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pilot ground school

Pre-Pilot Studies

Phil Croucher

"Never allow your ego, self-confidence, love of flying, pressure from a customer, boss or co-pilot, or economic need to interfere with your good judgement during any stage of a flight. There is no amount of pride, no thrill, pleasure, schedule or job that is worth your licence or your life and the lives of your passengers. Complacency kills, and so does being a cowboy." John Bulmer

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Introduction 0

This document is a sample of the notes published for the modular self-study programs for the EASA pilot examinations provided by Caledonian Advanced Pilot Training in the UK. It also provides the basic knowledge required before joining the classes.

The full notes can be obtained as a PDF for £49.95 from **https://www.aviationexam.com/product/10768/easa-professional-pilot-studies.aspx?idCat=20** for aeroplanes and **https://www.aviationexam.com/product/10769/professional-helicopter-pilot-studies.aspx?idCat=20** for helicopters.

Proper pilot performance is based on knowledge, planning, and anticipation of what the aircraft will do - and you will not be able to achieve that without studying properly. Your real training starts in your first job, and what you learn before then can be very important.

For example, most pilots gain licences from several countries over their careers - if you have a good core knowledge, you will be in and out of the exam rooms a lot quicker. In addition, if you do the minimum work for your exams, by learning the answers rather than the material ☺, it will be painfully obvious to the interview panel when you finally go for a job. Our course go beyond the exams to the technical interview

With regard to examinations, it may seem that you are learning a lot of stuff that will not be useful to you. That's certainly true to some extent, but the EASA system makes you learn everything you might need for your career before you start, rather than as you go along - in North America, you will likely be exposed to the same material over the years, but from company ground school and various other type rating courses. It's just that the Europeans have no guarantee that this will happen and expect you to be a seasoned professional from the start - the original intention behind the EASA exams was to make them the equivalent of a BA degree, since people were regarded as joining a profession. As with many other degrees, a lot of the subject matter was included as padding for credibility purposes, and the main purpose was forgotten. Currently, the EASA ATPL, according to Bristol University, has the same standing as two years of a degree-level course, although the exam procedures are nowhere near as rigorous as that.

However, some of the content is there for third party reasons - Human Factors training is an international requirement, and radio theory must be learnt because you have a cut-down version of the amateur radio licence, and you need to know how not to screw up the airwaves.

Maths 1

Aviation, in common with many other disciplines, uses a precise language so that communication can take place with the minimum of effort. So do maths and science, in the shape of graphs and algebraic symbols. Mathematics is the language used by engineers, and (Newtonian) physics provides the laws under which aircraft operate. You may also come across circuit diagrams with the electronics involved with radio navigation.

Factors & Rounding

Underneath the heading of arithmetic, numbers can be added, subtracted, multiplied or divided (it is assumed that you know how to do them all).

A **prime number** is a natural number (greater than 1) that can only be divided by 1 and itself. A number greater than 1 that is not a prime number is a composite number.

When you divide one number into another, it is a *factor* if the division takes place without leaving a remainder. For example, 4 divides into 20 5 times exactly. If you tried to divide 3 into 20, you would be left with a *remainder* of 2.

Often, if a remainder leaves you some way between two numbers, you must round up or down to answer a question. If the number is less than halfway, it is the custom to round down, or truncate. If it is halfway and above, you round up.

The Decimal System

The following numbers are used in the decimal system, which operates to a base of 10:

```
0 1 2 3 4 5 6 7 8 9
```

Their position determines value. For example, the number 6 has a different meaning in each of the following:

```
146
164
614
```

In the above examples, it occupies the position of a *unit*, a *ten* or a *hundred*, respectively (each number being ten times bigger than the one on its right). A fourth place would be a *thousand*, so the smallest numbers (the units) are always on the right hand side. Zero (0) is used as a placeholder when a unit is missing to make sure the numbers are kept in their right places:

```
620
602
```

Thus, the number of digits tells you something about the size of a number rather than what's in it.

The Sexagesimal System

Time, angles and geographic co-ordinates use a base of 60, as originated by the Sumerians, and handed down to us through the Babylonians and other peoples. The number 60 has twelve factors, namely 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60, of which 2, 3, and 5 are prime numbers. With so many factors, many fractions involving sexagesimal numbers are simplified. For example, you can divide one hour evenly into sections of 30, 20, 15, 12, 10, 6, 5, 4, 3, 2, and 1 minute(s). 60 is the smallest number that is divisible by every number from 1 to 6; that is, it is the lowest common multiple of 1, 2, 3, 4, 5, and 6.

The Binary System

The decimal system is useless for counting numbers when you need to be able to discriminate between levels of voltage, which requires analogue methods. For example, say you had the answer to Life, The Universe and Everything[1], which is 42 (101010 in binary). To calculate it, you must multiply 6 by 7, so you start with 7 volts. Now you have to feed it into an amplifier with a gain of 6 to get 42 volts. Easy enough, but if you start multiplying by thousands, you will soon have problems.

Using only 2 numbers is a lot better, hence the use of the binary system, mentioned in *Systems* (there was an old English method of counting with firkins, also in units of two, as in two firkin big, or two firkin heavy). Now, you only need to find out if a voltage exists or not, rather than how large it is, and use more wires for bigger numbers.

1. From *The Hitchhiker's Guide To The Galaxy*.

Addition & Subtraction

It is often quicker to add then subtract - to add 9 to 13, you could add 10 to 13 to get 23, then take one away. Subtraction can also be done in more ways than one - taking 8 away from 10 is the same as asking what the difference between them is. You can, in fact, take a larger number from a smaller one - all you need to do is use....

Positive & Negative Numbers

A number is positive if it is greater than zero. There is usually nothing in front of positive numbers, but if you mean to make a distinction, you can put a plus sign (+) in front, as with +20°C for temperature. Negative numbers use a minus sign (-). You might see this on thermometers when the temperature is colder than freezing (-20°C). However, they are also used in algebra, discussed later. If you take 12 away from 6, you would end up with -6.

- + and + is +
- - and - is +
- + and - is -
- - and + is -

Multiplication

This is simply a shortcut for adding up, and it doesn't matter which way round the numbers are: 4 x 2 is the same as 2 x 4 (the *commutative law*). Again, you can use a higher number, and bounce off it - when multiplying by 9, you will find it easier to multiply by 10 then take off the excess, which is a tenth. 9 x 56 = 560 - 56 = 504. To multiply by 11, do so by 10 and add a tenth. 340 x 11 is simply 3400 + 340 = 3740.

Your life will be a lot easier if you simply remember the multiplication tables, particularly 3 and 5 for aviation.

Fractions

A fraction is a number that is not a whole number, described as *vulgar*, *simple* or *common*. Decimal fractions are discussed below.

Just to confuse matters, a fraction such as ½ is also called a *proper fraction*, because the numerator (the small number) is above the larger one (denominator). In other words, the fraction has a value of less than 1.

An improper fraction has a value of more than one, such as $^{22}/_{7}$, which will become significant as the value of π (pi) which we will come across in *Geometry*, below.

If you multiply or divide the numerator and denominator by the same number, you get a fraction with the same value as the original one. Reducing a fraction by division is called *cancelling*. When you can't cancel any more, the fraction is said to be in its lowest terms.

However, you can only add or subtract fractions that have the same denominator. If you have two with different denominators, you have to find the lowest common denominator, or a number into which they both divide as whole numbers. The lowest common denominator for 3 and 2, for example, is 6. For 4 and 8, it is 8.

To venture into electrics, with 4 resistances in parallel, of 1, 3, 8 and 15 ohms, to find the unknown total R:

$$\frac{1}{R} = \frac{1}{1} + \frac{1}{3} + \frac{1}{8} + \frac{1}{15}$$

The least common denominator is 120[1], so....

$$\frac{1}{R} = \frac{120 + 40 + 15 + 8}{120}$$

This becomes:

$$\frac{1}{R} = \frac{183}{120}$$

The non-reciprocal of which is:

$$\frac{R}{1} = \frac{120}{183}$$

As the denominator is greater than the numerator, the answer will be less than 1.

1. Increase the top numbers to match.

Tip: If the calculation is hard, convert them to......

DECIMAL FRACTIONS

Decimal fractions work the same way as the numbers do in the decimal system (above), except that the values go from right to left and they are separated from the main number by dot called a decimal point (sometimes a comma in Europe).

½ is 0.5 because it has the same value as 50/100.

You can divide numbers into pieces that are ten times smaller, so the figure to the right of the dot represents tenths, the second one hundredths, and so on. For example, 1.5 (one and five tenths) is the same as 1½. 0.01 kilovolts is 10 volts (to multiply a decimal number, simply move the decimal point to the right by the same number of zeros). A recurring decimal (with the same last number multiple times) sometimes has a dot above the last digit, which tells you that it never really divides properly. Although π carries on forever, it is not a recurring decimal but a transcendental number. It's probably the only one.

Percentages

Whereas decimals deal with tens, percentages deal with hundreds, so anything that is a percentage is a part of a hundred. 25% is a fourth part of a hundred, or a quarter.

Averages

The word *Mean* (as used in the term *Local Mean Time*) more or less means *average*. Centre of Gravity calculations are averages, where you take a series of numbers, add them up, and divide them by the number of numbers involved. Technically, this gives you an arithmetic mean. The *median* of a set of values is the middle one. The *mode* is the most common value.

Mental Maths

This is needed for the KSA 100 exam. A common requirement is for descents and the time involved, or from how far away to start a descent into an airfield (various rules of thumb can be used). The 3 and 5 times tables are particularly relevant. One way of calculating the distance for a descent is to take the height to lose in thousands of feet and multiply by 3 so, for 10,000 ft, start the descent 30 nm away, although it is probably more accurate (but more difficult) to use 2.5. This provides a slightly steeper descent than using another method that involves flight levels and dividing by 3 - 10,000 feet is FL 100, so you get 33 nm. Add 1 nm for each 10 knots for deceleration.

Using addition and subtraction rather than just addition, we can simplify tasks that look dreadful. 2998 + 4026 can be done simply by realising that the first is nearly 3000 and the second is just over 4000. You can therefore jump straight to 7000 and add 24 (26 - 2) to get 7024.

Jumping is actually quite handy - when adding 7 and 5, you can jump to ten (or bounce off it) and take the difference from the second number - that is, add 3 to the 7 to get 10, then subtract the 3 from 5 to get 2 and add that to the 10. *Compensating* is adding or subtracting more or less than you need to, then adjusting the answer. Although it sounds like a lot of work, it is actually very quick.

```
45 + 27 is 50 + 30 - 8 = 72
```

Splitting a number into parts is called *partitioning*. This can be handy with subtraction. Say you wanted to subtract 42 from 90 - start with the 40 to get 50, then take away the remaining 2 to get 48.

Algebra

This uses letters instead of numbers when you are more concerned about the ratio or relationship between objects rather than their values, although it can be used to find an unknown value when you know several others. If you fly 90 miles in 3 hours, your average speed would be 30 knots. This is the result of dividing 90 by 3:

$$90 \div 3 = 30$$

The figures would be different for another journey so, to save us writing down different numbers every time, we need a procedure, such as "To find an average speed in knots, divide the number of miles travelled by the number of hours in the air."

Or, even shorter: "To get an average speed, divide the distance by the time."

As we are now using more general units, you can use minutes or seconds instead of just hours.

Mathematically, the above could be made even shorter:

$$\text{Average speed} = \text{Distance} \div \text{Time}$$

But even that can be tedious, so try:

$$S = D \div T$$

or, using the ordinary rules of arithmetic:

$$S = \frac{D}{T}$$

Obviously, you can't divide letters - they are there to show you what to do with the numbers when you get them. In other words, to use the formula, you *substitute* the letters for the correct figures. For example, using x to represent almost anything unknown:

$$x + 6 = 8$$

You know that some number plus 6 equals 8. Of course, this is 2. You found that out by subtracting 6 from 8, which is the reverse of addition.

S, D and T were chosen above because they suit the problem, but you could have used A, B or C or X, Y and Z, if you remembered their basic meaning[1].

Other letters can be used when you want to mix different things. You can't add 3 helicopters and two aeroplanes together, but you can express their relationship like this:

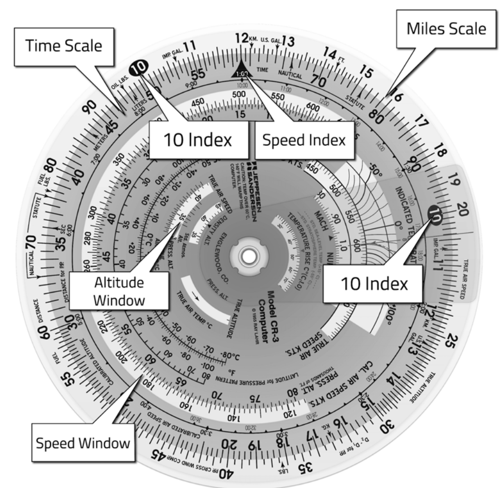
```
2h + 3a
```

Otherwise, some letters are already reserved, such as *s* for distance because when Galileo started all this off, he used the word *scale* from his own language. Similarly, Ampere was concerned with the *intensity* of electric current, so he used *I* to represent it instead of *A*.

SYMBOLS & SIGNS

Because of the limited number of letters in the alphabet, there are also various ways of distinguishing them. If you were faced with several resistors in an electrical circuit, you could label them R_1, R_2, R_3, etc. However, you should not put the numbers above, like this: 5^2, 5^3.... because a number in that position already has a special meaning, such as squaring or cubing, respectively (squaring means multiplying a number by itself, and cubing means doing it three times, and so on).

The number above is an *index*, and it has some curious properties. When you apply an index to the number 10, it is called a power, such as "10 to the power of 2" when you mean 10^2 (squared). Such powers indicate the number of places the decimal point must be away from 1. It is a convenient way of expressing large (or small) numbers. 10^6 is also 1,000,000, or 1 with 6 zeros after it. 10^{-6} means 0.0000001. 10^{28} expresses how many electrons there are in a coulomb, a unit which is used in electricity.



Powers have another property that is made use of in the slide rule part of the flight computer. You can add them together to get the same effect as multiplication - 10^3 x 10^3 is the same as 10^6 (adding the powers), and you have just multiplied 1000 by 1000 to get 1,000,000. When you operate the slide rule side of the flight computer, you are not adding numbers, but indices.

1. Constants tend to use letters from the beginning of the alphabet, and variables from the other end.

On the reverse side of all computers is a circular slide rule, with the space between the numbers (from 10 to 100) decreasing as the numbers increase.

The outer, stationary, scale is called the *miles scale*, and the inner one, which rotates, is the *minute scale*, so distance and time are always opposite each other. They correspond to the C and D scales of the traditional slide rule. As with any slide rule, you need to know the approximate answer first, as a gross error check, and to give you an idea of where to put the decimal point.

To multiply any number, place the 10 of the inner scale against the number on the outer scale, and the answer will be found on the outer scale opposite the number you are multiplying by on the inner scale.

For division, set up the fraction as it looks on the page on the outer and inner scales (that is, the number to be divided should be on the outer scale, and the divisor on the inner scale), and the answer will be on the miles scale, opposite the 10 on the minute (inner) scale.

Other useful symbols include:

Symbol	Meaning
≥	Greater than or equal to
≤	Less than or equal to
≈	Approximately equal
√	Square root
∝	Proportionality

Hooke's Law can use the proportionality sign. The tension in a spring is directly proportional to its extension:

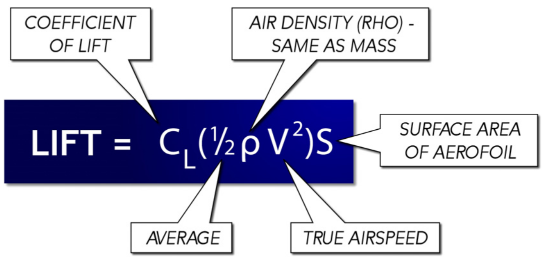
$$T \propto \text{extn}$$

With any such relationship, if one variable is increased by a given factor, such as 2, the other is increased by the same, so if you double the tension, you also double the spring's extension.

EQUATIONS

An equation is a statement that shows the relationship between quantities, and how they change when one is increased or decreased. You can recognise it by the equals sign (=), and the expressions either side must balance.

To use the Lift Formula as an example, when one of the quantities on the right side is varied, Lift on the left side will follow.



Increasing the density on the right hand side will increase the value of lift on the left hand side.

Some letters, when used as symbols, have been allocated meanings by international agreement, or they may change according to the context in which they are used. The Greek symbol ρ (rho) represents air density in Meteorology and resistivity in electronics. Even within disciplines it can change - μ (mu) can mean amplification factor or permeability, depending on the (electronic) context. When making your own formulae, its best to state the meaning you use to help the person who reads it later.

Say you now knew an average speed and a distance, but needed to find the time. You can just move the figures around in the formula. What we need to do is get T by itself on one side of the equal sign. As the figures either side must balance each other, you can multiply both sides of the equation by the same figure, in this case T.

$$S = \frac{D}{T}$$

The short cut is just to move T from one side of the equation to the other, and reverse its function:

$$ST = D$$

Notice that T is now a multiplier, where it was previously a divisor. Note also that ST is a shorthand way of saying S x T (the period, or full stop, may be used in algebra instead of the multiplication sign, as in S.T). If you divided the equation by S you would now get:

$$\frac{D}{S} = T$$

Which now isolates the time on one side of the equation.

Again, the shortcut is to move S diagonally.

Simultaneous Equations

These are used when you have two or more unknown quantities, such as when you know the wingspan of one aeroplane and you want to find the wingspan of another without going out in the rain and measuring it (if you had a tape measure long enough).

You need an equation for each one. For example:

```
a + b = 8
a - b = 4
```

The simple way is to cancel the *b*s out. You end up with:

```
2a = 12

a = 6
```

Quadratic Equations

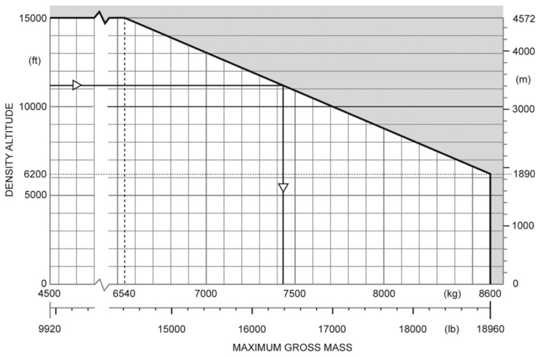
These involve a square value, of which a positive number will have two - one with a minus value and one with a plus value. A negative number has no roots.

To solve a quadratic equation, turn both sides of it into a square.

As simultaneous and quadratic equations are not often used in aviation, we will proceed to ignore them.......

GRAPHS

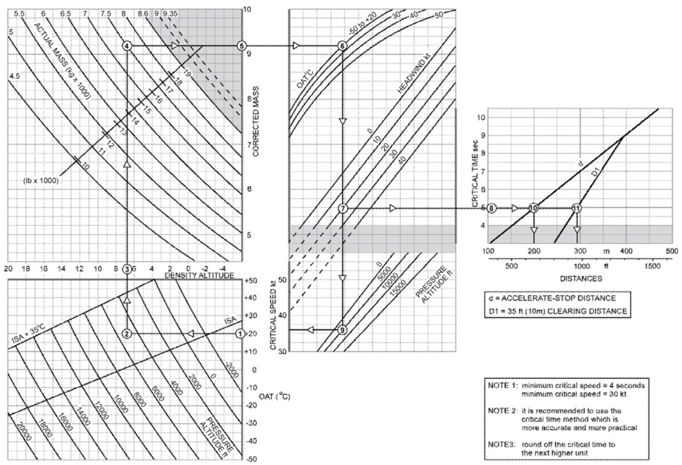
Pilots use graphs a lot, especially when calculating performance. A graph is a visual representation of the relationship between several numbers, on the basis that it is easier to look at pictures.



The same principle is used when dealing with vectors.

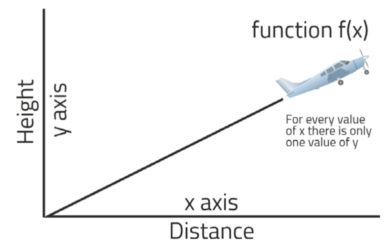
Say you have a fuel tank that reduces its contents over time, and as the level goes down, you make a mark on the side of the tank. This doesn’t tell you very much, unless you added the time taken. Now place the fuel tank on a conveyer belt and stick a pencil to the level float inside the tank (a bit of poetic licence needed here). As the belt moves, marks would be made on the wall as the level reduced and you would have a graphical representation of your fuel use over time. Both sides of the graph need a scale to keep them in proportion to each other.

The value of zero on whatever scale is called the *origin*. It comes in useful when drawing tangents from it to the curve of the graph (as used in power graphs).

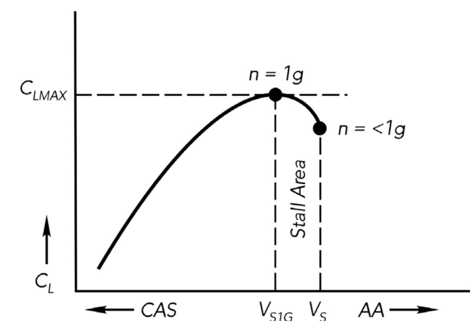


Calculus

Calculus works around functions, which are just ways of relating one set of numbers to another, easily done with a graph. When you take off, you will be covering some distance and gaining height as you do so, like this:



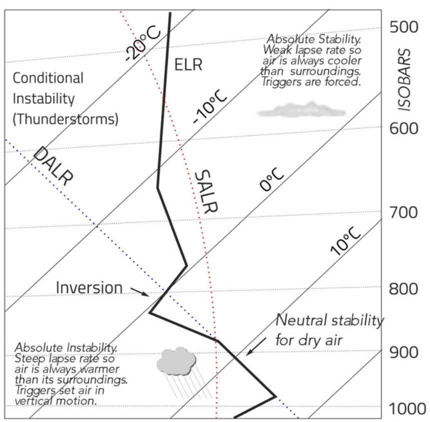
Your position at any particular distance would be a *function* of the x and y axes. However, a position on a graph like the one below is not a function because there is more than one value of x for every value of y:



The *domain* of a function is the portion of the x axis it occupies. The *range* is the same for the y axis.

SLOPES

Sometimes you can get information from a graph without looking at any numbers. If the slope of a graph is steep, for example, there is rapid movement. If it is shallow, movement is slow. This is often what happens with temperature readings from the atmosphere.



The value of a straight line graph (where the rise in y is equal to the run of x) can be easily calculated with a formula, described below. However, when the graph is curved, the change in y as compared to x varies, and you need to find some way of calculating the value without drawing the graph. To do this you need to use an infinitesimally small change in order to find the slope of a tangent drawn to that point.

To use another aviation metaphor, if your speed is constant, you can find the distance travelled with a simple calculation (speed x time) but, if your speed is constantly varying, you need something more powerful. You essentially need to calculate the area underneath a curve, meaning a rectangle with one side that is curved. This kind of calculation (differential[1] calculus) is at the heart of Inertial Navigation/Reference systems, and there is a discussion below.

Meanwhile, the form of equation that is used to plot the slope of straight line graphs takes the form:

```
y = mx + b
```

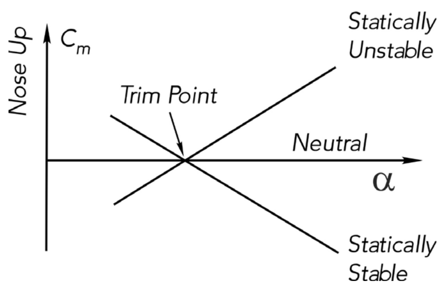
where *m* represents the slope and *b* where the y axis crosses the x axis (the intercept). If an equation isn't in that form, you just solve for *y*, for example, starting with 2x - 3y = 12, subtract 2x from both sides to get -3y = -2x + 12, then divide by -3 to get:

```
y = 2 - 4
3
```

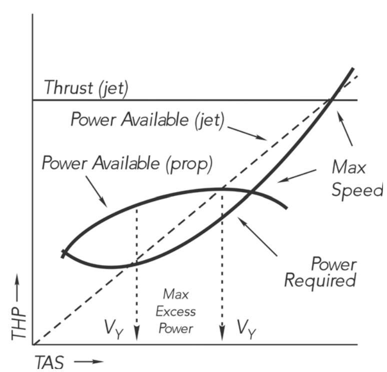
1. Calculus comes in two flavours, namely *Differential* and *Integral*. The former allows you to find all the slopes a function can have, and the latter helps you find the area underneath the function.

