



Communication Creates Essential Bond to Allow Air Traffic Control System to Function Safely

Information must not only be transmitted — it must be received and understood by pilots and controllers to communicate effectively and ensure safe operations.

—
by
Richard D. Gless
Aviation Safety Consultant

Air traffic control towers, approach control facilities, air route traffic control centers and trained personnel are essential components of the worldwide air traffic control (ATC) system, but pilot-controller communication is the common bond that enables it to function. Thus, the better the communication between those who staff the system and those who use it, the better the system will function.

For pilots and controllers to communicate, messages and information must not only be transmitted, but they must be received and understood. Too often, communication fails.

The following excerpt from a recent U.S. National Aeronautics and Space Administration (NASA) Aviation Safety Reporting System (ASRS) report illustrates a pilot-controller communication problem and an intracockpit communication problem as well.

I was captain and pilot flying. We had just taken off and were being vectored during our climb. Initially, we were cleared to 10,000 feet. We were on an easterly heading, and as we approached 9,000 feet and I began to level off, departure gave us what I thought was a clearance to 11,000 feet. Our procedures call for the pilot not flying to set in altitudes on the mode control panel, and for the pilot flying to repeat the cleared altitude.

I repeated the cleared altitude of 11,000 and ... the aircraft increased its climb rate. The co-pilot said what I thought was "cleared to 11 thousand." I did not look at the altitude window to see what he had set in. As we were passing through 9,700 [feet] at a rapid rate, he said "Level 10,000" and pointed to the altitude window. Sure enough, it still said 10,000. I pushed the nose over as rapidly as I could without disturbing the passengers, and we ended up peaking out at 10,350

I asked the copilot what was really said, and he said that departure had pointed out traffic at 11,000 feet. Also

that, when I had said "Cleared to 11,000," he had replied, "He's clear at 11,000," referring to the traffic. He then said, "Boy, I'll never say that again."

For several years, the U.S. aviation community has been concerned about effective communication between ATC system providers (ground controllers) and users (pilots).

Several problems have been identified, which are common to the worldwide ATC system.

Poor Phraseology Creates Widespread ATC Problems

The most common problem is the improper use of recommended phraseology by pilots and controllers. A large number of daily incidents are attributed to improper phraseology which has resulted in a miscommunication by both controllers and pilots.

Nearly 30 years ago, the U.S. Federal Aviation Administration (FAA) developed a glossary to establish an industry standard for ATC communication between pilots and controllers. [The International Civil Aviation Organization (ICAO) *Lexicon* is the international counterpart to the U.S. *Pilot/Controller Glossary*.] The phraseology was developed through extensive coordination between the FAA and ATC system users to provide optimum terms of reference. This glossary, used in combination with *Air Traffic Control* [FAA publication 7110.65] and the U.S. *Airman's Information Manual (AIM)*, is the U.S. standard. But it is only as effective as each individual's knowledge and familiarity with it.

The most effective method to reduce the problems caused by improper phraseology is for pilots and controllers to know and use the standard terminology prescribed in the *Pilot/Controller Glossary* — for controllers, "Appendix A" of *Air Traffic Control*, for pilots, the last section in *AIM* or *Lexicon*.

Improper phraseology resulting in communication breakdown is not isolated to any specific segment of pilots or controllers nor to an operational scenario. Phraseology problems occur in every imaginable situation — initial radio contacts, readbacks, hearbacks, clearance instructions, pilot requests, position reports, weather advisories, traffic advisories, and etc.

The Avianca Boeing 707 crash at Cove Neck, N.Y., U.S., on Jan. 25, 1990, is a classic example of a tragic accident that stemmed, in part, from a breakdown in pilot/controller communication. The U.S. National Transportation Safety Board (NTSB) found that the probable cause of the accident was "the failure of the flight crew to adequately manage the airplane's fuel load and their failure

to communicate an emergency fuel situation to air traffic control before fuel exhaustion occurred." The NTSB listed windshear, crew fatigue and stress among several contributing factors. It made several safety recommendations, including one that the FAA develop, in cooperation with ICAO, a "standardized glossary of definitions, terms, words, and phrases to be used that are clearly understandable to both pilots and air traffic controllers regarding minimum and emergency fuel communications."

According to the *AIM* pilot/controller glossary, the phrase "minimum fuel," when transmitted, "indicates that an aircraft's fuel supply has reached a state where, upon reaching the destination it can accept little or no delay. This is not an emergency situation, but merely indicates an emergency situation is possible should any undue delay occur."

Timely transmission of "minimum fuel" by the crew of Avianca 052 might have prevented the accident.

