GEN 2
Pilot-Controller Communications

1. Introduction

1.1. Until data link communication comes into widespread use, air traffic control (ATC) will depend primarily upon voice communication.

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

2. Cross-checking on the Flight Deck

2.1. The first line of defence is the cross-checking process that exists on the flight deck between the pilot flying (PF) and the pilot not flying (PNF) (pilot monitoring).

2.2. The following procedure is typical in many airlines:

(a) When the autopilot is engaged, the PF sets the cleared altitude;

(b) When the autopilot is not engaged, the PNF sets the cleared altitude.

(c) Each altitude setting triggers a cross-check:

(d) The PF calls out the altitude set;

(e) The PNF checks what has been set and announces the value of the altitude.

This procedure allows any discrepancy, in what was heard by the pilots, or in the setting made to be resolved without delay.

2.3. The procedure in use within an airline must be standardised, clearly stated in the operations manual, reinforced during training and adhered to by all pilots.

3. Pilot-Controller Communication Loop

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

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

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

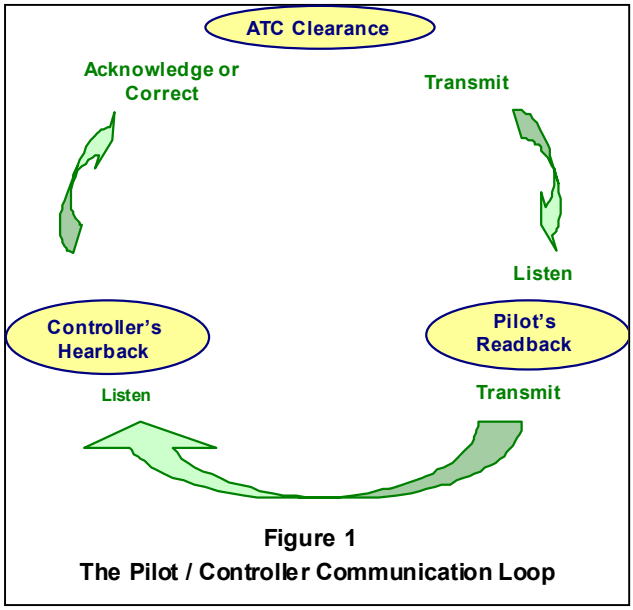

Figure 1
The Pilot / Controller Communication Loop

4. Effective Communications

4.1. Pilots and controllers are involved equally in the air traffic management (ATM) system.

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

Human Factors

4.3. Effective communication is achieved when the message transmitted by one party is correctly interpreted and understood by the other party.

4.4. This process can be summarised as follows:

(a) How do we *perceive* the message?

(b) How do we *reconstruct* the information contained in the message?

(c) How do we link this information to an *objective* or to an *expectation* (e.g. route, altitude or time)?

(d) What *bias* or *error* is introduced in this process?

4.5. Crew resource management (CRM) (for pilots) and team resource management (TRM) (for controllers) highlight the relevance of the *context* and *expectation* in communication. Nevertheless, expectations may introduce either a positive or a negative bias in the effectiveness of the communication.

4.6. High workload, fatigue, distractions, interruptions and conflicts are among the factors that may adversely affect pilot-controller communications and result in:

(a) Incomplete communication;

(b) Omission of callsign or use of an incorrect callsign;

(c) Use of non-standard phraseology;

(d) Failure to hear or to respond; and,

(e) Failure to implement effectively a confirmation or correction.

Language and Communication

4.7. Native speakers may not speak their own language correctly. The language of pilot-controller communication is intended to overcome this basic shortcoming.

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

(a) **Purpose** – clearance, instruction, conditional statement or proposal, question or request, confirmation;

(b) **When** – immediately, anticipate, expect;

(c) **What and how** – altitude (climb, descend, maintain), heading (left, right), airspeed; and,

(d) **Where** – (at […] waypoint).

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

(a) Following the chronological order of the actions;

(b) Grouping instructions and numbers related to each action; and,

(c) Limiting the number of instructions in the transmission.

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

Mastering the Language

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

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

4.13. 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.