The graph starts at -4 on the y axis, you then move up 2 and right 3 - slope is a fraction as it is *rise* over *run*.

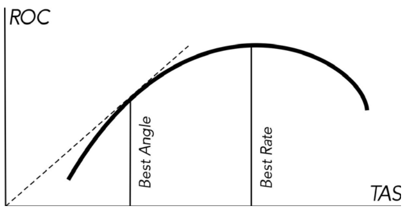
Positive slopes move up as you go to the right or down to the left:



The slope for a function that is not a straight line is called a *derivative*, related to which is a *secant line*, or a straight line that touches a function through at least two points.



Out of a series of secant lines, one will be nearly touching the function concerned, and this will be a tangent line touching the slope at one point and which will have the same value of slope:



You won't be surprised to learn that there is a formula for finding that as well, involving the symbol delta (Δ), which represents a change, such that the change in y divided by the change in x:

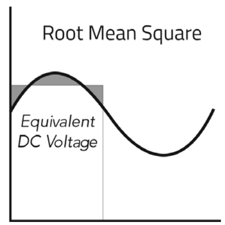
$$\frac{dy}{dx}$$

produces a real number equal to the slope at the point concerned.

This is not *d* multiplied by *x* or *y*, but shorthand representing "a little bit" of x or y. If you wanted to show off you would call it an element.

Another symbol that causes confusion is this one, ∫, which just means "the sum of". Again, to show off, you would say it was "the integral of", or a collection of ~~little bits~~ elements that are to be added up.

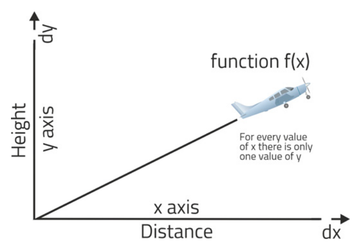
The area *under* a function is an *integral*.



So, we are dealing with small things, one minute being a minute fraction of an hour (which is where the name comes from), which in turn can be subdivided into second minutes (a second order of smallness[1]), or seconds for short.

We are also dealing with quantities that are growing, and their rates of growth, and how the processes interact with each other. The height reached by an aircraft depends on the time taken to reach that height.

If you had a quantity such as *x* that decides to grow by a small amount, we end up with *x* plus a bit, or $x + dx$. Similarly for *y*, if your rate of climb is kept constant.



However, if the aircraft should slow down, the rate of climb would change, meaning that *dy* would get shorter, in which case we would have $y - dy$, or a negative increment in *y* for a positive increment in *x*. This doesn't mean that *y* gets shorter, just that *dy* does.

1. Order of magnitude to a mathematician.

GEOMETRY

Geometry concerns lines and angles.

- The **perimeter** is the total length of all the sides of a two dimensional object. The perimeter of a circle is its circumference.
- The **area** is the space inside the perimeter, found by multiplying the length by the breadth or, in the case of a circle, the square of the radius (half the diameter) multiplied by π[2].
- **Volume** is found by multiplying area by height.

Circles

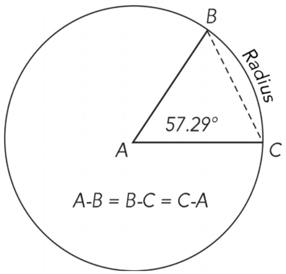
The *diameter* of a circle is the length of a straight line across it, through the middle. The *radius* goes from the centre to the circumference, or half the diameter.

2. π represents the ratio of the circumference of a circle to its diameter, being 22 divided by 7. It is commonly taken to have a decimal value of 3.1412, but it actually goes on forever.

TRIGONOMETRY

Angles & Arcs

Angles are measured in degrees and radians. A radian is an angle of 57.29º which subtends an arc of the same length as the radius of a circle (it is popular with scientists and is useful when intercepting radio beams).



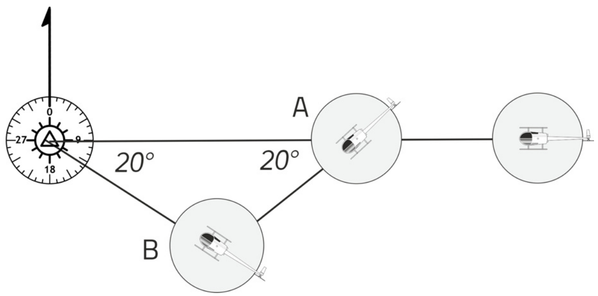
360° = 2π radians. As the radius of a circle is equal to 2πr, its circumference can be written as the angle in radians round the circle multiplied by the radius (r).

STOP Make sure you use the right mode with your electronic calculator!

Triangles

There are three types of triangle:

- An **equilateral** triangle, which has three sides of the same length.
- An **isosceles** triangle, which has two sides of equal length, and two angles of equal value, and is sometimes very useful for navigation.



For example, it will take the same time to fly from point B in the picture to the navigation beacon as it does from A to B. It is a handy way of estimating time without taking you too far out of your way.

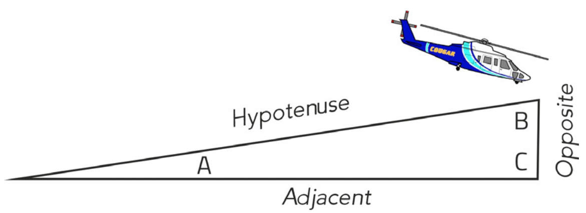
The third side is 1.4 times the length of a short side, or the short sides are 70% the length of the long side. Once you see a bearing change of 45º, you can bet you are dealing with an isosceles triangle.

- A **scalene** triangle has three sides of different lengths.

The internal angles of a triangle should add up to 180°. One of 90° is called a right angle (after *upright*). One less than that is an **acute angle**. Angles between 90-180° are **obtuse** angles. Those greater than 180° are **reflex** angles.

A right angled triangle thus has two others that add up to 90°. After Pythagoras, the square[1] of the hypotenuse (the long side) is equal to the sum of the squares on the other two sides (although this refers to areas, Pythagoras is usually used to find the length of a side).

The value of one of the other angles in a right angled triangle depends on the relationship between two sides of it. In the case of angle A in the picture below, if you divide the height of the helicopter (opposite side) by the distance it has travelled through the air (the hypoteneuse), you have the *sine* of angle A.



1. The square of a number is that number multiplied by itself. The square root of a number is one which, when multiplied by itself, produces the original number. It is the same as raising the original number by a half, such as $6^{0.5}$.

Two angles that add up to 90° are called *co-angles,* so angle B is called a cosine (C is already 90°). Its value again depends on dividing the height of the helicopter by distance it has travelled through the air, but the helicopter's height is now *adjacent* (i.e. next to) to B, rather than being opposite A.

If you divide the helicopter's height (opposite) by the distance it has travelled over the ground (adjacent), you have the *tangent* of angle A.

To find the length of any side, you need to remember these letters:

```
SOH CAH TOA
```

The initial letters of each group refer to Sine, Cosine and Tangent, respectively, and the others refer to one side of the triangle, namely Hypoteneuse, Adjacent and Opposite (there is an easy way to remember them below).

```
Some Old Hens
Can Always Have
Turnips Or Apples
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To find Angle A in the previous example, you would therefore use this formula:

$$\text{Sine} = \frac{\text{Opposite}}{\text{Hypoteneuse}}$$

To find out which formula you need, take the above letters and cross out the items you know, then use the one where both are crossed out together:

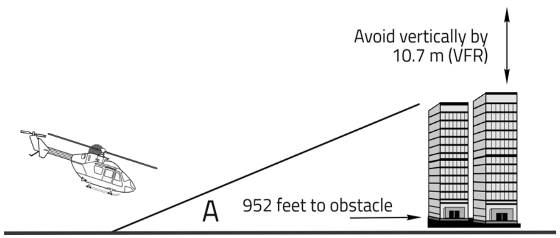
S~~O~~~~H~~ CA~~H~~ T~~O~~A

Once you have done the division, use your calculator to find the angle corresponding to the result.

These relationships remain the same regardless of the size of the triangles - they are simply ratios.

Example

Performance rules require you to clear a building by 35 feet as you get out of a landing site.



You first need to find the angle between the surface and the top of the obstacle. Angle A is 40°.

The tangent of angle A multiplied by the distance to the base of the obstacle gives you the height required, 952 x 0.84 = 800 feet. Then add the 35 feet clearance required (you do it this way because it is easier to line up on the top of the building than try to estimate a height above it).

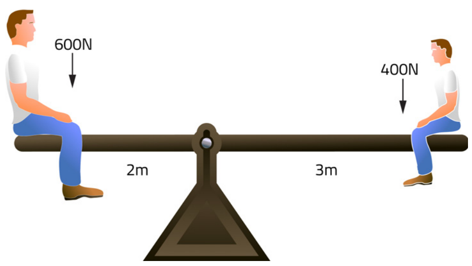
MACHINES

Machines make life easier for humans, being any device that helps you do work, by changing the amount or direction of a force, or its speed of action, amongst others, but mainly transforming or transferring energy, particularly electrical, so computers are machines with no moving parts (solid state).

There are only six simple mechanical machines - the lever, the block, the wheel and axle, the inclined plane (wedge), the screw and the gear, although physicists only recognise two basic principles: the lever and the inclined plane. The rest may be considered to be levers, while the screw is based on the inclined plane anyway. Complex machines are combinations of simple machines.

Levers

These are the simplest machines, used in aviation mostly with mass & balance of aircraft.



There are three basic elements, the fulcrum (or balance point), a force or effort *applied* at a distance from the fulcrum and a resistance *acting* at a distance. The distances concerned are the *arms* of the lever.

The above example is known as a **first class lever**, as the fulcrum is between the effort and the resistance - a good example would be oars on a rowing boat.

A **second class lever** has the fulcrum at one end, and the effort is applied at the other, so the resistance is somewhere between them - a wheelbarrow. 50 lbs of effort applied to the handles 4 feet from the wheel will allow you to lift 200 lbs a foot away from it.

First and second class levers help you to overcome large resistances with relatively little effort. In other words, they can magnify an applied force, and provide a *mechanical advantage*.

A **third class lever** also has the fulcrum at one end, but the resistance is at the other, and the effort is applied between them. They are used to speed things up, even though you have to use a lot of effort to do so. Your arm is a third class lever, but closing a door from a point 2-3 inches away from the hinges rather that where the handle is would be a good example - the handle moves faster because it has to cover a greater distance in the same amount of time, but the effort involved when applied near the hinges is much more.

A third class lever provides a *fractional disadvantage*, or one in which a greater force is required than that of the load lifted - speed is created at the expense of force to provide a mechanical advantage of less than 1.

Wheel & Axle

These magnify an applied force - doorknobs do this very well, as trying to turn the shaft with just your fingers would be quite difficult. Two forces operating in the same direction to cause a rotation are known as a *couple*, which creates a *torque*, or twist, when applied continuously.

Inclined Plane (Wedge)

The inclined plane allows you to overcome a large resistance by applying a small force over a longer distance when raising a load.

A wedge is a special application of the inclined plane, as used when splitting logs.

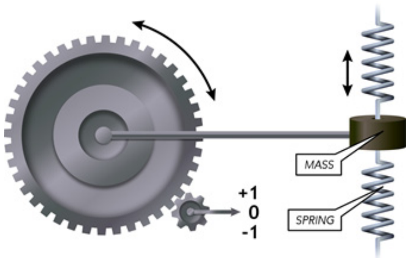
THE SCREW

This is a modified version of the inclined plane, being one in the shape of a cylinder.

Gears

These can change the direction of motion, increase or decrease the speed of the applied motion and magnify or reduce the force applied.

When two gears of unequal size are meshed together, the smaller one is usually called a pinion, although the teeth on both wheels will be the same size. This would be the principle behind a basic accelerometer:



Helical gears have their teeth cut slantwise, so one end will lie ahead of the other, with a leading and a trailing end, sometimes curved, as shown:

As contact between them is constant, smoother action is possible. As they tend to push each other apart, this action can be used as the basis of measuring the torque applied to a gearbox.

Work

A force is said to do work when it overcomes a body's inertia and moves it in the direction in which the force is acting, so it is the same as *force x distance*, or *force x velocity*, if you bring time into it, and think in terms of power (below). If an object doesn't move even if a force is applied, no work is done, although it obviously has in the casual sense. In the English system, work is measured in foot-pounds - with CGS, it is measured in ergs, 10,000,000 of which make a joule.

POWER

This is the *rate* of doing work, or force x velocity, as measured in *horsepower*, which has a standard value of 33,000 ft/lbs per minute, or 550 per second, based on the idea that a standard horse (in a British mine) could lift 100 pounds out of a vertical shaft while walking away at about 4 mph (330 fpm). When you lift a weight, you work against gravity and the power you need depends on the weight of the item concerned and how high you raise it. So, if you lift 10 lbs over 55 feet, or 55 lbs over 10 feet, you require 550 ft-lbs, the product of weight multiplied by distance, but that 550 ft-lbs must be used within 1 second to qualify as a horsepower. The SI unit for power is the watt, which is 1 joule/second. 1 horsepower equates to 0.746 kilowatts, or 746 watts (to convert kW to hp, multiply by 1.34).

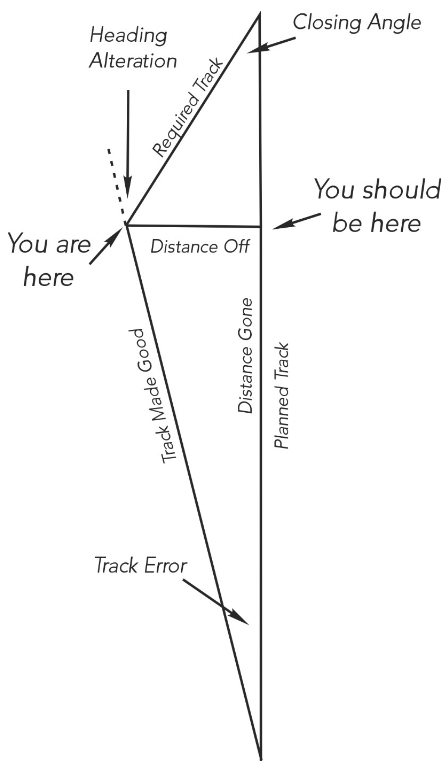
THE 1 IN 60 RULE

This is a rule of thumb that can solve many problems in aviation without getting the calculator out. The sine or tangent of a small angle is more or less the same as the number of degrees in the angle divided by 60.

Although it is only accurate to within 5% up to about 40° for sines and 10° for tangents, it is a very useful tool (used in Navigation) for quickly working out by how much your track is in error if you have been drifting off.

In other words, it is accurate enough to be a very good rule of thumb, as the angles involved are very small.

For example, after flying for 180 miles, you are 9 miles away from your planned track.



9 in 180 is the same as 3 in 60, so you are 3° off (it's a tangential relationship if you want to work it out properly).

The formula starts off like this:

$$\frac{\text{Error}}{60} = \frac{\text{Distance Off}}{\text{Distance Gone}}$$

It ends up like this:

$$\text{Error} = \frac{\text{Distance Off x 60}}{\text{Distance Gone}}$$

Of course, when you are off track, there is the potential for getting lost, so the first thing to do is parallel the original track. Now, at least, you shouldn't get any further off track while you work out how to get to the destination.

- To **parallel your original track**, alter course by the track error in the appropriate direction
- To **get back on the original track** (provided you haven't gone more than halfway), alter course by double the track error. Then apply the correction as a single figure to keep you there
- To **track directly to the original destination**, you would need an extra bit, called a *closing angle*, which you can find by altering the formula above:

  $$\text{CA} = \frac{\text{Distance Off x 60}}{\text{Distance To Go}}$$

  Add the combination of closing angle and track error to the heading the appropriate way.

Notes: The time to regain track may be more than that used to create the error in the first place. Also, these rules are approximate, because altering heading changes the relationship of the wind to your machine. 1 in 60 is used for convenience - if the exact figures for π are used it should be 1 in 57. The Tan may be used up to 25°, and the Sine is accurate up to 40° (within 10% up to 70°).

Tip: If you have travelled ¼ of the way along your track, the heading alteration is 4 times the closing angle.

You can use the 1 in 60 rule to see if you are still inside an airway. If the centreline was 045°, and you were on the 040° radial, you would be off track by 5°. If the DME says you are 45 nm away, it's a simple calculation:

```
Dist Off = TE x Dist Gone
           60
```

The answer is 3.75 nm, so you are OK.

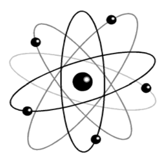
PHYSICS

Pretty much the whole of aviation works on physics, especially meteorology, so let's start with the atmosphere.

ATOMIC THEORY

Matter is anything that has mass and volume. For our purposes, it exists as a solid, liquid or a gas, but it can be a plasma as well. An **element** is a substance that cannot be reduced to a simpler form by chemical means because it contains only one type of atom - what distinguishes one element from another is the number of protons, neutrons and electrons in the atoms it contains. A *compound* contains 2 or more elements - one example is water, which has 2 hydrogen atoms and one of oxygen.

However, for most purposes, the atom is the most basic building block of matter. The word derives from the Greek *a tomos* which means "not cut", or that you can't reduce (or cut) the atom into anything smaller, as you can with a molecule, which is a collection of atoms in a chemical compound, the smallest part of an object that retains its identity (meaning that, if you split a molecule, the substance changes its character). By the time Einstein came along, it had been discovered that atoms are both a lot smaller and a lot bigger than was originally thought. If you enlarged an apple until it became the size of the Earth, for example, the atoms inside would be the size of cherries (and the atmosphere would have the thickness of clingfilm). Gold leaf has the thickness of about 5 atoms - if this book were printed on gold leaf, and you multiplied it by four, the total thickness would be that of a single sheet of paper.



The diagram on the left is a loose depiction of the inside of an atom (the Bohr model). The large ball in the middle is the *nucleus* and the smaller ones spinning rapidly round it are a cloud of *electrons*, which are **negatively charged particles** and around 2,000 times smaller in size. The nucleus contains positive- and neutrally charged particles, called *protons* and *neutrons* (both contain quarks and other strange things). The neutrons are there to bind the protons together, as particles of a like charge are repelled. As an example of how large atoms can be, if the nucleus were the size of the apple above, the first electron would be found anywhere between 1-10 miles away, and be hardly visible at that.

In an atom, there are an equal number of electrons to protons, to make it electrically neutral, or uncharged. An atom with one extra electron is *negatively* charged, and an atom with one missing is *positively* charged, or "carrying a positive charge", which is a bit strange, as all it has done is lost an electron. This is called *ionisation*, because an unbalanced (charged) atom is an *ion*, which we will come across in *Radio Navigation* when we discuss the ionosphere that surrounds the Earth. Some components, like transistors, depend on the movement of electrons or holes (missing electrons) one way or the other.

None of the components of an atom are physical in nature - they are actually electromagnetic charges, or tiny whirlwinds of electromagnetic force. The negative electrons are held in place by the positive protons with *electrostatic attraction,* as particles with opposite charges attract each other. Once an electron leaves an atom, lines of force exist between them, to create a kind of electrical "tension" which is made use of in radio transmissions. Electrons spin round the nucleus at around 600 miles per second so, bearing in mind the relative distances above, you can see that they work quite hard! In fact, they move so quickly round a nucleus that they give the *illusion* of a more solid construction because our senses don't work fast enough to detect the difference. So, an atom:

- is not solid
- is mostly full of nothing

Of course, Einstein proved that energy is really matter in another form with his formula:

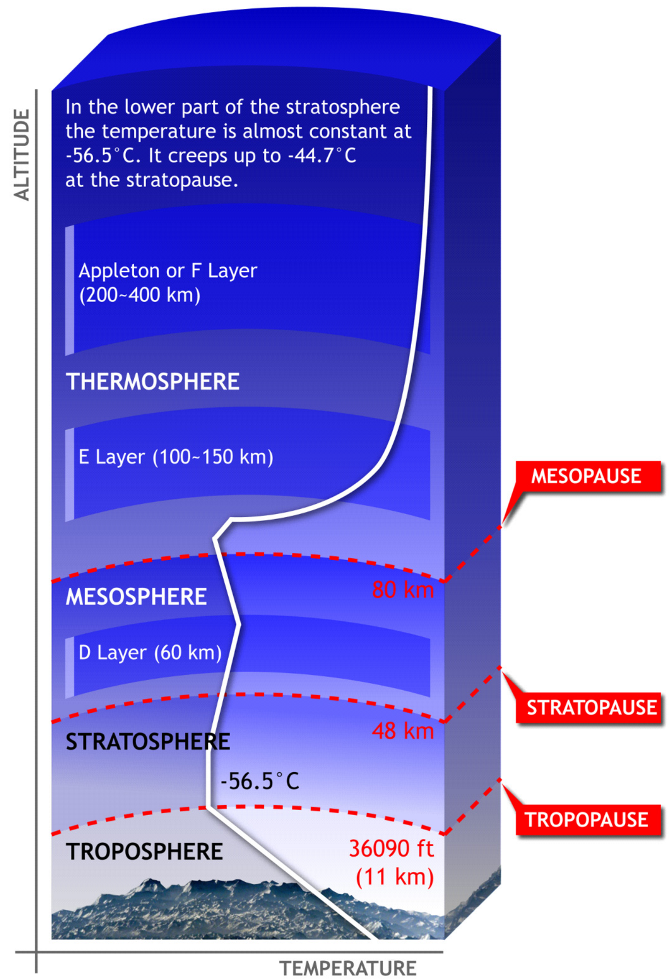
$$e=mc^2$$

In other words, energy is equal to the mass of a body multiplied by the speed of light, squared. Matter converts into energy and back again depending on what you do with its velocity.

THE ATMOSPHERE

The atmosphere is an ocean of gases around the Earth, and which moves with it, although it is in continuous motion due to uneven heating.

Various concentric(ish) layers of the atmosphere have been identified over the years. Starting from the bottom, they include the *troposphere*, *stratosphere*, *mesosphere* and *thermosphere*, although the last two are not of much concern to the average pilot. However, the first two layers do concern us, and we live at the bottom of the troposphere, which is at once the thinnest and most dense area because it is compressed by the weight of the air above it. In fact, it contains around 85% of the total mass of the atmosphere. The boundary (or transition zone) between it and the stratosphere is the *tropopause*, where any clouds are made of ice crystals. It lies at an average height of 36 090 feet, or 11 km.



21% of the troposphere, luckily for us, is oxygen, but 78% is nitrogen (N_2), with 1% of odds and ends, like argon (0.9%) and CO_2 (0.03%), and others, that need not concern us here, plus bits of dust and the odd pollutant, and water in various forms in suspension (the nitrogen, as an inert gas, keeps the proportion of oxygen down, since it is actually quite corrosive).

Normally, because of the constant mixing, these proportions remain constant (in dry air*) up to about 80 km, but there are exceptions:

- **Water**. 2% of the Earth's total water supply can be found suspended in the atmosphere. It would add about an inch of water to the Earth's surface.
- **Ozone**. 0.001%. **This is toxic**, and the main gaseous constituent of airborne pollution.
- **Carbon Dioxide** (CO_2). 0.05%. This absorbs infrared radiation and allegedly contributes to the greenhouse effect, described in *Meteorology.*

*Not saturated.

If the air wasn't continually being stirred up, the heavier gases would simply sink to the lower levels.

Thus, the atmosphere provides oxygen for us to breathe, and filters out harmful cosmic rays, aside from helping to regulate the Earth's temperature. The main characteristic of the troposphere is that its temperature falls off with altitude (because gases cool as they expand), whilst that of the stratosphere is assumed to remain constant until it increases slightly in the latter stages as the Sun's energy has enough power to heat its molecules directly*. See *International Standard Atmosphere*, below.

*The **ozone layer** lies in the middle part of the Stratosphere, about 30 kilometres up (between 11-50 km), where the air absorbs ultraviolet radiation from sunlight, to break the bonds of the two atoms that make up oxygen molecules and allow the creation of molecules with three.

Because the lapse rate stops at the Tropopause, and the temperature begins to increase with altitude, the upward movement of air is damped and all the weather is locked into the Troposphere. The Stratosphere is around 30 km thick on average, with its highest and warmest layer at around 50 km above the Earth's surface. Almost all the remaining 15% of the atmosphere lies within the Stratosphere as, above about 25 km, less than 1% remains.

The International Standard Atmosphere

Because the atmosphere (in terms of temperature, pressure and density) changes almost from minute to minute, we need some sort of model to work with, particularly when the volume of a gas changes so much with pressure. You can only get a true idea of the actual quantity of a gas if the volume it would have under some sort of standard is used.

To make sure that everyone works on the same page, a couple of typical scientists went to a typical place (at 40° N latitude) and took the average year round conditions, part of which turned out to be 1013.25 millibars (29.92" of mercury) and 15° Centigrade, which is 288K. This was adopted as the International Standard Atmosphere, and now everyone who makes altimeters, or whatever, calibrates them with it so that everything is standard. In short, ISA is a standard that provides universal values of temperature, pressure, density and lapse rate, by which others can be compared. It not only covers conditions at sea level, but also variations with altitude, although viscosity has not been standardised. The chief difference between actual and standard air is the presence of water vapour, which is more to do with Meteorology. In the standard atmosphere, ½ sea level pressure is obtained at 18 000', one third at 27 500' and ¼ at 33 700'. Thus, pressure decreases with height, but not linearly, because air is compressible and therefore more dense in the lower layers - a layer 1 hectopascal deep is about equal to 27 feet at sea level - at 3 000 feet, it's 30 feet, or around 90 feet at the heights jets fly at, i.e. 35 000 feet. The greatest rate of change is in the lowest 5000 feet. The sea level pressure on which the standard atmosphere is based relates 1" of mercury to 1,000 feet of altitude, so you would expect to see an altimeter read 1 000 feet less if you set it to 28.92 instead of 29.92 inches.

THE GENERAL GAS LAWS

A gas has three variables - *pressure (altitude)*, *density* and *temperature*, which are all intimately related. For example, if a gas were restrained in a rigid container (so the volume doesn't change), increasing the temperature makes the gas expand and increase the pressure inside, and *vice versa*. If the container were not rigid, the volume could change, and affect the gas's density. Air density affects aircraft performance. Put another way, you can alter the volume of a gas by changing its pressure or temperature, or both.

Temperature

The quantity of heat contained in a substance is a measure of the kinetic energy of the molecules it contains, depending on the temperature, mass and nature of the material concerned. A bucketful of warm water will melt more ice than a cupful of boiling water because it contains more heat, so two bodies containing the same amounts of thermal energy may not have the same temperature, because temperature is a measure of the *quality* of heat (or the rate at which molecules are moving), which means it cannot strictly be measured, but only compared against some form of scale.

Officially, temperature is a measure of the average kinetic energy of air molecules measured in Kelvins (K), or absolute temperature (see overleaf).

Two common ways of measuring temperature are *Fahrenheit* or *Celsius*, and it's a real pain to convert between the two. The quick and easy way is to use a flight computer:

But here are the calculations if you want to show off:

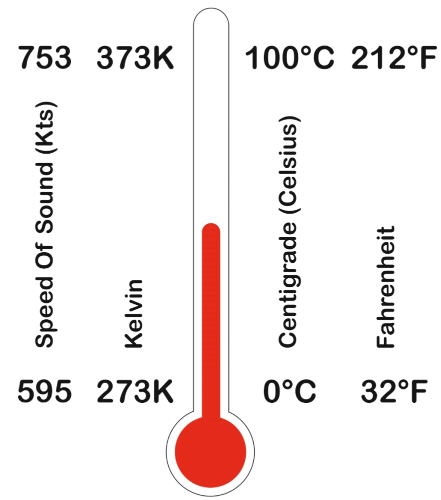
F - C Tc = Tf-32 x $^{5}/_{9}$

C - F Tf = Tc x $^{9}/_{5}$ + 32

They work for any temperatures above freezing. The freezing level (in flight) is where the temperature is 0°C.

16°C is equal to 61°F, 20°C is 68°F and 30°C is 86°F, for gross error checks and quick conversions - however, given the standard of performance charts in the average flight manual, doubling the Celsius figures and adding 30 to get Fahrenheit, or subtracting 30 from Fahrenheit and dividing the remainder in half for Celsius is good enough!

The Fahrenheit scale assumes that water freezes at 32°, and boils at 212° (32° was the coldest possible temperature of an ice-salt mixture. 100° would be the temperature of the human body). Centigrade (which is a modified version of the standard introduced by Anders Celsius in the 1700s), starts at 0° and finishes at 100°, which is more logical, but the scale is coarser (the original started at 100°). As the full range of each is 180 and 100 respectively, we get the $^{9}/_{5}$ fraction.



For each °C of cooling, a gas will reduce volume by $^{1}/_{273}$, which brings us into scientific methods of temperature measurement, in the shape of Kelvins, which don't use a degree sign. -273.15°C is equal to 0 K, or *Absolute*, which is when all molecular motion is supposed to have stopped, and therefore has the least kinetic energy, although this is scientifically impossible and just used for reeference. At this point, there should be zero pressure because the air molecules aren't moving, which is why the absolute temperature is used in the gas equation.

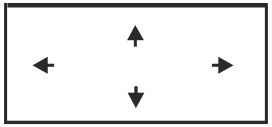
You could also say that 0°C is equal to 273K, from which you can infer that the 1° steps in both scales are the same.

Density

Air density is the mass of air occupying a given volume. It depends on pressure (below), temperature and humidity (water has less mass than air). It is measured in slugs per cubic foot, which are units of mass that accelerate at 1 foot per second when acted on by a force of 1 pound.

Pressure

Pressure is the ratio between an applied force that is perpendicular to a surface and the area of the surface concerned. As it is measured in terms of the force it will produce on an area, it should really be expressed in Newtons (sea level pressure is around 101 kN/m^2), but, for convenience, we use the (incorrect) values for weight, such as kilograms or pounds.



Static pressure (which plays a major part in breathing, lift, drag, and the operation of carburettors, amongst other things) is proportional to air temperature and density. It arises from the average continuous random motion of air molecules. As the random motion involves collisions between them, and they tend to repel each other, the end result is the formation of pressure in all directions.

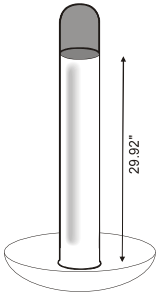
The motions average out at the speed of sound.

Standard atmospheric pressure, or *barometric pressure*, is the weight of the atmosphere at any given point, at sea level. It depends on the number and mass of air molecules (density), and how fast they are moving (temperature).

At a given height, the only thing that stops the air above you falling to the ground is the pressure of the air below you acting upwards, so the total pressure acting on your aircraft is equal to the weight of the air above it.

The weight of a column of air is commonly expressed in one of three ways:

- **Pounds per square inch**. The force that air exerts in pounds over a square inch of a surface - about 14.7 lbs in the standard atmosphere (2116 lbs per square foot).
- **Inches of mercury**. If you fill a tube with mercury (because it is more dense than water and takes up less space), and tip it upside down into a bowl that is also full of mercury, the level in the tube will drop until the force exerted by atmospheric pressure on the mercury in the bowl equals the weight of the mercury in the tube. Atmospheric pressure under standard conditions will hold up a column of mercury that is 29.92 inches long.



- **Hectopascal**. The **Hectopascal** (hPa), which is replacing the millbar, consists of 100 Pascals. 1 millibar is equal to 1 Hectopascal.

The weight of the air in a column that is 1 foot square at sea level is 2116.16 lbs (on a standard day). This pressure surrounds an aircraft from above, below and all around.

That is, the aircraft is being squeezed from all directions at a static pressure of around 2000 lbs per square foot. If you can reduce the pressure above its aerofoils by more than the weight of the aircraft, it will fly, which is what we do mechanically, by moving forward to concentrate the airflow over the top of the wing and bring its streamlines closer together.

Humidity

To function properly, the human body requires a certain amount of humidity, which concerns the amount of invisible water (vapour) contained in a parcel of air. The *absolute humidity* is the actual mass, expressed in grams per cubic metre (i.e. as a volume). For a particular temperature, the *relative humidity* is a measure of how much moisture an air parcel is holding against the maximum it could hold at that temperature (and pressure) or, in other words, the *percentage saturation*, which will *decrease* if the air gets warmer. Thus, the amount of water vapour that air can hold is determined by the temperature.

The Ideal Gas

An ideal (perfect) gas obeys the gas laws. As it happpens, no gas is really ideal, but they are considered to be so in low subsonic flow, at about 30% of the speed of sound.

The *kinetic theory of gases* (from Maxwell, after Bernoulli) states that gases consist of molecules that are in constant motion, on which their properties depend. The *volume* of a gas is the space through which its molecules are free to move. From *Avogadro's Law*, which states that equal volumes of all gases at the same temperature and pressure contain the same number of molecules (assuming you could count them), you can deduce that the same number of molecules should have the same volume.

Contributions to the kinetic theory of gases include:

- **Charles'** Law, from a Frenchman, Jacques Charles, which states that, if the *pressure* remains constant, volume (and density) is very nearly proportional to the *absolute* temperature so, the hotter a gas gets, the more space it takes up, or the more you compress it into a smaller space, the hotter it gets, and *vice versa*. If you double the temperature of a gas, you double its volume. Put another way, equal volumes of different gases expand equally for the same temperature if the pressure is kept constant, with the change in volume being $^1/_{273}$ of its initial volume at 0°C, for each degree change in temperature, up or down, so at -273°C the volume would be zero. This law (which is only approximately true anyway) helped Charles make the first meteorological flight in a balloon, taking a barometer with which to work out his height.

  Thus, if Spain and Iceland have the same pressure, the air in Iceland will be denser.

- **Boyle**, an Irish physicist, discovered that, for a perfect gas*, if *temperature* remains constant (i.e. it is **isothermal**), its volume (and density) varies inversely with its pressure, so if you double the pressure of a gas, you halve its volume. As you climb, and pressure reduces, the volume of the gases within various body cavities, such as the middle ear, sinuses, the gut, lungs and teeth, increases and may cause pain and/or discomfort.

*Only approximately with high pressures. Boyle's and Charles' laws are only accurate in small ranges.

If it's 25°C all over Spain, the air density will be lower in the mountains than it is on the beach.

- **Dalton** says that the total pressure of a mixture of gases is the same as the sum of the *partial pressures* exerted by each of the gases in the mixture, assuming they don't react chemically with each other, which is relevant for oxygen. In other words, each gas's pressure contributes a part of the total according to its constituent proportion, or exerts the same pressure that it would do on its own, and the total pressure of the mixture is equal to their sum. This allows meteorologists to figure out how much water vapour there is in a given parcel of air - if they know the makeup of a gas on the ground, they can calculate the amounts for any altitude.

So, after Dalton, if the pressure at a certain altitude were 986 hectopascals, the pressure from oxygen would be 21% of 986, or 207 hPa. An average set of lungs absorbs oxygen at a partial pressure of 3 psi, which is well enough to saturate the blood. The overall and partial pressures of the gases in the atmosphere *decrease* with increasing altitude.

- **Gay-Lussac's Law** states that equal increases in temperature result in equal increases in pressure if the *volume* is kept constant.

When everything changes at once, you must use Boyle's and Charles' laws, in that order. By adding Gay-Lussac and Avogadro to the mix, you can get a single expression called the *General Gas Law* (also known as the *Equation of State*), which connects temperature, pressure and density like this:

```
p = RT?
```

ρ is the density, *T* the absolute temperature and *p* the pressure. *R* is a constant that depends on the gas (2.87 for dry air). The constant doesn't change, of course (unless you change the gas), and if temperature stays the same, pressure is proportional to density* - because you are increasing pressure by cramming more molecules into a smaller space, density automatically increases. If pressure stays the same, an increase in temperature reduces the density. So you can calculate density if you know the pressure and temperature.

*If density remains constant, pressure and temperature are directly proportional.

The formula could also arise this way:

```
PV = RT
```

NEWTON'S LAWS

Aside from inventing the catflap (true!), Sir Isaac Newton (influenced by Kepler and Galileo, amongst others), formulated three laws of motion that govern material bodies, which are also relevant to flight:

The First Law

In the absence of an unbalanced force, *an object at rest (or in motion) will remain at rest (or in motion at that velocity) until acted upon by an external force,* otherwise known as **Inertia**. Or, if you want the original version:

> *"Every body perseveres in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed thereon"*

As first presented by Galileo, a body will continue to move with a constant velocity unless a force is applied to it, as bodies have a natural tendency to maintain their current state of motion. However, Newton defined it as the natural tendency of bodies to move in a straight line at a constant speed. This is often called *inertial motion*. It is a force resisting change that gives a body the tendency to remain at rest, or carry on with what it's doing - in other words, not to change its present state, or to maintain a constant velocity, and be hard to get moving (but see *Momentum*, below, about stopping). To do its work, air must possess the property of inertia.

Inertia should not be confused with Momentum, as even bodies at rest have inertia. Both can add stress to the materials used in aircraft, as found with wings that flex on takeoff or landing.

When mass changes, inertia changes, too, as it is proportional to mass.

Put more simply, an object in a steady state is neither accelerating nor decelerating (although it might be moving) and you must apply a force to make it move or change direction (or if you observe an acceleration, there must be a force behind it). As air has mass, it is capable of applying force, which becomes a problem at the speed of sound because the air compresses so much that it behaves like a brick wall, which is a force in anyone's language.

Momentum is the quantity of motion in a body, or its resistance to being brought to rest. Also called *impetus*, it is complementary to inertia, signified by the letter p.

As it is a vector quantity, momentum concerns the *velocity* of a body as well as its mass, so the formula *mass x velocity* denotes how much is moving and how fast (only bodies with velocity can have momentum). If either mass or velocity increase, the momentum increases and you need a bigger force to change the body's state of motion. Any change in momentum is proportional to the size of the forces involved - a bullet and a steamroller may have similar momenta, but they have different masses and speeds. For example, a heavy aircraft taxying at a high rate of knots requires more power to stop than if it were going at walking pace. You could also use a relatively small force for a longer time. This is particularly important when handling large aircraft, in that you cannot change the flight path so easily, and cannot afford to wait until a situation has developed before you do something about it. In fact, you almost have to correct things before they happen, for which you need anticipation otherwise the machine will run away from you.

The Second Law

The rate of change of motion (of a body) [acceleration] *is directly proportional to the force acting on it, along its line of action, inversely proportional to the body's mass.* Put more precisely, when a body is made to change its state, its acceleration is proportional to, and in the direction of, the applied force. This is the basis for the discussion of load factors, later.

Acceleration is the rate of change of motion in speed and/or direction (velocity), divided by time. If you change one or the other, or both, an object is accelerating, as with a turning aircraft affected by centripetal force.

> Although the word *acceleration* refers to any change in velocity, *deceleration* also indicates a decrease. As velocity is involved, both can be represented as a vector.

Force and mass are related, in that doubling both produces the same value of acceleration. Doubling force doubles acceleration if mass stays the same, and doubling mass for the same force halves acceleration, which therefore depends on force divided by mass (force is proportional to mass multiplied by acceleration). As force is measured in *newtons* (kgm/s^{2}), represented by the letter *F*, if 30 newtons is applied to a mass of 10 kg, the acceleration is 30 divided by 10*, or 3 m/s^2.

*On the surface of the Earth, a mass of 1 kg experiences a gravitational attraction of about 9.81 newtons, usually rounded to 10. 1 newton is the force that makes a mass of 1 kg accelerate at 1 m per second per second.

A *slug* is a unit of *mass* that accelerates at 1 ft/sec when acted on by a force of 1 pound. It is found by dividing the weight of an object by the acceleration from gravity (32 ft/sec^2) so, if you weighed 128.8 lbs, you would have a mass of 4 slugs.

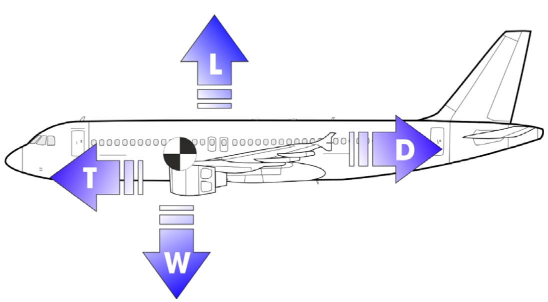
The density of the air at sea level is 0.002378 slugs per cubic foot. At 10,000 feet, it is 0.001756, as the air density has only ¾ of the sea level value, so a correction must be made to find the True Airspeed at that level.

The Third Law

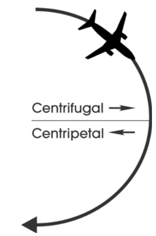
If one body exerts a force on another body, the second body will exert an equal and opposite force on the first body, popularised as: *For every action, there is an equal* *and opposite reaction*. This law is made use of by propellers and jet engines to drive aeroplanes (and autogyros) forward.

Force is a dynamic influence that changes a body's state of rest to one of motion, or changes its rate of motion. In simple terms, a push (the only forces that truly pull are gravity, magnetism and electrical attraction, and even gravity is suspect these days). It is equal to *mass x acceleration* (f=m.a). In studying the principles of flight, we are looking at how accelerating a mass (of air) produces a reaction force called Lift that overcomes gravity, or Weight. In this respect, we are interested in its speed and density. The speed concerns kinetic energy, or the additional (dynamic) pressure that is there because the air is moving. However, it is the differences in static pressure that give us lift (and drag), as we shall see later.

In fact, four forces act on an aircraft in flight, called *Lift*, *Weight*, *Thrust* and *Drag*.



For now, lift makes a flying machine go up, weight makes it go down, thrust makes it go forward, and drag tries to stop it. Creating an imbalance between them is what makes an aircraft go in one direction or another.



- **Centrifugal Force**. Under Newton's first law, a moving body will travel along a straight path (with constant velocity) unless a force acts on it from the outside. With circular motion, the constant force pushing a body to the centre is *centripetal force*, inwards along the radius of a curve. It is an accelerating force, as it affects velocity in terms of its line of direction, and is proportional to the body's mass.

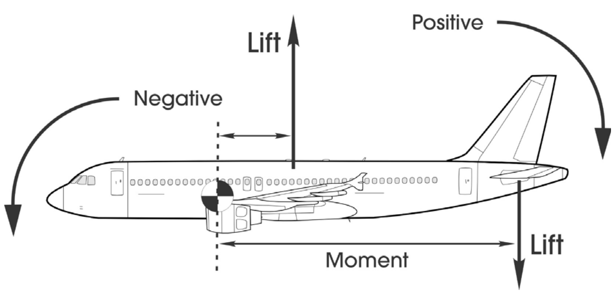
  However, under Newton's third law the opposite reaction is *centrifugal force*, which is a fictitious one acting *outwards* (it is called a reaction force as it is only there as a reaction to centripetal force). It increases with *mass*, the *square of rotational speed,* and the *distance from the axis,* as shown here.

  $$\frac{m \times V^2}{r}$$

  Centrifugal force is inversely proportional to the radius of the curve, so the smaller a curve is, the more influence centrifugal force has.

Being fictitious, centrifugal force does not act on the body in motion - the only one actually involved is centripetal force. It is the *removal* of centripetal force that allows a blade to fly from a propeller hub when it is released, not the application of centrifugal force.

- A **couple** is a combination of two equal, parallel and opposite forces that produces a rotation. In the picture above, the combination of Lift and Weight produces a couple that creates a nose down attitude. The *moment* of a couple is one of its forces multiplied by the distance between them both.
- A **moment** is the turning effect of a force about a point, in foot-pounds or newton-metres. **Torque** is similar, but is a continuous force in one direction, applied at a distance from a centre of rotation.



The size of a moment arises from the force involved multiplied by the distance from the point concerned to the line of action of the force. In the picture above, the two lift values are different, yet they balance because of their relative distances from the Centre of Gravity. Clockwise movement is positive, because it involves a nose-up pitching moment, and anticlockwise is negative.

- **Equilibrium** is state of balance between forces, where the sum of the clockwise moments is equal to that of anticlockwise moments (zero acceleration), as with straight and level flight.

Forces may be in balance, but not in equilibrium, as in a turn with a constant bank angle (where you are accelerating).

GLOSSARY

G

This bit contains the definitions, abbreviations and acronyms required by the EASA learning objectives (particularly for the Air Law syllabus) for ICAO Documents 8168 & 4444, Annex 11, Annex 13, Part FCL and EASA Regulation (EU) No 965/2012, plus others required for other subjects and around the world.

Most of them are explained in the study notes as the text progresses anyway.

DEFINITIONS

Abortive Start
An attempt to start, where the (turbine) engine lights up, but fails to accelerate, assuming its handling is under manufacturer's instructions!

Absorbent material
Material that absorbs liquid from dangerous goods should it leak from inner packaging, and will not react.

Absolute Ceiling
Where ROC is theoretically zero.

Absolute Minima
A theoretical value, calculated according to the approach and facilities available at the aerodrome, which will be equal to or less than the specified operating RVR for a category A aircraft carrying out that instrument approach.

ACAS
See *Airborne Collision Avoidance System*.

ACARS
Aircraft Communications Addressing and Reporting System. An onboard, computerised communications system that provides a digital, voiceless datalink between aircraft and their operating companies using VHF radios. It is typically linked to the FMC, so flight plans can be uploaded easily (takeoff parameters are typically transmitted en route to the runway, and clearances can also be transmitted).

ACC
Area Control Centre or *Area Control*.

Accelerate-Stop Distance Available (ASDA)
The length of the takeoff run available plus the length of stopway, if declared available and capable of bearing the mass of an aeroplane under the prevailing conditions.

Acceptable Means of Compliance (AMC)
Non-binding standards adopted by the Agency to illustrate means to establish compliance with Regulation (EC) No 216/2008 and its Implementing Rules.

Acceptance Check List
A document used to help with checking the external appearance of dangerous goods packages and associated documents to determine that requirements have been met.

Accepted/Acceptable
Not objected to for the purpose intended.

Accepting Unit
The ATC unit next to take control of an aircraft.

Accident
An occurrence associated with the operation of an aircraft which, in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, or in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until such time it comes to rest at the end of the flight and the primary propulsion system is shut down, in which:

- a person is fatally or seriously injured as a result of:
  - being in the aircraft, or
  - direct contact with any part of the aircraft, including parts which have become detached from the aircraft, or
  - direct exposure to jet blast

  except when the injuries are from natural causes, self-inflicted or by other persons, or when the injuries are to stowaways hiding outside the areas normally available to the passengers and crew, or
- the aircraft sustains damage or structural failure which:
  - adversely affects the structural strength, performance or flight characteristics of the aircraft, and
  - would normally require major repair or replacement of the affected component,

  except for engine failure or damage, when the damage is limited to a single engine, (including its cowlings or accessories), to propellers, wing tips, antennas, probes, vanes, tires, brakes, wheels, fairings, panels, landing gear, doors, windscreens, the aircraft skin (such as small dents or puncture holes), or for minor damages to main rotor blades, tail rotor blades, landing gear, and those resulting from hail or bird strike (including holes in the radome); or

- the aircraft is missing or is completely inaccessible.

For statistical uniformity only, an injury resulting in death within thirty days of the date of the accident is classified, by ICAO, as a fatal injury. An aircraft is considered to be missing when the official search has been terminated and the wreckage has not been located. The type of unmanned aircraft system to be investigated is addressed in Annex 13, 5.1. Guidance for the determination of aircraft damage can be found in Annex 13, Attachment G.

Accountable Manager
The person acceptable to the Authority with corporate authority for ensuring that operations and maintenance can be financed and carried out to standards required.

Accredited Representative
Persons designated by a State, on the basis of their qualifications, for the purpose of participating in a safety investigation conducted by another State. An accredited representative designated by a Member State shall be from a safety investigation authority.

Accuracy
A degree of conformance between the estimated or measured value and the true value. For measured positional data the accuracy is normally expressed in terms of a distance from a stated position within which there is a defined confidence of the true position falling.

AD
Aeronautical Directive. A notice that requires a mandatory maintenance action to be carried out before the aircraft flies again (also Airworthiness Directive).

Adequate Aerodrome
One on which an aircraft can be operated, taking account of performance requirements and runway characteristics.

ADF
Automatic Direction Finding Equipment.

ADR
Advisory Route.

ADS-B

Automatic Dependent Surveillance Broadcast is a transponder based system that generates radar-like displays for pilots and controllers that show traffic, weather and terrain in real time. It is an advisory system that does not replace TCAS, but is useful for situations where nothing else would even be available.

ADS-C Agreement

A reporting plan which establishes the conditions of ADS-C data reporting (i.e. data required by the ATS unit and frequency of ADS-C reports which have to be agreed to prior to using ADS-C in the provision of ATC services). The terms of the agreement will be exchanged between the ground system and the aircraft by means of a contract, or a series of contracts.

Adult

A person aged 12 years and above.

Advance Ratio

The forward speed of the helicopter as a fraction of the tip speed of the blades, typically ranging from 0 to about 0.5.

Adviser

Persons appointed by a State, on the basis of their qualifications, for the purpose of assisting its accredited representative in a safety investigation.

Advisory Airspace

An airspace of defined dimensions, or designated route, within which air traffic advisory service is available.

Advisory Area

A designated area where air traffic advisory service is available.

Advisory Route

A designated route along which ATC advisory service is available.

Aerial Application

The seeding, or the spraying or dusting of chemicals from an aircraft, or any other operation of a similar nature.

Aerial inspection

Inspection from an aircraft of crops, forests, livestock or wildlife, patrolling of pipelines or power lines, etc.

Aerial work

A commercial air service, not for air transport or flight training. Where an aircraft is used for specialised services such as agriculture, construction, photography, surveying, observation and patrol, search and rescue, aerial advertising, etc. In other words, not carrying passengers in the normal fare-paying sense, although up to 6 "essential persons" may be carried to, during and from a job.

Aerial Work Aircraft
An aircraft (not public transport) flying for aerial work.

Aerial Work Undertaking
An undertaking whose business includes aerial work.

Aerial Sightseeing Flight
One that is part of a sightseeing operation or any other commercial flight conducted for sightseeing from the air.

Aerobatic Flight
Intentional manoeuvres involving abrupt changes in aircraft attitude, an abnormal attitude, or abnormal acceleration, not necessary for normal flight or instruction for licences or ratings other than the aerobatic rating.

Aerobatic Manoeuvres
Include loops, spins, rolls, bunts, stall turns, inverted flying, etc., usually with a change of bank greater than 60°, an abnormal attitude or acceleration not incidental to normal flying.

Aerodrome
A defined area of land or water designed, equipped, set apart or commonly used for the landing and departure of aircraft (including vertically), assuming it has not been abandoned. Alternatively, a defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft. This also includes sites other than aerodromes which may be used by certain types of aircraft, e.g. helicopters or balloons.

Aerodrome Control Service
An air traffic control service for aircraft on the manoeuvring area or apron of an aerodrome where the service is being provided, or which is flying in, or near, the aerodrome traffic zone by visual reference to the surface (TC). More simply, from ICAO, an air traffic control service for aerodrome traffic.

Aerodrome Control Tower
A unit that provides ATC service to aerodrome traffic.

Aerodrome Flight Information Service (AFIS)
A flight information service for aerodrome traffic.

Aerodrome Elevation
The elevation of the highest point of the landing area.

Aerodrome Operating Minima

The limits of usability of an aerodrome for:

- takeoff, expressed in terms of runway visual range (RVR) and/or visibility and, if necessary, ceiling.
- landing in 2D instrument approach operations, expressed in terms of visibility and/or RVR, minimum descent altitude/height (MDA/H) and, if necessary, ceiling.
- landing in 3D instrument approach operations, expressed in terms of visibility and/or RVR and decision altitude/height (DA/H) as appropriate to the type and/or category of the operation.

Aerodrome Traffic

That on the movement area of an aerodrome and aircraft flying in its vicinity (when in, entering or leaving an aerodrome traffic circuit).

Aerodrome Traffic Circuit

The specified path to be flown by aircraft operating in the vicinity of an aerodrome.

Aerodrome Traffic Zone

A 2 nm circular airspace round an aerodrome notified for rule 39, unless within that of a controlling aerodrome, with the longest runway less than 1850 metres, from the surface to 2000 ft agl or msl when offshore. If the longest runway is greater than 1850 metres, the radius of the circle becomes 2.5 nm. Offshore, it is 1.5 nm.

Aeronautical Beacon

An aeronautical ground light that designates a point on the surface of the Earth.

Aeronautical Fixed Service (AFS)

A telecommunication service between fixed points provided primarily for the safety of air navigation and the regular, efficient and economical operation of air services.

Aeronautical Fixed Station

A station in the aeronautical fixed service.

Aeronautical Ground Light

A light provided as an aid to air navigation, other than one on an aircraft.

Aeronautical Information Publication (AIP)

A publication issued by or with the authority of a State and containing aeronautical information of a lasting character essential to air navigation.

Aeronautical Mobile Service
A mobile service between aeronautical stations and aircraft stations, or between aircraft stations, in which survival craft stations may participate; emergency position-indicating radio beacon stations may also participate in this service on designated distress and emergency frequencies.

Aeronautical Radio Station
A radio station on the surface, transmitting or receiving signals to assist aircraft.

Aeronautical Station
A *land* station in the aeronautical mobile service, that is, a transmitting or receiving node, on land, a ship or a platform at sea, or a satellite (one would logically include *in the air*, but it would appear not). Normally, control is exercised by the ground station (meaning that you must do what they tell you), except for distress calls, which are controlled by the station initiating the call. Between aircraft, the one *called* has control.

Aeronautical Telecommunication Station
A station in the aeronautical telecommunication service.

Aeroplane
According to ICAO, "a power driven heavier-than-air aircraft, deriving its lift in flight chiefly from aerodynamic reactions on surfaces which remain fixed under given conditions of flight". EASA says: "A heavier-than-air engine-driven fixed-wing aircraft supported in flight by the dynamic reaction of air against its wings."

Aeroplane Required To Be Operated With A Co-pilot
A type of aeroplane which is required to be operated with a co-pilot as specified in the flight manual or by the air operator certificate.

Aided Night Vision Imaging System (NVIS) Flight
In the case of NVIS operations, that portion of a visual flight rules (VFR) flight performed at night when a crew member is using night vision goggles (NVG).

AFIS
Aerodrome Flight Information Service.

AGL
Above Ground Level.

AIP
Aeronautical Information Publication.

AIRAC
Aeronautical Information Regulation And Control.

Airborne
Entirely supported by aerodynamic forces.

Airborne Collision Avoidance System (ACAS)
An aircraft system based on (SSR) transponder signals which operates independently of ground-based equipment to provide advice to the pilot on potential conflicting aircraft that are equipped with SSR transponders.

Air Carrier
Any person operating a commercial air service.

Aircraft
A machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface.

Aircraft Address
A unique combination of 24 bits available for assignment to an aircraft for the purpose of air-ground communications, navigation and surveillance.

Aircraft Identification
A group of letters, figures or a combination thereof which is either identical to, or the coded equivalent of, the aircraft call sign to be used in air-ground communications, and which is used to identify the aircraft in ground-ground air traffic services communications.

Aircraft Identification Plate
A fireproof plate that identifies an aircraft as a whole.

Aircraft Observation
The evaluation of one or more meteorological elements made from an aircraft in flight.

Aircraft Proximity
A situation in which, in the opinion of a pilot or air traffic services personnel, the distance between aircraft as well as their relative positions and speed have been such that the safety of the aircraft involved may have been compromised. Proximities are classified as:

- *Risk of collision*. The risk classification in which serious risk of collision has existed.
- *Safety not assured*. The risk classification of an aircraft proximity in which the safety of the aircraft may have been compromised.
- *No risk of collision*. The classification of an aircraft proximity in which no risk of collision has existed.

Aircraft Security Check
An inspection of the interior of an aircraft to which passengers may have had access and an inspection of the hold for the purposes of discovering suspicious objects, weapons, explosives or other dangerous devices, articles and substances.

Aircraft Stand
Part of an apron for parking aircraft.

Aircraft Station
A mobile station in the aeronautical mobile service on board an aircraft.

Aircraft Tracking
A ground based process that maintains and updates, at standardised intervals, a record of the four dimensional position of individual aircraft in flight.

Aircraft Tracking System
One that relies on aircraft tracking in order to identify abnormal flight behaviour and provide alerts.

Aircraft Variant
The same basic type, with modifications not causing significant changes in handling or flight characteristics, or crew complement, but still causing significant changes to equipment and/or procedures.

Airframe
The fuselage, booms, nacelles, cowlings, fairings, aerofoil surfaces (including rotors but not propellers and rotating engine aerofoils), and landing gear, and their accessories and controls.

Air-Ground Communication
2-way simplex communications between aircraft and stations or locations on the surface of the Earth.

Air/Ground Communication Service
One provided from an aerodrome to give information to pilots of aircraft flying near it by means of radio signals. The term *air/ground communications service unit* shall be construed accordingly (ANO).

Airmanship
The consistent use of good judgment and well-developed knowledge, skills and attitudes to accomplish flight objectives.

AIRMET Information
Information issued by a meteorological watch office concerning the occurrence or expected occurrence of specified en-route weather phenomena which may affect the safety of low-level aircraft operations and which was not already included in the forecast issued for low-level flights in the flight information region concerned or sub-area thereof.

Air Operator
The holder of an Air Operator Certificate.

Air Operator Certificate
A certificate issued by the Authorities that authorizes its holder to operate a commercial air service.

AIRPROX
A situation in which, in the opinion of a pilot or controller, the distance between aircraft as well as their relative positions and speed have been such that the safety of the aircraft involved was or may have been compromised.

Air Report
A report from an aircraft in flight prepared in conformity with requirements for position, and operational and/or meteorological reporting.

Airship
A power-driven, lighter-than-air aircraft, not including hot-air airships which, for the purposes of this (EASA) Part, are included in the definition of balloon.

Air Show
An aerial display or demonstration before an invited assembly of people by one or more aircraft.

Airspace Reservation
A defined volume of airspace that, by agreement between appropriate ATS authorities and requesting agencies, is temporarily reserved for exclusive use by an agency.

Air-Taxiing
Movement of a helicopter/VTOL above the surface of an aerodrome, normally in ground effect and at a ground speed normally less than 37 km/h (20 kt). The actual height may vary, and some helicopters may require air-taxiing above 8 m (25 ft) AGL to reduce ground effect turbulence or provide clearance for cargo sling loads.

Air Time
For technical records, the time from when an aircraft leaves the surface until it comes into contact with it again at the next point of landing.

Air Traffic
All aircraft in flight or operating on the manoeuvring area of an aerodrome.

Air Traffic Advisory Service
A service provided within advisory airspace to ensure separation, in so far as practical, between aircraft which are operating on IFR flight plans.

Air Traffic Control Clearance
Authorisation for an aircraft to proceed under conditions specified by an air traffic control unit. For convenience, the term *air traffic control clearance* is frequently abbreviated to *clearance* when used in appropriate contexts. It may be prefixed by words such as *taxi*,

takeoff, *departure*, *en route, approach* or *landing* to indicate the particular portion of flight to which the air traffic control clearance relates.

Air Traffic Control Instruction
Directives issued by air traffic control for the purpose of requiring a pilot to take a specific action.

Air Traffic Control Service
A service provided for the purpose of:

- preventing collisions:
    - between aircraft, and
    - on the manoeuvring area between aircraft and obstructions
- expediting and maintaining orderly flows of traffic

Air Traffic Control Unit
A generic term meaning variously, area control centre, approach control unit or aerodrome control tower. Alternatively, a person appointed by the authorities or anyone else maintaining an aerodrome or place, to give instructions, advice or information by radio to aircraft in the interests of safety, but not including flight information service officers.

Air Traffic Flow Management (ATFM)
A service established to contribute to a safe, orderly and expeditious flow of air traffic by ensuring that ATC capacity is utilized to the maximum extent possible and that the traffic volume is compatible with the capacities declared by the appropriate ATS authority.

Air Traffic Management (ATM)
The dynamic, integrated management of air traffic and airspace including air traffic services, airspace management and air traffic flow management, safely, economically and efficiently, through the provision of facilities and seamless services in collaboration with all parties involving airborne and ground-based functions.

Air Traffic Management System
A system that provides ATM through the collaborative integration of humans, information, technology, facilities and services, supported by air and ground- and/or space-based communications, navigation and surveillance.

Air Traffic Service
A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or aerodrome control service).

Air Traffic Services Airspaces
Airspaces of defined dimensions, alphabetically designated, within which specific types of flights may operate and for which air traffic services and rules of operation are specified. ATS airspaces are classified as Class A to G as described in 2.6.

Air Traffic Services Reporting Office.
A unit established for the purpose of receiving reports concerning air traffic services and flight plans submitted before departure. An ATS reporting office may be a separate unit or combined with an existing unit, such as another air traffic services unit, or a unit of the aeronautical information service.

Air Traffic Services Unit
A generic term meaning variously, air traffic control unit, flight information centre or ATS reporting office.

Airway
A control area or portion thereof established in the form of a corridor.

Air Transport Undertaking
One whose business includes flights for public transport of passengers or cargo.

ALERFA
The code word used to designate an alert phase.

Alerting Service
One provided to notify appropriate organizations regarding aircraft in need of search and rescue aid, and assist such organizations as required.

Alert Phase
A situation wherein apprehension exists as to the safety of an aircraft and its occupants.

Allocation, Allocate
Distribution of frequencies, SSR codes, etc. to a State, unit or service. Distribution of 24-bit aircraft addresses to a State or common mark registering authority.

Alphanumeric Characters (Alphanumerics)
A collective term for letters and figures (digits).

Alternate Aerodrome
An adequate aerodrome to which an aircraft may proceed when it becomes either impossible or inadvisable to proceed to or land at the aerodrome of intended landing, where the necessary services and facilities are available, where aircraft performance requirements can be met, and which is operational at the expected time of use:

- **Takeoff alternate**. An alternate aerodrome at which an aircraft would be able to land if it becomes necessary shortly after takeoff and it is not possible to use the aerodrome of departure.
- **En route alternate (ERA)**. An alternate aerodrome at which an aircraft would be able to land if a diversion becomes necessary while en route. A fuel/energy en route alternate is an ERA aerodrome that is required at the planning stage for use in the calculation of fuel/energy.
- **Destination alternate**. One at which an aircraft would be able to land if it becomes either impossible or inadvisable to land at the aerodrome of intended landing.

Along-Track Tolerance (ATT)
A fix tolerance along the nominal track resulting from the airborne and ground equipment tolerances.

Alternate Airport
Where an aircraft may land if a landing at the intended airport becomes inadvisable.

Alternative Means of Compliance
Those means that propose an alternative to an existing acceptable means of compliance or those that propose new means to establish compliance with Regulation (EC) No 216/2008 and its Implementing Rules for which no associated AMC have been adopted by the Agency.

Altitude
The vertical distance of a level, point or object considered as a point, measured from mean sea level (MSL).

Air Traffic Control Clearance
Authorization for an aircraft to proceed under conditions specified by an air traffic control unit. For convenience, the term air traffic control clearance may be abbreviated to clearance when used in appropriate contexts.

Airworthy
With regard to an aeronautical product, in a fit and safe state for flight, as per its type design.

AIS
Aeronautical Information Service.

All-Engines-Operating Takeoff Distance
That from the start of the takeoff roll to when an aeroplane reaches the height above the runway elevation in the basis of its certification.

All-Engines-Operating Takeoff Run
That from the start of the take-off roll to midway between the lift-off point and the end of the all-engines-operating take-off distance (see above).

Alternate Aerodrome
One to which a flight may proceed when landing at the destination is inadvisable or impossible. This could be a takeoff, enroute or destination alternate.

