

Θέμα 6^ο

Flight Instruments II: Compass (2)

Pre-reading Activity

Match the terms on the left with their definitions on the right.

1. deceleration	a. A repeated variation in the value of some physical quantity, as position or voltage.
2. longitude	b. The angular distance north or south of the Earth's equator, measured in degrees along a meridian, as on a map or globe.
3. oscillation	c. A measure of relative position east or west on the Earth's surface, given in degrees from a certain meridian, usually the prime meridian at Greenwich, England.
4. latitude	d. The angle that a magnetic needle makes with the plane of the horizon.
5. magnetic dip	e. A rate of decrease in velocity.

1. 2. 3. 4. 5.

Reading (ΜΕΤΑΦΡΑΣΗ)

Read the text below and check your answers.

Aircraft Magnetic Compass

The **magnetic** compass is the only instrument in the aircraft by which the pilot determines the direction of flight. Magnets in the compass cause it to **align with** the Magnetic North Pole. It is nearly always fitted on top of the visor¹ that shades the instrument panel or is hung from the top of the windshield frame in order to keep it as far away from electrical gear as possible.

¹ Meaning the sun visor, which is a fixed or movable shield against glare attached on the interior side of the windshield.

An aircraft magnetic compass has two small magnets attached to a metal float² sealed inside a bowl of clear compass fluid similar to kerosene. A graduated scale, called a **card**, is wrapped around the float and viewed through a glass window with a lubber line across it to enable exact reading of the compass. The compass card has the four cardinal headings shown as N, E, S, and W. Numbers appear every 30 degrees. Long vertical marks occur in 10 degree increments, with

² Something for buoying up.

intervening short marks at 5 degree points.

Compass errors

Magnetic lines of force surround the Earth, flowing from the North to South Magnetic poles. The strength of the magnetic field is greatest near the magnetic poles and weakest at the Equator. Several compass errors can occur. These are:

1. **Magnetic Variation.**
2. **Compass Deviation.**
3. **Magnetic dip.**
4. **Compass Card oscillation.**

Magnetic Variation

The **Magnetic North Pole** and the **True North Pole** are not at the same location on the surface of the Earth. Magnetic Variation at any given location on the Earth's surface is the difference between the Compass North and True North. Magnetic North changes in small amounts each year. **Aeronautical charts** are updated periodically to correct for this yearly change. When **plotting** a course on an aeronautical chart, the degrees of **heading** are measured against **latitude** and **longitude** lines³. This is called a **True Course** (TC) because it is being measured relative to the True North Pole. The pilot, on the other hand, relies on the magnetic compass for direction, so he steers the aircraft relative to the Magnetic North Pole. That is why he must convert the True Course (TC), as plotted on the navigation chart, to a Magnetic Course (MC) by adding variation.

Compass Deviation

Magnetic deviation is the difference between the compass indications when installed in the aircraft compared to the indications when the compass is outside the aircraft. The cause of this difference is that the compass magnets can be influenced by magnetic fields within the aircraft due to electronic equipment and other factors. These magnetic disturbances may cause the compass readings to be slightly in error. Such errors are called Compass Deviation. In other words, the compass reading when inside the aircraft "deviates" from a normal reading.

That is why a small card is placed in the cockpit to show the compass deviation for each heading. This card is called **compass correction card** or **deviation card**.

"Several compass errors can occur. These are:

- 1. Magnetic variation;*
- 2. Compass deviation;*
- 3. Magnetic dip;*
- 4. Compass card oscillation."*

Compass Dip Errors

Any time the compass card is not perfectly level, the magnets dip downward toward the Earth. The result is that the compass does not correctly align with Magnetic North the same as when the card is level. This results in erroneous indication while in the non-level state. Dip occurs under two conditions:

1. During turns from the north and south (i.e. Plane is in a bank).
2. During acceleration or **deceleration** while on an East or West heading.

³ More about these lines in Unit 6, Section One.

Reading Activity – Comprehension Questions

Read the text again and answer the following questions.

1. What appears on the compass card?
2. What is called “true course”?
3. What is compass deviation?
4. When do compass dip errors occur?

Word Study

Read the text again and choose the appropriate words in bold that best complete the sentences below.

1. The deviation listed on the corrects true course to magnetic course.
2. is the direction north as determined by the Earth’s magnetic lines of force.
3. A plotter is used to measure
4. is determined in reference to the Earth’s axis rather than to the magnetic poles.
5. Apply to the true course to derive magnetic course.
6. The magnetic compass error created by magnetic disturbances within the aircraft is called
7. The is designed for convenient navigational use by pilots. It is intended to be written on and marked up as needed by the pilot to plot the course and/or solve navigational problems such as calculations of direction and distance.
8. Some sources of are wheel braking, airplane drag, aerodynamic brakes, reversed turbojet thrust, etc.
9. In aircraft, the is found by using either the magnetic compass or heading indicator, two instruments that most aircraft have as standard.