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

4.15. 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 communications").

Non-standard Phraseology

4.16. Non-standard phraseology is a major obstacle to effective communications.

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

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

(a) Of different native languages; or,

(b) Of the same native language, but who use, pronounce or understand words differently.

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

4.20. For example, any message containing a number should indicate what the number refers to (e.g. a

flight level, a heading or an airspeed). Including key words prevents erroneous interpretation and allows an effective readback/hearback.

4.21. Particular care is necessary when certain levels are referred to because of the high incidence of confusion between, for example, FL100 and FL110.

4.22. Non-standard phraseology is sometimes adopted unilaterally by national or local air traffic services, or is used by pilots or controllers in an attempt to alleviate these problems; however, standard phraseology minimises the potential for misunderstanding. Section 7 lists examples of phraseology which have been adopted for use by UK CAA, but which are contrary to ICAO standard.

Building Situational Awareness

4.23. Radio communications 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

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

Omission of Callsign

4.25. Omitting the callsign or using an incorrect callsign jeopardises an effective readback/hearback.

Omission of Readback or Inadequate Readback

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

(a) A pilot says "roger" (instead of providing a readback) to acknowledge a message containing numbers, thus preventing effective hearback and correction by the controller; or,

(b) 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 speed restriction cannot be met), thus decreasing both the pilot's and the controller's situational awareness.

Failure of Correct Readback

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

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

4.29. An uncorrected erroneous readback (known as a *hearback error*) may lead to a deviation from the cleared altitude or non-compliance with an altitude restriction or with a radar vector.

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

4.31. Less than required vertical or horizontal separation (and near mid-air collisions) is often the result of hearback errors.

Expectations

4.32. Bias in understanding a communications can affect pilots and controllers.

4.33. The bias of expectation can lead to:

(a) Transposing the numbers contained in a clearance (e.g. a flight level) to what was expected, based on experience or routine; and,

(b) Shifting a clearance or instruction from one parameter to another (e.g. perceiving a clearance to maintain a 280° heading as a clearance to climb/descend and maintain flight level 280).

Failure to Request Confirmation or Clarification

4.34. Misunderstandings may include half-heard words or guessed-at numbers.

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

4.36. Reluctance to seek confirmation may cause pilots to:

(a) Accept an inadequate instruction (over-reliance on ATC); or,

(b) Determine for themselves the most probable interpretation.

4.37. Failing to request clarification may cause flight crew to believe erroneously that they have received an expected clearance (e.g. clearance to climb to a requested level).

Failure to Question Instructions

4.38. 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 on collision course with another.

If there is any doubt as to the content of a clearance, or its meaning is not clearly understood, pilots must obtain clarification or confirmation.

Taking Another Aircraft's Clearance or Instruction

4.39. Level busts often occur because an aircraft accidentally takes a clearance intended for another aircraft.

4.40. This usually occurs when two aircraft with similar-sounding callsigns are on the same RTF channel[1] and are likely to receive similar instructions, or the callsign is blocked by another transmission.

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

4.42. Some national authorities have instituted callsign de-confliction programmes.

4.43. All operators should study their schedules and arrange callsigns to reduce the chance of company aircraft operating in the same airspace at the same time having similar callsigns.

Filtering Communications

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

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

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

4.47. For example, when operating in congested airspace the pilots should listen and give attention to all communications related to clearances to climb or descend to, or through, their level.

Timeliness of Communications

4.48. 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).

4.49. 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 acknowledgement.

4.50. 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 separations.

Blocked or Simultaneous Transmissions

4.51. Blocked transmissions are responsible for many altitude deviations.

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

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

4.54. 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).

4.55. The absence of a readback from the pilot should be treated as a blocked transmission and prompt a request to repeat or confirm the message.

4.56. In practice, most pilots are unlikely to treat the absence of a hearback acknowledgement from the controller as evidence of a blocked transmission, and only question the controller if they are uncertain that the read-back was correct or have other reasons to suspect a blocked transmission.

4.57. Although not official procedure, some pilots make a practice of alerting controllers and other pilots to an apparent blocked or garbled transmission by saying "Blocked" immediately afterwards.