Altitude
The vertical distance of a level or a point, measured from mean sea level. It is represented by the QNH.

AMSL
Above Mean Sea Level.

Angular Operation
An instrument approach operation in which the maximum tolerable error/deviation from the planned track is expressed in terms of deflection of the needles on the Course Deviation Indicator (CDI) or equivalent display in the cockpit.

Anti-Icing
In the case of ground procedures, a procedure that provides protection against the formation of frost or ice and accumulation of snow on treated surfaces of the aircraft for a limited period of time (hold-over time).

Also the process of protecting an aircraft to prevent contamination due to existing or expected weather, typically by applying anti-icing fluids on uncontaminated aircraft surfaces.

Anti-Icing Fluid
Includes, but is not limited to typically, Type II, III or IV fluid (neat or diluted), normally unheated (when de-icing and anti-icing in a one-step process, Type II and Type IV fluids are typically applied diluted and heated) or Type I fluid/water mixture heated to at least 60°C at the nozzle.

Annual costs
An estimate for the year beginning the previous 1st of January, of the costs of keeping, maintaining and operating the aircraft, excluding direct costs and those incurred without a view to profit.

Annual Flying Hours
An estimate of the hours flown, or to be flown, by an aircraft from the previous 1st of January.

Appliance
Any instrument, mechanism, equipment, part, apparatus, appurtenance, accessory, including communications equipment, used or intended for operating or controlling an aircraft in flight, installed in or attached to it, and not part of an airframe, engine, or propeller.

Applicant
Someone after the approval of aircraft, parts, licence, etc.

Approach Control Service
An ATC service for aircraft not receiving an aerodrome control service, that is nevertheless flying in, or near an aerodrome traffic zone, whether or not with visual reference. Alternatively, air traffic control service for arriving or departing controlled flights.

Approach Control Unit
A unit established to provide ATC services to controlled flights arriving at, or departing from, aerodromes.

Approach Sequence
The order in which two or more aircraft are cleared to approach to land at the aerodrome.

Approach To Landing
That portion of a flight below 1000 ft above the relevant DH or MDH.

Appropriate Aeronautical Radio Station
One serving an area in which an aircraft is for now.

Appropriate Air Traffic Control Unit
Either that serving the area where an aircraft is, or the area it intends to enter and with which it must communicate before entering.

Appropriate Authority
With regard to flight over the high seas, the relevant authority of the State of Registry. Otherwise, the relevant authority of the State having sovereignty over the territory being overflown.

Appropriate ATS Authority
The relevant authority designated by the State responsible for providing air traffic services in the airspace concerned.

Approved
Compliance with the applicable JTSO has been demonstrated, or relevant airworthiness standards where one does not exist. Accepted by a Contracting State as being suitable for a particular purpose.

Approved By The Authority
Documented as suitable for the purpose intended.

Apron
Part of a land aerodrome for accommodating aircraft for loading and unloading passengers, cargo, fuelling, parking or maintenance. Also a defined area, on a land aerodrome, intended to accommodate aircraft for purposes of loading or unloading passengers, mail or cargo, fuelling, parking or maintenance.

Apron Management Service
One provided to regulate the activities and the movement of aircraft and vehicles on an apron.

APU
Auxiliary power unit. Any power unit delivering rotating shaft power or compressed air, or both, not intended for direct propulsion of an aircraft.

Area Control Centre (ACC)
An air traffic control unit providing an area control service to aircraft within a notified flight information region, not receiving an aerodrome control or approach control service. Also a unit established to provide air traffic control service to controlled flights in control areas under its jurisdiction.

Area Control Service
An air traffic control service for aircraft not flying in or near an aerodrome traffic zone except for one notified as being subject to an area control service. Also, an air traffic control service for controlled flights in control areas.

Area Minimum Altitude (AMA)
The lowest altitude to he used under instrument meteorological conditions (IMC) that will provide a minimum vertical clearance of 300 m (1 000 ft) or in designated mountainous terrain 600 m (2 000 ft) above all obstacles in the area specified, rounded up to the nearest (next higher) 30 m (100 ft). In the exact calculation 984 feet can be used as an equivalent to 300 metres.

Area Navigation (RNAV)
A method of navigation which permits aircraft operation on any desired flight path within the coverage of station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination.

Area navigation includes performance-based navigation as well as other operations that do not meet the definition.

Area Navigation Equipment
Equipment on an aircraft enabling it to navigate on any desired flight path in the coverage of appropriate ground-based navigation aids, or within the limits of that equipment, or a combination of the two.

Area Navigation Route
One established for the use of aircraft capable of employing area navigation.

ASHTAM
A NOTAM referring to Volcanic Ash.

ASL
Above Sea Level.

Assignment, Assign
Distribution of frequencies to stations. Distribution of SSR codes or 24-bit aircraft addresses to aircraft.

ATC
Air Traffic Control (in general).

ATC clearance
An authorization from ATC authorizing an aircraft to proceed within controlled airspace under conditions specified. If it is not suitable, you may request and, if practicable, obtain an amended one.

ATC instruction
A directive from an ATC unit for ATC purposes.

ATD
Actual Time of Departure.

ATIS
See *Aeronautical Terminal Information Service*.

Atmosphere, International Standard
As defined in ICAO Document 7488/2, but for JAR purposes, the following is acceptable:

- The air is a perfect dry gas.
- The temperature at sea-level is 15°C.
- The pressure at sea-level is 1.013250 x l05 Pa (29.92 in Hg) (1013.25 hPa).
- The temperature gradient from sea level to where it becomes -565°C is 3.25°C/500 m (1.98°C/l000 ft).
- The density at sea level, under the above conditions is 1.2250 kg/m3 (0.002378 slugs/ft3).

ATS
Air Traffic Services.

ATS Route
A specified route designed for channelling the flow of traffic as necessary for the provision of air traffic services.

The term is used to mean variously, airway, advisory route, controlled or uncontrolled route, arrival or departure route, etc. An ATS route is defined by route specifications which include an ATS route designator, the track to or from significant points (waypoints), distance between significant points, reporting requirements and, as determined by the appropriate ATS authority, the lowest safe altitude.

ATS Surveillance Service
A term used to indicate a service provided directly by means of an ATS surveillance system.

ATS Surveillance System
A generic term meaning variously, ADS-B, PSR, SSR or any comparable ground-based system that enables the identification of aircraft. A comparable ground-based system is one that has been demonstrated, by comparative assessment or other methodology, to have a level of safety and performance equal to or better than monopulse SSR.

Authority
The competent body responsible for the safety regulation of Civil Aviation.

ATZ
Aerodrome Traffic Zone.

Authorised Person
Any constable, or person authorised by the Secretary of State (article 118), or the CAA.

Auto-Flight System (AFS)
The combination of autopilot, autothrottle/autothrust, flight director, autoland systems etc. used to control the flight through the Flight Management System (FMS).

Autoland
An autopilot function that enables the aircraft to be landed automatically.

Automatic Dependent Surveillance — Broadcast
ADS-B is a means by which aircraft, aerodrome vehicles and other objects can automatically transmit and/or receive data such as identification, position and additional data, as appropriate, in a broadcast mode via a data link.

Automatic Dependent Surveillance — Contract
ADS-C is a means by which the terms of an ADS-C agreement will be exchanged between the ground system and the aircraft, via a data link, specifying under what conditions ADS-C reports would be initiated, and what data would be contained in the reports. The abbreviated term ADS Contract is commonly used to refer to ADS event contract, ADS demand contract, ADS periodic contract or an emergency mode.

Automatic Terminal Information Service (ATIS)

The automatic provision of current, routine information to arriving and departing aircraft throughout 24 hours or a specified portion thereof:

- Datalink-Automatic Terminal Information Service (D-ATIS). The provision of ATIS via data link.
- Voice-Automatic Terminal Information Service (Voice-ATIS). The provision of ATIS by continuous and repetitive voice broadcasts, mostly broadcast on VHF, sometimes on VOR and even on NDB. This is done over a discrete frequency (e.g. the VOR), and the contents include:
    - Wind direction and speed, variations thereof
    - Visibility
    - Present weather
    - Cloud amount and type
    - Temperature and dew point
    - Pressure values (QNH/QFE)
    - Other information (warnings, etc.)

Automatic Direction Finder (ADF)

A flight instrument that indicates the direction from which a signal from a non-directional beacon is coming, i.e. a relative bearing.

Autopilot (AP)

A computerised system that commands the flight controls.

Autorotation

Flight with the lifting rotor driven entirely by action of the air when a rotorcraft is in motion.

Autothrottle

An automatic engine power control system.

Autothrust

A computerised system that commands the engines.

Auxiliary Power Unit

The APU is a turbine engine that delivers power or compressed air, and is not intended for direct propulsion. In other words, it's a spare engine that runs the air and electrical systems when the aircraft is on the ground, or in emergency when in flight, through a gearbox or something. It saves you relying on ground power units. Sometimes, you can use the APU to power air conditioning, etc., so the main engines can give a little extra if you are heavy.

Auxiliary Rotor

A rotor that principally serves to counteract the effect of main rotor torque on a rotorcraft and/or to manoeuvre it about one or more of its three principal axes.

Aviation English
Although broader than ICAO standard phraseology, this is the language used by pilots and controllers in an operational context.

Avionics Bay
The under-floor avionics compartment where computers and other electronic equipment are located (Airbus). Boeing call it the main equipment centre.

Avoidance
Distancing oneself from an obstacle, danger etc.

Avoiding Action
Announcements by controllers to alert crews that they must modify their flight paths to avoid conflict with other traffic.

Axle
A shaft on which one or more landing gear wheels are mounted.

Azimuth Angle
The rotational position of a helicopter rotor blade. The zero position is when the blade points down stream (i.e. directly above the tailboom). The advancing side is from 0 to 180 degrees and the retreating side from 180 to 360 degrees.

Back Course
A procedure for when a reverse ILS localizer signal can be used for an approach.

Backtrack
Having landed on the runway in use, to turn 180° and proceed along the runway in the opposite direction or, having entered the runway lower down, to taxi to the end of the runway and turn 180° for a longer takeoff run.

Balloon
A non-power-driven lighter-than-air aircraft that sustains flight through the use of either gas or an airborne heater. For EASA purposes, a hot-air airship, although engine-driven, is also considered to be a balloon.

Base Turn
A turn executed by an aircraft during the initial approach between the end of the outbound track and the beginning of the intermediate or final approach track, which are not reciprocal. Base turns may be made in level flight or while descending, according to circumstances.

Basic Instrument Training Device (BITD)
A ground-based training device that represents the student pilot's station of a class of aeroplanes. It may use screen-based instrument panels and spring-loaded flight controls, providing a training platform for at least the procedural aspects of instrument flight.

Basic Service
An ATS provided for the purpose of giving advice and information useful for the safe and efficient conduct of flights. This may include weather information, changes of serviceability of facilities, conditions at aerodromes, general airspace activity information, and any other information likely to affect safety. The avoidance of other traffic is solely the pilot's responsibility.

Beneficial interest
Those arising under contract and other equitable interests.

Blind Transmission
A transmission from one station where 2-way communications cannot be established, but it is believed that the called station can receive it. The transmission should be preceded with the words "Blind Transmission" or "Transmitting Blind" and an indication of the time of the next transmission.

Block Fuel
That required for a route or route segment.

Boost Pressure
On piston engines, the manifold pressure measured relative to standard sea-level atmospheric pressure.

Broadcast
A transmission of information relating to air navigation that is not addressed to a specific station or stations.

Brake Horsepower
Power delivered at the propeller shaft (main drive or main output) of an aircraft engine.

Cabin Attendant
See *Cabin Crew.*

Cabin Crew
People on public transport flights performing safety functions for passengers, but who are not members of the flight crew.

Cabin Crew Member

An appropriately qualified crew member, other than a flight crew or technical crew member, who is assigned by an operator to perform duties related to the safety of passengers and flight during operations.

Calendar
Discrete temporal reference system that provides the basis for defining temporal position to a resolution of one day (ISO 19108).

Calibrated Airspeed
Indicated airspeed, corrected for position and instrument error. CAS is equal to TAS in the standard atmosphere at sea level.

Captive balloon
One which, when in flight, is attached by a restraining device to the surface.

Captive flight
Flight by an uncontrollable balloon which is attached to the surface by a restraining device.

Cargo
Includes mail and animals.

Cargo aircraft
An aircraft that is not a passenger aircraft, carrying goods or property. Crew members, employees, authorised people or people with duties concerning particular shipments on board are not passengers.

Category
The classification of aircraft according to specified basic characteristics, such as aeroplane, powered-lift, airship, (free) balloon, glider, gyroplane, helicopter or ultra-light. Otherwise, a grouping of aircraft based on use or limitations, such as normal, utility, aerobatic, commuter.

Category A
A multi-engined rotorcraft with engine and system isolation features as per JAR 27 or 29, capable of using takeoff and landing data under a critical engine failure concept which assures adequate designated surface area and performance capability for continued safe flight or safe rejected takeoff if an engine fails.

Category B
A single- or multi-engined rotorcraft that does not meet Category A standards, and which has no guaranteed capability for safe flight if an engine fails - an unscheduled landing is assumed.

Causes
Actions, omissions, events, conditions, or a combination, that led to an accident or incident. The identification of causes does not imply the assignment of fault or the determination of administrative, civil or criminal liability;

CAVOK
Cloud and Visibility OK.

Ceiling
The height above the ground or water of the base of the lowest layer of cloud below 6000 m (20,000 ft) covering more than half the sky.

Certificate of Airworthiness
Includes any validation and flight manual, performance schedule or other document, incorporated by reference

Certificated for single pilot operation
Refers to an aircraft not required to carry more than one pilot because of its current C of A, that last in force, that of an identical aircraft, or a permit to fly.

Certification Specifications (CS)
Technical standards adopted by the Agency indicating means to show compliance with Regulation (EC) No 216/2008 and its Implementing Rules and which can be used by an organisation for the purpose of certification.

Changeover Point
The point at which an aircraft navigating on an ATS route segment defined by reference to VOR ranges is expected to transfer its primary navigational reference from the facility behind the aircraft to the next one ahead of it.

Changeover points provide the optimum balance in respect of signal strength and quality between facilities at all levels to be used and to ensure a common source of azimuth guidance for all aircraft operating along the same portion of a route segment.

Child/Children
Persons of an age of two years and above but less than 12 years of age.

Child Restraint System
A device, not a safety belt, designed to restrain, seat or position a person defined as a child.

Circling
The visual phase of a circling approach operation.

Circling Approach Operation
A Type A instrument approach operation designed to bring an aircraft into position for landing on a runway/final approach and takeoff area (FATO) that is not suitably located for a straight-in approach.

Civil Aircraft
An aircraft on the civil register of a State, other than in its service, permanently or temporarily.

Class
Machines with similar operating characteristics, that is, single-engined, multi-engined, etc.

Class Of Aeroplane
A categorisation of single-pilot aeroplanes not requiring a type rating.

Class Of Balloon
A categorisation of balloons taking into account the lifting means used to sustain flight.

Class X airspace
Airspace respectively notified as such, where X refers to the classification.

Clearance Limit
The point to which aircraft are granted an ATC clearance.

Clear Ice
A coating of ice, generally clear and smooth, but with some air pockets. It forms on exposed objects, the temperatures of which are at, below or slightly above the freezing temperature, by the freezing of super-cooled drizzle, droplets or raindrops. Clear ice is very difficult to be detected visually.

Clearway
A defined rectangular area on the ground or water under the control of the appropriate authority, selected or prepared as a suitable area over which an aeroplane may make a portion of its initial climb to a specified height.

Climates, Standard
There are three, *Temperate*, *Tropical* and *Arctic*, whose conditions are unlikely to be exceeded more than one day per year, except that they do not cover the extremes of temperature occasionally reached in tropical deserts or Siberia in winter.

Cloud Base
The height of the base of the lowest observed, or forecast, cloud near an aerodrome or heliport, or within a specified area of operations. It is normally measured above aerodrome elevation but, offshore, above mean sea level.

Cloud Ceiling
The vertical distance from the elevation of an aerodrome to the lowest part of any cloud visible from it sufficient to obscure more than one-half of the sky.

Cockpit Voice Recorder (CVR)
A crash-protected flight recorder that uses a combination of microphones and other audio and digital inputs to collect and record the aural environment of the flight crew compartment and communications to, from and between the flight crew members.

Code (SSR)
The number assigned to a particular multiple pulse reply signal transmitted by a transponder in Mode A or C.

Code Share
An arrangement under which an operator places its designator code on a flight operated by another, and sells and issues tickets for that flight.

Cold Soaked Surface frost (CSSF)
Frost developed on cold soaked aircraft surfaces by sublimation of air humidity. This effect can take place at ambient temperatures above 0° C. Cold soaked aircraft surfaces are more common on aircraft that have recently landed. External surfaces of fuel tanks (e.g. wing skins) are typical areas of CSSF formation (known in this case as cold soaked fuel frost (CSFF)), due to the thermal inertia of very cold fuel that remains on the tanks after landing.

Cole's Law
This can have a significant primary effect on a pilot, and a secondary effect on the velocity of the machine if the cockpit is open. In closed cockpits (without oxygen masks in use) the effect is on the aircrew only but can be intense depending on time since consumption and the state of the cabbage used in the dish.

Commander
The member of the flight crew so designated by the operator, or whoever is for the time being the pilot in command. In other words, the person who gets it in the neck at the subsequent Board of Inquiry.

Commercial Air Service
Any use of an aircraft for hire or reward.

Commercial Air Transportation
Transportation by air of passengers, cargo or mail for remuneration or hire (ICAO). The transport of passengers, cargo or mail for remuneration or hire (EASA).

Commercial Air Transport (CAT) Operation
An aircraft operation to transport passengers, cargo or mail for remuneration or other valuable consideration (EASA).

Committal Point (CP)

The point in the approach where the PF decides that, if a power unit failure is recognised, the safest option is to continue to the deck.

Common Point

A single fix over which two or more aircraft will pass or have passed before proceeding on the same, reciprocal or diverging tracks. Also a point on the surface of the Earth common to the tracks of two aircraft, used as a basis for the application of separation (e.g. significant point, waypoint, navigation aid, fix).

Competency

- **Common sense:** A combination of skills, knowledge and attitude required to perform a task to the prescribed standard.
- **EASA**: A dimension of human performance that is used to reliably predict successful performance on a job and which is manifested and observed through behaviours that mobilise the relevant knowledge, skills and attitudes to carry out activities or tasks under specified conditions.

Competency-based Training

Assessment and training programs that are characterised by a performance orientation, emphasis on standards of performance and their measurement and the development of training to the specified performance standards.

Competency Element

An action that constitutes a task that has a triggering event and a terminating event that clearly defines its limits, and an observable outcome.

Competency Framework

A complete set of identified competencies developed, trained and assessed in an operator's evidence-based training program utilising scenarios that are relevant to operations and which is wide enough to prepare the pilot for both foreseen and unforeseen threats and errors.

Competency Unit

A discrete function consisting of competency elements.

Competent Authority

Any country authority responsible under its law for promoting the safety of civil aviation.

Computer
A device that performs sequences of arithmetical and logical steps upon data without human intervention. A computer complex includes one or more computers and peripheral equipment.

Conditions Conducive To Ground Icing
Freezing fog, freezing precipitation, frost, rain or high humidity (on cold soaked wings), hail, ice pellets, snow or mixed rain and snow, etc.

Conference Communications
Communication facilities whereby direct speech conversation may be conducted between three or more locations simultaneously.

Congested area
For a city, town or settlement, any area substantially used for residential, industrial, commercial or recreational purposes (including golf courses).

Consignee
The person or organisation to whom a consignment is being delivered.

Contamination
All forms of frozen or semi-frozen deposits on an aircraft, such as frost, snow, slush or ice.

Contamination Check
A check of an aircraft for contamination to establish the need for de-icing.

Contaminated Runway
A runway is contaminated when more than 25% of its surface (in isolated areas or not) is covered by surface water more than 3 mm (0.125 inches) deep, or the equivalent in slush, or loose snow, or snow which has been compressed into a solid mass which resists further compression and will hold together or break into lumps if picked up (compacted snow), or ice, including wet ice.

Contingency Fuel/Energy
Extra for degraded performance, route or level deviations and weather that could have an influence on the fuel/ energy consumption to a destination.

Continuous Descent Final Approach (CDFA)
A technique, consistent with stabilised approach procedures, for flying the final approach segment (FAS) of an instrument non-precision approach (NPA) as a continuous descent, without level-off, from an altitude/ height at or above the final approach fix altitude/height:

- for straight-in approaches, to a point approximately 15 m (50 ft) above the landing runway threshold or the point where the flare manoeuvre begins; or
- for circling approach operations, until MDA/H or visual flight manoeuvre altitude/height is reached.

Continuous Maximum Icing
See *Icing, Atmospheric Conditions*.

Contour Line
A line on a map or chart connecting points of equal elevation.

Contracting State
Any State that is a party to the Chicago Convention.

Controllable balloon
A balloon, not small, capable of free controlled flight.

Control Area
Controlled airspace extending upwards from a specified limit above the Earth or further notified as a control area extending upwards from a notified altitude or flight level.

Control Zone
Controlled airspace extending upwards from the surface of the Earth to a specified upper limit.

Controlled Aerodrome
An aerodrome at which air traffic control service is provided to aerodrome traffic. The term indicates that air traffic control service is provided to aerodrome traffic butdoes not necessarily imply that a control zone exists.

Controlled Airspace
An airspace of defined dimensions within which air traffic control service is provided in accordance with the airspace classification. It is a generic term which covers ATS airspace Classes A, B, C, D and E as described in 2.6.

Controlled Flight
A flight that is subject to an air traffic control clearance.

Controller-Pilot Data Link Communications (CPDLC)
Originally developed for use over the Atlantic and Pacific Oceans, *Controller-Pilot DataLink Communications* effectively allows pilots and controllers to text each other, as an addition to the more traditional VHF and HF methods, which reduces congestion and blocked frequencies, assuming they are available in the first place. Messages are received in the same way as ACARS - crews send a logon message to start things off.

Convention
The Convention on International Civil Aviation signed at Chicago in 1944, as amended.

Converted Meteorological Visibility (CMV)
A value, equivalent to RVR, derived from the reported meteorological visibility.

Co-pilot
A pilot serving as other than PIC or commander, on an aircraft for which more than one pilot is required (EASA) but not for the sole purpose of receiving flight instruction for a licence or rating. A pilot subject to the direction of another one in the aircraft.

Crew Member
A person assigned by an operator to perform duties on board an aircraft.

Critical Phases Of Flight
- For **aeroplanes** - the takeoff run, the takeoff flight path, final approach, missed approach, landing, including the landing roll, and any other phases of flight as determined by the PIC or commander.
- For **helicopters** - taxying, hovering, takeoff, final approach, missed approach, landing and any other phases as determined by the PIC or commander.

Cross-Track Tolerance (XTT)
A fix tolerance measured perpendicularly to the nominal track resulting from airborne and ground equipment tolerances and Flight Technical Tolerance (FTT).

Country
Includes a territory.

CPDLC
See *Controller-Pilot Data Link Communications*.

CPDLC Message
Information exchanged between an airborne system and its ground counterpart, consisting of a single message element or a combination of message elements conveyed in a single transmission by the initiator.

CPDLC Message Set
A list of standard message elements and free text message elements.

CRC
See *Cyclic Redundancy Check*.

Crew
A member of the flight crew, or someone on the flight deck, appointed to give or to supervise the training, experience, practice and tests required under article 34(3), or a cabin crew member.

Crew Member
A person assigned to duty in an aircraft during flight time.

Critical Altitude
The maximum altitude you can maintain, without ram, at max continuous rotational speed, the max continuous power (for engines where this power rating is the same at sea level and rated altitude), or the max continuous rated manifold pressure (for engines with the max continuous power governed by a constant manifold pressure).

Critical Engine
One whose failure most adversely affects performance or handling of an aircraft.

Critical Part
When a part must achieve and maintain a particularly high level of integrity if hazardous effects are not to occur on more than extremely remote occasions, it is a Critical Part.

Critical Surfaces
The wings, control surfaces, rotors, propellers, horizontal stabilizers, vertical stabilizers or other stabilizing surface of an aircraft and, for one with rear-mounted engines, includes the upper surface of its fuselage.

Cross Country Flight
One between a point of departure and arrival following a pre-planned route using standard navigation procedures.

Cruise Climb
An aeroplane cruising technique resulting in a net increase in altitude as the aeroplane mass decreases.

Cruise Relief Co-pilot
One who relieves co-pilots of their duties at the controls during the cruise phase of a flight in multi-pilot operations above FL 200.

Cruising Level
A level maintained during a significant portion of a flight.

CTR
Control Zone.

Current Data Authority
The designated ground system through which a CPDLC dialogue between a pilot and a controller currently responsible for the flight is permitted to take place.

Current Flight Plan (CPL)
The flight plan, including changes, if any, brought about by subsequent clearances.

Current Fuel/Energy Scheme
The approved fuel/energy scheme used by an operator.

Cushioning Material
For dangerous goods, material used to safeguard inner packaging from breakage and movement within outer packaging, not reacting dangerously with the contents.

Cyclic Redundancy Check (CRC)
A mathematical algorithm applied to the digital expression of data that provides a level of assurance against loss or alteration of data.

D
The largest dimension of a helicopter with rotors turning.

Damp Runway
A runway is damp when the surface is not dry, but moisture on it does not give it a shiny appearance.

Danger Area
Airspace of defined dimensions, notified, within which activities dangerous to flight may exist at specified times.

Dangerous Goods
Anything that poses a risk to life, property or the environment, such as aerosols, solvents, paints, chainsaws, matches, stoves, car batteries, gas tanks and even perfume under the right circumstances, as shown in the list of dangerous goods in the technical instructions or which are classified according to those instructions.

Dangerous Goods Accident
An occurrence associated with and related to the transport of dangerous goods by air which results in fatal or serious injury or major property damage.

Dangerous Goods Incident
An occurrence other than a dangerous goods accident associated with and related to the transport of dangerous goods by air, not necessarily on board an aircraft, which results in injury to a person, property damage, fire, breakage, spillage, leakage of fluid or radiation or other evidence that the integrity of the packaging has not been maintained, and any occurrence relating to the transport of dangerous goods which seriously jeopardises an aircraft or its occupants.

Dangerous Goods Transport Document
A document specified by the Technical Instructions, completed by the person who offers dangerous goods for air transport, with information about them. The document bears a signed declaration indicating that the dangerous goods are fully and accurately described by their proper shipping names and UN/ID numbers and that they are correctly classified, packed, marked, labelled and in a proper condition for transport.

Data Convention
An agreed set of rules governing the manner or sequence in which a set of data may be combined into a meaningful communication.

Datalink Communications
A form of communication intended for the exchange of messages over a data link.

Data link Initiation Capability (DLIC)
A data link application that provides the ability to exchange addresses, names and version numbers necessary to initiate data link applications.

Data Processing
A systematic sequence of operations performed on data.

Data Quality
A degree or level of confidence that the data provided meets the requirements of the data user in terms of accuracy, resolution and integrity.

Datum Crossing Point (DCP)
