April 2023

100 KNOTS

India's Aviation Ecosystem

Safety
Handling Unruly Passengers in Flight

Communication
Guide to Passenger Address (PAs)

Health
Protecting Hearing in Aviation

Aero Sports
Ballooning Basics

A Kerospace Solutions Company

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EDITORIAL DESK

Radhika Bansal
Editor

Dear Colleagues,

Welcome to the May 2023 issue of the 100 Knots Magazine.

In the May edition, Managing Director & Co-Founder of E-Factor Experiences Limited, Mr. Samit Garg talks about the Hot Air Balloons, its history, physics and ecosystem in India. Consultant Aerospace Medicine Specialist, Dr. Sanjay Bhargava MD explains the importance of hearing hazards in aviation, science behind it and mitigation strategies. A320
Capt. Vijay Devadas talks about the importance of Passenger Address and how Pilots can use this opportunity to demonstrate confidence and warmth among nervous flyers. Deputy Chief Pilot of Air India Express, Capt. Vikas Nautiyal talks about the pressing issue of Unruly Passengers, Jurisdictional Gaps, accountability issues and latest developments.

This month will be saddened with the news of Go First going into bankruptcy. This will mark an unfortunate end to the long running struggle of Go First after it was forced to ground more than half of its fleet due to recurrent issues and non-supply of engines from Pratt & Whitney. Our prayers go to Go First team and we hope for their revival.

As always, Contributions, comments, and feedback are always welcome. All papers are received with a high degree of enthusiasm and will find a home in future issues.

Our sincere thanks to all the contributors for their support and interest.

We hope to hear from you soon!

Happy Reading!

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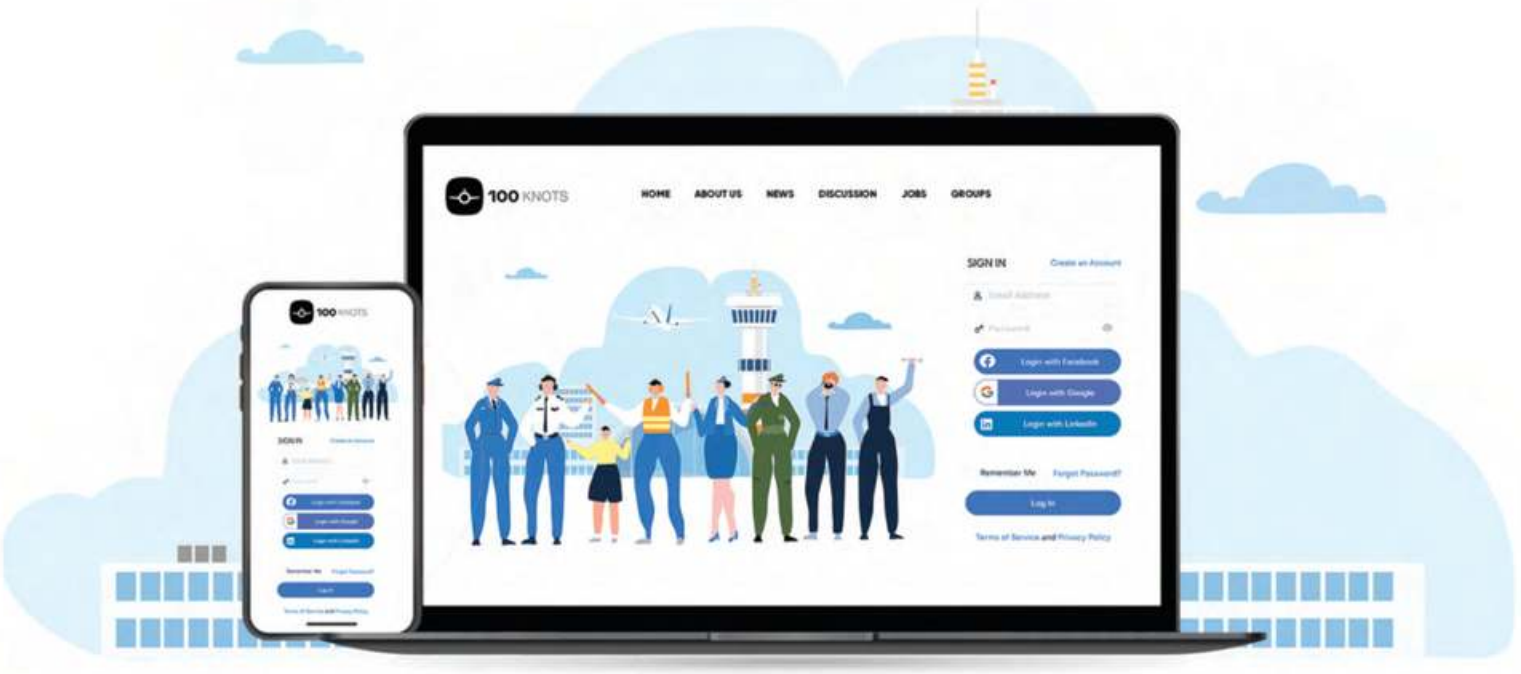

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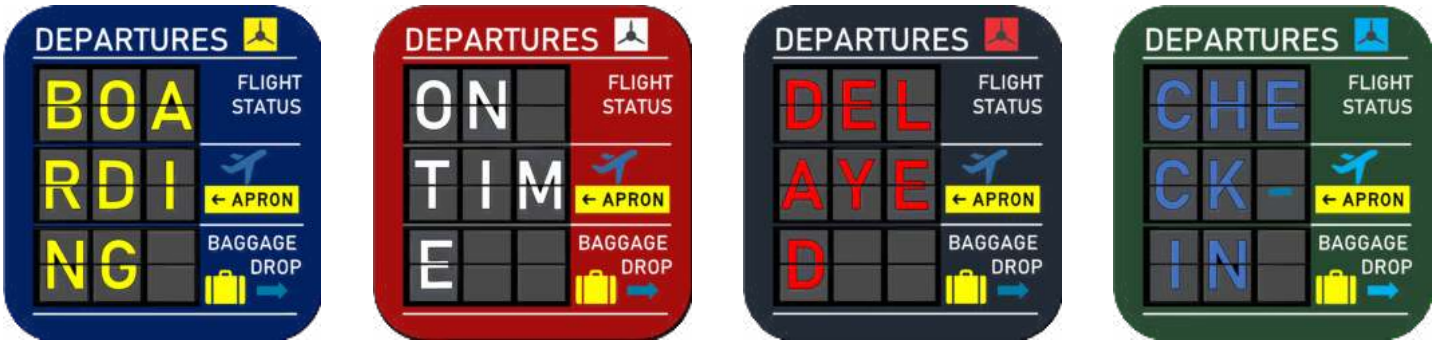

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Dealing with Unruly Passengers in Flight

Capt. Vikas Nautiyal
Deputy Chief Pilot
Air India Express

The DGCA has finally come out with directives about dealing with Unruly passengers on flights, an initiative that was long awaited. Whether it was the heat gathered by the recent unresolved Air India 'Peegate' scandal that made news for all the wrong reasons and in which the airline was fined a hefty sum is a matter of another debate, but it suffices to say that, these bizarre situations need not drag in courts endlessly and need some quick remedies. Dealing with unruly passengers on any flight, whether it be an international or a domestic flight can be a challenging and stressful experience for both the crew and fellow passengers. Unruly passengers can cause disruptions, threaten the safety of the flight, and create an uncomfortable environment for everyone onboard.

As per DGCA, Airlines should categories cases of unruly behaviors on board into 3 categories. The airline's internal committee can then decide the duration for which the unruly passenger should be banned from flying and who should be handed over to law enforcement agencies upon landing.

Prevention

The first step in dealing with an unruly passenger is prevention. Airlines can reduce the likelihood of unruly behavior by setting clear expectations for passengers regarding conduct, offering clear instructions on in-flight behavior, and providing regular updates on any changes in flight status. In this regard, the recent step taken by DGCA is in the right direction that sets the regulatory guidelines in place. The reasons why a passenger may become unruly may be many, but not restricted to excessive alcohol consumption, mental health issues, social environment, boisterous behavior, etc. Airlines clearly need to have policies to guard against these, like limiting alcohol consumption, checking on previous alcohol levels before boarding, assessing passenger mental health while boarding, treating large non-family exuberant groups as suspectable, etc. Crew members also need to be trained (and retrained periodically) in specific conflict resolution and de-escalation techniques to prevent minor issues from escalating into more significant incidents.

Level 1

Unruly behaviors, including physical gestures, verbal harassment, and unruly inebriation.