[1] Refer to briefing note GEN 3 – Callsign Confusion.

5. Communicating Specific Events

5.1. The following events should be reported as soon as practical to ATC, stating the nature of the event, the actions taken and the flight crew's further intentions:

(a) Airborne collision avoidance system (ACAS) resolution advisory (RA);

(b) Severe turbulence;

(c) Volcanic ash;

(d) Windshear or microburst; and,

(e) A terrain avoidance manoeuvre prompted by a ground proximity warning system (GPWS) warning or terrain awareness and warning system (TAWS) warning.

6. Emergency Communication

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

6.2. The standard ICAO phraseology "Pan Pan" or "Mayday" must be used by the pilot to alert a controller and trigger an appropriate response.

6.3. Loss of pressurisation is an example of such an emergency; pilots should not delay declaring an emergency in the hope of receiving re-clearance before commencing descent.

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

(a) Time;

(b) Airspace; and,

(c) Silence.

6.5. The controller's response to the emergency situation could be patterned after a memory aid such as ASSIST[2]:

(a) **A**cknowledge:

– Ensure that the reported emergency is understood and acknowledged;

(b) **S**eparate:

– Establish and maintain separation from other traffic and/or terrain;

(c) **S**ilence:

– Impose silence on your control frequency, if necessary; and,

– Do not delay or disturb urgent flight crew action by unnecessary transmissions;

(d) **I**nform:

– Inform your supervisor and other sectors, units and airports, as appropriate;

(e) **S**upport:

– Provide maximum support to the flight crew; and,

(f) **T**ime:

– Allows flight crew sufficient time to handle the emergency.

7. Non-standard Phraseology used within UK

7.1. The UK CAA has adopted certain non-standard phraseology designed to reduce the chance of mishearing or misunderstanding RTF communications. This phraseology is not in accordance with ICAO standards but is based on careful study of the breakdown of pilot/controller communications. The following paragraphs taken from the UK Manual of Radiotelephony[3] summarise the main differences.

(a) The word 'to' is to be omitted from messages relating to FLIGHT LEVELS.

(b) All messages relating to an aircraft's climb or descent to a HEIGHT or ALTITUDE employ the word 'to' followed immediately by the word HEIGHT or ALTITUDE. Furthermore, the initial message in any such RTF exchange will also include the appropriate QFE or QNH.

(c) When transmitting messages containing flight levels each digit shall be transmitted separately. However, in an endeavour to reduce 'level busts' caused by the confusion between some levels (100/110, 200/220 etc.), levels which are whole hundreds e.g. FL 100, 200, 300 shall be spoken as "Flight level (number) HUNDRED". The word hundred must not be used for headings.

7.2. Examples of the above are:

[2] The ASSIST concept was first employed by ATC at Amsterdam Schiphol Airport.

[3] UK CAA CAP 413 Radiotelephony Manual. See also UK CAA CAP 493 Manual of Air Traffic Services Part 1 and UK CAA Air Traffic Services Information Notice 8/2002 – Phraseology Associated With Clearances Involving Flight Level 100, 200, 300 and 400

(a) “RUSHAIR G-BC climb flight level wun too zero.”

(b) “RUSHAIR G-BC descend to altitude tree tousand feet QNH 1014.”

(c) “RUSHAIR G-BC climb flight level wun hundred.”

(d) “RUSHAIR G-BC turn right heading wun wun zero.”

8. Training Program

8.1. A company training program on pilot-controller communications should strive to involve both flight crew 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:

(a) Modern flight decks (e.g. flight management system reprogramming) and ATC equipment;

(b) Operational requirements (e.g. aircraft climb, descent and deceleration characteristics, performance, limitations); and,

(c) Procedures for operating and threat and error management (e.g. standard operational procedures [SOPs]) and instructions (e.g. CRM).

