FLIGHT SAFETY FOUNDATION

ALAR

APPROACH-AND-LANDING ACCIDENT REDUCTION

TOOL KIT

FSF ALAR BRIEFING NOTE 2.3

Pilot-Controller Communication

Until data-link communication comes into widespread use, air traffic control (ATC) will depend primarily upon voice communication that is affected by various factors.

Communication between pilot and controller can be improved by the mutual understanding of each other's operating environment.

Statistical Data

The Flight Safety Foundation Approach-and-landing Accident Reduction (ALAR) Task Force found that incorrect or inadequate ATC instruction/advice/service was a causal factor[1] in 33 percent of 76 approach-and-landing accidents and serious incidents worldwide in 1984 through 1997.[2]

These accidents and incidents involved incorrect or inadequate:

- ATC instructions (e.g., radar vectors);
- Weather or traffic information; and/or,
- Advice/service in an emergency.

Pilot-Controller Communication Loop

The responsibilities of the pilot and controller overlap in many areas and provide backup.

The pilot-controller confirmation/correction process is a "loop" that ensures effective communication (Figure 1).

Whenever adverse factors are likely to affect communication, adherence to the confirmation/correction process is a line of defense against communication errors.

Effective Communication

Pilots and controllers are involved equally in the ATC system.

Achieving effective radio communication involves many factors that should not be considered in isolation; more than one factor usually is involved in a breakdown of the communication loop.

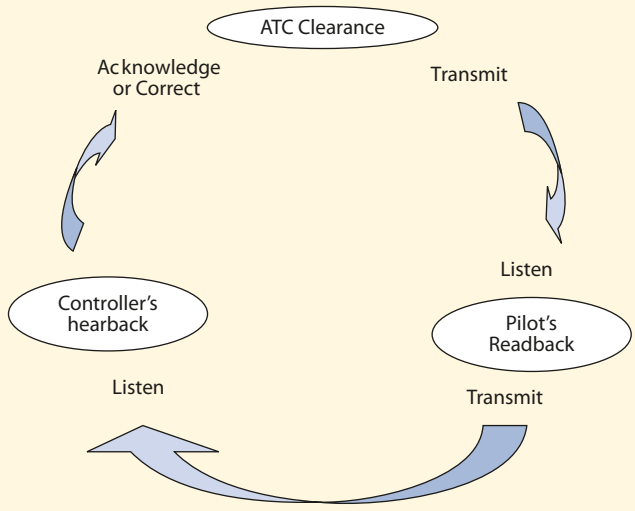
Human Factors

Effective communication is achieved when the intellectual process for interpreting the information contained in a message accommodates the message received.

This process can be summarized as follows:

- How do we *perceive* the message?
- How do we *reconstruct* the information contained in the message?
- How do we link the information to an *objective* or to an *expectation* (e.g., route, altitude or time)?

Pilot-Controller Communication Loop: The Confirmation/Correction Process



ATC = air traffic control

Source: FSF ALAR Task Force

Figure 1

- What *bias* or *error* is introduced in this process?

Crew resource management (CRM) highlights the relevance of the *context* and the *expectation* in communication. Nevertheless, expectation may introduce either a positive bias or a negative bias in the effectiveness of the communication.

High workload, fatigue, noncompliance with the "sterile cockpit rule,"[3] distractions, interruptions and conflicts are among the factors that may affect pilot-controller communication and result in:

- Incomplete communication;
- Omission of the aircraft call sign or use of an incorrect call sign;
- Use of nonstandard phraseology;
- Failure to hear or to respond; and,
- Failure to effectively implement a confirmation or correction.

Language and Communication

Native speakers may not speak their own language correctly and consistently.

The language of pilot-controller communication is intended to overcome this basic shortcoming.

The first priority of any communication is to establish an *operational context* that defines the following elements:

- Purpose — clearance, instruction, conditional statement or proposal, question or request, confirmation;
- When — immediately, anticipate, expect;
- What and how — altitude (climb, descend, maintain), heading (left, right), airspeed; and,
- Where — (at […] waypoint).