Reading Comprehension – Vertigo (OXI ΜΕΤΑΦΡΑΣΗ)

*An instructor is talking to his pilot trainees about vertigo during a flight lesson. Read both **Part I** (items 1-5) and **Part II** (items 6-10), then choose the most appropriate answer choice (a, b, or c).*

Part I

“An archaic definition of disorientation literally meant “difficulty in facing the east.” To the pilot, it more often means “Which way is up?” Disorientation, or vertigo, is actually a state of temporary spatial confusion resulting from misleading information sent to the brain by various sensory organs. The body’s elaborate navigational system was superbly designed for locomotion on the ground at a normal gait, but in an aircraft, during sudden acceleration or radial flight, it can trick you.

The most difficult adjustment that you must make as you acquire flying skill is a willingness to believe that, under certain conditions, your senses can be wrong. When you are seated on an unstable moving platform at altitude (and your vision is cut off from the Earth, horizon, or other fixed reference) and you are exposed to certain angular accelerations or centrifugal forces (which you cannot distinguish from gravity forces), you are susceptible to innumerable confusing, disorienting experiences.

In a level turn, you may think you are in straight flight or climbing. In a coordinated, banked turn you may believe yourself to be in straight and level flight. In recovery from a level turn, you may feel as though you are diving. In a left turn, if you suddenly bend your head forward, you may think you are falling to the left.

These alarming sensations are due primarily to misinterpretation of messages sent to the brain by the two primary sensory organs: (1) the semicircular canals of the inner ear, and (2) groups of pressure-sensitive nerve endings located mainly in the muscles and tendons. These organs tell you where you are in relation to the ground, your normal environment. When your eyes are open and your feet are on the ground, they serve you well. You have little trouble deciding which direction is up or down. In an airplane, though, these organs may send your brain inaccurate reports.”

Part I

1. In aviation, disorientation refers to...
 - a. a state of temporary spatial confusion.
 - b. difficulty in facing the east.
 - c. loss of altitude.
2. The human body’s navigational system can be easily confused...
 - a. in an aircraft during straight and level flight.
 - b. on the ground, when walking at normal pace.
 - c. in an aircraft during sudden acceleration.
3. When learning to fly, you must be prepared to believe that ...
 - a. you can never trust your senses under any conditions.
 - b. your senses may trick you under certain conditions.
 - c. your senses cannot be wrong under any conditions.

4. In recovery from a level turn, you may feel as though you are...
 - a. turning upwards.
 - b. in straight and level flight.
 - c. diving.
5. Vertigo is the result of...
 - a. the brain receiving inaccurate messages by the primary sensory organs.
 - b. various sensitive nerve endings sending inaccurate reports.
 - c. alarming sensations caused in the semicircular canals of the inner ear.

Part II

“Needless to say, without instrument training, the chances of maintaining normal aircraft attitude in limited visibility are extremely rare. Repeated small control movements may eventually create a sensation of gradual turning which may cause you to misinterpret the degree of bank and have a false impression of tilting when you’re in a skid or a slip.

I should point out that spatial disorientation occurs most often in instrument conditions created by rain, fog, clouds, smoke or dark nights. And, it’s further aggravated by other factors such as lack of recent instrument experience or training, or attempts to mix VFR and IFR. Other factors that may aggravate the situation are unfamiliarity with the aircraft or flight situation, fear or worry, and excessive head movements.

You can overcome the effects of vertigo by relying upon your aircraft’s instruments. Read your instruments! They are the best insurance you will ever have. However, remember that the time required to shift from VFR to IFR may be long enough for the aircraft to enter a dangerous attitude.

Also, bear in mind that vertigo can occur **any time** the outside visual reference is temporarily lost, which may happen during map reading, or changing a radio channel. It may also occur during fuel managing, or when you’re computing a navigational problem, or during any thing else you might need to do inside the cockpit. Nearly all experienced pilots have had a brush with vertigo -usually minor and of short duration. Vertigo **can** be disastrous, however. Pilot error, resulting from vertigo, has been identified beyond any doubt as the direct contributing cause of many accidents.

In a nutshell, if you want to reduce the danger of vertigo, you must, above all else, have a good understanding of the nature and causes of the condition and, if possible, to avoid the flight conditions which tend to cause it. It’s also imperative that you obtain instrument flight instruction and maintain proficiency. And, as I have mentioned before, it’s equally important that you read your instruments and have faith in them, rather than take a chance on your sensory organs. Obviously, it’s also important that you always remember that it **can happen to anyone!**

Finally, you should constantly be aware of the danger in shifting between the instrument panel and the exterior visual field when the latter is poorly structured or obscured. You should also avoid sudden head movements, particularly when the aircraft is changing attitude and should be careful not to fixate too long on the instruments.

I may sound a bit repetitive, but I would like once more to remind you that when your senses seem to disagree with the instruments, trust the instruments. They may save your life.”