Poor Enunciation Invites Trouble

English is the international language of aviation but not everyone speaks this language with a common clarity and understanding. In many instances, it is not so much what we say, but how we say it that conveys a particular message. Common enunciation errors that contribute to miscommunication include voice volume, rate of speech and voice inflection.

Today's radios have built-in amplifiers and volume controls, so loud speech is unnecessary. A properly positioned microphone and normal speaking volume is a basic requirement for transmission clarity.

Most pilots have heard a controller who speaks very rapidly to minimize the time required to issue instructions to numerous aircraft. This is not appropriate for most communication situations. Rapid speech requires increased attention by speaker and listener. It only takes one "Say again all after" by a pilot to eliminate any time advantage gained by a controller who spoke too fast. Emergencies, in particular, require calm, measured speech, which can contribute positively to the situation.

Voice inflection or an accent can be troublesome. A military pilot training story illustrates a humorous side of this problem:

An instructor pilot was teaching his foreign student how to use visual ground references for traffic pattern check points by verbally referring to each reference as it was overflown. The instructor noticed that each time he told the student when they overflew one of the most prominent references — a cotton gin — the student became con-

fused and non-responsive. When questioned about this behavior after the flight, the student explained that he could not understand why the instructor kept advising him to "cut engine" even though they were not near the runway.

If accents are involved, extra care must be taken when listening and speaking. A speaker should plan what he wants to say, and use proper phraseology to minimize confusion.

One self-improvement tactic is to listen to your own speech as others hear you. Record yourself making some typical radio transmissions while varying the speed and volume of your speech. The playback may suggest some areas to improve your technique.

Similar Alphanumerics Cause Confusion

Confusion resulting from similar alphanumeric call signs is a problem in busy terminal areas. ATC instructions and clearances being issued to the wrong aircraft do occur, especially when several air carrier companies are operating on the same radio frequency with similar flight numbers, or several general aviation or corporate aircraft are operating similar equipment using the same frequency.

Unprecedented traffic growth during the past several years has increased the number of operational errors and system deviations caused by confusion of similar call signs. Airline hub programs have introduced large concentrations of traffic arriving or departing at an airport during a short period of time, usually by the same carrier, and generally involving the use of consecutive or similar flight numbers. Under such circumstances, it is clear how flight numbers, trip numbers, aircraft types and call signs can be transposed or misread by controllers, and that properly transmitted control instructions can be misinterpreted by pilots.

For example, consider that a controller issues an approach clearance to an aircraft ("Fastrack one niner niner zero") at the bottom of a holding stack, but an aircraft ("Cargoair seven niner niner zero") with a similar call sign at the top of the stack incorrectly acknowledges the clearance with the last two or three numbers of his call sign ("niner zero"). If the crew at the bottom of the stack was momentarily distracted and did not intervene, flight safety would be affected when the higher aircraft began to descend while other aircraft were still holding beneath it.

FAA has distributed information to airmen and to controllers to promote increased awareness of problems resulting from similar call signs. Excerpts from an FAA letter to airmen are reprinted below:

This letter solicits your cooperation and assistance in prefixing all ATC communications with your aircraft type, model, or manufacturer's name. Use of call signs that are too brief or, worse, not including your call sign in radio requests or acknowledgments can lead to confusion. Because number and letter call signs can often sound similar, prefixing your call sign with your aircraft type or model or manufacturer's name is the extra insurance that may prevent you from taking another aircraft's instruction/clearance and prevent a controller from thinking you acknowledged ... an instruction when someone else takes your instruction.

Non-U.S. pilots flying into U.S. airspace should review and be familiar with the *AIM*, which describes proper call sign designations, appropriate phraseology and preferred technique. Pilot knowledge of these procedures will promote response to controller requests, especially when operating in heavy traffic areas when pilot workload is high and concentration on proper phraseology and call sign use may be abbreviated. Specifically, pilots need to be familiar with those terms in the *Pilot/Controller Glossary* that are printed in ***bold italics***.

Simultaneous Radio Transmissions Degrade Safety

Simultaneous radio transmissions on the same frequency in proximity to the intended receiver are frequent and detrimental to effective communication. Initiation of a transmission on an occupied frequency can result in vital information not being received by the intended ATC facility or aircraft, and potentially degrading flight safety. Although these communication disruptions may occur in areas where traffic density is less, the growth of air traffic (and communication) has increased the number of disruptive incidents.

The most basic human factors solution is for controllers and pilots to listen before transmitting on the frequency. If someone else is speaking on the frequency, keying another transmitter will probably render all the communication unintelligible. Repeat transmissions will be required and frequency congestion will increase.