The construction of the initial message and subsequent message(s) should support this operational context by:

- Following the chronological order of the actions;
- Grouping instructions and numbers related to each action; and,
- Limiting the number of instructions in the transmission.

The intonation, the speed of speaking and the placement and duration of pauses may affect the understanding of a communication.

Mastering the Language

CRM studies show that language differences on the flight deck are a greater obstacle to safety than cultural differences on the flight deck.

Because English has become a shared language in aviation, an effort has been initiated to improve the English-language skills of pilots and controllers worldwide.

Nevertheless, even pilots and controllers for whom English is the native language may not understand all words spoken in English because of regional accents or dialects.

In many regions of the world, language differences generate other communication difficulties.

For example, controllers using both English (for communication with international flights) and the country's official language (for communication with domestic flights) hinder some flight crews from achieving the desired level of situational awareness (loss of "party-line" communication).

Nonstandard Phraseology

Nonstandard phraseology is a major obstacle to effective communication.

Standard phraseology in pilot-controller communication is intended to be understood universally.

Standard phraseology helps lessen the ambiguities of spoken language and, thus, facilitates a common understanding among speakers:

- Of different native languages; or,
- Of the same native language but who use, pronounce or understand words differently.

Nonstandard phraseology or the omission of key words may change completely the meaning of the intended message, resulting in potential traffic conflicts.

For example, any message containing a number should indicate what the number refers to (e.g., an altitude, a heading or an airspeed). Including key words prevents erroneous interpretation and allows an effective readback/hearback.

Pilots and controllers might use nonstandard phraseology, with good intentions, for simplicity; however, standard phraseology minimizes the potential for misunderstanding.

Building Situational Awareness

Radio communication should contribute to the pilot's and the controller's situational awareness, which may be enhanced if they provide each other with advance information.

Frequency Congestion

Frequency congestion significantly affects the flow of communication during approach-and-landing phases at high-density airports, and demands enhanced vigilance by pilots and by controllers.

Omission of Call Sign

Omitting the call sign or using an incorrect call sign jeopardizes an effective readback/hearback.

Omission of Readback or Inadequate Readback

The term "roger" often is misused, as in the following situations:

- A pilot says "roger" (instead of providing a readback) to acknowledge a message containing numbers, thus preventing any effective hearback and correction of errors by the controller; or,
- A controller says "roger" to acknowledge a message requiring a definite answer (e.g., a positive confirmation or correction, such as acknowledging a pilot's statement that an altitude or airspeed restriction cannot be met), thus decreasing both the pilot's and the controller's situational awareness.

Failure to Correct Readback

The absence of an acknowledgment or a correction following a clearance readback is perceived by most flight crews as an implicit confirmation of the readback.

The absence of acknowledgment by the controller usually is the result of frequency congestion and the need for the controller to issue clearances and instructions to several aircraft in succession.

An uncorrected erroneous readback (known as a *hearback error*) may lead to a deviation from the assigned altitude or noncompliance with an altitude restriction or with a radar vector.

A deviation from an intended clearance may not be detected until the controller observes the deviation on his/her radar display.

Less-than-required vertical separation or horizontal separation (and near midair collisions) and runway incursions usually are the result of hearback errors.

Expectations

Bias in understanding a communication can affect pilots and controllers.

The bias of expectation can lead to:

- Transposing the numbers contained in a clearance (e.g., a flight level [FL]) to what was expected, based on experience or routine; and,
- Shifting a clearance or instruction from one parameter to another (e.g., perceiving a clearance to maintain a 280-degree heading as a clearance to climb/descend and maintain FL 280).

Failure to Seek Confirmation

Misunderstandings may involve half-heard words or guessed-at numbers.

The potential for misunderstanding numbers increases when an ATC clearance contains more than two instructions.

Failure to Request Clarification

Reluctance to seek confirmation may cause flight crews to either:

- Accept an inadequate instruction (over-reliance on ATC); or,
- Determine for themselves the most probable interpretation.

Failing to request clarification may cause a flight crew to believe erroneously that they have received an expected clearance (e.g., clearance to cross an active runway).

