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Language as a Factor In Aviation Accidents and Serious Incidents: A Handbook for Accident Investigators ed. 2

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LANGUAGE AS A FACTOR IN AVIATION ACCIDENTS AND SERIOUS INCIDENTS

A HANDBOOK FOR ACCIDENT INVESTIGATORS

A Publication from

LANGUAGE AS A HUMAN FACTOR IN AVIATION RESOURCE CENTER

EMBRY-RIDDLE AERONAUTICAL UNIVERSITY

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**LANGUAGE AS A FACTOR IN AVIATION ACCIDENTS AND SERIOUS INCIDENTS:
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Synopsis

In an increasingly multicultural and multilingual aviation industry, it is important that accident investigators understand the complex role of language in maintaining safe operations. This Handbook supports investigators to systematically identify and consider possible language factors in aviation accidents and serious incidents.

References

ICAO Annexes 1, 6, 10, 11
ICAO Doc. 4444: PANS-ATM
ICAO Doc. 9835: Manual for the Implementation of ICAO Language Proficiency Requirements

Taxonomy

The Taxonomy of Communication Factors in Aviation is based on research by E. Mathews in 2012, revised collectively (2013 - 2018) by Angela Albritton, Michael Kay, and Elizabeth Mathews. The final version, included in this Handbook, was based on a linguistic review of the Aviation Safety Network Database conducted in 2018 by Joan Carson, E. Mathews, Steven Singleton, Enrique “Rick” Valdes, and Dave Williams.

Usage Note

All accident information contained in this Handbook is based on official accident investigation reports, published on the Flight Safety Foundation’s Aviation Safety Network Database, unless otherwise noted. <https://aviation-safety.net>

Reviewers

See Appendix E—End Notes for complete list of reviewers

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PART ONE: PURPOSE OF HANDBOOK

The purpose of this handbook is to support accident investigators in the identification and consideration of possible language factors in aviation accidents and serious incidents. This handbook provides guidance, background information, and tools that will assist accident investigators in conducting a systematic review of possible language factors.

PART TWO: THE ROLE OF LANGUAGE IN MAINTAINING SAFE OPERATIONS

The International Society of Air Safety Investigators (ISASI) suggests that accident investigation “findings” be defined as “all significant conditions and events, causal and non-causal, found in the investigation.” Relatedly, “Cause” has been defined as a “deficiency [that] the correction, elimination, or avoidance of which would likely have prevented or mitigated the mishap, damage, or significant injuries. A cause is an act, an omission, a condition or a circumstance [that] either starts or sustains the mishap sequence¹.”

Operational and safety experts universally acknowledge that communication plays a role in maintaining safe operations. Yet, investigating and analyzing communications is problematic in accident investigations because of the complexity of its various components which, in addition to language, include cultural, technical, and procedural elements.

A communication failure can be the result of technical issues, such as static noise on the radio, or an equipment failure. Communication problems can include procedural issues such as readback / hearback errors or a failure to share information. Communications can be hindered by cultural factors such as group versus individual orientation, issues of power distance, principles of Crew Resource Management, or issues within an organization’s culture. There is generally broad industry awareness and understanding of these categories of communication factors. Accident investigators bring technical, operational, and human factors expertise to the analysis of technical, procedural, and cultural factors in aviation accidents and serious incidents.

The most important component of communication, however, is language. The effect of language on aviation safety includes not only issues addressed by the Language Proficiency Requirements, adopted by the International Civil Aviation Organization (ICAO) in 2008, including the use of standard ICAO phraseology and plain language proficiency for radio communications, but also the role of language in other aspects of aviation safety².

Without adequate awareness and understanding of language as a human factor, accident investigators and the industry in general can miss language factors as a “significant condition” upon which other errors may have been allowed to develop. For example, in many anonymous reporting systems, and in taxonomies of human factors, language factors are simply included under “communication” or “language barrier.” Without a clear description of what these factors are, it is simply not possible to provide the industry with recommendations/actionable items to improve aviation safety.

¹ Wood, Richard H., and Sweginnis, Robert W. *Aircraft Accident Investigation*, ed. 2. Endeavor Books. p. 8.

² Appendix A—Examples of Language as a Human Factor in Accidents.

PART THREE: ICAO LANGUAGE PROFICIENCY REQUIREMENTS

In an initial effort to address language safety concerns, ICAO has defined oral language proficiency requirements for pilots and air traffic controller radiotelephony communications³. The ICAO language Standards and Recommended Practices are generally referred to as the ICAO Language Proficiency Requirements (ILPRs) and are intended to ensure that pilots and ATCs have minimum adequate levels of language proficiency. The LPRs require that pilots and air traffic controllers demonstrate proficiency in English in order to operate along international routes. In cases where these requirements are not met, safety may be compromised.