Level 2

Physically abusive behaviors, including pushing, kicking, hitting, and grabbing or inappropriate touching or sexual harassment.

Level 3

Life-threatening behaviors, including damage to aircraft operating systems, physical violence such as choking, eye gouging, murderous assault and attempted or actual breach of flight crew compartment.

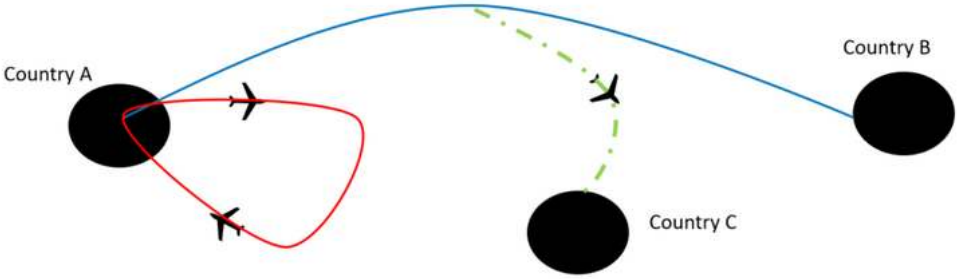
Safety is the Top Priority

In the event of an unruly passenger, crew members should approach the situation calmly and professionally. They should assess the situation and determine the level of threat posed by the passenger. If the passenger is becoming physically or verbally aggressive, crew members should contact the cockpit immediately to alert the pilots of the situation. The PIC can then take appropriate action, and in cases where a passenger is deemed a significant threat to the safety of the flight, the captain has the authority to make an emergency landing at the nearest suitable airport. This decision is not taken lightly, as it can result in significant delays and costs for the airline. However, the safety of all passengers and crew members is the top priority, and emergency landings may be necessary to prevent harm.

Jurisdictional Gaps

The subsequent actions when a diversion is made are of the jurisdiction of airspace and the registration of the aircraft where the offense has been committed. These are issues that can make or mar a subsequent investigation. The International Civil Aviation Organization (ICAO) has developed guidelines for handling unruly passengers on international flights. These guidelines are included in the ICAO Annex 17, which sets out standards and recommended practices for aviation security. However, each member state/country has its own set of regulations regarding unruly passengers. So, different yardsticks may apply to the same case in case of an air-turn back to the departure airport or if the flight continues to its destination, or if it is diverted to an enroute alternate airport where jurisdiction may not exist. Also, if the aircraft is leased from a different third country, and operating in a different part of the world, law enforcement is all the more difficult.

Scenarios to illustrate the jurisdictional gaps in the Tokyo Convention of 1963



The aircraft is registered in and the airline is based in Country A. The flight departs but there is an unruly passenger incident en-route to country B (scheduled destination)

Scenario 1

Captain elects to return to Country A - The aircraft is registered in Country A. Police and prosecutors can deal with the passenger under national law. No problems!

Scenario 2

Captain elects to continue to Country B (scheduled destination) - but authorities in Country A as State of aircraft registration have jurisdiction under the Tokyo Convention 1963. But they are 5,000km away.
What can the police at the airport in Country B do? Usually, they release the passenger without charge.

Scenario 3

Captain elects to divert to an airport in Country C, but again Country A has jurisdiction and the same problem occurs as in Scenario 2

Scenario 4

The aircraft is dry-leased from a lessor and is registered in Country D. In this case, authorities in Country A (where the aircraft operates most flights to/from), Country B or Country C do not have jurisdiction.

Gaps in the Tokyo Convention 1963(TC63) which governs these offenses and certain other acts committed on aircraft means that many unruly passengers escape punishment for their misconduct. The main issue is that the State where an aircraft is registered has jurisdiction over offenses committed onboard. This causes problems at overseas airports, where local police may not have jurisdiction to deal with incidents that occur onboard foreign registered aircraft. This means unruly passengers are often released without charge which undermines the deterrent. This is the primary reason for prosecutions not proceeding in around 60% of unruly passenger cases. To address this, the Montreal Protocol 2014 (MP14) was adopted. MP14 amended the TC63 by extending jurisdiction over offenses to the state of intended landing (destination) in addition to the state of aircraft registration. Other changes give greater clarity to what at a minimum constitutes unruly behavior and reinforce the right of airlines to seek recovery of the significant costs from unruly passengers. MP14 entered into force on 01 Jan 20, following ratification by 22 ICAO Member States. Since then, further states have ratified bringing the current total to 41. However, despite this progress, TC63 still covers around two-thirds of global traffic. The more states ratify MP14 the more the jurisdiction gaps can be closed so that unruly passengers can be prosecuted according to uniform global guidelines.

Who is Accountable?

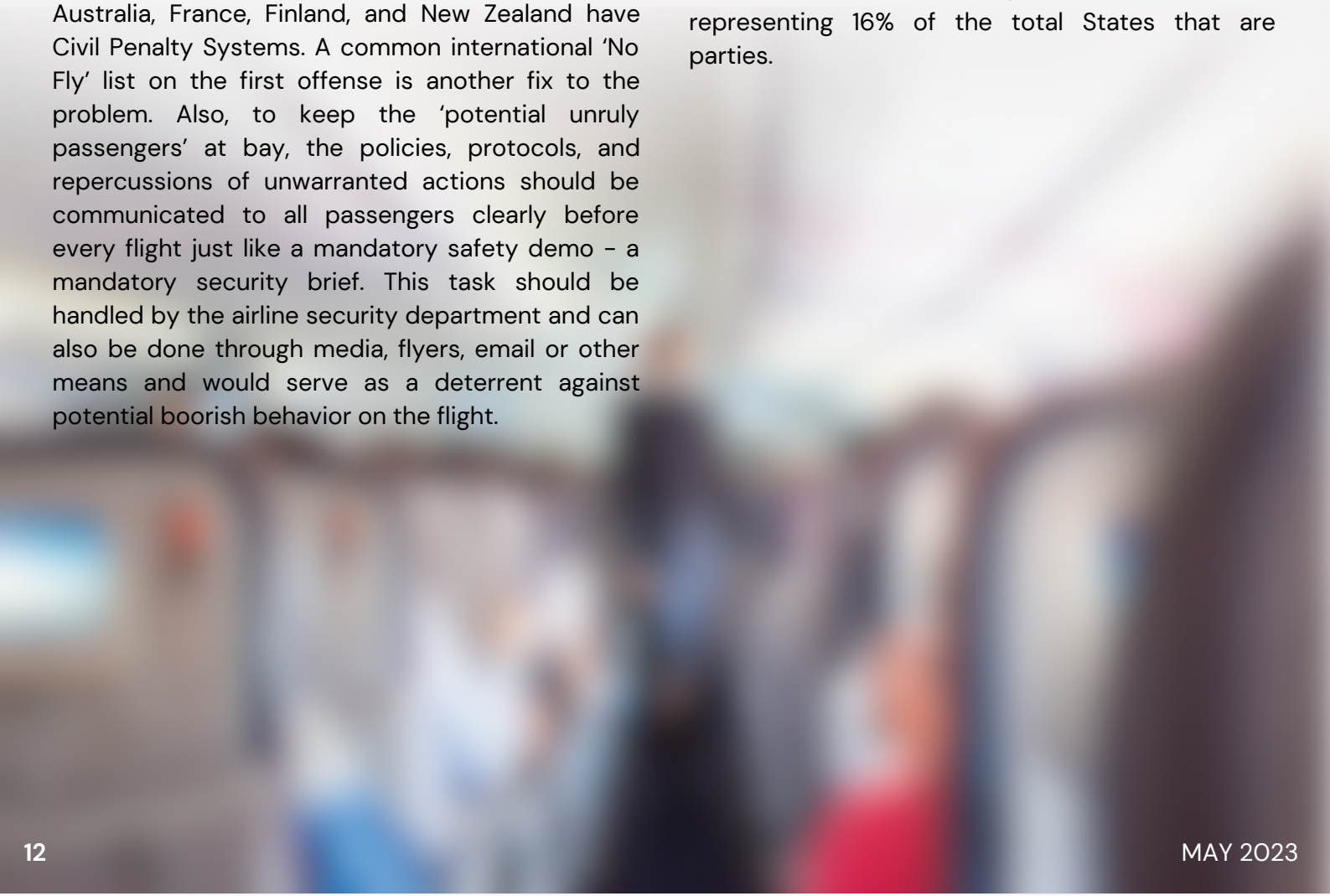
The other weak link in the chain is the problem of who takes care of the 'case' once the aircraft has landed and the unruly passenger is handed over to the security agencies. Most airlines have an elaborate security set-up, often utilized only for manning boarding gates, and not much else. Thus, many unruly passengers are let off because the crew is expected to proceed to the local police station to file an FIR and other formalities while the airline security setup and local police / CISF remain mute spectators. Often, the crew does not have the will and the resolve to follow up on these cases after a long flight, leading to low conviction rates. This can be addressed if police or aviation security officers have the power to issue administrative infringement notices “on the spot”, under a civil penalty regime.