Failure to Question Instructions

Failing to question an instruction can cause a crew to accept an altitude clearance below the minimum safe altitude (MSA) or a heading that places the aircraft near obstructions.

Taking Another Aircraft's Clearance or Instruction

This usually occurs when two aircraft with similar-sounding call signs are on the same frequency and are likely to receive similar instructions, or when the call sign is blocked by another transmission.

When pilots of different aircraft with similar-sounding call signs omit the call sign on readback, or when simultaneous readbacks are made by both pilots, the error may go unnoticed by the pilots and the controller.

Filtering Communications

Because of other flight deck duties, pilots tend to filter communications, hearing primarily communications that begin with their aircraft call sign and not hearing most other communications.

For workload reasons, controllers also may filter communications (e.g., not hearing and responding to a pilot readback while engaged in issuing clearances/instructions to other aircraft or ensuring internal coordination).

To maintain situational awareness, this filtering process should be adapted, according to the flight phase, for more effective listening.

For example, when occupying an active runway (e.g., backtaxiing or holding in position) or when conducting a final approach to an assigned runway, the flight crew should listen and give attention to communications related to the landing runway.

Timeliness of Communication

Deviating from an ATC clearance may be required for operational reasons (e.g., a heading deviation or altitude deviation for weather avoidance, or an inability to meet a restriction).

Both the pilot and the controller need time to accommodate this deviation; therefore, *ATC should be notified as early as possible* to obtain a timely acknowledgment.

Similarly, when about to enter a known non-radar-controlled flight information region (FIR), the pilot should contact the appropriate ATC facility approximately 10 minutes before

reaching the FIR boundary to help prevent misunderstandings or less-than-required separation.

Blocked Transmissions (Simultaneous Communication)

Blocked transmissions often are the result of not immediately releasing the push-to-talk switch after a communication.

An excessive pause in a message (i.e., holding the push-to-talk switch while considering the next item of the transmission) also may result in blocking part of the response or part of another message.

Simultaneous transmission by two stations (two aircraft or one aircraft and ATC) results in one of the two (or both) transmissions being *blocked* and *unheard* by the other stations (or being heard as a buzzing sound or as a squeal).

The absence of a readback (from the pilot) or a hearback acknowledgment (from the controller) should be treated as a blocked transmission and prompt a request to repeat or confirm the message.

Blocked transmissions can result in altitude deviations, missed turnoffs and takeoffs, landings without clearances and other hazards.

Communicating Specific Events

The following events should be reported as soon as practical to ATC, stating the nature of the event, the action(s) taken and the flight crew's intention(s):

- Traffic-alert and collision avoidance system (TCAS) resolution advisory (RA);
- Severe turbulence;
- Volcanic ash;
- Wind shear or microburst; and,
- A terrain-avoidance maneuver prompted by a ground-proximity warning system (GPWS) warning or terrain awareness and warning system (TAWS)[4] warning.

Emergency Communication

In an emergency, the pilot and the controller must communicate clearly and concisely, as suggested below.

Pilot

The standard International Civil Aviation Organization (ICAO) phraseology "Pan Pan"[5] or "Mayday"[6] must be used to alert a controller and trigger an appropriate response.

Controllers

Controllers should recognize that, when faced with an emergency situation, the flight crew's most important needs are:

- Time;
- Airspace; and,
- Silence.

The controller's response to the emergency situation could be patterned after a memory aid such as ASSIST:

- Acknowledge:
  - Ensure that the reported emergency is understood and acknowledged;
- Separate:
  - Establish and maintain separation with other traffic and/or terrain;
- Silence:
  - Impose silence on your control frequency, if necessary; and,
  - Do not delay or disturb urgent flight crew action by unnecessary transmissions;
- Inform:
  - Inform your supervisor and other sectors, units and airports as appropriate;
- Support:
  - Provide maximum support to the flight crew; and,
- Time:
  - Allow the flight crew sufficient time to handle the emergency.

