceptable speech rate? Do you enunciate, and emphasize when necessary for clarity? Do you ask the other party to repeat if transmission was not clear, or may have been stepped on? Do you listen up for similar callsigns?

These are just a few of the questions you should ask yourself. I'm sure you can think of many other good technique questions.

Area Familiarity

Pilots should work to improve their "situational awareness" skills. For instance, you often fly in the Dallas/Ft. Worth area and have observed that normally the departures are restricted to 10,000 feet, and the arrivals are held up to 11,000 or higher until arrival and departure routes have crossed. You probably should question any altitude assignment which appears to be in conflict with these normal ATC procedures. Most terminal ATC facilities utilize standard routes and altitudes, and your situational awareness can help prevent an incident.

Reduce the Number of Numbers

Controllers can help make a conscientious effort to defeat the hearback problem, by being aware of the nasty effects of including too many numbers in the same transmission, and by using named intersections rather than number of miles when issuing crossing restrictions. (If necessary, consider changes to local procedures or to letters of agreement.)

Summary

Let's take a final look at some of the reasons for the 10 thousand/11 thousand altitude problem. Factors include:

- Similarity in the sound of one-zero and one-one-thousand, particularly when other numerical information is being transmitted at the same time.
- Pilots may be spring loaded to expect a 250 knot airspeed in conjunction with a 10,000 foot altitude, thus a clearance for an airspeed of 250 knots may lead the flight crew to mistakenly assume an altitude requirement of 10,000.
- Failure to question an unexpected or unusual clearance; anticipating 10 when hearing a lot of zeros; flight crew and controller distraction; and breakdown in cockpit management.
- The 10K/11K quandary seems to be rooted in confusing phraseology and improper radio technique—compounded by the Readback/Hearback problem.

The solution to the 10K/11K problem lies in realizing the potential for error when descending or climbing through or near the 10,000 and 11,000 foot boundaries, and using *both* single digit and group forms to express these altitudes. Be prepared to question a clearance that seems unusual. If pilots and controllers use clear, concise radio technique, paying particular attention to the hearback phase, the potential for error will be reduced.

An Invitation

No doubt there are a good many readers of this article who are actively engaged in training activities, and you may want to consider this problem as the subject of a lesson or two. If you are interested in obtaining a small package of ASRS reports (about 20) on which to base training sessions, please call or write ASRS and request the 10K/11K Report Package. It will be sent at no charge.

What Goes UP …
…Must Come DOWN

by Bill Richards

A three-engine wide-body air carrier aircraft climbing to flight level 410 experienced a compressor stall and had to shut down an engine just prior to level off. The flight crew *"…advised center [that they were] descending, [had] shut down an engine, and need[ed] 24,000 feet."*

The controller cleared the stricken aircraft for a descent to flight level 370, but the flight crew *"…advised twice we had to get down [to yet a lower altitude]."* Due to traffic at flight level 350, the controller was unable to approve their request, and so stated. The flight crew kept repeating their request for lower (altitude) and the controller kept repeating that he was *"unable."*

Controller's Dilemma

It is well publicized that air carrier aircraft will fly very well with one and, in some cases, two engines shut down. What is not made clear is that this is not true at higher altitudes such as thirty-seven thousand feet, thus it is possible that the controller did not realize the urgency of the need for a lower altitude. It is, however, more likely that the controller fully understood the seriousness of the flight crew's situation, but the controller's hands were tied.

An air traffic controller's primary function is to maintain certain minimum separation standards between aircraft. The controller was undoubtedly trying to provide the requested descent clearance as quickly as possible, but until he could clear traffic from below the troubled aircraft, the flight could not be issued a clearance to descend. An air traffic controller cannot issue a *clearance* that will result in a loss of standard separation, but can and will provide assistance in the form of traffic point-outs and/or recommendations intended to increase separation *between* conflicting traffic.

Meanwhile, the flight crew had lost control of their airplane. Minus the power of the failed engine, they were descending and there was nothing they could do to prevent it. This was certainly an emergency situation, yet the crew never declared an emergency. The controller was finally able to vector the traffic out of the way and to clear the stricken aircraft for a continued descent, but by this time the aircraft had already descended slightly below flight level 370.