The ICAO LPRS are intended to apply to Pilot and ATC radiotelephony—i.e., **spoken language**. They do not specify the language proficiency required for safe and effective flight crew communications, for threat and error management communications, or crew resource management. The ICAO LPRS do not address the language proficiency needed in ground school, simulator or flight training instruction conducted in an English as a foreign or second language environment. There are no ICAO language requirements that address the demands of **written language** in aviation; there are no reading proficiency requirements, even though globally most operational and safety manuals are published in English and used by operational personnel who use English as a foreign language. Neither are there ICAO language requirements that address the range of communication environments and situations faced by other key aviation personnel (maintenance technicians, cabin crew, etc.), all of which may be implicated in accidents or incidents.

Because language is a key factor in every phase of aviation, accident investigators need to be aware of what ICAO has specified as the minimum adequate language proficiency so that they can identify situations in which a lack of language proficiency—for whatever reason and to whatever extent—may have played a role in the accident/incident.

ICAO LPRS are contained in the following ICAO Documents, (and are excerpted in ICAO Document 9835—*Manual on the Implementation of the ICAO Language Proficiency Requirements*, Appendix A):

Annex 1—*Personnel Licensing* (Chapter 1.2.9 and Appendix 1)

Annex 6—*Operation of Aircraft* (Part 1, chapter 3.1.8)

Annex 10—*Aeronautical Telecommunications*, Volume II (Chapter 5.1 and 5.2)

Annex 11—*Air Traffic Services* (Chapter 2.29)

Doc 4444—*PANS-ATM* (Chapter 12.2.1)

³ Appendix B—The ICAO Rating Scale

ICAO LPRs SYNOPSIS

From the point of view of the accident investigator, the more salient aspects of the ICAO LPRs are as follows:

1. It is the responsibility of the Civil Aviation Authorities (CAAs) to provide oversight of national English language testing.
 - CAAs may provide national testing, either in-house or contracted to a testing service provider, or they may approve testing provided by an airline, an air navigation service provider, or a civil aviation training institute.
 - A CAA may accept the language endorsement from another Civil Aviation Authority.
2. It is the responsibility of airlines to ensure that their pilots demonstrate English language proficiency at least at the ICAO Operational Level 4. (ICAO Annex 6; para 3.1.8.)
3. It is the responsibility of air navigation service providers to ensure that their air traffic controllers demonstrate English language proficiency at least at the ICAO Operational Level 4. (ICAO Annex 11; para 2.29.)
4. Pilots and air traffic controllers must demonstrate ICAO Operational Level 4 in *each* of the ICAO Rating Scale descriptor areas: Pronunciation; Structure; Vocabulary; Comprehension; Fluency; Interactions. (ICAO Annex 1; Appendix 1)
5. ICAO Annex 1 requires that language proficiency be documented on pilot licenses. (Annex 1: para 5.1.1)
6. ICAO LPRs require proficiency ***not only*** in the use of ICAO phraseology, ***but also*** in plain language.⁴ (Annex 10, Vol 2, para 5.1.1.1).
7. The ICAO LPRs specify a minimum adequate level of English language proficiency for pilot-ATC communications. However, the level of English language proficiency required for cross-cultural flight deck communications, for effective crew resource management, or for flight training in English contexts may be higher. ATC communications are generally relatively constrained, while CRM, flight deck communications, and flight training in English require intensive communications in English that may extend beyond the requirements of performing at ICAO Operational Level 4. Accident investigators should be aware of the varying demands on language ability in varying situations.

⁴ The use of ICAO phraseology is a standard prescribed by ICAO Annex 10, Vol. 2, para 5.1.1.1: “ICAO standardized phraseology shall be used in all situations for which it has been specified. Only when standardized phraseology cannot serve an intended transmission, plain language shall be used.”

ICAO OPERATIONAL LEVEL 4 LANGUAGE COMPETENCIES (From ICAO Document 9835)

At ICAO Operational Level 4, pilots and ATCs should be able to:

- Communicate effectively in voice-only and in face to face situations;
- Communicate on work related topics with accuracy and clarity;
- Use communicative strategies to check, confirm, or clarify information;
- Handle with relative ease the linguistic challenge presented by unexpected turn of events with context of work;
- Use an accent that is intelligible in an international context.

ICAO OPERATIONAL LEVEL 4 DESCRIPTORS (excerpts; see full descriptors in the Rating Scale in Appendix B)

- **Pronunciation**...only sometimes interferes with ease of understanding.
- **Grammar** errors may occur...but rarely interfere with meaning.
- **Vocabulary** is sufficient to communicate work related topics. Can paraphrase.
- **Fluency** permits effective communication.
- **Comprehension** mostly accurate on work related topics.
- **Interacts** adequately, can initiate and maintain exchanges, can confirm and clarify.

AVIATION ENGLISH LANGUAGE TESTING

It is also important that accident investigators know that aviation English language testing (and training) programs are largely unregulated⁵. There are no licensing requirements for aviation English testers, and no universal or national language-specialist regulatory oversight of language testing programs. As a result, the reliability of aviation English testing worldwide is uneven. The EUROCONTROL Test of English Language Proficiency for Aeronautical

⁵ Note that in addition to finding that some pilots and controllers had language proficiency below ICAO minimum standards, Clark notes in her recent research report to the UK CAA that there were "...grounds to suspect cheating on aviation English exams...[and] grounds to suspect that some non-native English speakers are not being tested, but instead are granted ICAO Level 4 certificates on 'sweetheart' deals (handshakes, via friends, etc.)..." Clark, B. 2017. *Aviation English Research Project: Data analysis findings and best practice recommendations*. Civil Aviation Authority, Aviation House, Gatwick Airport South, West Sussex, RH6 -0YR.