***A speaker should
plan what he wants
to say, and use
proper phraseology
to minimize
confusion.***

Stuck Microphones Reduce Traffic Flow

The pilot's microphone, a vital link in the communication process, has been disruptive on too many occasions, not only for the pilot whose microphone was stuck, but for the others sharing the frequency (and the airspace) with him.

In 1984, the FAA was petitioned to require anti-blocking circuitry in radios that would prevent transmissions on a frequency already in use. Because an industry standard for such equipment was not available, the FAA deferred action on the petition and asked the Radio Technical Commission for Aeronautics (RTCA) to establish a special committee to develop appropriate guidance and equipment standards. RTCA Special Committee 163 was formed to develop standards for anti-blocking devices and for a means to terminate unintentional continuous transmissions (stuck microphones). The final draft is expected this year.

Periodic surveys from 1968 through 1981 reflected major increases in the occurrence of stuck microphones in the ATC system. Subsequent incident and operational error reports substantiate the continued problem. A U.S. survey conducted during a four-month period reported 1,730 incidents. Of these, 78 percent occurred in terminal areas. Other aircraft operations were affected in more than 70 percent of the recorded incidents. Some 503 incidents were attributed to general aviation aircraft, 345 to air carriers, 52 to military, 20 to ground vehicles/other, and 810 to unknown sources. These incidents caused a total of 391.4 hours of frequency blockage.

Microphones rarely become keyed by mechanical failure. Operator error is usually the cause of unintentional continuous microphone keying. Therefore, pilots and controllers must make deliberate efforts to guard against inadvertent keying of the microphone. The problem becomes serious when it causes a complete and prolonged frequency blockage for several minutes in an environment where separation of aircraft is dependent upon timely communications to or from ATC. The following are examples of serious problems that were caused by stuck microphones:

Unsatisfactory Condition Report: (Air carrier name) had a stuck mike during peak rush period at Chicago O'Hare. Numerous aircraft were arriving and descending for sequencing into the O'Hare terminal

complex. (Air carrier) mike remained stuck for approximately five minutes; this rendered all aircraft on frequency 135.9 MHz incapable of receiving control guidance, causing an extremely dangerous situation and system delays to more than 25 aircraft.

The most basic human factors solution is for controllers and pilots to listen before transmitting on the frequency.

Daily Operations Report: Departure delays at Newark of between 19 to 23 minutes due to mike stuck on Newark frequency. Affected airports included Newark (four departures averaging delays of 22 minutes each) and other adjacent facilities, and New York La Guardia (45 departures averaging delays of 20 minutes each) and other adjacent facilities.

Report of Near Midair Collision Report: A near midair collision occurred between (air carrier #1) and (air carrier #2) in vicinity of Livingston VORTAC in which a stuck microphone kept air crews from hearing separation instructions from the Atlanta Air Route Traffic Control Center (ARTCC). Subsequent investigation by FAA personnel found air carrier #1 had a mike continuously keyed for over five minutes.

Readback Problems Cause Flight Deviations

The files of the National Aeronautics and Space Administration's (NASA's) Aviation Safety Reporting System (ASRS) and the FAA have extensive reports of incidents caused by the failure of pilots to read back clearances issued by ATC. A 1986 NASA report dealing with readback problems noted that "perhaps no other essential activity in aircraft operations is as vulnerable to failure through human error and performance limitations as spoken communication."

"Readback" is defined in the *Pilot/Controller Glossary* as "read my message back to me." While there is no regulatory requirement that pilots read back clearances, the *AIM* states:

Pilots of airborne aircraft should read back those parts of ATC clearances and instructions containing altitude assignments or vectors, as a means of mutual verification. Readback of the "numbers"

serves as a double check between pilots and controllers and reduces the kinds of communication errors that occur when a number is either "misheard" or is incorrect.

Microphones rarely become keyed by mechanical failure. Operator error is usually the cause of unintentional continuous microphone keying.

Airline flight operation manuals often impose more stringent requirements on air carrier pilots than those found in the *AIM*. Usually, airline manuals upgrade the priority of reading back clearances from "should" to "must" status.

Pilots with a high degree of professionalism will listen carefully to a clearance and read it back in the sequence in which it was delivered. Making a deliberate effort to do so reinforces a positive habit pattern.

The FAA holds controllers responsible for ensuring that pilot readbacks of clearances are correct. Pilots can help controllers fulfill that responsibility by providing them with consistent readbacks of all clearances in the sequence they were issued.

Problems associated with "hearback" refer to occasions when the controller experiences difficulty understanding what a pilot says when he reads back a clearance, requests a clearance change or asks for other information. Ambient noise in a controller's proximity can interfere with completely understanding messages transmitted from aircraft. Controller work load during periods of heavy traffic, which involves simultaneous handling of several aircraft while coordinating with other controllers, creates pressures and distractions to hearing correctly.