Training Program

A company training program on pilot-controller communication should involve flight crews and ATC personnel in joint meetings, to discuss operational issues and, in joint flight/ATC simulator sessions, to promote a mutual understanding of each other's working environment, including:

- Modern flight decks (e.g., flight management system reprogramming) and ATC equipment (e.g., absence of primary returns, such as weather, on modern radar displays);
- Operational requirements (e.g., aircraft deceleration characteristics, performance, limitations); and,
- Procedures (e.g., standard operating procedures [SOPs]) and instructions (e.g., CRM).

Special emphasis should be placed on pilot-controller communication and task management during emergency situations.

Summary

The following should be emphasized in pilot-controller communication:

- Recognize and understand respective pilot and controller working environments and constraints;
- Use standard phraseology;
- Adhere to the pilot-controller confirmation/correction process in the communication loop;
- Request clarification or confirmation when in doubt;
- Question an incorrect clearance or inadequate instruction;
- Prevent simultaneous transmissions;
- Listen to party-line communications as a function of the flight phase; and,
- Use clear and concise communication in an emergency.

The following FSF ALAR Briefing Notes provide information to supplement this discussion:

- 2.1 — Human Factors;
- 2.2 — Crew Resource Management;
- 2.4 — Interruptions/Distractions; and,
- 7.1 — Stabilized Approach.

Notes

1. The Flight Safety Foundation Approach-and-landing Accident Reduction (ALAR) Task Force defines *causal factor* as "an event or item judged to be directly instrumental in the causal chain of events leading to the accident [or incident]." Each accident and incident in the study sample involved several causal factors.
2. Flight Safety Foundation. "Killers in Aviation: FSF Task Force Presents Facts About Approach-and-landing and Controlled-flight-into-terrain Accidents." *Flight Safety Digest* Volume 17 (November–December 1998) and Volume 18 (January–February 1999): 1–121. The facts presented by the FSF ALAR Task Force were based on analyses of 287 fatal approach-and-landing accidents (ALAs) that occurred in 1980 through 1996 involving turbine aircraft weighing more than 12,500 pounds/5,700 kilograms, detailed studies of 76 ALAs and serious incidents in 1984 through 1997 and audits of about 3,300 flights.
3. The *sterile cockpit rule* refers to U.S. Federal Aviation Regulations Part 121.542, which states: "No flight crewmember may engage in, nor may any pilot-in-command permit, any activity during a critical phase of flight which could distract any flight crewmember from the performance of his or her duties or which could interfere in any way with the proper conduct of those duties. Activities such as eating meals, engaging in nonessential conversations within the cockpit and nonessential communications between the cabin and cockpit crews, and reading publications not related to the proper conduct of the flight are not required for the safe operation of the aircraft. For the purposes of this section, critical phases of flight include all ground operations involving taxi, takeoff and landing, and all other flight operations below 10,000 feet, except cruise flight." [The FSF ALAR Task Force says that "10,000 feet" should be height above ground level during flight operations over high terrain.]
4. Terrain awareness and warning system (TAWS) is the term used by the European Aviation Safety Agency and the U.S. Federal Aviation Administration to describe equipment meeting International Civil Aviation Organization (ICAO) standards and recommendations for ground-proximity warning system (GPWS) equipment that provides predictive terrain-hazard warnings. "Enhanced GPWS" and "ground collision avoidance system" are other terms used to describe TAWS equipment.
5. ICAO says that the words "Pan Pan" at the beginning of a communication identifies *urgency* — i.e., "a condition concerning the safety of an aircraft … or of some person on board or within sight, but which does not require immediate assistance." ICAO says that "Pan Pan" (pronounced "Pahn, Pahn") should be spoken three times at the beginning of an urgency call.
6. ICAO says that the word "Mayday" at the beginning of a communication identifies *distress* — i.e., "a condition of being threatened by serious and/or imminent danger and of requiring immediate assistance." ICAO says that "Mayday" should be spoken three times at the beginning of a distress call.

Related Reading From FSF Publications

Lacagnina, Mark. "Glideslope Unusable." *AeroSafety World* Volume 3 (November 2008).

Mathews, Elizabeth; Gill, Alan. "Can They Talk the Talk?" *AeroSafety World* Volume 3 (November 2008).

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Werfelman, Linda. "Blindsided." *AeroSafety World* Volume 3 (February 2008).