A point on a glide path directly above the LTP or FTP at a height specified by the RDH.

Day
The time from half an hour before sunrise until half an hour after sunset (both times exclusive), sunset and sunrise being determined at surface level. In some countries, the definition also means where the centre of the sun's disc is less than 6° below the horizon (if you're in the Frozen North, where the Sun doesn't really set).

Dead Reckoning (DR) Navigation
The estimating or determining of position by advancing an earlier known position by the application of direction, time and speed data.

Decision Height/Altitude (DH/DA)
Aa specified altitude or height in a 3D instrument approach at which a missed approach procedure must be initiated if the required visual reference to continue the approach has not been established.

Declared Capacity
A measure of the ability of the ATC system or any of its subsystems or operating positions to provide service to aircraft during normal activities. It is expressed as the number of aircraft entering a specified portion of airspace in a given period of time, taking due account of weather, ATC unit configuration, staff and equipment available, and any other factors that may affect the workload of the controller responsible for the airspace.

Deconfliction Service
A surveillance based ATS where, as well as the provisions of a Basic Service, the controller provides specific surveillance derived traffic information and issues headings and/or levels aimed at achieving planned deconfliction minima against all observed aircraft in Class F/G airspace, or for positioning and/or sequencing. Avoiding other traffic is the pilot's responsibility.

Defined Point After Takeoff (DPATO)
In Performance Class 2 helicopter operations, the point during takeoff and initial climb, before which the helicopter's ability to continue the flight safely, with the critical power unit inoperative, is not assured and a forced landing may be required.

Defined Point Before Landing (DPBL)
In Class 2 helicopter operations, the point in the approach and landing phase, after which a helicopter's ability to continue safely, with the critical power unit inoperative, is not assured and a forced landing may be required.

De-icing
In the case of ground procedures, a procedure by which frost, ice, snow or slush is removed from an aircraft in order to provide uncontaminated surfaces. Also, the process of eliminating frozen contamination from aircraft surfaces, typically by applying de-icing fluids.

De-Icing/Anti-Icing
The combination of de-icing and anti-icing performed in either one or two steps.

De-Icing Fluid
Including, but not limited to heated water, preferably, Type I fluid (neat or diluted (typically), Type II, III or IV fluid (neat or diluted). The-icing fluid is normally applied heated to ensure maximum efficiency and its freezing point should be at the outside air temperature (OAT) or below. Not used on helicopters.

Dependent Parallel Approaches
Simultaneous approaches to parallel or near-parallel instrument runways where radar separation minima between aircraft on adjacent extended runway centre-lines are prescribed.

Descent Fix
A fix established in a precision approach at the FAP to eliminate certain obstacles before the FAP, which would otherwise have to he considered for obstacle clearance.

Detent
A mechanical arrangement which indicates, by feel, a position of an operating control. The detent holds the lever there and an additional-to-normal force is required to move it away (CS 25 only).

DETRESFA
The code word used to designate a distress phase.

Direct costs
For a flight, the costs actually and necessarily incurred in connection with it without a view to profit but excluding anything paid to the pilot.

Distance DR
The horizontal distance a helicopter has travelled from the end of the TODA.

Distress Phase
A situation wherein there is reasonable certainty that an aircraft and its occupants are threatened by grave and imminent danger or require immediate assistance.

Ditching
The forced landing of an aircraft in water. Lifejackets should be inflated when leaving the aeroplane.

Diverging Tracks
Tracks downstream of the common point whose angular divergence is equal to or less than 90 degrees.

DME
Distance Measuring Equipment.

DME Distance
The line of sight distance (as slant range) from the source of a DME signal to a receiving antenna.

Dry Lease
The term used to mean that you didn't get fuel with an aircraft when you leased it, but now it seems to mean that an aircraft is operated under a lessee's AOC or responsibility (that is, without flight crew). The end result is probably the same.

Dry Operating Mass
The total mass of an aircraft ready for a specific type of operation, excluding usable fuel and traffic load. This includes crew and baggage, catering and removable passenger service equipment, and potable water and lavatory chemicals.

Dry Runway
One whose surface is free of visible moisture and not contaminated within the area intended to be used.

Downstream Clearance
One issued to an aircraft by an air traffic control unit that is not the current controlling authority of that aircraft.

Dual Instruction Time
Flight time or instrument ground time during which a person is receiving flight instruction from a properly authorised instructor.

Duplex Communication
Communication between two stations that can take place in both directions at the same time.

EBT
Evidence Based Training.

EBT Module
A combination of sessions in a qualified flight simulation training device as part of the 3-year period of recurrent assessment and training.

EEA Agreement
The Agreement on the European Economic Area signed at Oporto on 2nd May 1992 as adjusted by the Protocol signed at Brussels on 17th March 1993.

EEA State
A State which is a contracting party to the EEA Agreement.

EET
Estimated Elapsed Time.

EFB
Electronic Flight Bag.

EFB Application
A software application on a host platform that provides operational functions that support flight operations.

EFB Host Platform
Hardware equipment in which computing capabilities and basic software reside, including the operating system and input/output software.

EFB System
The hardware equipment (including any battery, connectivity provisions, input/output components) and software (including databases and the operating system) needed to support the intended EFB application(s).

ELA1 Aircraft
The following manned European Light Aircraft:

- an aeroplane with an MTOM of 1200 kg or less that is not classified as complex motor-powered aircraft.
- A sailplane sailplane of 1200 kg MTOM or less.
- A balloon with a maximum design lifting gas or hot air volume of not more than 3400 m^3 for hot air balloons, 1050 m^3 for gas balloons, 300 m^3 for tethered gas balloons.

ELA2 Aircraft
The following manned European Light Aircraft:

- an aeroplane with a Maximum Takeoff Mass (MTOM) of 2000 kg or less that is not classified as complex motor-powered
- a sailplane or powered sailplane of 2000 kg MTOM or less
- a balloon
- a hot air ship
- a gas airship meeting all of the following elements:
  - 3% maximum static heaviness
  - Non-vectored thrust (except reverse thrust)
  - Conventional and simple design of: structure, control system and ballonet system
  - Non-power assisted controls;
- a Very Light Rotorcraft

Electronic Flight Bag (EFB)
An electronic information system, with equipment and applications for flight crew, which allows for the storing, updating, displaying and processing of EFB functions to support flight operations or duties.

Elementary Work
Maintenance tasks that may be completed by an unqualified person.

Elevation
The vertical distance of a point or a level, on or affixed to the surface of the Earth, measured from mean sea level.

Elevated Final Approach and Takeoff Area (FATO)
A FATO that is at least 3 m above the surrounding surface.

Elevated Heliport
One at least 3 m above the surrounding surface (ICAO does not specify a height).

Emergency Exit
An installed exit-type egress point from the aircraft that allows maximum opportunity for cabin and flight crew compartment evacuation within an appropriate time period and includes floor level door, window exit or any other type of exit, for instance hatch in the flight crew compartment and tail cone exit.

Emergency Phase
A generic term meaning, as the case may be, *uncertainty phase*, *alert phase* or *distress phase*.

Empty Weight
The total weight of the airframe, engines, fixed ballast, unusable fuel, the maximum amount of normal operating fluids, such as oil, power plant coolant, hydraulic fluid, de-icing and anti-icing fluid, not including potable water, lavatory pre-charge fluid or that for injection into the engines, and all installed equipment.

Enhanced Flight Vision System (EFVS)
An electronic means of providing a flight crew with a real-time sensor-derived or enhanced display of the external scene topography (the natural or man-made features of a place or region especially in a way to show their relative positions and elevation) through the use of imaging sensors; an EFVS is integrated with a flight guidance system and is implemented on a head-up display or an equivalent display system; if an EFVS is certified according to the applicable airworthiness requirements and an operator holds the necessary specific approval (when required), then it may be used for EFVS operations and may allow operations with operational credits.

EFVS Operation
An operation in which visibility conditions require an EFVS to be used instead of natural vision in order to perform an approach or landing, identify the required visual references or conduct a roll-out.

EFVS 200 Operation
An operation with an operational credit in which visibility conditions require an EFVS to be used down to 200 ft above the FATO or runway threshold. From that point to land, natural vision is used. The RVR shall not be less than 550 m;

Enhanced Vision System (EVS)
An electronic means of providing a flight crew with a real-time image of the actual external scene topography (the natural or man-made features of a place or region especially in a way to show their relative positions and elevation) through the use of imaging sensors.

Enrolment
The administrative action carried out by an operator when a pilot participates in the operator's EBT program.

Enrolled Pilot
A pilot that participates in an EBT recurrent training program.

Enroute Phase
From the end of the takeoff and initial climb phase to the start of the approach and landing phase.

Equivalency Of Approaches
All approaches that place an additional demand on a proficient crew regardless of whether they are used or not in the EBT modules.

Equivalency Of Malfunctions
All the malfunctions that put a significant demand on a proficient crew regardless of whether they are used or not in the EBT modules.

Equivalent Airspeed
Calibrated airspeed corrected for adiabatic compressible flow at particular altitudes, equal to CAS in standard atmosphere at sea level.

Error
An action or inaction that leads to deviations from organisational or flight intentions or expectations.

Error Management
The process of detecting and responding to errors with countermeasures that reduce or eliminate the consequences of errors, and mitigate the probability of errors or undesired aircraft states.

Estimated Elapsed Time
The estimated time required to proceed from one significant point to another.

Estimated Off-Block Time
The estimated time at which the aircraft will commence movement associated with departure.

Estimated Time of Arrival (ETA)
For IFR flights, the time at which it is estimated that the aircraft will arrive over that designated point, defined by reference to navigation aids, from which it is intended that an instrument approach procedure will be commenced, or, if no navigation aid is associated with the aerodrome, the time at which the aircraft will arrive over the aerodrome. For VFR flights, the time at which it is estimated that the aircraft will arrive over the aerodrome.

ETA
See *Estimated Time of Arrival*.

ETD
Estimated Time of Departure.

Evaluation Phase
One of the phases of an EBT module which is a line-orientated flight scenario, representative of the operator's environment during which there are one or more occurrences to evaluate key elements of the defined competency framework.

Evaporation
The conversion of liquid to vapour at temperatures below boiling point (vaporisation occurs at the boiling point).

Evidence-based Training (EBT)
Assessment and training based on operational data that is characterised by developing and assessing the overall capability of a pilot across a range of competencies (competency framework) rather than by measuring the performance in individual events or manoeuvres.

Exemption
For dangerous goods, an authorisation issued by an appropriate national authority providing relief from the provisions of Annex 18.

Exhaust Gas Temperature
Average temperature of exhaust gas streams (turbines).

Expected Approach Time
The time at which ATC expects that an arriving aircraft, following a delay, will leave the holding fix to complete its approach for a landing. The actual time of leaving the holding fix will depend upon the approach clearance.

Exposure Time
Time during which the performance of a helicopter with the critical power unit inoperative in still air does not guarantee a safe forced landing or safe continuation.

External Load
One that is carried, towed or extends outside the aircraft fuselage.

External Load Attaching Means
Structural components that attach an external load to an aircraft, including containers, the backup structure at the attachment points, and quick-release devices to jettison the load.

Extremely Remote
Unlikely to occur when considering the total operational life of a number of aircraft of the type in which an engine is installed, but has to be regarded as being possible.

Fail-Operational Flight Control System
In a failure below alert height, the approach, flare and landing, can be completed automatically, and the automatic landing system reverts to fail-passive.

False Start
An attempt to start in which a turbine engine fails to light up, assuming handling is as per manufacturer's instructions.

Farmer
A person whose primary source of income is derived from tilling the soil, raising livestock or poultry, dairy farming, the growing of grain, fruit, vegetables or tobacco, or any other operation of a similar nature.

Fatal Injury
One that is sustained by a person in an accident which results in death within 30 days of the date of the accident.

FATO
Final Approach and Takeoff Area. A defined area over which the final phase of a helicopter approach manoeuvre to hover or landing is completed and from which the takeoff manoeuvre is started and, where the FATO is to be used by Performance Class 1 helicopters, includes the rejected takeoff area available.

Federal Aviation Regulations
As published by the FAA in the USA.

FIC
Flight Information Centre.

Fictitious Threshold Point (FTP)
A point over which the final approach segment path passes at a relative height specified by the reference datum height. It is defined by the WGS-84 latitude, longitude and ellipsoid height. The FTP replaces the LTP when the final approach course is not aligned with the runway extended centreline or when the threshold is displaced from the actual runway threshold. For non-aligned approaches the FTP lies on the intersection of the perpendicular from the FAS to the threshold. The FTP elevation is the same as the actual threshold elevation.

Filed Flight Plan (FPL)
The flight plan as filed with an ATS unit by the pilot or a designated representative, with no subsequent changes.

Final Approach
That part of an instrument approach procedure which commences at the specified final approach fix or point, or where such a fix or point is not specified:

- at the end of the last procedure turn, base or inbound turn of a racetrack procedure, if specified; or
- at the point of interception of the last track specified in the approach procedure; and
- ends at a point near an aerodrome from which a landing can be made, or a missed approach procedure is initiated.

Final Approach and Takeoff Area (FATO)
A defined area over which the final phase of an approach to hover or landing is completed and from which the takeoff manoeuvre is commenced. Where the FATO is to be used by Performance Class 1 helicopters, the defined area includes the rejected takeoff area available.

Final Approach Segment
That segment of an instrument approach procedure in which alignment and descent for landing are accomplished.

Final Approach Track
The flight track in the final approach segment that is normally aligned with the runway centreline. For offset final approach segments, the final approach track is aligned with the orientation of the FTP and the FPAP.

FIR
Flight Information Region.

Fireproof
The ability of materials, components and equipment to withstand heat from a flame, for 15 minutes without any failure that creates a hazard to the aircraft. For materials, this is equivalent to withstanding a fire at least as well as steel or titanium in appropriate dimensions.

Fire Resistant
As for Fireproof, but for 5 minutes, and equivalent to aluminium alloy.

First Aid Oxygen
Additional oxygen for passengers who do not satisfactorily recover after subjection to excessive cabin altitudes, when they had been provided with supplemental oxygen.

FIS
Flight Information Service.

Fixed
About a light, means having a constant luminous intensity when observed from a fixed point.

FL
See *Flight Level*.

Flame Resistant
Not likely to combust if flame is propagated, beyond safe limits, after ignition is removed.

Flammable
A quality of a substance that means it will burn, or is susceptible to igniting readily or exploding. This word replaced *inflammable* in the 60s.

Flash Point
The lowest temperature of a liquid when flammable vapour is given off.

Flash Resistant
Not susceptible to violent burning if ignited.

Flight and Navigation Procedures Trainer (FNPT)
A training device that represents the flight deck or cockpit environment, including the assemblage of equipment and computer programs necessary to represent an aircraft type or class in flight operations to the extent that the systems appear to function as in an aircraft.

Flight Attendant
A crew member assigned duties in the interest of passengers.

Flight Authority
A C of A or permit to fly showing an aircraft's fitness for flight under Article 31 of the Convention.

Flight Control System
A system which includes an automatic landing system and/or a hybrid landing system.

Flight Crew
Members of the crew of an aircraft who undertake to act as pilot, flight navigator, flight engineer and flight radiotelephony operator, which means that when you're in the pub, you are not flight crew, as you are not undertaking to act as such.

Flight Crew Member
A licensed crew member charged with duties essential to the operation of an aircraft during a flight duty period.

Flight Data Monitoring (FDM)
The proactive and non-punitive use of digital flight data from routine operations to improve aviation safety.

Flight Data Recorder (FDR)
A crash-protected flight recorder that uses a combination of data sources to collect and record parameters that reflect the state and performance of the aircraft.

Flight Deck Duty Time
The period spent by a crew member at a relevant position during flight time.

Flight Dispatcher
See *Flight Operations Officer*.

Flight Duty Time
The period starting when a crew member reports for a flight, or standby, and finishes at engines off or rotors stopped at an appropriate period after the final flight.

Flight Following
The recording in real time of departure and arrival messages by operational personnel to ensure that a flight is operating and has arrived at the destination aerodrome or an alternate aerodrome.

Flight Information Centre
A unit established to provide flight information service and alerting service.

Flight Information Region
An airspace of defined dimensions within which flight information service and alerting service are provided.

Flight Information Service
A service for giving advice and information useful for the safe and efficient conduct of flights.

Flight Information Service Officer (FISO)
One at any aerodrome or area control centre.

Flight Information Service Unit
A person appointed by the CAA or any other person maintaining an aerodrome to give information by radio to aircraft flying or intending to fly within the aerodrome traffic zone, and grant or refuse permission, under Rule 35 or 36(2). For an area control centre, the former applies.

Flight Level
One of a series of levels of equal atmospheric pressure, separated by notified intervals and expressed as hundreds of feet indicated at that level on an ISA pressure altimeter. In normal usage, altitude in hundreds of feet, on an altimeter set to 29.92 inches of mercury or 1013.25 hPa.

Flight Line
A predetermined directional line of flight within a flying display area, marked and clearly visible from the air.

Flight Manual
A manual, associated with the C of A, containing limitations within which the aircraft is considered to be airworthy, and instructions and information necessary to the flight crew for the safe operation of the aircraft.

Flight Monitoring
In addition to the requirements for flight following:

- Operational monitoring of flights by suitably qualified operational-control personnel from departure throughout all phases of the flight.
- Communication of all available and relevant safety information between the operational-control personnel on the ground and the flight crew.
- Critical assistance to the flight crew in the event of an in-flight emergency or security issue, or at the request of the flight crew.

Flight Operations Officer
Also a flight dispatcher, a suitably qualified person designated by an operator to engage in the control and supervision of flight operations, who supports, briefs or assists, or both, the PIC in the safe conduct of the flight;

Flight Path Alignment Point (FPAP)
A point in the same lateral plane as the LTP or FTP that is used to define the alignment of the final approach segment. For approaches aligned with the runway centreline, the FPAP is at or beyond the opposite threshold of the runway. The delta length offset from the opposite threshold of the runway defines its location.

Flight Path Angle
This is defined in two ways. To the aerodynamicist, it is the angle between the flight path vector (where the airplane is going) and the local atmosphere. To the flight crew, it is normally known as the angle between the flight path vector and the horizon, also known as the climb (or descent) angle. It can also be defined as that between the horizontal (or some other reference angle) and a tangent to the flight path at a point.

Flight Path Monitoring
The use of ATS surveillance systems for the purpose of providing aircraft with information and advice relative to significant deviations from nominal flight path, including deviations from the terms of their air traffic control clearances. Some applications may require a specific technology, e.g. radar, to support the function of flight path monitoring.

Flight Plan
Such information as may be notified for an air traffic control service unit being information provided or to be provided to that unit, relative to an intended flight or portion of a flight of an aircraft.

Flight Recorder
Any type of recorder installed in an aircraft for the purpose of facilitating accident/incident safety investigations.

Flight Recording System
A system with a flight data recorder, cockpit voice recorder, or both.

Flight Simulator
Apparatus that simulates flight conditions on the ground.

Flight Simulation Training Device (FSTD)
A training device which is:

- for aeroplanes, a full flight simulator (FFS), a flight training device (FTD), a flight and navigation procedures trainer (FNPT), or a basic instrument training device (BITD).
- for helicopters, a full flight simulator (FFS), a flight training device (FTD) or a flight and navigation procedures trainer (FNPT).

Flight Time

Generally, the time from when an aircraft first moves under its own power to take off until it comes to rest at the end of the flight. For EASA:

- for **aeroplanes**, the total time from the moment an aeroplane first moves for the purpose of taking off until the moment the aeroplane finally comes to rest at the end of the flight.
- for **helicopters**, the total time between the moment a helicopter's rotor blades start turning for the purpose of taking off until the moment the helicopter finally comes to rest at the end of the flight, and the rotor blades are stopped.
- For **airships**, the total time from being released from the mast for the purpose of taking off until coming to rest at the end of the flight, and being secured on the mast.
- For **sailplanes**, the total time from commencing the ground run in the process of taking off until coming to a rest at the end of flight.
- For **balloons**, the total time from the moment the basket leaves the ground for the purpose of taking off until coming to a rest at the end of a flight.

Flight Time Under Instrument Flight Rules (IFR)

All flight time during which an aircraft is being operated under the Instrument Flight Rules.

Flight Training

A program of ground instruction and airborne training under the flight instructor guide and flight training manual for the aircraft used.

Flight Training Device (FTD)

A full sized replica of a specific aircraft type's instruments, equipment, panels and controls in an open flight deck area or an enclosed aircraft flight deck, including the assemblage of equipment and computer software programs necessary to represent the aircraft in ground and flight conditions to the extent of the systems installed in the device. It does not require a force cueing motion or visual system, except in the case of helicopter FTD levels 2 and 3, where visual systems are required.

Flight Visibility

The visibility forward from the flight deck when in flight.

Flight Watch
In addition to all elements defined for 'flight monitoring', the active tracking of a flight by suitably qualified operational-control personnel throughout all phases of the flight to ensure that the flight is following its prescribed route without unplanned deviations, diversions or delays.

Flow Control
Measures designed to adjust the flow of traffic into a given airspace, along a given route, or bound for a given aerodrome, so as to ensure the most effective utilization of the airspace.

Flying Display
Flying activity deliberately performed for an exhibition or entertainment at an advertised event open to the public.

Flying Machine
For the exams, "a heavier than air power driven aircraft", as ICAO only define an aeroplane. It may be a glider, aeroplane or rotorcraft.

Forecast
A statement of expected meteorological conditions for a specified time or period, and for a specified area or portion of airspace.

Formation Flight
When an aircraft is flown solely with reference to another aircraft. Also, more than one aircraft which, by prior arrangement between the pilots, operate as a single aircraft with regard to navigation and position reporting. Separation between the aircraft within the formation remains the responsibility of the flight leader and the pilots of the other aircraft in the flight, including periods when aircraft within the formation are maneuvering to attain separation from each other to effect individual control and during join-up and break-away.

Free Balloon
One which, which, when in flight, is not attached by a restraining device to the surface.

Free Controlled Flight
Where a balloon is not attached to the surface by a restraining device (other than a tether less than 5 metres long used during takeoff), and during which height is controllable by a device attached to the balloon operated by the commander or by remote control.

Free Text Message Element
Part of a message that does not conform to standard message elements in PANS-ATM (Doc 4444).

Freight Container
An article of transport equipment for radioactive materials, designed to facilitate their transport, either packaged or unpackaged, by one or more modes of transport. See *Unit Load Device* for where the dangerous goods are not radioactive.

Full Flight Simulator (FFS)
A full size replica of a specific type or make, model and series aircraft flight deck, including the assemblage of all equipment and computer programs needed to represent the aircraft in ground and flight operations, a visual system providing an out-of-the flight deck view, and a force cueing motion system.

GBAS Landing System (GLS)
An approach landing system using ground based augmented global navigation satellite system (GNSS/GBAS) information to provide guidance to the aircraft based on its lateral and vertical GNSS position. It uses geometric altitude reference for its final approach slope.

GCA
Ground Controlled Approach.

General Air Traffic
Flights operating under civil air traffic procedures.

General Aviation Operation
An aircraft operation other than a commercial air transport or aerial work operation.

General Lighthouse Authority
See section 193 of the *Merchant Shipping Act*, 1995.

Geodetic Datum
A minimum set of parameters required to define location and orientation of the local reference system with respect to the global reference system/frame.

Glider
A non-power-driven heavier-than-air aircraft deriving lift from aerodynamic reactions on fixed surfaces.

Glide Path
A descent profile determined for vertical guidance during a final approach.

Go-around
A transition from an approach to a stabilised climb. This includes manoeuvres conducted at or above the MDA/H or DA/H, or below the DA/H (balked landings).

Goods
Anything that may be taken or placed on an aircraft as personal belongings, baggage or cargo.

Government Aerodrome
An aerodrome in UK occupied by a Govt Department or visiting force.

Granted
Granted by an authority under a procedure assessed as satisfactory after an inspection by standardisation teams.

Gregorian Calendar
One in general use, first introduced in 1582 to define a year that more closely approximates the tropical year than the Julian calendar (ISO 19108*). In the Gregorian calendar, common years have 365 days and leap years 366 days divided into twelve sequential months.

Ground Effect
A condition of improved performance (lift) due to the interference of the surface with the airflow pattern of the rotor system when a helicopter or other VTOL aircraft is operating near the ground. Rotor efficiency is increased by ground effect to a height of about one rotor diameter for most helicopters.

Ground Emergency Service Personnel
Any (policemen, firemen, etc.) involved with HEMS and whose tasks are pertinent to helicopter operations.

Ground Ice Detection System (GIDS)
A system used during aircraft ground operations to inform the personnel involved in the operation and/or the flight crew about the presence of frost, ice, snow or slush on the aircraft surfaces.

Ground Idling Conditions
For turbines, conditions of minimum rotational speed associated with zero forward speed and maximum EGT.

Grounding
The formal prohibition of an aircraft from taking off and the taking of such steps as are necessary to detain it.

Ground Station
A location with radio transmitting and receiving equipment capable of two-way voice communications with aircraft.

Ground Visibility
That at an aerodrome as reported by an accredited observer or by automatic systems.

Group Of Balloons
A categorisation of balloons, according to the size or capacity of the envelope.

Gyroplane
A heavier-than-air aircraft deriving lift from aerodynamic reactions on one or more non-power-driven rotors on substantially vertical axes. A rotorcraft with rotors not engine-driven (except for initial starting), but which rotate from action of the air when moving, and an independent means of propulsion, usually propellers.

H24
24 hour operation.

Handling Agent
An agency which performs on behalf of an operator some or all of the latter's functions including receiving, loading, unloading, transferring or other processing of passengers or cargo.

Hang glider
One designed to carry less than two people with a typical launch weight of 45 kg (99.2 pounds) or less.

Harness
Equipment, consisting of two shoulder straps and a lap belt, that restrains a member of the flight crew against inertia loads in emergency conditions.

Heading
The direction in which the longitudinal axis of an aircraft is pointed, in True, Magnetic or Grid degrees from North.

Head-Up Display Landing System (HUDLS)
An airborne system which provides head-up guidance to enable pilots to control an aircraft or monitor the autopilot during takeoff (if applicable), approach and landing (and roll-out if applicable), or go-around. It includes sensors, computers, power supplies, indications and controls.

Heavier-than-air aircraft
One supported in the atmosphere by lift derived from aerodynamic forces.

Height
The vertical distance of a level or a point measured from a specific datum, such as airfield datum. It is referenced by the QFE.

Helicopter
A power-driven heavier-than-air aircraft deriving lift from aerodynamic reactions on one or more power-driven rotors on substantially vertical axes. A rotorcraft that depends principally on its engine-driven rotors for horizontal motion.

Helicopter Hoist Operation (HHO) Crew Member
A technical crew member who performs assigned duties relating to the operation of a hoist.

Helicopter Hoist Operations Flight