Communications (ELPAC) is the only aviation English testing program that retains an ICAO acknowledgement of compliance with ICAO Test Criteria.

PART FOUR: HOW TO USE THIS MANUAL

A. BE AWARE OF POSSIBLE LANGUAGE ENVIRONMENTS AND SITUATIONS

Be aware of environments and situations in which language may be a factor:

Language and other communication factors affect aviation safety in many ways, with a potential chain of causality going back as far as the effect of language proficiency on ab initio training. Examples of other communication and language use events include:

- Flight deck communications between pilots or flight engineers which can be first language communications or, often, English as a foreign language communications.
- Reading or listening to checklists or emergency checklist instructions being read aloud in English as a second language.
- Pilot and maintenance technician communications, written or spoken.
- Situational awareness issues in operational environments in which English and another language are used.
- Safety communications between pilots and flight attendants. Safety instructions between flight attendants and passengers.
- Communications between pilots and emergency rescue services.
- Reading or speaking/listening proficiency of all aviation personnel (pilots, maintenance technicians, dispatchers, controllers, cabin crew) during initial or subsequent training.

The following chart illustrates the many types of environments in which language (spoken and written) may arise as a factor that affects flight safety.

ENGLISH USE IN AVIATION

Where language can impact aviation safety

Language Skill Required:	Speaking / Listening	Reading	Writing
Personnel	Only those underlined communication requirements are governed by ICAO Standards		
Pilots: Professional	<ul style="list-style-type: none"> • Pilot-controller • Pilot - pilot, CRM and flight deck communications • Pilot - PAX • Pilot - Ground crew • Pilot - Instructor/Check airman • Pilot - Mechanics/engineers • Pilot - Dispatcher 	<ul style="list-style-type: none"> • Aircraft and Operating Manuals • Quick Reference Handbooks • Safety updates and briefings • Training devices • Safety materials. • Training materials • Datalink • Flight Management Systems. 	<ul style="list-style-type: none"> • Datalink • Maintenance reports • Safety incident reports
Pilots: ab initio	<ul style="list-style-type: none"> • Cadet - Instructors • Cadet - Examiner • Cadet – controller 	<ul style="list-style-type: none"> • Training materials • Aircraft Manuals • Safety updates and briefings • Training devices • Safety materials. 	<ul style="list-style-type: none"> • Tests
Maintenance Technicians: Professional	<ul style="list-style-type: none"> • With pilots • Other ground crew • Aircraft manufacturer representatives • With controllers 	<ul style="list-style-type: none"> • Aircraft manuals • Safety updates and briefings • Training materials • Training devices • Safety materials • Training materials 	<ul style="list-style-type: none"> • Records and reports
Maintenance Technicians: ab initio	<ul style="list-style-type: none"> • Instructors 	<ul style="list-style-type: none"> • Training materials • Aircraft manuals • Aircraft documents • Training devices • Safety materials, updates, briefings • Policies and procedures 	<ul style="list-style-type: none"> • Tests
Controllers: Professional	<ul style="list-style-type: none"> • Controller-pilot • Ground staff • Emergency services • Controller - pilot dispatchers 	<ul style="list-style-type: none"> • Training materials • Safety updates and briefings • Training devices • Safety materials 	<ul style="list-style-type: none"> • Reports • Datalink
Controllers: ab initio	<ul style="list-style-type: none"> • Cadet – instructors 	<ul style="list-style-type: none"> • Training materials • Safety updates and briefings • Training devices • Safety materials 	<ul style="list-style-type: none"> • Tests
Cabin crew: Professional	<ul style="list-style-type: none"> • Passengers • Pilots • Other crew members 	<ul style="list-style-type: none"> • Manuals and learning materials. • Equipment instructions. • Safety updates. 	<ul style="list-style-type: none"> • Reports
Cabin: ab initio	<ul style="list-style-type: none"> • Instructors 	<ul style="list-style-type: none"> • Training materials 	<ul style="list-style-type: none"> • Tests

B. EMPLOY INITIAL “LANGUAGE ENVIRONMENT” CHECKLIST

Use the “Language Environment Checklist” to systematically gather language related information.

The US National Transportation Safety Bureau (NTSB) accident investigation protocols include checklists for, *inter alia*, Operations which collect flight crew information such as training, certificates and ratings held and dates acquired, as well as Human Factors which collect personal and operational information such as education, family information, sleeping habits, and general and specific training. Collecting this information does not mean that any of the Operations or Human Factors information thus noted was necessarily relevant to a particular accident/incident. Rather, the information helps the investigators to a) bring into focus any one piece of information that may deviate from expected norms, and b) access these pieces of information should they become significant in the course of the ongoing investigation.