The deterrence element is reintroduced if a person receives a fine for misconduct (specific deterrence) and these fines can be generally publicized (general deterrence) by the government, airports, and airlines. Countries such as Singapore, Australia, France, Finland, and New Zealand have Civil Penalty Systems. A common international ‘No Fly’ list on the first offense is another fix to the problem. Also, to keep the ‘potential unruly passengers’ at bay, the policies, protocols, and repercussions of unwarranted actions should be communicated to all passengers clearly before every flight just like a mandatory safety demo - a mandatory security brief. This task should be handled by the airline security department and can also be done through media, flyers, email or other means and would serve as a deterrent against potential boorish behavior on the flight.

Latest on Countries who have ratified the MP14

Effective from 1 May, authorities in the UAE will have the jurisdiction to manage unruly and disruptive passengers that land in the country, irrespective of where the aircraft is registered. This resolves an existing gap in international aviation law that often results in those accused of unruly behavior from being prosecuted for their misbehavior. In a survey, 60% of IATA member airlines cited lack of jurisdiction is a key factor for why prosecutions do not proceed.

The UAE is the 44th State to ratify MP14 and it is estimated that more than a third of international traffic is covered by States that are parties to it. Important aviation markets in the Middle East region have led the way in ratifying this important treaty. In addition to the UAE, Bahrain, Egypt, Jordan, Kuwait, Oman and Qatar have ratified MP14, representing 16% of the total States that are parties.



Final Words

Dealing with unruly passengers on international and domestic flights can be challenging, but it is crucial to have appropriate protocols and procedures in place to handle these situations quickly and efficiently. Prevention is key, and airlines should take steps to reduce the likelihood of disruptive behavior, such as setting clear expectations for conduct and limiting alcohol consumption, and warning passengers before the commencement of the flight. In the event of an unruly passenger, crew members should remain calm and professional and use de-escalation techniques to diffuse the situation. Airlines must have clear policies and protocols in place for dealing with unruly passengers and work with local law enforcement and airport authorities to ensure legal requirements are met. Even one offense should guarantee a place in a National / International 'No-Fly' list without exception. Some countries have made laws that permit the Civil Penalty Regime that enables law enforcement officers to levy payment of 'On the Spot' fines or opt for 'Challenge in Court'. This can be done on landing, in most cases serves as a sobering end to a sordid saga. The cash penalty is akin to a parking ticket that the passenger needs to pay up to go home, failing which he is to be present in court and also risk addition to the 'No-Fly' list. These laws are sadly enabled in only a very few countries and need to be across the board. Finally, a post-incident debriefing process should be in place to assess the effectiveness of the airline's policies and procedures and incorporate any lessons learned into future policies.

About the Author

Capt. Vikas Nautiyal grew up in Dehradun and was commissioned in the Indian Air Force in 1991 in the fighter stream. He flew MiG-21 and MiG-29 before graduating as a Cat 'A' Qualified Flying Instructor and Directing Staff / Flight Commander at the prestigious Flying Instructors' School. He is a graduate of the National Defense Academy and has a Master's Degree in Aviation Management. He served as Chief Operations Officer at a frontline forward base and at Flight Safety and Inspection Directorate. On graduating in civil aviation, he is qualified on the Boeing-737, empaneled as a Subject Matter Expert with the Aircraft Accident Investigation Board of the Ministry of Civil Aviation, an IOSA certified Quality Auditor, and currently serving as a management pilot, appointed as Dy Chief Pilot in his airline. Capt. Vikas Nautiyal is a member of the Royal Aeronautical Society.

Guide to Passenger Address (PAs)

Best Practices & Techniques

Capt. Vijay Devadas
A320 Captain

Structure

Remember, you think that passengers understand what you are saying exactly how it paints a picture in your head, but you would be surprised if you asked them. When you talk on the pa, you are converting the mental image in your head into words and expecting passengers to convert it into a similar idea in their head. However, there is a vast knowledge gap, and the coding-decoding from the sender to the receiver presents a considerable challenge. The solution is to give the information block by block in the correct order, sequence, orientation, perspective, and appropriate phase, just like how one constructs a Lego set part by part. Then, the passengers can build a mental model, which would be more conscious of the pilot's mental model.

Language

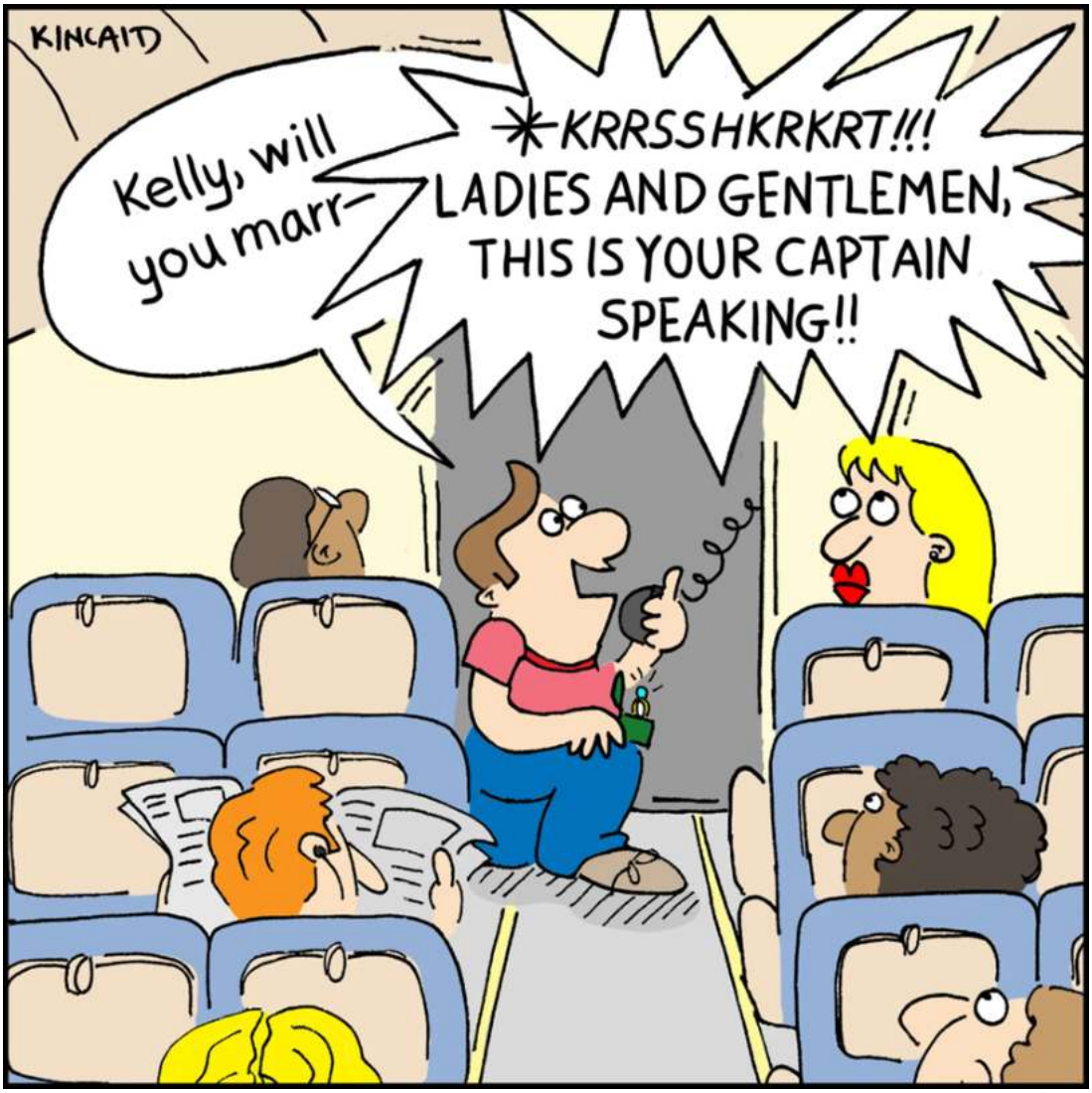
Suppose you are flying a commercial airliner, and you did think that every passenger will understand your scholarly English with an accent and English as the first language. In that case, you will be upset as that is not valid. Today's travel is not explicitly going on flights between 2 states with a cabin full of similar cultural identities; instead, it's a mix of nationalities, ethnicity, language, age, and educational background. With this in mind, the pilot has to ensure the pa reaches out to everyone comprehensively with similarity in perception. The solution is to keep it simple in plain English, along with a few straightforward points of what your pa is expected to convey. Remember, a 5-15-50-year-old will have to comprehend similarly with your PA.