Part II

- 1.** If you are flying in limited visibility without having undergone proper training,...
 - a.** it's not always possible to maintain normal aircraft attitude.
 - b.** it's rather easy to control gradual turning.
 - c.** it's extremely difficult to maintain normal aircraft attitude.
- 2.** Vertigo can be intensified by...
 - a.** excessive head movements.
 - b.** flying only under VFR.
 - c.** not trusting your own sensory organs.
- 3.** Relying on the aircraft's instruments...
 - a.** may increase the effects and duration of vertigo.
 - b.** may help the pilot overcome the effects of spatial disorientation.
 - c.** may cause the pilot to lose his insurance.
- 4.** Spatial disorientation may occur anytime...
 - a.** the pilot's attention is focused on the outside of the cockpit.
 - b.** the outside visual reference is temporarily lost.
 - c.** the pilot flies under IFR.
- 5.** The danger of vertigo may be reduced among other things by...
 - a.** being fully aware of its nature and causes.
 - b.** having faith in what you see and hear.
 - c.** having visual flight instruction.

Focused Reading (OXI ΜΕΤΑΦΡΑΣΗ)

Read the text below about technology and advances in aviation's "Golden Age" and answer the following questions.

1. What motivated the construction of faster aircraft in the U.S.A.?
2. Were there any female pilots during that period?
3. What happened to the Hindenburg airship? Could have it been prevented?
4. What were the consequences of the Hindenburg disaster?
5. What kind of gases were used in airships?
6. When was instrument flight developed and by whom?

AVIATION IN THE 20th CENTURY - Technology and Performance

Advances in Aviation's "Golden Age" (1918-1939)

The years between World War I and World War II saw great advancements in aircraft technology. Airplanes evolved from low-powered biplanes made from wood and fabric to sleek, high-powered monoplanes made of aluminum.

After WWI experienced fighter pilots were eager to show off their new skills. Many American pilots became barnstormers, flying into small towns across the country and showing off their flying abilities, as well as taking paying passengers for rides. Eventually the barnstormers grouped into more organized displays. Air shows sprang up around the country, with air races, acrobatic stunts, and feats of air superiority. The air races drove engine and airframe development. With pilots competing for cash prizes, there was an incentive to go faster. Amelia Earhart was perhaps the most famous of those on the barnstorming/air show circuit. She was also the first female pilot to achieve records such as crossing of the Atlantic and Pacific Oceans.

Other prizes, for distance and speed records, also drove development forwards. For example Charles Lindbergh took the Orteig Prize of \$ 25,000 for the first solo non-stop crossing of the Atlantic.

Australian Charles Kingsford Smith was the first to fly across the larger Pacific Ocean in the Southern Cross. His crew left Oakland, California to make the first trans-Pacific flight to Australia. On arrival, Kingsford Smith was met by a huge crowd of 25,000 at Eagle Farm Airport in his hometown of Brisbane. Accompanying him were Australian aviator Charles Ulm as the relief pilot, and the Americans James Warner and Captain Harry Lyon (who were the radio operator, navigator and engineer). With Ulm, Kingsford Smith later continued his journey being the first in 1929 to circumnavigate the world, crossing the equator twice.

The first lighter-than-air crossings of the Atlantic were made by airship in July 1919 by His Majesty's Airship R34 and crew when they flew from East Lothian, Scotland to Long Island, New York and then back to Pulham, England. By 1929, airship technology had advanced to the point that the first round-the-world flight was completed by the Graf Zeppelin in September and in October, the same aircraft inaugurated the first commercial transatlantic service. However the age of the dirigible ended in 1937 with the terrible fire aboard the Zeppelin Hindenburg. After the now famous footage of the hydrogen-filled Hindenburg burning and crashing on the Lakehurst, New Jersey, landing field, people stopped using airships, despite the fact that most people on board survived. The Hindenburg, combined with the Winged Foot Express disaster that occurred on July 21, 1919, in Chicago, Illinois, in which 12 civilians died, started the demise of the airship. Flammable gas dirigibles did not burn and crash often, but when they did crash they caused a disproportionate amount of destruction to the crash zone compared with the airplanes of the time. It was more shock value than the number of fatalities that caused the retirement of the world's airships. This may not have been the case had helium been available to the Zeppelin company. The United States, holder of the world's only reserves of helium at the time, was loathe to supply it to the company, which was based in Germany.

Meanwhile in Germany, who was restricted by the Treaty of Versailles in its development of powered aircraft, instead developed gliding as a sport, especially at the Wasserkuppe, during the 1920s. In its various forms, this activity now has over 400,000 participants.

In 1929 Jimmy Doolittle developed instrument flight. 1929 also saw the first flight of by far the largest plane ever built until then: the Dornier Do X with a wing span of 48 m.

In the 1930s development of the jet engine began in Germany and in England. In England Frank Whittle patented a design for a jet engine in 1930 and towards the end of the decade began developing an engine. In Germany Hans von Ohain patented his version of a jet engine in 1936 and began developing a similar engine. The two men were unaware of each other's work, and both Germany and Britain would go on to develop jet aircraft by the end of World War II.