One human factors problem that controllers share with pilots is that people tend to hear what they expect to be said. For example, a controller asks a pilot to report leaving nine thousand feet during a descent because he may want to vector it around other traffic at six thousand. The pilot mistakenly reads back that he will report passing five thousand feet and the controller, expecting nine thousand feet, believes that he hears the correct altitude and does not correct the pilot.

Controller and pilot must take care to ensure that they hear what is actually said and not what they expect to hear. If either has any doubt what he heard, it is important to repeat the readback or to ask for a clarification.

Headsets Reduce Problems from Background Noise

Some communication problems result because pilots and controllers rely upon loudspeakers rather than headsets which allow clearer communication by reducing distracting background noise, from the drone of engines in the cockpit to voices in the background of a busy ATC center. A loudspeaker allows a gap between the source of the sound and the ear that results in attenuation of sound strength and the introduction of extraneous noise. With a

proper headset, there is a close, noise-protected connection between the source of the sound and the ear.

A large number of ASRS reports cited the use of a loudspeaker as a factor in the incident. A brief summary of one incident follows:

Controller and pilot must take care to ensure that they hear what is actually said and not what they expect to hear.

(Air carrier) cleared to 10,000 feet. I became uneasy because we were flying in the clouds ... heading directly for mountains ... requested co-pilot ask ATC for higher altitude ... understood cleared to FL310 ... immediately initiated climb ... as climbing through 12,500 feet, controller said "Say altitude" ... I reported cleared to FL310 ... controller responded clearance limit was to 10,000 feet ... at that moment we entered VFR conditions and saw a medium/large transport aircraft less than three-quarters of a mile distance going away from us The cockpit loudspeaker was not clear enough to allow a full understanding of all words spoken, and I missed essential instructions.

Some pilots and controllers may prefer to use speakers, rather than headsets, but communication problems occur more frequently with those individuals using only loudspeakers.

These solutions to communication problems in the ATC system are practical and, if practiced by pilots and controllers, they will realize improvements to communication — and to the safety of flight.

About the Author

Richard D. Gless is an independent aviation safety consultant. He retired in early 1991 from the AOPA Air Safety Foundation, where he directed various aviation safety courses since 1974 and was the editor of the Flight Instructor Safety Report.

A former career aviator in the U.S. Navy, Gless has logged more than 10,000 flying hours. In the military, he flew the Martin Mars flying boat on Pacific routes, commanded a squadron of Lockheed P3A Orion patrol aircraft and headed the Navy flight standardization office at the Pentagon. He was later employed by American Airlines as a first officer.

His aeronautical credentials include flight engineer, airline transport pilot and flight and ground instructor certificates. A current pilot, Gless flies his own Beechcraft Debonair.

Articles in this publication may be reprinted in whole or in part, but credit must be given to: "Flight Safety Foundation and *Accident Prevention*," as well as the author.

What's Your Input?

Flight Safety Foundation welcomes articles and papers for publication. If you have an article proposal, a completed manuscript or a technical paper that may be appropriate for *Accident Prevention* please contact the editor. Submitted materials are evaluated for suitability and a cash stipend is paid upon publication. Request a copy of "Editorial Guidelines for Flight Safety Foundation Writers."

ACCIDENT PREVENTION

Copyright © 1992 FLIGHT SAFETY FOUNDATION INC. ISSN 1057-5561

Please send two copies of reprinted material to the editor. Suggestions and opinions expressed in this publication belong to the author(s) and are not necessarily endorsed by Flight Safety Foundation. Content is not intended to take the place of information in company policy handbooks and equipment manuals, or to supersede government regulations. The editors reserve the right to edit all submissions. • Manuscripts must be accompanied by stamped and addressed return envelopes if authors want material returned. Reasonable care will be taken in handling manuscripts, but Flight Safety Foundation assumes no responsibility for material submitted. • Subscriptions : \$70 U.S. (U.S. - Canada - Mexico), \$75 Air Mail (all other countries), twelve issues yearly. • Staff: Roger Rozelle, director of publications; Arthur H. Sanfelici, senior editor; Ashton Alvis, production coordinator; Sandra Mitchell, editorial assistant • Request address changes by mail and include old and new addresses. • Flight Safety Foundation, 2200 Wilson Boulevard, Suite 500, Arlington, Virginia 22201-3306 U.S. • telephone: (703) 522-8300 • telex: 901176 FSF INC AGTN • fax: (703) 525-6047