Timing

It's a preconceived notion that the passengers always receive a pilot's PA. Well, you're mistaken, as the recipient is the passenger, and to listen to your PA effectively, even they have to be in a state of low workload in their perception. For example, the passengers are distracted during boarding or settling down with their baggage just before the doors close; hence good to wait out until the doors close and all are seated. Similarly, during the cruise, it is wise to check with the crew if the passengers are sleeping or busy with the inflight entertainment, as you could rather avoid disturbing them with a PA when they do not want to be bothered. Alternatively, you could liaise with the crew to see during times of an entertainment system disruption or daylight conditions to grab the attention of your passengers for PA. Likewise, for descending, await for the passengers to settle down after the last meal or lavatory usage, and primarily when the crew has collected their headsets back is an excellent time to get their attention with a farewell PA. Above all, nothing deters the pilots from doing things at their convenience and low workload; however, it's wise always to remember both you and your recipient have to be ready; remember it's a two-way communication "talking and receiving'.

Listen up Before Transmitting

Flight Deck PA transmission has the highest priority logic. Hence, unless required due to urgency, you don't want to step on your crew members' transmission.



Jetlagged Comic

Distraction Free Environment

Announcements should be made on stationary aircraft and/or low workload phases of flight. This will ensure your complete attention and the least probability of any distraction.

Correct Siting Position

Yes, you heard it right! Right posture enhances speech delivery.

Prefer Use of Handset

Cockpit PA handsets are specifically designed for this purpose. This will avoid irregular pitch and air disturbance during the transmission. Also, remember to keep a good steady distance between the handset and your mouth.

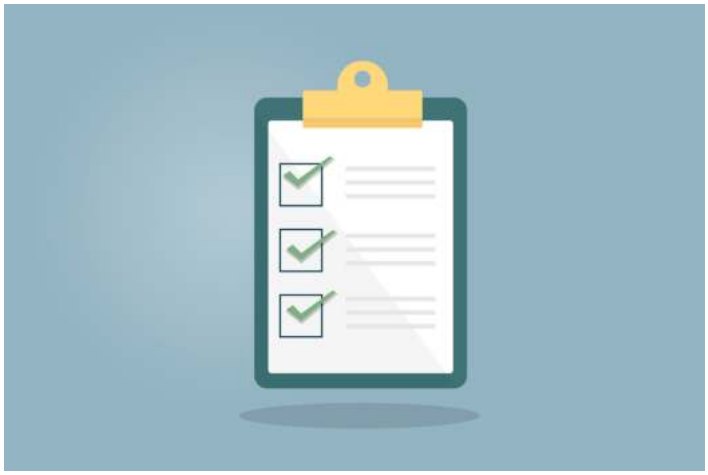
Jetlagged Comic

Keep All the Details Handy

This will ensure that you finish your message without any breaks and avoid fillers like aahhh, mm, etc. You can also consider rehearsing if it's a new or non-routine PA.

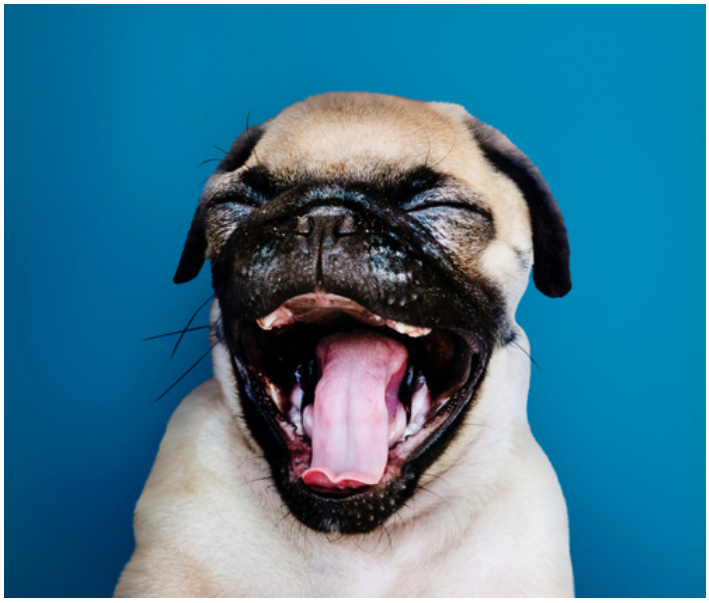
Coordinate Timing of PA with Crew

Flight Deck PAs command a sequence of actions by the crew. Hence good coordination will ensure the crew are not out of the loop or rushed.



Review

Take a moment to review what to say. This is especially important during non-routine announcements.



Humor

Adding humor to any routine relaxes everyone instantly. I use it a lot and it comes naturally to me. It invariably gets a great response. Even if just a few passengers listen, understand and it makes them smile.

Clarity and Correct Rate of Speech

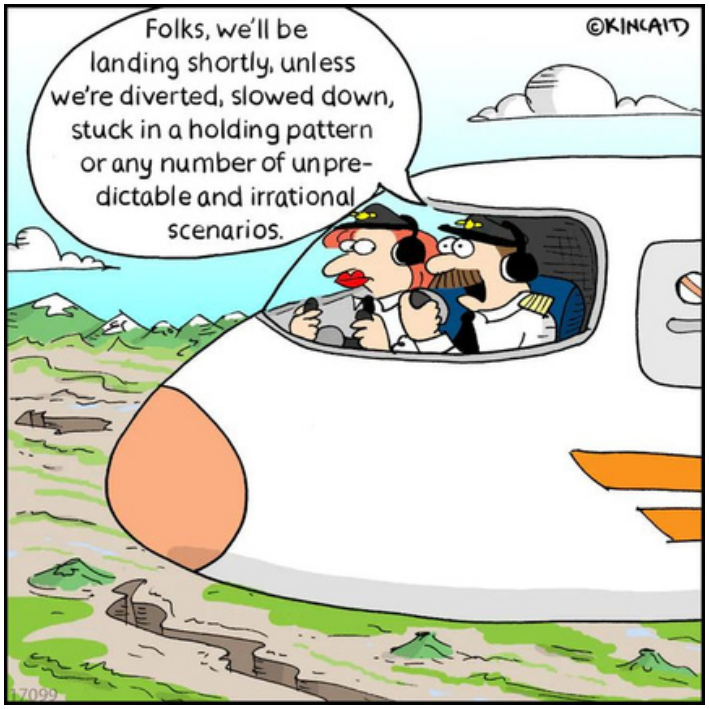
Speak slightly lower than your normal rate. You can also consider short pauses between sentences to make the message stand out.

Project a Calm and Confident Image

The ease with which a Captain speaks, the voice itself, has the ability to put a nervous flyer at ease, get a child excited and make an elder feel safe. Always introduce yourself and show how happy you are doing what you do to project a warm and calm authority. Use a slightly lower but natural pitch to sound more confident and relaxed.

Vocabulary and Grammar

The pilot's profession is regarded by most to be of high intellect and professionalism. We can't afford to have grammatical mistakes or a poor vocabulary. This can be easily avoided by using simpler words and smaller sentences. A written prepared message will also be helpful.



Jetlagged Comic

Be Honest & Show Warmth

Honesty is underrated! By respecting the passenger's intellect and capacity to understand the situation, you get them to see your perspective. The passenger is the Guest, the most important person in the aircraft, and the captain can make him/her feel that!

Accent & Use of Simple Language

As much as we fail to believe, our accent may be quite difficult to understand for someone from the other side of the planet. Challenges of different accents include but are not limited to eating words, speaking fast, silent letters, using slang, native language fillers, etc. This can be mitigated by the use of proper enunciation and a slower rate of speech. Avoid using technical terms. Remember, these terms have little, if not nil, application outside of the aviation industry. If required, technical terms can be substituted by common language terms to ensure better understanding.