Emergency

I won't speculate why the flight crew didn't declare an emergency; however, they may have neglected to properly assess the effect of their descent on other traffic in the vicinity and thus ATC's potential difficulty in maintaining traffic separation. Given the declaration of an emergency, the controller could have pointed out conflicting traffic to all involved, and provided traffic advisories even though a loss of standard separation might result from the flight crew's actions.

A Different Twist

In another incident, a trans-Atlantic wide-body aircraft was forced to descend and reverse course after shutting down an engine. The flight crew advised the Center controller of the nature of their problem, requested a lower altitude, and stated they wanted to return to their departure airport. They made their situation, intentions, and altitude capability very clear. They also **declared an emergency**, but for some reason, Center did not acknowledge their declaration of an emergency. The crew began the "Contingency Procedure," announcing their intentions in the blind to all other traffic. Center was *"…a bit slow at re-clearing us back towards [the departure airport] thereafter."*

Upon changing to the next Center sector an hour later, the flight crew discovered that Center was treating the whole thing as a routine change of destination and that *"no emergency existed in the ATC view."* In this case, no apparent conflicts arose. It can only be assumed that had Center understood that an emergency had been declared, their service would have been much more prompt. As with all ATC/aircraft communications, if a flight crew is not sure that a transmission or request has been properly understood, they should repeat their message and make sure that they receive a proper acknowledgment. In this instance, the fact that the flight was over water and using high frequency (HF) radio surely added to the breakdown in communications. Nonetheless, the flight crew must share the responsibility for accuracy in the information exchange.

The Pilot's Toolbox

There seems to be great reluctance among pilots to declare an emergency. It is not uncommon for reporters to the ASRS to indicate that they believe that declaration of an emergency will bring the wrath of the FAA down upon them and cause them innumerable hours of tedious paperwork. FAR 91.3(c) states that "Each pilot-in-command who deviates from a rule under paragraph (b) of this section shall, *upon the request* of the Administrator, send a written report of that deviation to the Administrator." In most cases, the Report of Irregularity that the Captain has already written for his company supervisors should provide all the information the FAA might need, and no further paperwork would be required.

When determining if an emergency condition exists, flight crews need to consider the implications of their potential inability to conform to ATC instructions. Emergencies should not be frivolously declared, of course, but declaring an emergency is something in the pilot's "toolbox" that can be put to use if it is needed. ***Don't overlook it.***

Weather Deviations

Between a Rock *and a Hard Place*

by Ed Arri

Each year both pilots and controllers are confronted with weather-related problems that have a significant impact on the safety of flight, and on the air traffic system as a whole. Pilots want to deviate around build-ups they see and/or observe on their airborne weather radar as “red cells.” In the face of weather mandated route or altitude changes, the controller must maintain standard separation from other aircraft. Pilots frequently blame controllers for not understanding their need to deviate. Controllers, on the other hand, believe pilots have little idea of what is involved in granting such requests and the subsequent impact on other traffic.

Different Jobs, Different Viewpoints

The air traffic control system is designed to handle a large number of aircraft within a highly standardized route structure. Whenever weather becomes a factor, workload for both the pilot and controller are greatly increased. Since weather has little regard for the standardized route structure, the air traffic control system at that particular time and location demands non-standard remedies to reduce the negative impact on all aircraft. Controllers will, if they are able, approve deviations around the “red cells” for passenger comfort, and more importantly, for safety. Most of the time these deviations can be approved with minimal impact on the system; however, there are times when even slight deviations can create enormous problems for the controller. Adding to the control problem is the movement of the storm. It generally doesn’t stay in one place long enough for the controller to work out some sort of routine with other sectors/positions.

The pilot has relatively few options when it comes to avoiding severe weather. The forces of nature can be extremely nasty at times. The instinct for survival tells the pilot that the weather ahead is bad stuff, and must absolutely, positively, be avoided. When ATC approval for deviation is denied, solutions and alternatives must be communicated and worked out by both the controller and pilot. Of course, all of this is taking place while the aircraft continues to head toward the problem.