For these reasons, checklists should be used to collect information relevant to the language environment of the accident/incident.⁶

⁶ Appendix C—Checklist of Language Environment Factors in Accidents/Incidents.

C. USE COMMUNICATION TAXONOMY

Use the Taxonomy of Aviation Communication Factors to help identify and categorize language factor(s)

The Taxonomy of Aviation Communication Factors⁷ categorizes factors related to effective and safe communications in aviation. It has been developed to illustrate how “Communication” in aviation is a broad and complex category within Human Factors Taxonomies, and that Language is a distinct and complex category within the broader context of Communications. The Taxonomy of Aviation Communication Factors is crucial for helping accident investigators identify the type of language issue that may have been a contributory or latent factor in an accident/incident. The Taxonomy identifies four types of factors involved in Communications: Language Factors, Cultural Factors, Technical Factors, and Procedural Factors.

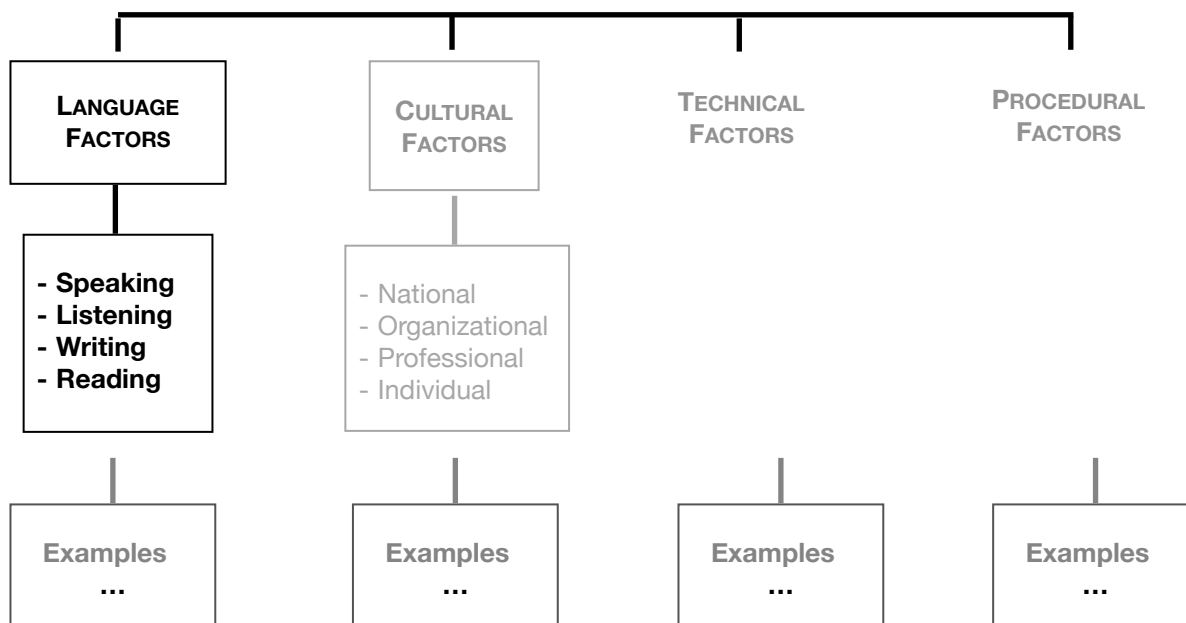
However, this Handbook focuses exclusively on the dimensions of Language, not only to clarify its role within Communication, but also to allow the industry to use standardized terms to reveal meaningful and interpretable language issues over time, providing a clear picture of the impact of language on aviation safety. Overall, technical, procedural, and cultural factors that affect communications are areas that are better understood by the industry than language factors tend to be. The examples provided are not exhaustive, and aviation safety experts will be able to identify more.

The purpose of the Taxonomy which highlights Language Factors is:

1. To situate and clarify the role of language within the field of human factors;
2. To improve identification and analysis of language factors in aviation accidents and incidents; and
3. To heighten industry awareness and understanding of language in aviation safety.

⁷ Appendix D—Taxonomy of Aviation Communication Factors

TAXONOMY OF AVIATION COMMUNICATION FACTORS



D. USE LINGUISTIC EXPERTISE WHEN NECESSARY

If a need for external linguistic input is identified, ensure that the linguistic expert has “Best Qualifications” according to ICAO Guidance Document 9835. The qualifications are, specifically, a Master’s or Ph.D. degree in *Applied Linguistics* AND experience in aviation communications. Note that there are many academic fields related to communication, such as Speech Therapy, Communications, literature-based degrees in English or other languages, and theoretical linguistics. These are not appropriate fields for aviation investigations, as they do not provide the necessary training or expertise in the kinds of approaches to language usage and practice that are needed here.

APPENDIX A—EXAMPLES OF HOW LANGUAGE IMPACTS FLIGHT SAFETY

Language proficiency can impact flight safety in a number of ways. Sometimes language use or language proficiency is a more clearly discernible factor in an accident or incident and is identified by accident investigators as a contributory factor.