Jetlagged Comic

Non-Routine & Disruption Announcements

Whether it's delay PAs, Inflight turbulence advisories, or diversions/return to stand situations, a piece of timely information to the passengers will go a long way in cultivating their understanding and, eventually, compliance. Passengers feel valued and cared for when we show empathy during disruptions and assure them that we are doing our best. Do not hesitate to apologize, these small apology messages can do wonders.

Native Language PAs

Passenger background varies based on the destination, and English may not be a well-understood language. Native language PAs will ensure an efficient message delivery while at the same time creating a sense of belonging.

About the Author

Vijay Macmilton Devadas is a line training captain and an Airbus procedural trainer with an airline in India. He also works with the CRM team as a pilot and cabin crew facilitator. He has formerly worked with various airlines, including Indian Airlines, Air India, and Emirates flying A320, A380 and B787. In his educational background, he has a bachelors in Mechanical engineering and Post Graduate Diploma in Business Administration, and currently a student with Embry Riddle Aeronautical University in the Master of Science- Human Factors. The author is also an Affiliate member of the Royal Aeronautical Society, a Student member of the American Psychological Association, and a full member of the Society of Experimental Test Pilots – Indian Section.

His motivation is to understand "why we think the way we think" and apply them to the commercial aviation environment of human psychology and bring awareness to the industry and public. In his personal life, he mostly enjoys reading various disciplines of science, philosophy, and psychology. His hobbies include motorcycle riding and bodybuilding. He also enjoys having different coffees as a beverage, which helps him think with insight and penning down his thoughts.


AIR INDIA

Ballooning Basics

Samit Garg
Managing Director & Co-Founder
E-Factor Experiences Limited

As they say, it is the safest form of aviation that ever existed and it is also the second most photographed object in the world after a celebrity. Yessss – that is what a Hot Air Balloon is all about. Hot air ballooning is a unique and thrilling experience that provides a breath-taking view of the world from above. The silence and gentle motion of the balloon make it a serene and peaceful way to travel, providing an escape from the hustle and bustle of daily life.

What is a Hot Air Balloon?

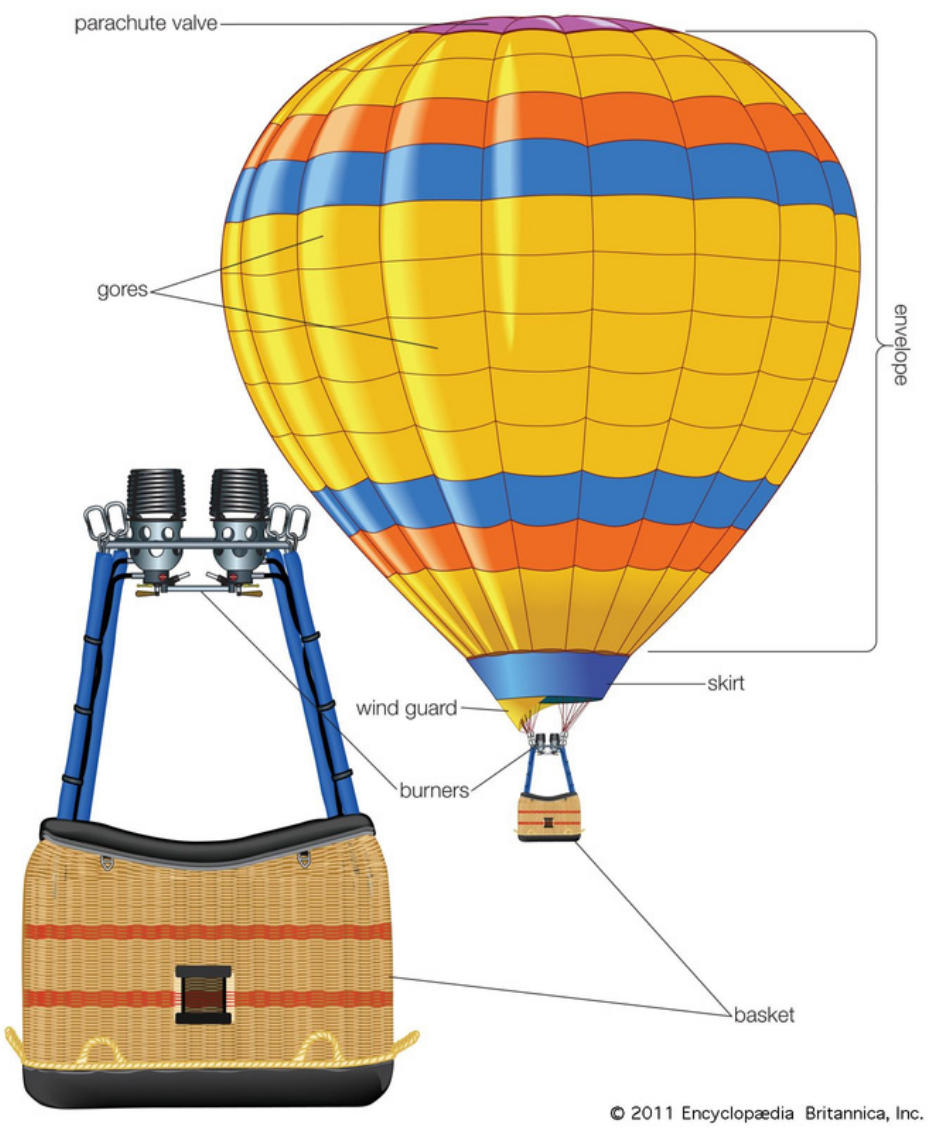
A hot air balloon is a type of aircraft that uses heated air to rise and float in the atmosphere. The major components are:

Envelope – An envelope or fabric envelope, or simply the balloon, that is filled with heated air. The envelope of a hot air balloon is typically made of lightweight and durable nylon or polyester. The fabric is coated with a special material that makes it heat resistant, allowing it to withstand the high temperatures generated by the propane burner.

Basket - The basket is usually made of wicker or other lightweight materials and is suspended beneath the envelope, carrying the pilot and passengers.

Burner - A propane burner that heats the air inside the envelope.

Skirt - This part helps to keep away the wind from the burner flame so the flame will go directly up into the envelope.



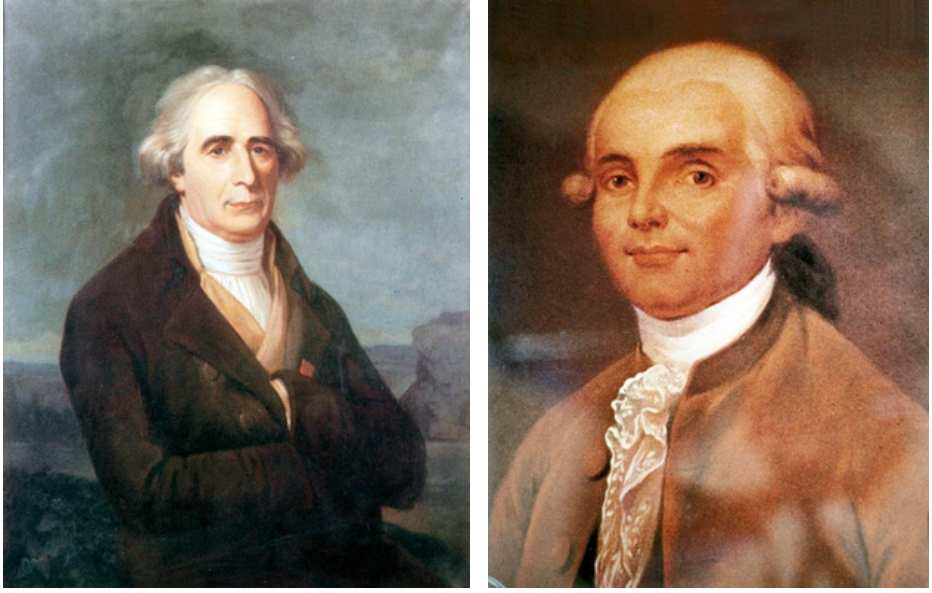
The size of a hot air balloon can vary widely, from small balloons that can carry a few people to large ones that can hold up to 40 passengers. The largest hot air balloon ever made had an envelope volume of 74,000 cubic meters. The height that a hot air balloon can reach depends on several factors, including the size of the balloon, the amount of fuel it carries, and weather conditions. Typically, hot air balloons fly at heights of around 1,000 to 3,000 feet.

Beginning

The hot air balloon was invented by two French brothers, Joseph and Jacques Montgolfier, in 1783. The brothers were inspired by a laundry accident, in which they noticed that hot air rising from a fire caused a piece of fabric to lift. They conducted several experiments with hot air, and in November of 1783, they successfully launched the first manned flight of a hot air balloon in Paris, with the Montgolfier brothers' balloon carrying a sheep, a duck, and a rooster.