A flight by a helicopter under an HHO approval, to transfer people and/or cargo by hoist.

Helideck
A FATO on a floating or fixed offshore structure.

Heli-logging
The removal and carriage of logs and shake blocks by helicopter external load means.

Heliport
An aerodrome used for the arrival, landing, take-off or departure of aircraft capable of vertical take-off and landing. An area of land or water, or structure used or intended for the landing and takeoff of helicopters.

HEMS Crewmember
A technical crew member assigned to a HEMS flight to attend to people in need of medical assistance carried in the helicopter and assisting the pilot during the mission.

HEMS Flight
Helicopter Emergency Medical Service Flight. A flight by a helicopter under a HEMS approval, for emergency assistance, where *immediate* and *rapid* transportation is essential, by carrying medical personnel, supplies, or ill or injured people and others directly involved.

HEMS Operating Base
A heliport where HEMS crews and helicopters may be on standby for HEMS operations.

HEMS Operating Site
A site selected by a commander during a HEMS flight for helicopter hoist operations, landing and takeoff.

HF
High Frequency.

HHO Flight
A flight by a helicopter operating under an HHO approval, to facilitate the transfer of persons and/or cargo by means of a helicopter hoist.

HHO Offshore
A flight by a helicopter under an HHO approval, to facilitate the transfer of persons and/or cargo by means of a helicopter hoist from or to a vessel or structure in a sea area or to the sea itself.

HHO Passenger
A person to be transferred by means of a helicopter hoist.

HHO Site
A specified area at which a helicopter performs a hoist transfer.

High seas
Any body of water, or frozen surface, not within territorial waters of any state.

Hire or reward
Any payment, consideration, gratuity or benefit, directly or indirectly charged, demanded, received or collected by any person for the use of an aircraft.

Hire-Purchase Agreement
See section 189 of the Consumer Credit Act 1974.

Hoist Cycle
One down-and-up cycle of a hoist hook.

Holding Fix
A geographical location that serves as a reference for a holding procedure.

Holding Procedure
A predetermined manoeuvre that is intended to keep an aircraft within a specified airspace while awaiting further clearance.

Hold-over Time (HoT)
The estimated time that anti-icing fluid will prevent the formation of ice and frost and the accumulation of snow on the protected (treated) surfaces of an aeroplane (helicopters do not use deicing fluid). Also, the period of time during which an anti-icing fluid provides protection against frozen contamination to the treated aircraft surfaces. It depends among other variables, on the type and intensity of the precipitation, OAT, wind, the particular fluid (or fluid Type) and aircraft design and aircraft configuration during the treatment.

Hostile Environment

Where:

- A safe forced landing cannot be made because the surface is inadequate.
- The occupants cannot be adequately protected from the elements.
- SAR response/capability is not consistent with anticipated exposure.
- Unacceptable risk of endangering people or property on the ground.

These areas are always hostile:

- For overwater operations, the open sea North of 45N and South of 45S, as designated
- Congested areas without adequate safe forced landing areas

Hot Spot

A location on an aerodrome movement area with a history or potential risk of collision or runway incursion, and where heightened attention by pilots/drivers is necessary.

Human Factors Principles

Principles that apply to aeronautical design, certification, training, operations and maintenance and which seek a safe interface between human and other components by proper consideration to human performance.

Human–Machine Interface (HMI)

A component of certain devices that is capable of handling human–machine interactions. The interface consists of hardware and software that allow user inputs to be interpreted and processed by machines or systems that, in turn, provide the required results to the user.

Human Performance

Human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations.

Icing Atmospheric Conditions

- *Continuous Maximum Icing* - defined by cloud liquid water content, mean effective diameter of cloud droplets, ambient air temperature, and their relationship.
- *Intermittent Maximum Icing* - defined by the cloud liquid water content, mean effective diameter of cloud droplets, ambient air temperature, and their inter-relationship.

Identification
The situation which exists when the position indication of a particular aircraft is seen on a situation display and positively identified.

Identification Plate
A fireproof plate (preferably metal) containing identification information.

ID Number
A temporary identification number for an item of dangerous goods without a UN number.

IFR
Instrument Flight Rules. To be observed when flying in IMC.

IFR aircraft
One operating in IFR flight.

IFR Conditions
Weather below the minimum for VFR flight.

IFR flight
One conducted under IFR.

ILS
Instrument Landing System.

IMC
Instrument Meteorological Conditions. Those less than VMC, in terms of visibility and distance from cloud. Also a symbol that designates IMC.

INCERFA
The code word used to designate an uncertainty phase.

Incident
An occurrence, not an accident, associated with operation of an aircraft which may affect safety.

Incompatible
Dangerous goods which, if mixed, would be liable to cause a dangerous evolution of heat or gas or produce a corrosive substance.

Independent Parallel Approaches
Simultaneous approaches to parallel or near-parallel instrument runways where radar separation minima between aircraft on adjacent extended runway centre-lines are not prescribed.

Independent Parallel Departures
Simultaneous departures from parallel or near-parallel instrument runways.

Indicated Airspeed
The speed of an aircraft as shown on its ASI, calibrated to reflect standard atmosphere adiabatic compressible flow at sea level, uncorrected for airspeed system errors.

INFO
Information.

Infant
A person under two years of age (this may vary). A person 2 years old or above is not an infant.

Initial Approach Fix (IAF)
A fix that marks the beginning of the initial segment and the end of the arrival segment of an instrument approach.

Initial Approach Segment
That segment of an instrument approach procedure between the initial approach fix and the intermediate approach fix or, where applicable, the final approach fix or point.

INS
Inertial Navigation System.

In-seat Instruction
A technique used in the manoeuvres training phase or the scenario-based training phase, where the instructors can:

- provide simple instructions to one pilot or
- perform predetermined exercises acting, in a pilot seat, as pilot flying (PF) or monitoring (PM) for:
  - the demonstration of techniques and/or
  - triggering the other pilot to intervene or interact.

Installed
Complies with applicable airworthiness requirements or the relevant code for Type Certification, and any requirement in JAR OPS.

Instructor Concordance
The consistency or stability of scores between different EBT instructors which gives a score (or scores) of how much homogeneity, or consensus, there is in the ratings given by instructors (raters).

Instructor Rating
A flying instructor's rating, assistant flying instructor's rating, flight instructor rating (aeroplane) or (helicopter), type rating instructor rating (multi-pilot aeroplane) or (helicopter), a class rating instructor rating (single pilot aeroplane), an instrument rating instructor rating (aeroplane) or (helicopter).

Instrument
A device with an internal mechanism to show visually or aurally the attitude, altitude or operation of an aircraft or part, including electronic ones for automatically controlling aircraft in flight.

Instrument Approach
The orderly positioning of an IFR aircraft from the enroute phase to a position and altitude for a landing or a missed approach.

Instrument Approach Operations
An approach and landing using instruments for navigation guidance based on an instrument approach procedure. There are 2 methods for instrument approach operations:

- a 2-dimensional (2D) operation, using lateral navigation guidance only and
- a 3-dimensional (3D) operation, using both lateral and vertical navigation guidance.

Instrument Approach Procedure (IAP)
A series of predetermined manoeuvres by reference to flight instruments with specified protection from obstacles from the initial approach fix or, where applicable, from the beginning of a defined arrival route to a point from which a landing can be completed and thereafter, if a landing is not completed, to a position at which holding or en-route obstacle clearance criteria apply. IAPs are classified as follows:

- non-precision approach (NPA) procedure, which means an IAP designed for 2D instrument approach operations Type A.
- approach procedure with vertical guidance (APV) means a performance-based navigation (PBN) IAP designed for 3D instrument approach operations Type A.
- precision approach (PA) procedure means an IAP based on navigation systems designed for 3D instrument approach operations Type A or B.

Instrument Flight Rules
Those for flight solely with reference to instruments, as per the Rules of the Air.

Instrument Flight Time
Time during which a pilot is controlling an aircraft in flight solely by reference to instruments.

Instrument Ground Time
Time during which a pilot is receiving instruction in simulated instrument flight, in flight simulation training devices (FSTD).

Instrument Time
Instrument flight time or instrument ground time.

Intermediate Fix (IF)
A fix that marks the end of an initial segment and the beginning of the intermediate segment of an instrument approach procedure.

Intermittent Maximum Icing
See *Icing Atmospheric Conditions*.

Instrument Meteorological Conditions
Weather precluding flight under Visual Flight Rules in terms of visibility, distance from cloud, and ceiling (see Annex 2).

Integrity (Aeronautical Data)
A degree of assurance that data and its value has not been lost nor altered since its origination or amendment.

International Headquarters
As designated by Order in Council under section 1 of the International Headquarters and Defence Organisations Act 1964.

International NOTAM Office
An office designated by a State for the international exchange of NOTAMs.

International Standards & Recommended Practices
Those for aircraft accident and incident investigation adopted under Article 37 of the Chicago Convention.

Investigator In Charge
A person charged, on the basis of qualifications, with responsibility for the organisation, conduct and control of a safety investigation.

ITP Aircraft
One approved by the State of the Operator to conduct in-trail procedures (ITP).

ITP Distance
The distance between an ITP aircraft and a reference aircraft as defined by:

- *aircraft on the same track*, the difference in distance to an aircraft calculated common point along a projection of each other's track, or
- *aircraft on parallel tracks*, the distance measured along the track of one of the aircraft using its calculated position and the point abeam the calculated position of the other aircraft.

The term *reference aircraft* refers to one or two aircraft with ADS-B data that meet the ITP criteria in 5.4.2.7 and are indicated to ATC by the ITP aircraft as part of the ITP clearance request.

JAA
Joint Aviation Authorities, an associated body of the European Civil Aviation Conference.

JAA Full Member State
A full member of the JAA.

JAA licence
A licence granted under JAR-FCL.

JAR
A Joint Aviation Requirement of the JAA with a number or letters. Reference to a numbered or lettered JAR is one to such a requirement as adopted by JAA or, where a JAR has been annexed to the Technical Harmonisation Regulation, in the form it has been thus annexed and has effect under that Regulation.

JAR-FCL licence
A licence included in Section 2 of Part A of Schedule 8.

Known Traffic
That which the current flight details and intentions of which are known to the controller concerned through direct communication or co-ordination.

Land
As a verb, includes alighting on water.

Land Aircraft
One not capable of normal operations on water.

Landing
For other than airships, coming into contact with a supporting surface, including actions immediately before and after. Also, the act of bringing an airship under restraint, plus any acts immediately before and after.

Landing Area
That part of a movement area intended for the landing or taking off of aircraft.

Landing Decision Point (LDP)
The fixed point used in determining landing performance in Performance Class 1 helicopter operations from which, an engine failure having been recognised, the landing may be safely continued or a balked landing initiated.

Landing Distance at Time of Arrival (LDTA)
A landing distance that is achievable in normal operations based on landing performance data and associated procedures determined for the prevailing conditions at the time of landing.

Landing Distance Available (LDA)
The length of a runway which is declared available by the State of the aerodrome and suitable for the ground run of an aeroplane landing.

Landing Threshold Point (LTP)
A point over which the glide path passes at a relative height specified by the reference datum height. It is defined by the WGS-84 latitude, longitude and ellipsoid height. The LTP is normally located at the intersection of the runway centreline and threshold.

Landplane
A fixed wing aircraft designed for taking off and landing on land and includes amphibians operated as landplanes.

Large Aeroplane
One with a max certificated takeoff mass over 5700 kg.

Large Rocket
One with a total impulse from the engines over 10,240 Newton-seconds.

Latent Heat
Converting water (for example) from one state to the other requires energy, which originally comes from the Sun's rays as it is evaporated in the first place, and is stored with the vapour. While there, it is known as latent, and released when the water condenses. Latent heat becomes involved when you change the form of a substance without changing its temperature.

Lateral Separation
The specified spacing between aircraft expressed in terms of distance or angular displacement between tracks.

Launch Weight
The total weight of a hang glider or an ultra-light when ready for flight, including equipment, instruments, fuel or oil, but not occupants, float equipment, etc.

Landing Distance Available (LDA)
The length of a runway declared available and suitable for the ground run of landing aeroplanes.

LDP
Landing Decision Point.

Legal Personal Representative
The executor, administrator, or other representative, of a deceased person.

Level
A generic term relating to the vertical position of an aircraft in flight and meaning variously, height, altitude or flight level.

Level Bust
Any deviation from assigned altitude, height or flight level in excess of 300 feet.

Licence
Includes certificates of competency or validity issued with it, or required to be held in connection with it (e.g. a medical) by the law of the country it is granted.

Licence For Public Use
See article 103(3) of the UK Air Navigation Order.

Licensed Aerodrome
As licensed under the UK Air Navigation Order.

Lifejacket
Includes any device designed to support a person individually in or on the water.

Life-Limited
A part or parts that, as part of a type certificate, may not exceed a specified time or number of cycles, in service.

Lighter-Than-Air Aircraft
One supported in the atmosphere by its own buoyancy.

Light Turbulence
That which momentarily causes slight, erratic changes in altitude or attitude, or which causes slight, rapid and somewhat rhythmic bumpiness without appreciable changes in altitude or attitude.

Linear Operation
An instrument approach operation in which the maximum tolerable error/deviation from the planned track is expressed in units of length, for instance nautical miles, for cross-track lateral deviation.

Line-Orientated Flight Scenario
The assessment and training involving a realistic, 'real-time', full mission simulation of scenarios that are representative of line operations.

Line Check
A check conducted by an operator and completed by a pilot or technical crew member to demonstrate competence in carrying out normal line operations described in the operations manual.

Liquid Water Equivalent (LWE) System
An automated weather measurement system that determines the LWE precipitation rate in conditions of frozen or freezing precipitation. It provides flight crews with continuously updated information on the fluid protection capability under varying weather conditions.

LNAV
Lateral Navigation.

Load Factor
The ratio of a specified load to total weight of an aircraft, in terms of any of: aerodynamic forces, inertia forces, or ground or water reactions.

Local Helicopter Operation (LHO)
A commercial air transport operation of helicopters with a maximum certified take-off mass (MCTOM) over 3175 kg and a maximum operational passenger seating configuration (MOPSC) of nine or less, by day, over routes navigated by reference to visual landmarks, conducted within a local and defined geographical area specified in the operations manual.

Location Indicator
A four-letter code group formulated in accordance with rules prescribed by ICAO and assigned to the location of an aeronautical fixed station.

Logon Address
A specified code used for a datalink logon to an ATS unit.

Longitudinal Separation
The specified interval between aircraft expressed in units of time or distance along track.

Log Book
Includes records kept in a book, or other approved means.

LORAN
Long Range Air Navigation System.

Low Visibility Operations (LVOs)

Approach or takeoff operations on a runway with a runway visual range less than 550 m or with a decision height less than 200 ft.

Low Visibility Take Off (LVTO)

A takeoff with an RVR less than 550 m.

Lowest Operational Use Temperature (LOUT)

The lowest temperature at which a fluid has been tested and certified as acceptable in accordance with the appropriate aerodynamic acceptance test whilst still maintaining a freezing point buffer of not less than:

- 10°C for a Type I fluid, or
- 7°C for Type II, III or IV fluids.

LPV

Localiser Performance with Vertical Guidance.

Mach Number

The ratio of TAS to the speed of sound.

Mach Number Technique

The technique of clearing turbojet aircraft operating along the same track or continuously diverging tracks to maintain specified Mach numbers in order to maintain adequate longitudinal separation between successive aircraft at, or climbing or descending to, the same level.

Main Rotor

Rotor or rotors supplying the principal lift of a rotorcraft.

Maintenance

The overhaul, repair, required inspection or modification, or removal and installation of components of, an aeronautical product, not including elementary work or servicing. One or a combination of overhaul, air, inspection, replacement, modification or defect rectification of aircraft or components.

Maintenance Check Flight (MCF)

A flight of an aircraft with an airworthiness certificate or a permit to fly which is carried out for troubleshooting purposes or to check the functioning of one or more systems, parts or appliances after maintenance, if the functioning of the systems, parts or appliances cannot be established during ground checks and which is carried out in any of the following situations:

- as required by the aircraft maintenance manual (AMM) or any other maintenance data issued by a design approval holder being responsible for the continuing airworthiness of the aircraft.
- after maintenance, as required by the operator or proposed by the organisation responsible for the continuing airworthiness of the aircraft.
- as requested by the maintenance organisation for verification of a successful defect rectification.
- to assist with fault isolation or troubleshooting.

Maintenance Schedule

One required for inspections and other maintenance of aircraft.

Major Modification

An alteration to the type design of an aeronautical product with more than a negligible effect on weight and centre-of-gravity limits, structural strength, performance, power plant operation, flight characteristics or other qualities affecting airworthiness or environmental characteristics.

Major Repair

A repair to an aeronautical product with a type certificate that causes it to deviate from the design defined by the type certificate, with more than a negligible effect on the weight and centre-of-gravity limits, structural strength, performance, power plant operation, flight characteristics or other qualities affecting airworthiness or environmental characteristics.

Manifold Pressure

Absolute static pressure measured at the appropriate point in an induction system, usually in inches or millimetres of mercury.

Manoeuvres Training Phase

A phase of an EBT module during which, according to aircraft generation, crews have time to practice and improve performance in largely psychomotor skill-based exercises by achieving a prescribed flight path or performing a prescribed event to a prescribed outcome.

Manoeuvring Area
That part of an aerodrome used takeoff and landing of aircraft and movement on the surface, excluding the apron and any part used for maintenance.

Marker
An object displayed agl for indicating an obstacle or obstruction, or delineating a boundary.

Marking
A symbol or group of symbols displayed on the surface of a movement area for conveying aeronautical information.

Max Continuous Power and/or Thrust
The power and/or thrust in the performance data for unrestricted duration.

Max Continuous Power and/or Thrust Rating
The minimum test bed acceptance power and/or thrust, as in the engine type certificate data sheet, of series and newly overhauled engines running at the specified conditions within appropriate acceptance limitations.

Maximum Contingency Power and/or Thrust
The power and/or thrust for when a power-unit has failed or been shut down during takeoff, baulked landing or before a discontinued approach and limited continuously for up to 2.5 minutes.

Maximum Engine Overspeed
Piston - maximum rotational speed, inadvertent occurrence of which for up to 20 seconds does not require rejection or maintenance (other than for correction).

Turbine - maximum rotational speed of each independent main rotating system, inadvertent occurrence of which, for up to 20 seconds, does not require rejection or maintenance (other than to correct the cause). For each main rotating system, this is normally at least the maximum transient RPM in non-fault conditions.

Maximum Engine Overtorque
Maximum torque of a free power-turbine, inadvertent occurrence of which for up to 20 seconds does not require rejection or maintenance (other than to correct the cause).

Maximum Exhaust Gas Overtemperature
The maximum engine EGT of a turbine, inadvertent use of which for up to 20 seconds does not require rejection or maintenance (other than to correct the cause). Do not confuse with maximum temperatures for starting.

Maximum Mass
Maximum certificated takeoff mass.

Max Operational Pax Seating Configuration
The maximum passenger seating capacity of an individual aircraft, excluding crew seats, established for operational purposes and specified in the operations manual. Taking as a baseline the maximum passenger seating configuration established during the certification process conducted for the type certificate (TC), supplemental type certificate (STC) or change to the TC or STC as relevant to the individual aircraft, the MOPSC may establish an equal or lower number of seats, depending on the operational constraints.

Maximum Permitted Exposure Time
A period, based of the power unit failure rate for the engine type, during which the probability of a power unit failure can be discounted.

Max Power-Turbine Speed for Autorotation
The maximum rotational speed of the power-turbine (in a helicopter) during autorotation for periods of unrestricted duration.

Maximum Power Turbine Overspeed
The max rotational speed of the free power-turbine (in helicopters), inadvertent occurrence of which, for up to 20 seconds does not require rejection or maintenance (other than to correct the cause).

Maximum Structural Landing Mass
The maximum permissible total aeroplane mass on landing under normal circumstances.

Maximum Structural Take Off Mass
The maximum permissible total aeroplane mass at the start of the takeoff run.

Maximum Takeoff Mass
The maximum permissible total mass at takeoff.

Maximum Total Weight Authorised
The maximum total weight of an aircraft and contents, at which it may take off anywhere, in the most favourable circumstances under the C of A.

Maximum Zero Fuel Mass
The maximum permissible mass of an aeroplane with no usable fuel or, put another way, where any additional weight comes from fuel. The mass of fuel in particular tanks must be included when explicitly mentioned in Flight Manual limitations.

Medical Attendant
A person carried to attend to any person in need of medical attention, or to be available to attend to them.

Medical Passenger
A medical person carried in a helicopter during a HEMS flight, including but not limited to, doctors, nurses and paramedics.

MEL
Minimum Equipment List. A document that authorises inoperative equipment, or equipment that must be working.

MET
Meteorological.

Meteorological Office
An office designated to provide meteorological service for international air navigation.

Meteorological Report
A statement of observed meteorological conditions related to a specified time and location.

Microlight
An aeroplane with up to two seats, a V_{S0} of up to 35 knots CAS, and maximum takeoff mass up to:

- 300 kg for a landplane, single-seater
- 330 kg, single-seat amphibians, floatplanes
- 450 kg for a landplane, two-seater
- 495 kg for an amphibian or floatplane, two-seater, provided that a microlight that is a floatplane and a landplane falls below both MTOM limits.

Foot-launched aircraft are excluded.

Military aircraft
The naval, military or air force aircraft of any country, and any being constructed for them under a contract entered into by the Secretary of State, or for which there is a certificate that the aircraft is to be treated as such.

Military Rocket
The naval, military or air force rockets of any country, and any being constructed for them under a contract entered into by the Secretary of State, or for which there is a certificate that the aircraft is to be treated as such.

Minimum Descent Height/Altitude
A specified altitude or height in a 2D instrument or circling approach operation below which descent must not be made without the required visual reference.

Minimum Eye Height Over Threshold (MEHT)
The lowest height over the runway threshold at which a (VASI/PAPI) on-slope indication will be seen.

Minimum Drainage Period After a False Start
The minimum period to allow surplus fuel to drain from a turbine engine before trying again, from the time the starter is switched off and/or the engine fuel cock is closed during a false start.

Minimum Fuel
A situation where your fuel state is such that little or no delay can be accepted.

Minimum Governed Rotational Speed
The minimum rotational speed as determined by the setting of the (variable pitch) propeller governor or control mechanism.

Minimum Navigation Performance Specifications
A portion of the North Atlantic Region airspace between FL285 and FL420 extending between latitude 27º North in the New York FIR, the southern boundary of Santa Maria Oceanic, and the North Pole, bounded in the east by the eastern boundaries of control areas Santa Maria Oceanic, Shanwick Oceanic and Reykjavik, and in the west by the western boundary of Reykjavik CTA, the western boundary of Gander Oceanic CTA, and the western boundary of New York Oceanic CTA, excluding the area west of 60º West and south of 38º30' North.

Minimum Sector Altitude
The lowest altitude which may be used under emergency conditions which will provide a minimum clearance of 1000 ft above all objects in an area contained within a sector of 25 nm radius on a radio aid to navigation (or in certain countries of the ARP).

Minimum Stabilization Distance (MSD)
The minimum distance to complete a turn manoeuvre and after which a new manoeuvre can be initiated. The minimum stabilization distance is used to compute the minimum distance between waypoints.

Minor Failure Condition
A failure condition that would not significantly reduce aircraft safety, and which involves flight crew actions that are well within their capabilities.

Min Takeoff Crankshaft Rotational Speed
Minimum crankshaft rotational speed of a piston engine with max takeoff manifold pressure.

Missed Approach Holding Fix (MAHF)
A fix used in RNAV applications that marks the end of the missed approach segment and the centre point for the missed approach holding.

Missed Approach Holding Waypoint (MAHWP)
In RNAV procedures. The missed approach segment contains a waypoint which establishes tracking guidance during the missed approach.

Missed Approach Point (MAPt)
That point in an instrument approach procedure at or before which the prescribed missed approach procedure must be initiated In order to ensure that the minimum obstacle clearance is not infringed.

Missed Approach Procedure
To be followed if, after an instrument approach, a landing is not effected.

Misuse Of Substances
The use of one or more psychoactive substances by flight crew, cabin crew members and other safety-sensitive personnel in a way that constitutes a direct hazard to the user or endangers the lives, health or welfare of others, and/or causes or worsens an occupational, social, mental or physical problem or disorder.

Mixed EBT Program
An operator's recurrent training and checking program as per ORO.FC.230, a portion of which is dedicated to the application of EBT but which does not replace proficiency checks as per Appendix 9 to Annex I (Part-FCL) to Regulation (EU) No 1178/2011.

MLS
Microwave Landing System.

MNPS
Minimum Navigation Performance Specification.

Mode (SSR)
The conventional identifier related to specific functions of the interrogation signals transmitted by an SSR interrogator. There are four modes specified in Annex 10: A, C, S and intermode.

Model aircraft

One with a total weight typically under 35 kg (77.2 lbs), mechanically driven or launched into flight for recreational purposes, not designed to carry people or other living creatures.

Model Rocket

One with model engines that will not generate a total impulse over 80 newton-seconds, under 500kg and with a parachute or other device capable of retarding its descent.

Modified Engine

One previously approved, with unapproved modifications.

Modified Propeller

One previously approved, with unapproved modifications.

Module

A group of engine (or propeller) components defined and replaceable without mechanical or performance difficulties. It is uniquely identified and amenable to the setting of an overhaul life separate from other parts.

MOPSC

Maximum Operational Passenger Seating Configuration. The maximum passenger seating capacity of an individual aircraft, excluding crew seats, established for operational purposes and specified in the operations manual. Taking as a baseline the maximum passenger seating configuration established during the certification process conducted for the type certificate (TC), supplemental type certificate (STC) or change to the TC or STC as relevant to the individual aircraft, the MOPSC may establish an equal or lower number of seats, depending on the operational constraints.

Mountainous Area

An area of changing terrain profile where the changes of terrain elevation exceed 900 m (3 000 ft) within a distance of 18.5 km (10 nm).

Movement Area

Part of an aerodrome for the surface movement of aircraft, including the manoeuvring area and aprons.

Moving Airspace Reservation

An airspace reservation whose position in space changes with time.

MSA

Minimum Safe Altitude.

MSAW
Minimum Safe Altitude Warning. A ground-based safety net intended to warn ATC about increased risks of CFIT with alerts of aircraft proximity to terrain or obstacles.

It compares the levels reported by Mode C transponders against MSAs. When the level or altitude of an aircraft is detected or predicted to be lower than the MSA, a visual and sometimes an audible warning is generated for the ATCO concerned.

Multi-crew co-operation
Functioning of the flight crew as a team led by the PIC.

MNPS Airspace
North Atlantic Minimum Performance Specification Airspace prescribed as such.

Multilateration (MLAT) System
A group of equipment configured to provide position derived from the secondary surveillance radar (SSR) transponder signals (replies or squitters) primarily using time difference of arrival (TDOA) techniques. Additional information, including identification, can be extracted from the received signals.

Multi-Crew Cooperation (MCC)
The functioning of a flight crew as a team of cooperating members led by the PIC.

Multi-Pilot Aircraft
- For **aeroplanes**, those certificated for operation with a minimum crew of at least two pilots.
- For **helicopters**, airships and powered-lift aircraft, the type of aircraft required to be operated with a co-pilot as specified in the flight manual or by the air operator certificate or equivalent document.

Multi-Pilot Operation
- For **aeroplanes**, operations needing at least 2 pilots using multi-crew cooperation in either multi-pilot or single-pilot aeroplanes.