- Incorrect phraseology (Runway Collision; two B747's; Tenerife, Spain; 27 March 1977)
- Issuing or interpreting ambiguous ATC instructions (“Turn to the left” versus “Turns to the left.” CFIT; B727-46; Tenerife, Spain; 25 April 1980)
- Difficulty comprehending ATC communications (Incident; B737-500; Heathrow, London; 4 June 2007. Crash on approach; TU 154M; Longyear, Norway; 29 August 1996.)
- Failure to communicate severity of a low fuel situation to air traffic control (Boeing 707-321B; Cove Neck, New York; 25 January 1990)
- Inadequate plain language proficiency (CFIT; Boeing 757-223; Cali, Colombia; 20 December 1995)
- Pilot disregard of instructions (Midair collision between a B747-168B and Ilyushin IL76-TD; India; 12 November 1996)

Sometimes language has a more subtle but still significant effect on aviation safety, playing a role in the complex chain of events that is harder to detect but that may have contributed to constructing the landscape on which other errors could build. Sometimes, accident investigators uncover evidence of possible language factors; in such cases, language is a valid investigative question that merits the same systematic review given to other aspects of human performance.⁸

- Limited English plain language proficiency can inhibit pilots' and controllers' ability to troubleshoot problems, to clarify or confirm information. (CFIT, B767-200ER; Korea; 15 April 2002. Fuel exhaustion; Antonov 128K; Sri Lanka; 24 March 2000.)
- Bilingual flight deck communications in English as a foreign language may impede Crew Resource Management. Inadequate CRM among flight crew who do not share a common first language merits consideration as a possible language factor. (Crew incapacitation, B737, Greece, 14 August 2005. Loss of control, Saab 340-B, Switzerland, 10 January 2000.)
- Pilots or controllers who speak English as a foreign language can experience *language apprehension* and may subconsciously seek to avoid actions that would require additional

⁸ The purpose of this brief review of accidents is not to challenge the findings of any accident investigation. Rather, examples of how language may appear as a *valid investigative question* are provided to help raise awareness among accident investigators.

or non-standard communications in English. This can become evident as “radio silence;” a failure to convey important information; or a failure to clarify or confirm ambiguous information or communications. (Midair collision between B737 and Legacy 600, Brazil, 29 September 2006.)

- Low levels of reading proficiency can affect the operational understanding of the aircraft or of procedures when manuals, safety updates, or procedures are written in complex English (Crash on approach, B737-505, Russia, 14 September 2008. Ice on wings, ATR 72, Russia, 2 April 2012. Loss of control in flight, B747-209B, Taiwan, 25 May 2002.)
- Operational or maintenance manuals written in, or translated into, non-standard or unclear English may cause comprehension difficulties. (CFIT, Xian MA60, Indonesia, 7 May 2011. Let 410U-VP, Brazil, 13 July 2011.)
- Reading aloud or listening to English checklists may cause comprehension difficulties. A failure to use a checklist among crew members who do not share a common language or who must read the checklist aloud in English as a foreign language may be an indication of a language issue. (Mathews, *Language and Culture on a Multicultural Flight Deck*. Unpublished ms.)
- The use of two languages in a single operating environment may contribute to loss of situational awareness. (Runway collision between Shorts 330-200 and MD83, Charles de Gaul, Paris, 25 May 2000.)
- Limited English language proficiency can result in flight crew being unable to request, direct, or assist emergency services. (Emergency rescue personnel who did not understand directions, in English, from the First Officer, who survived the crash, on how to access accident victims still on the aircraft. B747-41, Taiwan, 31 October 2000.⁹)

⁹ Personal communication.