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

9. Summary

9.1. The following should be emphasised in pilot-controller communications:

(a) Observe the company SOPs for cross-checking communications;

(b) Recognise and understand respective pilot and controller working environments and constraints;

(c) Use standard phraseology;

(d) Always confirm and read back appropriate messages;

(e) Request clarification or confirmation, when in doubt;

(f) Question an incorrect clearance or inadequate instruction;

(g) Prevent simultaneous transmissions;

(h) Listen to party-line communications as a function of the flight phase;

(i) Use clear and concise communications in an emergency.

10. Resources

Other Level Bust Briefing Notes

10.1. The following Level Bust Toolkit Briefing Notes contain information to supplement this discussion:

GEN 3 – Callsign Confusion;

OPS 1 – Standard Operating Procedures;

OPS 2 – Altimeter Setting Procedures;

OPS 3 – Standard Calls;

ATM 1 – Understanding the Causes of Level Busts;

ATM 2 – Reducing Level Busts.

Access to Resources

10.2. Most of the resources listed may be accessed free of charge from the Internet. Exceptions are:

ICAO documents, which may be purchased direct from *ICAO*;

Certain Flight Safety Foundation (FSF) Documents, which may be purchased direct from *FSF*;

Certain documents produced by the Joint Aviation Authorities, which may be purchased from *JAA*.

Regulatory Resources

10.3. Documents produced by regulatory authorities such as ICAO, JAA and national aviation authorities are subject to amendment. Reference should be made to the current version of the document to establish the effect of any subsequent amendment.

10.4. Reference regarding pilot/controller communications can be found in many international and national publications, such as:

ICAO – Annex 6 – Operation of Aircraft, Part I – International Commercial Air Transport – Aeroplanes, Appendix 2, 5.15;

ICAO Doc 4444 – Procedures for Air Navigation Services – Rules of the Air and Air Traffic Services (PANS-ATM);

ICAO Doc 8168 – Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS), Volume I – Flight Procedures;

ICAO – Annex 10 – Volume II: Communication procedures, Chapter 5: Aeronautical Mobile Service;

ICAO Doc 9432 – Manual of Radiotelephony;

Training Material and Incident Reports

EUROCONTROL Level Bust Workshops – Level Bust: Case Studies;

FAA Report – An Analysis of Ground Controller-Pilot Voice Communications;

FSF ALAR Toolkit – Briefing Note 2.3 – Effective Pilot/Controller Communications;

FSF Accident Prevention Volume 57 No 10 – ATR Strikes Mountain on Approach in Poor Visibility to Pristina, Kosovo

Training Material – Posters

Level Bust Prevention posters produced by the UK CAA:

2 Many Things

Wun Wun Zero

Other Resources

FSF Digest June 1993 – Research Identifies Common Errors behind Altitude Deviation;

FSF Accident Prevention Volume 47 No 6 – My Own Mouth shall Condemn Me;

FSF Accident Prevention Volume 49 No 5 – Communication Creates Essential Bond to Allow Air Traffic System to Function Safely;

IATA Report – English Language in Civil Aviation;

NASA feature "One Zero ways to Bust an Altitude … or was that Eleven Ways?";

RAe Human Factors Conference – Level Busts: Considerations for Pilots and Controllers;

UK CAA CAP 710 – "On the Level" and associated recommendations;

UK CAA Air Traffic Services Information Notice 8/2002 – Phraseology Associated With Clearances Involving Flight Level 100, 200, 300 and 400;

UK CAA CAP 413 Radiotelephony Manual;

UK CAA CAP 493 Manual of Air Traffic Services Part 1;

UK CAA Flight Operations Department Communication 11/2000 – Understanding and Interpreting Phraseology and Procedures used by AirTraffic Service Providers;

UK NATS Incidents around Stacks – a Pilot's View.

This briefing note has been prepared by the Safety Improvement Sub-Group (SISG) of EUROCONTROL to help prevent level busts. It is one of 14 briefing notes that form a fundamental part of the European Air Traffic Management (EATM) Level Bust Toolkit.

The authors acknowledge the assistance given by many sources, particularly Airbus Industrie and the Flight Safety Foundation (FSF), in developing these notes, some of which draw on material contained in the FSF Approach and Landing Accident Reduction (ALAR) Toolkit.