Controller's Perspective

Many reports received at ASRS from controllers indicate that weather deviations have been responsible for a loss of separation between aircraft, and have frequently resulted in the controller being charged with an operational error. What the pilot wants to do does not always conform to ATC handbook requirements, and occasionally is contrary to good ATC practices. Allowing pilots to deviate from standard routes greatly diminishes the controller's ability to effectively provide positive separation between aircraft—the separation provided by the standard route structure suddenly does not apply. Aircraft can easily enter the adjacent controller's airspace without coordination due to the sheer volume of traffic and distractions. There is little time to coordinate new headings and routes with other ATC facilities because of frequency and interphone congestion.

A controller may also be unable to stop other traffic from entering his/her airspace right away due to coordination requirements. Traffic flow can't be turned on and off like a faucet.

> One controller involved in an operational error reported that *"…at the time of the incident I was working 22 plus aircraft with extreme weather conditions causing deviations and altitude changes…frequency congestion was a factor…"* —a loss of separation occurred.

The more aircraft that are deviating, the more problems the controller must contend with; the controller's ability to provide positive control to all aircraft under extreme conditions may be compromised. It's like having a tiger by the tail and you're afraid to let go.

The controller does not have authorization to use less-than-standard-separation, except in emergencies. When confronted with situations that limit their ability to provide positive control to all IFR aircraft, controllers encounter an increased risk of operational error. Operational errors are taken very seriously by the controller and the FAA. They may result in the controller being "off the boards" from two days to two weeks, and sometimes longer while the investigation and recertification process is conducted.

Pilot's Perspective

The number one priority for the pilot is safety. A request to deviate around weather is based on known factors that tell the flight crew some sort of action is necessary to remain clear of the adverse weather conditions ahead—for the well-being of the aircraft and its occupants.

Pilots may believe that controllers do not appreciate the risks that confront pilots in heavy weather.

> One pilot who was not allowed to deviate around a thunderstorm system reported, *"…I believe the situation occurred because ATC procedures do not change with the changing weather…controllers should be given ground instruction in the effects of thunderstorms and windshears."*

Many pilots believe there should be enough flexibility in the system to handle these adverse situations. They feel that if coordination with the next controller is necessary to allow an aircraft to deviate around weather, then the controller should go ahead and do it. The pilot does not want to play twenty questions before the deviation is finally approved. The pilot may also be reluctant to declare an emergency when the request to deviate is denied. One reporter claims that a *"…request to squawk 7700 is an invitation to paperwork."*

Some Examples...

Restricted Airspace

An air carrier flight on an airway wanted to deviate to the left around a large thunderstorm, but the controller was reluctant because of a nearby restricted area.

> *"...we encountered a large area of thunderstorms on our route...[and]...advised Los Angeles Center that deviations would be necessary. We requested and had approved an easterly heading which would keep us north of the weather. Center appeared to be concerned that our required deviations might eventually cause a conflict with Edward's restricted airspace...while we continued to deviate to remain clear of weather, we told Center several times that we could not turn right...Center's only concern seemed to be to keep us away from restricted airspace...we now had weather on both sides of us...Center said we could not enter the restricted airspace. The Captain declared an emergency...we were then told by Center to 'turn hard right' because there was 'live rounds ahead'...we were in trouble and they were no help."*

Conflicting Traffic

A Center controller had aircraft deviating around thunderstorms during moderate to heavy traffic conditions. Two aircraft on conflicting courses were unable to comply with ATC instructions due to build-ups along their route of flight. A loss of separation occurred between the aircraft.

> *"...[The controller] told air carrier B to turn left 15 degrees, vector for traffic. Air carrier B refused to take the turn, saying it would put him right into a thunderbumper with tops at flight level 400. Radar man told air carrier A to make a left turn 15 degrees. Air carrier A said that would put him in the clouds...the radar man said 'one of you is going to have to turn, you're head on [at] flight level 370'...air carrier A said he would go left...but it became obvious it wasn't enough...[separation] was later measured to be zero vertical, 1.9 miles lateral, but on the scope it looked much less than that. I respect the pilot's wishes not to fly into the clouds, but I sometimes think they don't take us seriously enough. A cloud may be a better choice than another aircraft."*

A departing air carrier discovered thunderstorm cells on radar and requested deviations around them. The controller was unable to approve the request due to heavy departure traffic in front and behind.