APPENDIX B—ICAO LANGUAGE PROFICIENCY RATING SCALE

Excerpted from the Attachment to ICAO Annex 1—Personnel Licensing

LEVEL	PRONUNCIATION	STRUCTURE	VOCABULARY	FLUENCY	COMPREHENSION	INTERACTIONS
Expert 6	Pronunciation, stress, rhythm, and intonation, though possibly influenced by the first language or regional variation, almost never interfere with ease of understanding.	Both basic and complex grammatical structures and sentence patterns are consistently well controlled.	Vocabulary range and accuracy are sufficient to communicate effectively on a wide variety of familiar and unfamiliar topics. Vocabulary is idiomatic, nuanced, and sensitive to register.	Able to speak at length with a natural, effortless flow. Varies speech flow for stylistic effect, e.g. to emphasize a point. Uses appropriate discourse markers and connectors spontaneously.	Comprehension is consistently accurate in nearly all contexts and includes comprehension of linguistic and cultural subtleties.	Interacts with ease in nearly all situations. Is sensitive to verbal and non-verbal cues and responds to them appropriately.
Extended 5	Pronunciation, stress, rhythm, and intonation, though influenced by the first language or regional variation, rarely interfere with ease of understanding.	Basic grammatical structures and sentence patterns are consistently well controlled. Complex structures are attempted but with errors which sometimes interfere with meaning.	Vocabulary range and accuracy are sufficient to communicate effectively on common, concrete, and work-related topics. Paraphrases consistently and successfully. Vocabulary is sometimes idiomatic.	Able to speak at length with relative ease on familiar topics but may not vary speech flow as a stylistic device. Can make use of appropriate discourse markers or connectors.	Comprehension is accurate on common, concrete, and work-related topics and mostly accurate when the speaker is confronted with a linguistic or situational complication or an unexpected turn of events. Is able to comprehend a range of speech varieties (dialect and/or accent) or registers.	Responses are immediate, appropriate, and informative. Manages the speaker/ listener relationship effectively.
Operational 4	Pronunciation, stress, rhythm, and intonation are influenced by the first language or regional variation but only sometimes interfere with ease of understanding.	Basic grammatical structures and sentence patterns are used creatively and are usually well controlled. Errors may occur, particularly in unusual or unexpected circumstances, but rarely interfere with meaning.	Vocabulary range and accuracy are usually sufficient to communicate effectively on common, concrete, and work-related topics. Can often paraphrase successfully when lacking vocabulary in unusual or unexpected circumstances.	Produces stretches of language at an appropriate tempo. There may be occasional loss of fluency on transition from rehearsed or formulaic speech to spontaneous interaction, but this does not prevent effective communication. Can make limited use of discourse markers or connectors. Fillers are not distracting.	Comprehension is mostly accurate on common, concrete, and work-related topics when the accent or variety used is sufficiently intelligible for an international community of users. When the speaker is confronted with a linguistic or situational complication or an unexpected turn of events, comprehension may be slower or require clarification strategies.	Responses are usually immediate, appropriate, and informative. Initiates and maintains exchanges even when dealing with an unexpected turn of events. Deals adequately with apparent misunderstandings by checking, confirming, or clarifying.

LEVEL	<i>PRONUNCIATION</i> <i>Assumes a dialect and/or accent intelligible to the aeronautical community.</i>	<i>STRUCTURE</i> <i>Relevant grammatical structures and sentence patterns are determined by language functions appropriate to the task.</i>	<i>VOCABULARY</i>	<i>FLUENCY</i>	<i>COMPREHENSION</i>	<i>INTERACTIONS</i>
<i>Levels 4, 5 and 6 are on preceding page.</i>						
Pre-operational 3	Pronunciation, stress, rhythm, and intonation are influenced by the first language or regional variation and frequently interfere with ease of understanding.	Basic grammatical structures and sentence patterns associated with predictable situations are not always well controlled. Errors frequently interfere with meaning.	Vocabulary range and accuracy are often sufficient to communicate on common, concrete, or work-related topics, but range is limited and the word choice often inappropriate. Is often unable to paraphrase successfully when lacking vocabulary.	Produces stretches of language, but phrasing and pausing are often inappropriate. Hesitations or slowness in language processing may prevent effective communication. Fillers are sometimes distracting.	Comprehension is often accurate on common, concrete, and work-related topics when the accent or variety used is sufficiently intelligible for an international community of users. May fail to understand a linguistic or situational complication or an unexpected turn of events.	Responses are sometimes immediate, appropriate, and informative. Can initiate and maintain exchanges with reasonable ease on familiar topics and in predictable situations. Generally inadequate when dealing with an unexpected turn of events.
Elementary 2	Pronunciation, stress, rhythm, and intonation are heavily influenced by the first language or regional variation and usually interfere with ease of understanding.	Shows only limited control of a few simple memorized grammatical structures and sentence patterns.	Limited vocabulary range consisting only of isolated words and memorized phrases.	Can produce very short, isolated, memorized utterances with frequent pausing and a distracting use of fillers to search for expressions and to articulate less familiar words.	Comprehension is limited to isolated, memorized phrases when they are carefully and slowly articulated.	Response time is slow and often inappropriate. Interaction is limited to simple routine exchanges.
Pre-elementary 1	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.	Performs at a level below the Elementary level.

Note.— The Operational Level (Level 4) is the minimum required proficiency level for radiotelephony communication. Levels 1 through 3 describe Pre-elementary, Elementary, and Preoperational levels of language proficiency, respectively, all of which describe a level of proficiency below the ICAO language proficiency requirement. Levels 5 and 6 describe Extended and Expert levels, at levels of proficiency more advanced than the minimum required Standard. As a whole, the scale will serve as benchmarks for training and testing, and in assisting candidates to attain the ICAO Operational Level (Level 4).