The first commercial use of hot air balloons was for scientific experiments and demonstrations. In 1794, the first recorded aerial photography was taken from a hot air balloon. Over time, hot air balloons became a popular form of entertainment, with balloon races and other events drawing large crowds.

Commercial hot air ballooning was introduced in India in 2009, with the first commercial flights taking off in Jaipur in January. Since then, hot air ballooning has become a popular tourist activity in several destinations across the country. About 10000 tourists take a balloon flight in India every year.

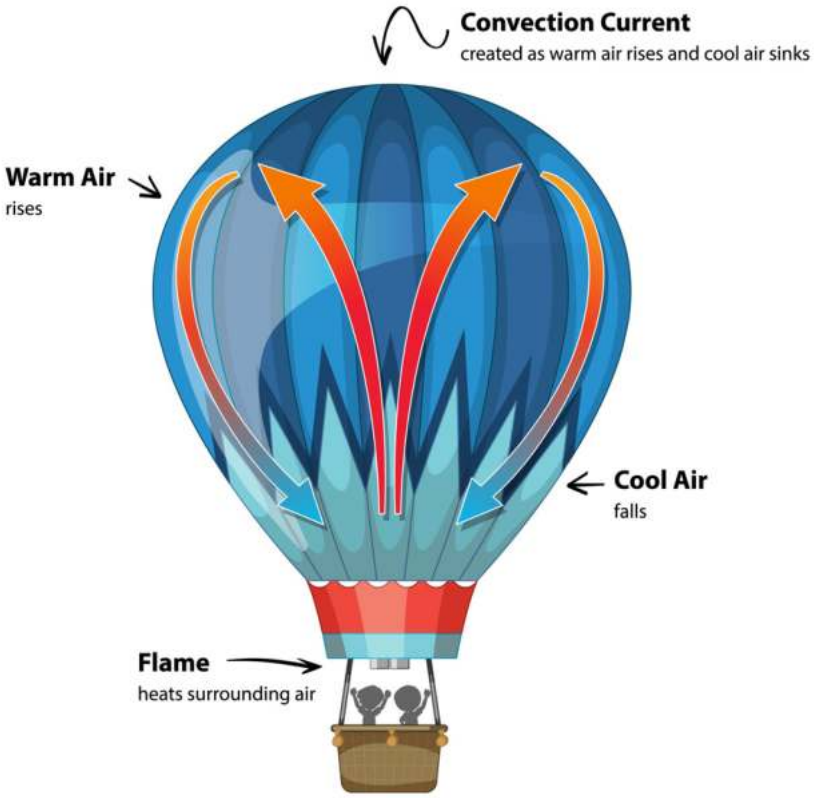


Joseph Montgolfier & Jacques Étienne Montgolfier

First public demonstration in Annonay, 4 June 1783 © Wikipedia

The Science

Hot air balloons work on the principle that hot air is lighter than cold air, and therefore rises. The envelope of the balloon is filled with heated air using a propane burner, which heats the air inside the envelope to a temperature higher than the surrounding air. The hot air makes the balloon rise and float in the atmosphere. The basket, which is suspended beneath the envelope, contains the pilot and passengers, as well as the propane tanks that fuel the burner.



Pre-flight Preparation

The current and forecast weather must have sufficient visibility. DGCA mandates The take-off point must be large enough to lay out and inflate the envelope and clear of obstructions such as power lines and poles, trees, and buildings to allow lift-off under the predicted wind conditions. Finally, the take-off point must be situated such that the predicted winds will move the balloon in the direction of suitable landing sites.

Mounting the Basket & Unfurling the Envelope

After checking the burner is working properly, it is connected to the Basket. The envelope is taken out of the bag, connected to the basket and unfurled totally on the ground.

Inflation & Take Off

Envelope is first inflated with cold air before heating it to stand it up on the ground. Once the balloon is upright, pilot and passengers climb into the basket. When the pilot is ready for launch, more heat is directed into the envelope and the balloon lifts off.

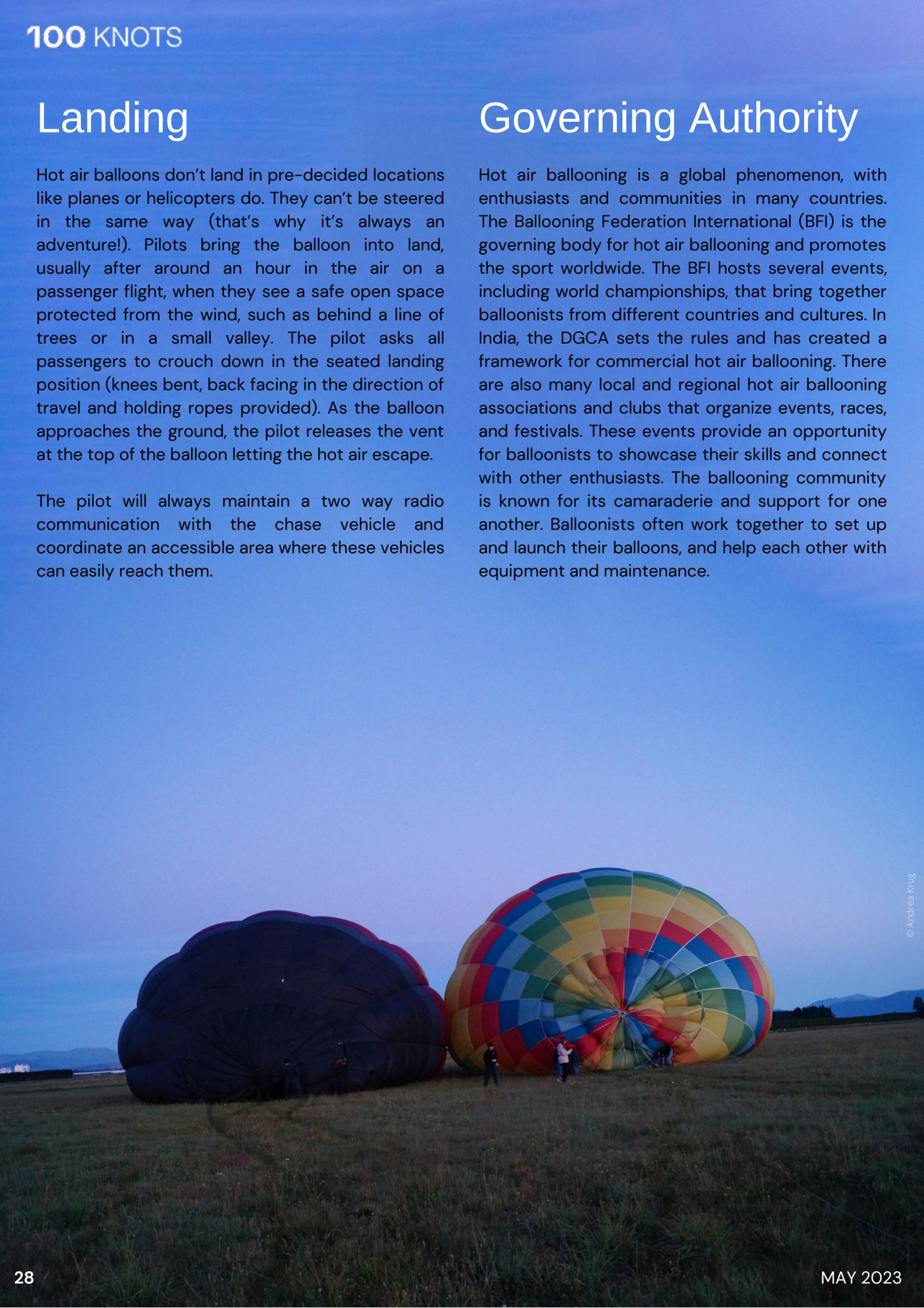
Landing

Hot air balloons don't land in pre-decided locations like planes or helicopters do. They can't be steered in the same way (that's why it's always an adventure!). Pilots bring the balloon into land, usually after around an hour in the air on a passenger flight, when they see a safe open space protected from the wind, such as behind a line of trees or in a small valley. The pilot asks all passengers to crouch down in the seated landing position (knees bent, back facing in the direction of travel and holding ropes provided). As the balloon approaches the ground, the pilot releases the vent at the top of the balloon letting the hot air escape.

The pilot will always maintain a two way radio communication with the chase vehicle and coordinate an accessible area where these vehicles can easily reach them.