> *"I noticed two thunderstorm cells on the radar...[and]...asked departure for deviations around the cells to the south. He told us 'unable.' We advised him that there was weather...and we needed to avoid it. He told us that there was a bunch of aircraft to our left, and he was unable to [approve a deviation] at this time...at about 5 miles the large cell was painting solid red 30 degrees on either side of the centerline of the scope...I asked the controller [again]...he said he would not, and to maintain our present heading...our heading was taking us into the center of the storm...at 3 miles from the storm, I told departure that we needed a 30 degree right turn...the controller seemed upset with us, but granted us a turn...then told us to descend to 3000 feet and that we had traffic behind us overtaking.... I can accept the fact that he was busy with traffic and weather re-routes, but my responsibility is for the safety of my passengers and aircraft."*

Reactions

The following comments indicate some typical reactions whenever requests cannot be granted by either the pilot or controllers:

> *"I believe the controller and his supervisor's attitude were extremely poor and very uncooperative, not to mention dangerous."* (Pilot)

> An operational error occurred *"Because [of a] vector to the west for traffic….this was the primary factor which caused me to lose lateral separation."* (Controller)

> *"The controller just did not understand the necessity to turn to avoid the thunderstorm."* (Pilot)

> *"Thunderstorms are extremely difficult to work with."* (Controller)

> *"Given the same situation [again], I would do it exactly the same way, and I [am] incredulous that any controller in his right mind would send any kind of aircraft through that kind of weather…."* (Pilot)

> Captain said:*"I never heard a controller turn aircraft into a thunderstorm."* Controller said:*"you won't hear anything in a couple of minutes when you meet the other aircraft."* (Both)

Weather Emergencies

ASRS reports indicate a reluctance on the pilot's part to declare an emergency whenever the "all else" fails. In the following report, the flight crew needed to deviate around thunderstorms, but the controller could not approve the deviation since it would take the aircraft into a restricted area.

> *"[Our request to]…deviate north to avoid thunderstorms was denied. A vector…was assigned…[however] a line of thunderstorms mandated a more southerly deviation. The controller became upset over our proximity to the adjacent restricted area and attempted to vector us into the thunderstorms and make us squawk 7700. Neither request was complied with…vectoring the flight south with the knowledge that the range in the restricted area was hot might have been the root problem. I don't see this as a big deal…."*

In another instance, a Center controller working aircraft with thunderstorm activity in the area approved a pilot's request to deviate, but due to the heavy concentration of aircraft and limited flexibility in the airspace, had to restrict where the aircraft could go.

> *"We observed a massive thunderstorm…weather radar was on and showed an extensive area of heavy precipitation and turbulence…we informed the Center that we would be unable to continue…because of the storm. We were told we could alter our heading right of [the projected] course, but do not proceed east…we informed Center that we would not be able to [comply on that heading] to avoid the storm condition…we were told again to not fly east…'under any circumstances.' We requested a higher altitude and were denied…we then requested a right…to circumnavigate the storm to the west, again denied. We were told that a left turn would be permitted. We informed ATC that a left was impossible because it would place [us in] the main intensity of the thunderstorm…our explanation was not accepted…an air carrier preceding us told ATC…that no one can get through…the PIREP was disregarded by ATC. We made a slight turn and just skirted the storm. Ice and turbulence was encountered…I told my First Officer if ATC instructs a further left turn to declare an emergency."*

Reducing The Impact

Timely communication can help the pilot avoid thunderstorms while still allowing the controller to provide separation from other traffic. Last minute requests are difficult to coordinate.

Pilots

- Don't assume that the controller knows where all the thunderstorm activity is located. Tell him what you want and what you *can do*, not what you can't do, when making your request.
- Plan ahead—give the controller as much notice as possible so that inter/intra facility coordination can be accomplished in a timely manner.
- The pilot is responsible for the operation of the aircraft and the safety of its passengers. Timely PIREPS can help the controller work with the pilot in accomplishing this by formulating a traffic plan in advance and relaying this information to other aircraft.