APPENDIX C—CHECKLIST OF LANGUAGE ENVIRONMENT FACTORS

1. NATIVE LANGUAGE OF PERSONNEL

- Pilots
- Cabin Crew
- ATC
- Maintenance Technicians
- Ground Staff
- Aeronautical Station Operators

2. LANGUAGE PROFICIENCY OF PERSONNEL

- Pilots (Include Documented Proficiency Level)
- Cabin Crew
- ATC (Include Documented Proficiency Level)
- Maintenance Technicians
- Ground Staff
- Aeronautical Station Operators

3. LANGUAGE USED IN ORAL SITUATIONS

- In Interactions
 - Pilot and Air Traffic Controller radiotelephony communications
 - Flight Deck Crew
 - Flight Deck
 - Reading aloud Checklists
 - Reading aloud Quick Reference Handbooks (QRH)
 - Reading aloud Electronic Centralized Aircraft Monitor (ECAM)
 - Flight Deck/Cabin Crew
 - Pilot/Maintenance Technician
 - Cabin Crew/Maintenance Technician
 - Ground Staff/ATC
 - Ground Staff/Pilot
- In Audio Alerts
- In Training (Ab Initio and Recurrent)
 - Pilot
 - ATC
 - Cabin Crew
 - Maintenance Technicians
 - Ground Staff

4. LANGUAGE USED FOR WRITTEN MATERIALS

- By Pilot
 - Aircraft Manuals (Training and Operating)
 - Quick Reference Handbooks
 - Safety Updates and Briefings (Training and Operating)
 - CBT Training Devices
 - Safety Materials (Training and Operating)

- Datalink
- Reports
- Logbooks

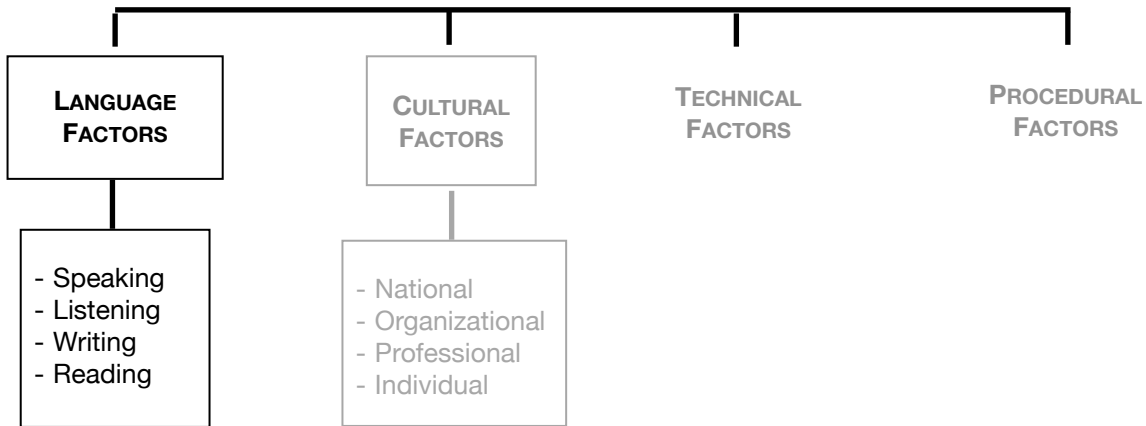
- By ATC or Aeronautical Station Operators
 - Training Materials
 - Safety Updates and Briefings (Training and Operating)
 - CBT Training Devices
 - Safety Materials (Training and Operating)
 - Datalink
 - Reports
 - Tests
 - Logbooks

- By Cabin Crew
 - Manuals
 - Equipment Instructions
 - Safety Updates and Briefings (Training and Operating)
 - Reports
 - Training Materials
 - Tests

- By Maintenance Technicians
 - Training Materials
 - Tests
 - MRO Manuals
 - Safety Updates and Briefings (Training and Operating)
 - Technical Updates
 - CBT Training Devices
 - Records
 - Reports and logbooks

- By Ground Staff
 - Training Materials
 - Manuals
 - Safety Updates and Briefings (Training and Operating)
 - Safety Materials
 - Logbooks

APPENDIX D—TAXONOMY OF AVIATION COMMUNICATION FACTORS



N.B. When using this taxonomy, it is important to remember that language skills, in particular, apply to both native and non-native English speakers. While lack of English language proficiency may be, at times, more easily identifiable for non-native English speakers, the use of inappropriate language on the part of native English speakers also contributes to communication problems.

I. LANGUAGE

a. Speaking

Examples of elements of speaking proficiency that can affect communication include the following:

1. Accent or Pronunciation
2. Structure or Grammar
 - Imprecise grammar may impede the transmission of an intended message.
 - Speaker's use of complex grammar can impede listener comprehension.
3. Vocabulary
 - Inaccurate use of ICAO or other Civil Aviation Authority (CAA)-approved phraseology
 - Failure to use ICAO phraseology
 - Use of slang or idiomatic expressions
 - Inadequate plain language ability
 - Homophony (e.g., "to" vs. "two")

- Ambiguity (e.g., uncertain references to “him,” “it, “things”).
4. Fluency
 - Speech rate too fast
 - Speech rate too slow
 - Hesitations interfere with comprehensibility
 5. Failure to communicate required information/silence
 6. Speaker’s language level not appropriate for varying levels of listeners.