Governing Authority

Hot air ballooning is a global phenomenon, with enthusiasts and communities in many countries. The Ballooning Federation International (BFI) is the governing body for hot air ballooning and promotes the sport worldwide. The BFI hosts several events, including world championships, that bring together balloonists from different countries and cultures. In India, the DGCA sets the rules and has created a framework for commercial hot air ballooning. There are also many local and regional hot air ballooning associations and clubs that organize events, races, and festivals. These events provide an opportunity for balloonists to showcase their skills and connect with other enthusiasts. The ballooning community is known for its camaraderie and support for one another. Balloonists often work together to set up and launch their balloons, and help each other with equipment and maintenance.



Ballooning in India

Hot air ballooning in India is a growing industry, with operators offering rides and tours in different parts of the country. According to a report by ResearchAndMarkets.com, the hot air ballooning market in India is expected to grow at a compound annual growth rate of 9.3% between 2023 and 2028.

Some of the popular spots for hot air ballooning in India include Jaipur, Pushkar, Lonavala in Maharashtra, and Goa. These locations offer stunning views of landscapes, heritage sites, and wildlife. It is heard that ballooning would soon be possible in historic places like Varanasi and Hampi in the coming times.

In terms of future developments, the Indian government has identified hot air ballooning as a potential growth area for tourism and has taken steps to promote it. The Ministry of Civil Aviation has issued guidelines for hot air ballooning operations in India, and the government has also proposed setting up dedicated balloon parks and training centres.

In conclusion, hot air ballooning is a fascinating and exciting activity that has a rich history and a vibrant global community. In India, the industry is growing rapidly and holds significant potential for tourism. With the government's support and the ballooning community's passion, the future of hot air ballooning in India looks bright.

Did You Know?

On November 26, 2005, Vijaypat Singhania set the world altitude record for highest hot air balloon flight, reaching 21,290 meters (69,850 feet). He took off from downtown Mumbai, India and landed 240 km (150 mi) south in Panchale.

About the Author

Samit is the Managing Director & Co-Founder of E-Factor Experiences Limited, an experiential firm - that enjoys a near-mythological status for crafting enviable and transformative events & experiences in the industry. Known as a pathological disrupter at heart, Samit wears many hats and is aggressively working on redefining the antiquated tourism & cultural sector by introducing superlative and sustainable heritage tourism experiences for the global audience.

Through Skywaltz Balloon Safari, he is also credited for having brought commercial Hot Air Ballooning to India, which until 2008 seemed like an impossible feat to achieve. Skywaltz is today the largest ballooning brand in this part of the world. Today, more than 7000 travellers and enthusiasts hop into a hot air balloon every year in India.


भारत INDIA

Protecting Hearing in Aviation

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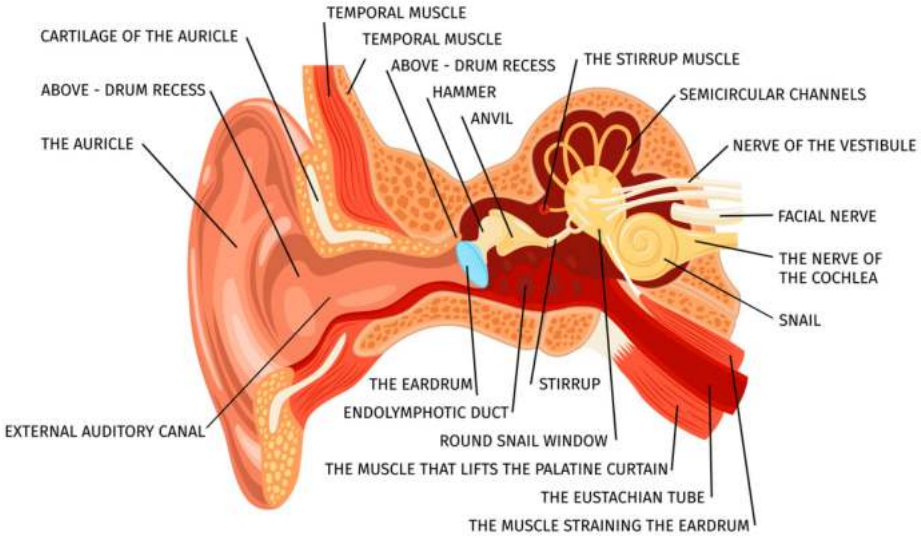
The main function of the human ear is in the ability to recognise sound. Hearing is next only to vision as a physiological sensory mechanism to obtain precarious information. The sense of hearing makes it possible to recognise, process, and identify among the innumerable sounds from the close environment.

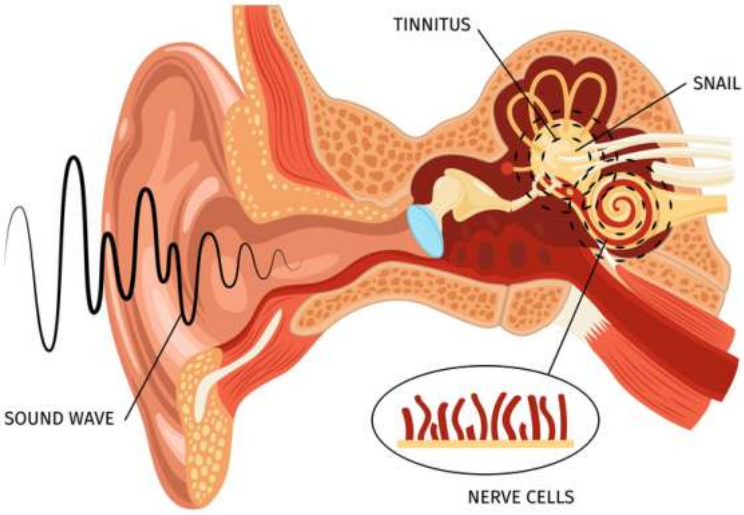
In aviation, Hearing has a much greater impact on performance than most people realize. Modern aircraft designs put high demands on vision as the primary sense for information gathering, but such designs can lead to increased attentional demands that have the potential to decrease situational awareness. To compensate, sound has become more important for delivering information or to divert a pilot's attention to an area that needs monitoring (Skybrary).

The Auditory System

The auditory system consists of the external ear, ear canal, eardrum, auditory ossicles, cochlea (a snail shell like organ and filled with fluid), and the auditory nerve.

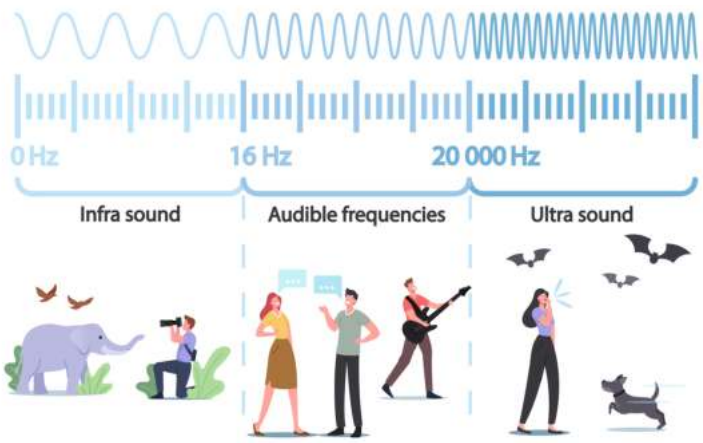
Ambient sound waves are gathered by the external ear, transmitted through the ear canal, resulting in the eardrum to vibrate. This vibration causes a pressure wave in the fluid located inside the cochlea, moving numerous hair-like sensory receptors lining the inner walls of the cochlea. The stimulation of these sensors creates an electrical signal that is conveyed to the brain by the auditory nerve. This signal is then managed by the brain and recognised as a particular type of sound.





What is Sound?

The term sound is used to define the mechanical radiant energy that is spread by longitudinal pressure waves in a medium (solid, liquid, or gas). In simple words, sound is simply a series of compressions (where molecules are dense) and rarefactions (where molecules are sparse). Sounds has two characteristic variables; frequency and amplitude whereas Human hearing is impacted by the Intensity and Duration of exposure.



Frequency

Frequency is typically expressed in Hertz (Hz), a measure of how many vibrations occur in one second, and directly corresponds to the pitch of a sound. Sounds that are perceptible to the human ear fall in the frequency range of about 20-20,000 Hz, and the highest sensitivity is between 500 and 4,000 Hz. Normal exchange takes place in the frequency range from 500 to 3,000 Hz.