Controllers

- Controllers need to minimize last minute surprises by finding out exactly what the pilot has in mind when they request clearance to deviate. *Carte Blanche* approvals can lead to problems.
- Controllers too should plan ahead. Developing a good plan for future traffic flow, and letting flight crews know in advance what's going on will go a long way toward reducing conflicts and last minute surprises.

When All Else Fails...

- Since the controller is not authorized to go below minimum-required separation unless an emergency is declared, and will do whatever is necessary to insure that separation loss does not occur, the final decision on the course of action rests with the pilot.
- Pilots are reluctant to declare an emergency. However, in certain situations, there may be no other alternative available to the pilot. FAR 91.3(b) states that: "In an in-flight emergency requiring immediate action, the pilot-in-command may deviate from any rule of this part to the extent required to meet that emergency."

  The Airmans Information Manual (AIM), paragraph 441, states: "An aircraft is in at least an urgency condition the moment the pilot becomes doubtful about position, fuel, endurance, weather, or any condition that could adversely affect flight safety."
- Once the pilot declares an emergency, the controller can provide advisories and other services until the emergency situation no longer exists and normal radar or vertical separation can be reestablished.

Summing Up

Good planning by both the pilot and controller, an awareness of adverse weather conditions, effective communications, the willingness to endure a little paperwork, and mutual cooperation are the key elements to reducing the impact of being **Between A Rock *and a Hard Place***.

Last Leg Syndrome

by Bill Monan

One of the routine details frequently noted in pilots' incident reports submitted to the ASRS is the seemingly innocuous statement, *"This was the last leg of the flight."* Terminology in other reports varies only slightly: *"The last flight of the day," "the final leg,"* and *"the end of a long day."*

These air carrier, commuter, and corporate/general aviation pilots were involved in altitude "busts," heading/course deviations, missed crossing restrictions, active runway transgressions, and other, less typical operational incidents.

What is there about the "last leg" that is fundamentally different from any other leg? Let's take a look at some of the factors involved in last-leg operations in the reports reviewed for this article.

Contributing Factors

Fatigue

Reporters identified fatigue as an obvious source of error. ASRS narratives included statements such as *"fighting bad weather all day," "multi-approaches to ILS minimums,"* and *"delays"* merged with *"end of a long thirteen hour duty day," "the ninth and last leg of a long day."* Such descriptions often prefaced complaints such as *"a little tired"* and *"somewhat fatigued"* to *"work[ed] out,"* and *"punchy,"* and *"mentally and physically exhausted." "After all,"* contended one pilot, *"some inattention is to be expected at the end of a long duty day."*

A good case can be made that fatigue contributed to subsequent breakdowns in discipline and procedure, and to attention problems.

Attention Problems

Loss of concentration was referenced in flight crews explanations of last-leg errors such as crossfeeds left ON, pressurization switches left OFF, and misreading of systems gauges and switches. Two flights departed without adequate fuel on board. *"I glanced at the fuel gauges,"* stated one first officer, *"but what I was looking at did not register."* The second, and compounding error came about *"when both the captain and second officer looked at the three fuel gauges, each reading 5,000 pounds, and came up with a total of 30,000."*

Forgetfulness plagued the pilots. A number of flight crews "forgot" to call the tower for landing clearances. *"Just too many landings for the day,"* explained one reporter. Flight crews neglected to reduce to 250 knots below 10,000 feet, to make crossing restrictions, to tell the other pilot of the ATC re-clearance and, on two occasions, *"forgot to let down."*

Fatigue-induced loss of concentration and breakdown in cockpit coordination is well illustrated in the following narrative.

"Last leg of the flight. Driving along at flight level 370, inbound to home, so I'm letting my guard down a bit. The controller gives us a clearance to descend, to cross 35 miles of XYZ at 19,000… A little later, another clearance, this time to cross 5 miles W[est] at 13,000. The controller added, 'See if you can make this one.' What happened? We had stayed at our cruise altitude. The captain didn't catch it and I missed it because I was so darned tired I was letting him run the store."