Werfelman, Linda. "Speaking the Same Language." *AeroSafety World* Volume 2 (November 2007).

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Gurney, Dan. "Change of Plan." *AviationSafety World* Volume 1 (December 2006).

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FSF Editorial Staff. "Inadequate Weather Communication Cited in B-737 Microburst-downdraft Incident." *Airport Operations* Volume 29 (January–February 2003).

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FSF Editorial Staff. "ATR 42 Strikes Mountain on Approach in Poor Visibility to Pristina, Kosovo." *Accident Prevention* Volume 57 (October 2000).

FSF Editorial Staff. "Use of Standard Phraseology by Flight Crews and Air Traffic Controllers Clarifies Aircraft Emergencies." *Airport Operations* Volume 26 (March–April 2000).

FSF Editorial Staff. "Studies Investigate the Role of Memory in the Interaction Between Pilots and Air Traffic Controllers." *Airport Operations* Volume 24 (January–February 1998).

Uplinger, Shannon. "English-language Training for Air Traffic Controllers Must Go Beyond Basic ATC Vocabulary." *Airport Operations* Volume 23 (September–October 1997).

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Koenig, Robert L. "Excess Words, Partial Readbacks Score High in Analysis of Pilot-ATC Communication Errors." *Airport Operations* Volume 23 (January–February 1997).

FSF Editorial Staff. "Flight Crew of DC-10 Encounters Microburst During Unstabilized Approach, Ending in Runway Accident." *Accident Prevention* Volume 53 (August 1996).

FSF Editorial Staff. "Pilot of Cessna 441 Incorrectly Taxis onto Active Runway and Aircraft Is Struck by McDonnell Douglas MD-82 on Takeoff Roll." *Accident Prevention* Volume 53 (March 1996).

FSF Editorial Staff. "Unaware That They Have Encountered a Microburst, DC-9 Flight Crew Executes Standard Go-around; Aircraft Flies Into Terrain." *Accident Prevention* Volume 53 (February 1996).

Cushing, Steven. "Pilot–Air Traffic Control Communications: It's Not (Only) What You Say, It's How You Say It." *Flight Safety Digest* Volume 14 (July 1995).

Duke, Thomas A.; FSF Editorial Staff. "Aircraft Descended Below Minimum Sector Altitude and Crew Failed to Respond to GPWS as Chartered Boeing 707 Flew into Mountain in Azores." *Accident Prevention* Volume 52 (February 1995).

FSF Editorial Staff. "Cockpit Coordination, Training Issues Pivotal in Fatal Approach-to-Landing Accident." *Accident Prevention* Volume 51 (January 1994).

Gless, Richard D. "Communication Creates Essential Bond to Allow Air Traffic Control System to Function Safely." *Accident Prevention* Volume 49 (May 1992).

Wilson, Donald R. "My Own Mouth Shall Condemn Me." *Accident Prevention* Volume 47 (June 1990).

Notice

The Flight Safety Foundation (FSF) Approach-and-Landing Accident Reduction (ALAR) Task Force produced this briefing note to help prevent approach-and-landing accidents, including those involving controlled flight into terrain. The briefing note is based on the task force's data-driven conclusions and recommendations, as well as data from the U.S. Commercial Aviation Safety Team's Joint Safety Analysis Team and the European Joint Aviation Authorities Safety Strategy Initiative.

This briefing note is one of 33 briefing notes that comprise a fundamental part of the FSF *ALAR Tool Kit*, which includes a variety of other safety products that also have been developed to help prevent approach-and-landing accidents.

The briefing notes have been prepared primarily for operators and pilots of turbine-powered airplanes with underwing-mounted engines, but they can be adapted for those who operate airplanes with fuselage-mounted turbine engines, turboprop power plants or piston engines. The briefing notes also address operations with the following: electronic flight instrument systems; integrated autopilots, flight directors and autothrottle systems; flight management systems; automatic ground spoilers; autobrakes; thrust reversers; manufacturers'/operators' standard operating procedures; and, two-person flight crews.

This information is not intended to supersede operators' or manufacturers' policies, practices or requirements, and is not intended to supersede government regulations.

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