Usage Notes

- Numbers can be particularly difficult for non-native English speakers to learn and fluently use, and are a frequent cause of incorrect hear back/call back and call sign errors. Numbers are often problematic for native English speakers in the same contexts.
- Responsibility for fluent communication in aviation is not placed just on non-native English speakers, but on all participants.
- Native English speakers often do not have to undergo tests of their knowledge of ICAO/CAA language phraseology. As a result, lack of standard phraseology may be an issue in communications.
- FAA phraseology is different from ICAO phraseology in some instances.
- Ground staff uses of non-standard communication can be problematic when communicating with ATC or pilots.
- Non-routine radiotelephony messages often rely on speaker’s plain language knowledge and proficiency, which can be particularly elusive for non-native English speakers in high stress situations.
- Speaker’s use of passive verbs can cause confusion between listener’s understanding of the agent of the action vs. the object of the action.
- Pronunciation/accent may interfere with listener comprehension of text in cases where a non-native speaker must read aloud from a QRH (or other manuals) written in English.
- Prolonged loss of communication (PLOC) can be confused with radio silence in which communication ceases for language reasons.
- Cultural norms of uncertainty avoidance can result in language apprehension or a reluctance to communicate, especially in non-routine situations.

b. Listening

Examples of observable aspects of language use that may indicate listening comprehension problems, include *inter alia*, the following:

1. Failure to respond appropriately to verbal communications
 - Failure to respond verbally, i.e., silence
 - Failure to perform instructed actions, or inappropriate action
 - Inappropriate verbal response
3. Inaccurate readback
4. Inaccurate callsign
5. No communication/silence.

Usage Notes

- Research has found that lack of adherence to ICAO phraseology, including the phonetic alphabet, is a significant reported condition causing confusion among pilots.¹⁰
- Numbers are used in handovers, call signs, flight level, and can interact with message complexity and speech rate to affect comprehension.
- Since auditory short-term memory performance declines rapidly at about 15 seconds from the onset of new information, lengthy messages containing several instructions contribute to pilots' cognitive workload and can interfere with comprehension of the message.
- Grammatically complex messages can be more difficult to understand.
- Pilot or FO may have difficulty understanding each other on a bilingual flight deck.

c. Writing

Examples of elements of writing that can affect communication include the following:

1. Level of writing adjusted for varying abilities of readers.
2. Sentence structure clarifies meaning.
3. Technical vocabulary used appropriately.
4. Familiarity with format (e.g., reports).

Usage Notes

- Grammatically complex texts can obscure meaning and interfere with comprehension and learning.
- Many writing demands (e.g., reports, logbooks) must adhere to specific format to be comprehensible.
- Safety and technical bulletins may not be written in language adjusted for varying abilities of readers.

¹⁰ Clark, B. (2017) *Aviation English Project: Data analysis findings and best practice recommendations*. Civil Aviation Authority, Aviation House, Gatwick Airport South, West Sussex, RH6 0YR. p. 57.

- Linguistically complex training materials may result in student's not learning at the level necessary to perform required tasks safely.

d. **Reading**

Examples of observable aspects of language use that may indicate reading comprehension problems, include *inter alia*, the following:

1. Following written instructions.
2. Learning from written text.

Usage Notes

- Reading comprehension is important for all categories of aviation personnel: pilots, ATC, cabin crew, maintenance technicians, ground staff, and aeronautical station operators.
- Because of the ubiquity of reading materials in training and operations, the effects of lack of or inadequate reading comprehension can be subtle, but always underlie aviation personnel behaviors.
- Reading comprehension is at the heart of much computer- based training.
- Skill-based errors may be the result of inadequate language proficiency which lead to below average acquisition of required abilities during training.

II. **Cultural Factors**

Examples of cultural factors that can affect communication include the following, *inter alia*¹¹:

1. National Culture
 - Individualism versus collectivism
 - Power distance gradient
 - Politeness norms
2. Organizational Culture
 - Safety culture
 - Crew Resource Management (CRM) and Threat and Error Management (TEM) training
3. Professional culture¹²
 - Pride in the profession
 - A commitment to the safety culture
 - Sense of invulnerability

¹¹ Because the topic of cultural factors in aviation has been relatively well covered in the literature on human factors in aviation, the categories here are representative, not inclusive. Accident investigators and safety experts will be aware of other aspects of culture that affect communications.

¹² Helmreich, R.L., "Building Safety on the Three Cultures of Aviation." *Proceedings of the IATA Human Factors Seminar*. 39-43. Bangkok, Thailand. 12 August 1998. And, ICAO Doc 9859—Safety Management Manual; para 2.6.10.

4. Individual Culture
 - Cultural and linguistic awareness
 - Personal attributes

III. Technical Factors

Examples of technical factors that can affect communication include the following, *inter alia*¹³:

1. Noise or static
2. Lack of radar coverage
3. Equipment failure

IV. Procedural Factors

Examples of procedural factors that can affect communication include the following, *inter alia*¹⁴

1. Blocked transmission
2. Incorrect or committed call sign
3. Two languages in use in same operational environment
4. Failure to relay information

¹³ Aviation safety experts and accident investigators are most readily familiar, by their background training and experience, with technical and procedural factors that affect communication. The categories here are representative not inclusive, intended to highlight some technical and procedural factors that have been identified in accident investigation reports as contributing to communication problems.

¹⁴ See preceding footnote.

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