Another flight crew failed to read the checklist. *"We advanced the throttles to takeoff power. Upon hearing the [takeoff] configuration warning horn, I glanced down to verify the warning and was totally surprised to see the flaps in the UP position. I could hardly believe we had forgotten to read the taxi checklist and to extend the flaps!"*

GetHomeItis

GetHomeItis is cockpit jargon for pilot anticipation and eagerness to get finished with the day's work. ASRS analysts include GETHOMEITIS as a diagnostic term when reviewing reports that demonstrate an *over-eagerness* to get home. *"I let my desire to get to the airport overshadow good judgment,"* stated a commuter pilot who opted to land straight-in at a non-tower airport without bothering to call in on UNICOM. A near collision occurred. An air carrier First Officer, reporting on a runway transgression, stated that *"The Captain had homeitis. On our arrival at home base, he was taxiing faster than normal to get to the gate. Next time I'll ask, 'Where's the fire?' "* In perhaps the ultimate embarrassment, one chagrined flight crew was informed that they had exited the aircraft with an engine still running at the gate.

General aviation pilots are not immune to the homeitis disease. As one rueful G/A pilot reported: *"My ground speed dropped off…I had a choice of either landing to refuel or to continue. I decided to press on. At 4 miles out, the engine went to idle. At 2-1/2 miles out, the engine stopped."*

GetHomeItis is a disease that can also afflict a pilot who is fresh and rested, but we're willing to bet that fatigue both occasions and compounds the problem.

Complacency

Perhaps the most welcome sight in aviation is the familiar home airport coming into view on the horizon, especially after a long, hard series of downline flights. However, the subtle slide into psychological letdown, (frequently cited in last-flight-of-the-day narratives), can lead to error, embarrassment or hazard. Noted one reporter: *"Having the field in sight and being very familiar with local area, I came off the gauges and busted my altitude."* Another reporter in reflection of his deviation noted: *"I was complacent about checking the approach plate and in flying our normal procedures."* A captain who strayed off the route was apologetic: *"Since it was the last leg home, I put away my charts. Next time I'll leave them out."*

Cockpit Management

The omission of cross-checking and crew concept monitoring duties was a common factor in last-flight-of-the-trip circumstances. *"We were relaxed,"* admitted one reporter. *"We were **too** relaxed,"* insisted another [emphasis added]. Common errors include selection of wrong VOR and ILS frequencies, radials, and DME distances; incorrect comprehension and readback of clearances; and misinterpreted runway assignments. Pilots psychological letdown in vigilance and cross-checking were frequently cited: *"Not paying attention to what the captain was doing…," "not monitoring the F/O's actions…," "the crew let down their guard…lost backup monitoring…."*

Looking for Solutions

Awareness of the potential for each of us to be a victim of fatigue, complacency, and GetHomeItis is the first step in the cure of the disease.

Combatting Fatigue

Fatigue is insidious. Without realizing its progressive impact upon alertness and attentiveness, tired pilots drift toward passivity, inertia and lethargy. In an increasingly competitive industry, air carrier pilots often cite scheduling as the major contributor to fatigue. There is little advice the author can give airline flight crews except to eat well and get as much rest as possible. General aviation pilots often have more control over their schedules and should plan for adequate rest periods.

Professionalism

By definition, complacency is not recognized as a problem in the cockpit while the flight is in progress. Complacency as a factor in flight crew error is identified only in post-incident reflection. None of us is immune to the condition of complacency. Working hard to maintain a professional attitude at all times will go a long way in providing a degree of immunity from the affliction. (By the way, you don't have to be a fly-for-hire pilot to strive for professionalism; even the newest student pilot needs to develop a professional attitude.)

Cockpit Management

Maintain proper cockpit and flight crew monitoring, and observe duty priorities. Projecting thoughts forward to post-arrival details distracts pilots from the tasks at hand.

It Ain't Over 'Til...

> *"The last leg of the flight should be flown in the same way as the first flight of the day,"* stated one reporter, *"or else it might be the last flight in the pilot's career."*

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