Intensity

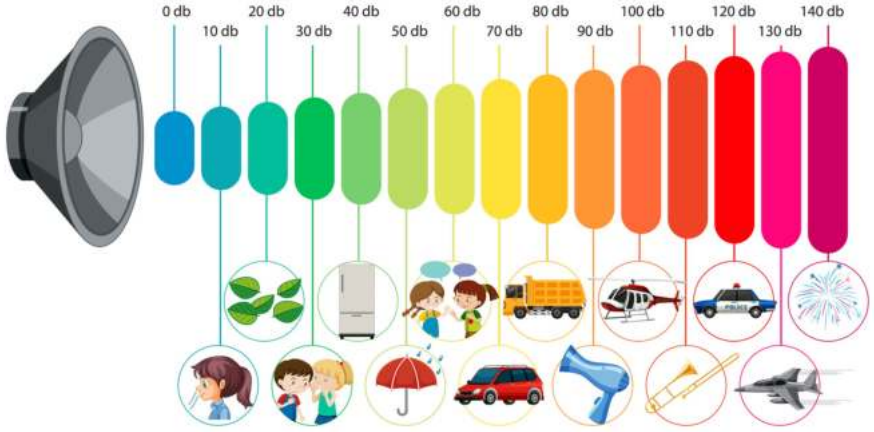
It is the correlation between sound intensity and loudness. The range of normal hearing sensitivity of the human ear is between -10 to +25 dB. A person who cannot perceive a sound unless its strength is higher than 25 dB is already suffering from hearing loss.

Duration

The hostile consequences of a short-duration exposure to a loud sound can be as bad as a long-duration contact to a less intense sound. Therefore, the imminent reason for causing hearing damage is determined not only by the intensity of a sound but also by its duration.

What is Noise?

The term noise refers to a sound, especially one which lacks delightful musical class, is strikingly disagreeable, or is too loud. Classifying a sound as noise can be very individualistic. For example, loud rock music can be described as an pleasing sound by some (usually teenagers), and at the same time described as clatter by others.



Sources of Noise in Aviation

The aviation atmosphere is characterized by many sources of noise, both on the surface and in the flight. Noise is shaped by aircraft gear like power plants, transmission systems, jet efflux, propellers, rotors, hydraulic and electrical actuators, cabin conditioning and pressurization systems, cockpit advisory and vigilant systems, communications equipment, etc. Noise can also be produced by the aerodynamic interaction amongst ambient air (boundary layer) and the exterior of the aircraft fuselage, wings, control surfaces, and landing gear. These auditory feedbacks allow pilots to evaluate and observe the working status of their aircraft. On the other hand, unexpected sounds or the absence of them, may alert pilots to possible faults, failures, or dangers.

Sources	Level (dB)
Whispered Voice	20-30
Urban Home, Average Office	40-60
Average Male Conversation	60-65
Noisy Office, Low Traffic Street	60-80
Jet Transports (Cabin)	60-88
Small Single Plane (Cockpit)	70-90

Sources	Level (dB)
Public Address (PA) Systems	90-100
Busy City Street	80-100
Single Rotor Helicopter (Cockpit)	80-102
Power Lawn Mower, Chain Saw	100-110
Snowmobile, Thunder	110-120
Rock Concert	115-120
Jet Engine (Proximity)	130-160

Physiologic & Psychologic Effects of Noise Exposure

Noise can act as a nonspecific physiologic stressor and can alter endocrine, cardiovascular and neurologic functions. These altered functions can cause biochemical changes that may have negative health effects.

Exposure to noise may induce pathological effects, mainly cardio-vascular disease. This is due to the generation of high levels of adrenaline that narrow blood vessel diameter resulting in increased blood pressure. Other common pathological problems related to noise are cholesterol issues, gastric ulcers, sleep disturbances and mental stress.

Most notably, noise can cause an increase in heart rate, vaso-constriction, digestive activity and muscular tension. Also, a 75 dB noise may change the diameter of the eye's pupil, which can significantly impact visual acuity.

Ear discomfort may occur during contact to a 120 dB noise.
Ear pain may occur during contact to a 130 dB noise.
Eardrum rupture may occur during contact to a 140 dB noise.

Provisional Hearing Impairment

Defenceless exposure to loud, steady noise over 90 dB for a short time, even numerous hours, may cause hearing damage. This effect is usually momentary and hearing returns to normal within some hours following termination of the noise contact.

Permanent Hearing Impairment

Unguarded exposure to loud noise (higher than 90dB) for eight or more hours per day for numerous years, may cause a permanent hearing loss. Permanent hearing damage occurs initially in the neighbourhood of 4,000 Hz (outside the conversational range) and can go undetected by the individual for some time. It is also vital to remember that hearing sensitivity usually declines as a function of age at frequencies from 1,000 to 6,000 Hz, beginning around age 30.

Subjective Effects

Irritating high-intensity noise can cause distraction, fatigue, touchiness, surprise responses, sudden arousal and poor sleep quality, loss of appetite, headache, vertigo, nausea, and impair concentration and memory.

Performance

Noise is an interruption and can increase the number of faults in any particular task. Tasks that require vigilance, attentiveness, calculations, and making judgments about time can be deleteriously affected by exposure to loud noise higher than 90 dB.

Acceptable Hearing Standards

DGCA / ICAO policy

- The applicant, when tested on a pure-tone audiometer, shall not have a hearing loss, in either ear separately, of more than 35 dB at any of the frequencies 500, 1000 or 2000 Hz, or more than 50 dB at 3 000 Hz.
- An applicant with a hearing loss greater than the above may be declared fit provided that the applicant has normal hearing performance against a background noise that reproduces or simulates the masking properties of flight deck noise upon speech and beacon signals.
- Alternatively, a practical hearing test conducted in flight in the cockpit of an aircraft of the type for which the applicant's licence and ratings are valid may be used.
- The hearing standards are very liberal; however, hearing aids are not permitted during flight.

How to Protect Your Hearing?

There is a recognized permissible noise exposure parameters for the workplace which includes the cockpit of an aircraft.

Noise reduction headsets practises active noise reduction technology that permits the manipulation of sound and signal waves to reduce noise, improve signal-to-noise ratios, and enhance sound quality. Active noise reduction provides effective protection against low- frequency noise.

If the ambient noise level beats permissible noise exposure limits, you should use hearing guard devices like earplugs and earmuffs. These protection devices lessen noise waves before they reach the eardrum, and most of them are effective at dropping high-frequency noise levels above 1,000 Hz.

The mixture of earplugs with earmuffs or communication headsets is suggested when ambient noise levels are directly above 115dB. Earplugs, combined with active noise reduction headsets, provide the focused level of distinct hearing protection that can be attained with current technology.

In Conclusion

Of all the five senses, our hearing is considered one of the most valuable. The sense of hearing allows us to obtain critical information about our surroundings.

While some degree of hearing loss is common among the general population, research suggests that aviation personnel are subjected to day-to-day exposure to noise levels greater than 90dB, putting them at an increased risk of permanent hearing loss. This can often go unobserved because it occurs in the neighbourhood of 4,000 Hz which is outside the conversational range (Normal speech frequency is in the range from 500 to 3,000 Hz). Exposure to loud noise during day-to-day life (at home, while driving, at a party, etc.) is also equally damaging.

Some of the common signs of hearing loss include listening to television or radio at high volume, an inability to hear high-pitched sounds, difficulty following conversations, or even a constant ringing or chirping in the ears.

If you think you may be suffering from hearing loss, tell your doctor about your symptoms. Hearing loss is gradual and accumulates over a lifetime, but it is preventable and treatable. Age or noise-related hearing loss can often be managed by using a hearing aid. Finally, always remember to use some form of hearing protection while flying or working around aircraft.

About the Author

Sanjay Bhargava is a consultant Aerospace medicine specialist is a renowned Class 1 medical examiner empanelled with DGCA. He is an alumnus of Armed Forces Medical College Pune. After completing his post-graduate in Aerospace medicine from the Institute of Aerospace medicine Bangalore, he worked as a specialist in Aerospace medicine in various appointments in Indian Air Force. He is a DGCA Class 1 examiner with extensive experience at AFCME, Delhi, AFS Tambaram, and as President MEC (EAST), Jorhat. He has been responsible for finalizing various policies at DGCA. He was the lead doctor for starting civil medical centres for class 1 medicals for DGCA. Over a while, he has been assisting aspiring pilots and solving their DGCA related medical issues through his website http://dgcamedical.in. He has a large following in social media and is respected for his advice given to pilots for the last 3 decades. Dr. Sanjay can be reached at:
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