- For **helicopters**, operations needing at least 2 pilots using multi-crew cooperation on multi-pilot helicopters.

Named Point
A reporting point identified by a name as well as by latitude and longitude.

Nationality Mark
Symbols, letters or numerals, or combinations, used by states to indicate nationality of aircraft registered in them.

Nautical Mile
The International Nautical Mile, that is, 1852 metres.

Navigation Specification
A set of aircraft and flight crew requirements needed to support performance-based navigation operations within a defined airspace. There are two kinds of navigation specifications:

- Required Navigation Performance (RNP). A specification based on area navigation that includes the requirement for performance monitoring and alerting, designated by the prefix RNP, e.g. RNP 4, RNP APCH.
- Area Navigation (RNAV). A specification based on area navigation that does not include the requirement for performance monitoring and alerting, designated by the prefix RNAV, e.g. RNAV 5, RNAV 1.

NDB
Non-Directional Radio Beacon.

Near-Parallel Runways
Non-intersecting runways whose extended centre lines have an angle of convergence or divergence of 15° or less.

Next Data Authority
The ground system designated by the current data authority through which an onward transfer of communications and control can take place.

Night
The time from half an hour after sunset until half an hour before sunrise (both times inclusive), sunset and sunrise being determined at surface level. In some countries, also where the centre of the Sun's disc is more than 6° below the horizon. ICAO & EASA say "between the end of evening civil twilight and the beginning of morning civil twilight, or as may be prescribed by the appropriate authority, as defined by the Member State."

Night Vision Goggles (NVG)
A head-mounted, binocular, light intensification appliance that enhances the ability to maintain visual surface references at night.

Night Vision Imaging System (NVIS)
The integration of all elements required to successfully and safely use NVGs while operating a helicopter. The system includes at least: NVGs, NVIS lighting, helicopter components, training and continuing airworthiness.

NIL
In radio, *None*, or “I have nothing to send you”.

Non-Hostile Environment
An environment where a safe forced landing can be accomplished, occupants can be protected from elements, and SAR is consistent with anticipated exposure. Congested areas with adequate safe forced landing areas are non-hostile.

Non-piloted Aircraft
A power-driven aircraft, other than a model, without a crew member.

Non-precision Approach
A instrument approach using non-visual aids for guidance in azimuth or elevation but not a precision approach.

Non-revenue Flight
A flight that a PPL holder (aeroplanes, helicopters or gliders) may undertake under paragraph (2)(a) and (b) of the privileges in Section 1 of Part A of Schedule 8.

Normal Operating Differential Pressure
The difference between cabin and outside pressure, including tolerances of normal regulating systems.

Normal Operating Zone (NOZ)
Airspace of defined dimensions extending to either side of an ILS localizer course and/or MLS final approach track. Only the inner half of the normal operating zone is taken into account in independent parallel approaches.

NOTAM
A notice to airmen about aeronautical facilities, services or procedures, or any hazard affecting aviation safety, essential to personnel engaged in flight operations. Under ICAO, a notice distributed by telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations.

No Transgression Zone (NTZ)
In the context of independent parallel approaches, a corridor of airspace of defined dimensions located centrally between the two extended runway centre lines, where a penetration by an aircraft requires a controller intervention to manoeuvre any threatened aircraft on the adjacent approach.

Notified
Set forth with the authority of the CAA in a document published by or under an arrangement entered into with the CAA and entitled 'United Kingdom NOTAM' or 'Air Pilot', for the time being in force.

NTZ
See *No Transgression Zone*.

NVG
Night Vision Goggles.

NVIS Crew Member
A technical crew member assigned to an NVIS flight.

NVIS Flight
A flight under night visual meteorological conditions (VMC) with the flight crew using NVGs in a helicopter operating under an NVIS approval.

Obstacle
Fixed (temporary or permanent) and mobile objects, or parts thereof, that:

- are located on an area intended for the surface movement of aircraft; or
- extend above a defined surface intended to protect aircraft in flight; or
- stand outside those defined surfaces and that have been assessed as being a hazard to air navigation.

Obstacle Assessment Surface (OAS)
A defined surface intended for the purpose of determining those obstacles to be considered in the calculation of obstacle clearance altitude or height for a specific ILS facility and procedure.

Obstacle Clearance Altitude (OCA) or Height (OCH)
The lowest altitude or the lowest height above the elevation of the relevant runway threshold or aerodrome elevation, as applicable, used in establishing compliance with the appropriate obstacle clearance criteria.

Obstacle Free Zone (OFZ)
The airspace above the inner approach surface, inner transitional surfaces, and balked landing surface and that portion of the strip bounded by these surfaces, which is not penetrated by any fixed obstacle other than a low-mass and frangibly mounted one required for air navigation purposes.

Obstacle Limitation Surfaces
See CAP 168, *Licensing of aerodromes*.

Oceanic Entry Point
That point on an FIR boundary where an aircraft enters the first oceanic control area.

Oceanic Exit Point
That point on the FIR boundary where an aircraft leaves the last oceanic control area.

Offshore Operation
A helicopter operation with a substantial proportion of any flight conducted over open sea areas to or from an offshore location.

Offshore Location
A facility intended for helicopter operations on a fixed or floating offshore structure or a vessel.

Open Sea Area
The area of water to seaward of a coastline.

Operating Site
A site, other than an aerodrome, selected by the operator or pilot-in-command or commander for landing, take-off and/or external load operations.

Operation In Performance Class 1
An operation that, if the critical engine fails, the helicopter is able to land within the rejected takeoff distance available or safely continue to an appropriate landing area, depending on when the failure occurs.

Operation In Performance Class 2
An operation where, if a critical engine fails, performance is available to enable a helicopter to safely continue the flight, except when the failure occurs early during the take-off manoeuvre or late in the landing manoeuvre, in which cases a forced landing may be required.

Operation In Performance Class 3
An operation where, in the event of an engine failure at any time during the flight, a forced landing may be required in a multi-engined helicopter and will be required in a single-engined helicopter.

Operational Control
The exercise of authority over, or the responsibility for, the initiation, continuation, diversion or termination of a flight in the interests of safety.

Operational Credit
A credit for operations with an advanced aircraft enabling lower aerodrome operating minima than would normally be established by the operator for a basic aircraft, based upon the performance of advanced aircraft systems utilising the available external infrastructure. Lower operating minima may include a lower decision height/altitude or minimum descent height/altitude, reduced visibility requirements or reduced ground facilities or a combination of these.

Operator
The person at the relevant time who has the management of an aircraft. ICAO: A person, organisation or enterprise engaged in, or offering to engage in, an aircraft operation. Often taken to mean a driver in road and rail legislation and, by extension, a pilot. In Annex 13, any natural or legal person operating, or proposing to operate, one or more aircraft.

Operator Proficiency Check
A check conducted by an operator and completed by a pilot or technical crew member to demonstrate competence in the carrying out of normal, abnormal and emergency procedures.

Opposite Direction Aircraft
Aircraft operating in the opposite direction on reciprocal tracks, or on parallel or non-intersecting tracks that are not laterally separated.

Optimum Altitude
Where specific range is maximum.

Other Training Devices (OTD)
Training aids other than flight simulators, flight training devices or flight and navigation procedures trainers which provide means for training where a complete flight deck environment is not necessary.

Overhaul
A restoration process including the disassembly, inspection, repair or replacement of parts, reassembly, adjustment, refinishing and testing of an aeronautical product, ensuring the product is in conformity with the tolerances in applicable instructions for continued airworthiness.

Overpack
An enclosure used by a single shipper to contain one or more packages and form one handling unit for convenience of handling and stowage (not including a unit load device).

Owner
The person with legal custody and control of an aircraft.

Package
The complete product of a packing operation consisting of the packaging and its contents prepared for transport.

Packaging
Receptacles and other components or materials necessary for the receptacle to perform its containment function and to ensure compliance with packing requirements.

Parascending Parachute
One towed by cable causing it to ascend.

Passenger
A person other than a crewmember, carried in an aircraft.

Passenger Classification
Adults, male and female, are 12 years of age and above. Children are 2 years old and above, but less than 12. Infants are less than 2 years old.

Passing Point
The point where aircraft are at the minimum distance from each other and from which longitudinal separation is calculated. This may or may not coincide with the common point.

Performance Based Communication (PBC)
Communication based on performance specifications applied to the provision of air traffic services. An RCP specification includes communication performance requirements that are allocated to system components in terms of the communication to be provided and associated transaction time, continuity, availability, integrity, safety and functionality needed for the proposed operation in the context of a particular airspace concept.

Performance Based Navigation (PBN)
Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace (ICAO).

Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace (EASA).

Performance requirements are expressed in navigation specifications (RNAV specification, RNP specification) in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept.

Performance Based Surveillance (PBS)
Surveillance based on performance specifications applied to the provision of air traffic services. An RSP specification includes surveillance performance requirements that are allocated to system components in terms of the surveillance to be provided and associated data delivery time, continuity, availability, integrity, accuracy of the surveillance data, safety and functionality needed for the proposed operation in the context of a particular airspace concept.

Performance Class A Aeroplanes
Multi-engined aeroplanes powered by turbo-propeller engines with an MOPSC of more than nine or a maximum takeoff mass exceeding 5700 kg, and all multi-engined turbo-jet powered aeroplanes.

Performance Class B Aeroplanes
Those powered by propeller engines with an MOPSC of 9 or less and with an MTOM of 5700 kg or less.

Performance Class C Aeroplanes
Those powered by reciprocating engines with an MOPSC of more than nine or a maximum takeoff mass exceeding 5700 kg.

Performance Class 1 Helicopter
Performance such that, if the critical power unit fails, a helicopter can land within rejected takeoff distance available or safely go to an appropriate landing area, depending on when the failure occurs.

Performance Class 2 Helicopter
Performance such that, if the critical power unit fails, a helicopter can safely continue, except early in the takeoff or late in landing, when a forced landing may be required.

Performance Class 3 Helicopter
Performance such that, if a power unit fails, a forced landing may be required in a multi-engined helicopter, but will be required in a single-engined helicopter.

Performance Criteria
A simple, evaluative statement on the required outcome of a competency element and a description of the criteria used to judge if the required level of performance has been achieved.

Person Involved
For Annex 13, the owner, a member of the crew, the operator of an aircraft involved in an accident or serious incident, any person involved in the maintenance, design, manufacture of that aircraft or in the training of its crew, any person involved in the provision of air traffic control, flight information or aerodrome services, who have provided services for the aircraft, staff of the national civil aviation authority or staff of EASA.

Personnel-Carrying Device System (PCDS)

A system including one or more devices that is either attached to a hoist or cargo hook or mounted to the rotorcraft airframe during human external cargo (HEC) or helicopter hoist operations (HHO). The devices have the structural capability and features needed to transport occupants external to the helicopter e.g. a life safety harness with or without a quick release and strop with a connector ring, a rigid basket or a cage.

A *simple* PCDS is one that:

- meets a harmonised standard under Regulation (EU) 2016/425 of the European Parliament and of the Council1 or Directive 2006/42/EC of the European Parliament and of the Council2.
- is designed to restrain no more than a single person (for instance, hoist or cargo hook operator, task specialist or photographer) inside the cabin, or to restrain no more than two persons outside the cabin.
- is not a rigid structure such as a cage, a platform or a basket.

Period Of Duty

The time between the start and end of a shift in which an air traffic controller performs, or could be called upon to perform, functions specified for a rating in a licence.

Pilot Flying (PF)

The pilot in charge of the controls of an aircraft.

Pilot In Command (PIC)

The pilot designated by an aircraft operator, or in the case of general aviation, the owner, as being in command and charged with the safe conduct of a flight.

A person in charge of the piloting of an aircraft without being under the direction of any other pilot in it. The pilot responsible for the operation and safety of an aircraft during flight time (not necessarily the handling pilot).

For commercial air transport operations, the pilot-in-command shall be termed the commander.

Pilot In Command Under Supervision (PICUS)

A co-pilot performing, under the supervision of a PIC, the duties and functions of a PIC.

Pilot Monitoring (PM)

See *Pilot Not Flying*.

Pilot Not Flying (PNF)

The pilot assisting the Pilot Flying under the multi- crew co-operation concept, when the flight crew is more than one (a better term is Pilot Monitoring).

Point-In-Space Approach (PinS)
One based on a basic GNSS non-precision approach procedure designed for helicopters only. It is aligned with a reference point located to permit subsequent flight manoeuvring or approach and landing using visual manoeuvring in adequate visual conditions to see and avoid obstacles.

Point-In-Space Reference Point (PRP)
A reference point for the PinS approach as identified by the latitude and longitude of the MAPt.

Police officer
A member of a police force or the RUC, including reserves, and special constables, all of whom must have a warrant card.

Portable EFB
A portable EFB host platform, used on the flight deck, not part of the configuration of the certified aircraft.

Portable Electronic Device (PED)
Any kind of electronic device, typically but not limited to consumer electronics, brought on board the aircraft by crew members, passengers, or as part of the cargo, that is not included in the configuration of the certified aircraft. It includes all equipment that is able to consume electrical energy. The electrical energy can be provided from internal sources such as batteries (chargeable or non-rechargeable) or the devices may also be connected to specific aircraft power sources;

Position Indication
The visual indication, in non-symbolic and/or symbolic form, on a situation display, of the position of an aircraft, aerodrome vehicle or other object.

Position Symbol
The visual indication in symbolic form, on a situation display, of the position of an aircraft, aerodrome vehicle or other object, obtained after automatic processing of positional data derived from any source.

Post-Treatment, De-Icing or De-/Anti-Icing Check

An external check of an aircraft after de-icing and/or anti-icing treatment accomplished by qualified staff and from suitably elevated observation points (e.g. from the de-icing/anti-icing equipment itself or other elevated equipment) to ensure that the aircraft is free from frost, ice, snow, or slush.

Power Definitions

For piston-engined aeroplanes and helicopters:

- *Takeoff Power* - output shaft power for takeoff, discontinued approach and baulked landing, up to 5 continuous minutes.
- *Takeoff Power Rating* - the test bed minimum acceptance output shaft power in the engine type certificate data sheet, of series and newly overhauled engines running at the declared maximum coolant CHTs, within appropriate acceptance limitations.
- *Maximum Continuous Power* - output shaft power in performance data for unrestricted duration (don't assume this is necessarily for normal operations).
- *Maximum Continuous Power Rating* - the minimum test bed acceptance power, as in the type certificate data sheet, of series and newly overhauled engines at declared max coolant CHTs within appropriate acceptance limitations.
- *Maximum Recommended Cruising Power Conditions* - crankshaft rotational speed, manifold pressure and other parameters for cruising.
- *Maximum Best Economy Cruising Power Conditions* - crankshaft rotational speed, manifold pressure and other parameters recommended for economical cruising mixture strength.

Powered Glider
An aeroplane that, with the engines inoperative, behaves like a glider.

Powered Lift Aircraft
Aircraft deriving vertical lift and in-flight propulsion/lift from variable geometry rotors or engines/propulsive devices attached to or within the fuselage or wings.

Powered Sailplane
An aircraft, with one or more engines, with the characteristics of a sailplane with engines not working.

Precision Approach
An instrument approach using ILS, MLS or PAR in azimuth and elevation.

Precision Approach Procedure
One providing azimuth and glide path information provided by an ILS or PAR.

Precision Approach Radar (PAR)
Primary radar equipment used to determine the position of an aircraft during final approach, in terms of lateral and vertical deviations relative to a nominal approach path, and in range relative to touchdown. Precision approach radars enable pilots to be given guidance by radio during the final stages of the approach to land.

Preliminary Report
The communication used for the prompt dissemination of data obtained during the early stages of an investigation.

Prescribed
Prescribed by regulations made by the Secretary of State under the ANO.

Pressure Altitude
An atmospheric pressure expressed in terms of altitude which corresponds to that pressure in the Standard Atmosphere.

Pressurised Aircraft
One that can maintain in any compartment a pressure greater than the outside atmosphere.

Pre-Takeoff Check
Within an aircraft's HOT and prior to takeoff, the flight crew should check the aircraft's wings or representative aircraft surfaces for frozen contaminants.

Pre-Takeoff Contamination Check
A check of the treated surfaces for contamination, performed when the HOT has been exceeded or if any doubt exists regarding the continued effectiveness of the applied anti-icing treatment. It is normally accomplished externally, just before starting the takeoff run.

Primary Area
A defined area symmetrically disposed about the nominal flight track in which full obstacle clearance is provided. (See also *Secondary Area*).

Primary Radar
A radar system which uses reflected radio signals.

Primary Surveillance Radar (PSR)
A surveillance radar system using reflected radio signals.

Principal Place Of Business
The head office or registered office of the organisation within which the principal financial functions and operational control of the activities referred to in this Regulation are exercised.

Printed Communications
Communications that automatically provide a permanent printed record at each terminal of a circuit of all messages which pass over such circuit.

Prioritisation Of Ramp Inspections
The dedication of an appropriate portion of the total number of ramp inspections conducted by or on behalf of a competent authority on an annual basis as in Part-ARO.

Proficient
Having demonstrated the necessary skills, knowledge and attitudes that are required to perform any defined tasks to the prescribed standard;

Private Flight
A flight which is not for aerial work or public transport.

Private Pilot
One who holds a licence which prohibits the piloting of aircraft in operations for which remuneration is given, except instruction or examination.

Procedural Control
Term used to indicate that information derived from an ATS surveillance system is not required for the provision of air traffic control service.

Procedural Separation
The separation used when providing procedural control.

Procedural Service
An ATS service where, as well as the provisions of a Basic Service, the controller provides vertical, lateral, longitudinal and time instructions which, if complied with, shall achieve deconfliction minima against other aircraft in the Procedural Service. Neither traffic information nor deconfliction advice can be passed with respect to unknown traffic.

Procedure Altitude/Height
A specified altitude or height flown operationally at or above the minimum and established to accommodate a stabilised descent at a prescribed gradient or angle in the intermediate or final approach segment.

Procedure Turn
A manoeuvre in which a turn is made away from a designated track followed by a turn in the opposite direction to permit the aircraft to intercept and proceed along the reciprocal of the designated track, designated Left or Right according to the direction of the initial turn.

Proficiency Check
The demonstration of skill to revalidate or renew ratings, including such oral examination as may be required.

Profile
The orthogonal projection of a flight path or portion on the vertical surface containing the nominal track.

Proper Shipping Name
The name to describe a particular article or substance in shipping documents and notifications and, where appropriate, on packagings.

Protective Breathing Equipment (PBE)
Equipment designed to cover the eyes, nose and mouth, or just the nose and mouth if the eyes are already protected, to protect the wearer from the effects of smoke, carbon dioxide or other gases.

PSR Blip
The visual indication, in non-symbolic form, on a situation display of the position of an aircraft obtained by primary radar.

Psychoactive Substances
Alcohol, opioids, cannabinoids, sedatives and hypnotics, cocaine, other psychostimulants, hallucinogens, and volatile solvents, with the exception of caffeine and tobacco.

Public Interest Site (PIS)
A site used only for operations in the public interest.

Public Transport
See article 130 of the UK Air Navigation Order.

Public Transport Aircraft
One flying, or intended by an operator to fly, for public transport.

QFE
An altimeter setting used near an airfield, particularly in the circuit, and is the pressure read directly from the altimeter when on ground at an the airfield.

QNH
An altimeter setting used for general transit away from an airfield, below the transition altitude. It is the QFE converted to a pressure that would theoretically exist at sea level at that point - this is done because reporting stations are not all at the same level. You add the pressure change for elevation above sea level on a standard day. The QFE is reduced to MSL using ISA temperatures and lapse rates. It is forecast for one or two hours ahead over large areas.

Quality Assurance
Planned and systematic actions necessary to provide adequate confidence that operational and maintenance practices satisfy given requirements.

Quality Manager
The manager responsible for the management of the Quality System, monitoring function and requesting remedial actions.

Quick-donning Mask
An oxygen mask that can be secured with one hand within five seconds, providing an immediate supply.

Radar Vectoring
The provision of aeronautical guidance to aircraft in the form of specific headings, based on radar.

R
Rotor radius.

Racetrack Procedure
A procedure designed to enable an aircraft to reduce altitude during the initial approach segment and/or establish the aircraft inbound when the entry into a reversal procedure is not practical.

Radar
A radio detection device which provides information on range, azimuth and/or elevation of objects.

Radar Approach
An approach in which the final approach phase is executed under the direction of a controller using radar.

Radar Clutter
The visual indication on a situation display of unwanted signals.

Radar Contact
When the radar position of a particular aircraft is seen and identified on a situation display.

Radar Separation
The separation used when aircraft position information is derived from radar sources.

Radio Navigation Service
A service providing guidance information or position data for the efficient and safe operation of aircraft supported by one or more radio navigation aids.

Radiotelephony
A form of radiocommunication primarily intended for the exchange of information in the form of speech.

Ramp Inspection
The inspection of aircraft, of flight and cabin crew qualifications and of flight documentation in order to verify the compliance with the applicable requirements.

RCC
Rescue Coordination Centre.

RCP Type
A label (e.g. RCP 240) that represents the values assigned to RCP parameters for communication transaction time, continuity, availability and integrity.

Reasonably Probable
Unlikely to occur often during operation of the type, but which may occur several times during operational life.

Receiving Unit/Controller
An air traffic services unit/air traffic controller to which a message is sent. See *Sending Unit/Controller*.

Rectification Interval
A limitation on the duration of operations with inoperative equipment.

Reduced Vertical Separation Minimum
The application of 1000 feet vertical separation from FL290 through FL410 between approved aircraft in RVSM designated airspace.

Reference Datum Height (RDH)
A point at a height above the intersection of a runway centreline and the threshold through which the downward extended straight part of an ILS glidepath passes.

Registered Owner
The person to whom a C of R for an aircraft is issued.

Registration Mark
The combination of letters, or letters and numerals, issued to an aircraft by a state as a registration identification.

Rejected Takeoff Distance Available (RTODAH)
The length of the final approach and takeoff area declared available and suitable for helicopters operated in performance class 1 to complete a rejected takeoff.

Rejected Takeoff Distance Required
The horizontal distance from the start of takeoff to where a helicopter comes to a full stop after a power unit failure and rejection of takeoff at TDP.

Relatives
The immediate family and/or next of kin and/or other person closely connected with the victim of an accident, as defined under the national law of the victim.

Released Flight
Flight by an uncontrollable balloon not attached to the surface by a restraining device.

Relevant Overseas Territory
Any colony and country or place outside Her Majesty's dominions in which HM has jurisdiction.

Remote
Unlikely to occur during total operational life but may occur several times in the total operational life of a number of aircraft of the same type.

Renewal
(of a rating or certificate) means the administrative action taken after a rating or certificate has lapsed for the purpose of renewing the privileges of the rating or certificate for a further specified period consequent upon the fulfilment of specified requirements.

Repair
Rectification of deficiencies in an aeronautical product, or restoration to an airworthy condition.

Repetitive Flight Plan (RPL)
A flight plan related to a series of frequently recurring, regularly operated individual flights with identical basic features, submitted by an operator for retention and repetitive use by ATS units.

Replica
An aircraft of any scale that is a duplicate of an original military aircraft.

Replacement
The removal and replacement of a part (whether the same or not), and whether or not any work is done on it, but not including parts that are designed to be removable solely for the checking another part, or loading cargo.

Reported Headwind Component
That reported during flight planning which may be used if there is no significant change of unfactored wind before takeoff.

Reporting Point
A specified geographical location in relation to which the position of an aircraft can be reported.

Required Communication Performance (RCP)
A statement of the performance requirements for operational communication in support of specific ATM functions.

Required Navigation Performance (RNP)
A statement of the navigation performance necessary for operation within a defined airspace.

Required Surveillance Performance (RSP)
Requirements for ATS provision and associated ground equipment, aircraft capability, and operations needed to support performance-based surveillance.

Required Visual Reference
That portion of the approach area of the runway, or those visual aids that, when viewed by the pilot of an aircraft, enable the pilot to assess the aircraft position and rate of change of position, to continue and complete a landing.

Rescue Coordination Centre (RCC)
A unit responsible for promoting efficient organization of search and rescue services and for coordinating the conduct of search and rescue operations within a search and rescue region.

Rescue Unit
A unit composed of trained personnel and provided with equipment suitable for the expeditious conduct of search and rescue.

Restricted airspace
Airspace of fixed dimensions within which flight is restricted.

Revalidation
(of a rating or certificate) - the administrative action taken within the period of validity of a rating or certificate which allows the holder to continue to exercise the privileges for a further specified period consequent upon the fulfilment of specified requirements.

Reversal Procedure
A procedure designed to enable aircraft to reverse direction during the initial approach segment of an instrument approach procedure. The sequence may include Procedure turns or Base turns.

RNAV
Area Navigation.

RNP
Required Navigational performance. A containment value expressed as a distance in nautical miles from the intended position within which flights would be for at least 95% of the total flight time. However, this concept has been overtaken by that of PBN. The term RNP is now solely used in the context of navigation specifications that require performance monitoring and alerting, e.g. RNP 4 refers to the aircraft and operating requirements, including a 4 nm lateral performance with on-board performance monitoring and alerting that are detailed in Doc 9613.

RNP APCH
A PBN specification used for instrument approaches.

RNP APCH To LNAV Minima
A 2D instrument approach for which the lateral guidance is based on GNSS positioning.

RNP APCH To LNAV/VNAV Minima
A 3D instrument approach for which the lateral guidance is based on GNSS positioning and the vertical guidance is provided either by the Baro VNAV function or by the GNSS positioning including SBAS.

RNP APCH To LPV Minima
A 3D instrument approach for which lateral and vertical guidance are based on GNSS positioning with SBAS.

RNP AR APCH
A navigation specification used for instrument approaches requiring a specific approval.

Required Navigation Performance Specification
A navigation specification for PBN operations that includes a requirement for on-board navigation performance monitoring and alerting.

RNP Type
A containment value expressed as a distance in nautical miles from the intended position within which flights would be for at least 95% of the total flying time.

Rocket
A device propelled by the ejection of expanding gases from self-contained propellant, not dependent on the intake of outside substances, including anything designed to drop off in flight.

Rotation Point (RP)
Where a cyclic input is made to initiate a nose-down attitude change during the takeoff. The last point from which, if engine failure is recognised, forced landing on the deck can be achieved.

Rotational Direction of Equipment
The direction of rotation as observed when looking at the drive face ('clockwise' or 'anti-clockwise').

Rotational Speed
- *Engine* - unless otherwise qualified (e.g. propeller rotational speed), the rotational speed in RPM of the engine crankshaft or its equivalent.
- *Propeller* - unless otherwise specified (e.g. prop RPM), the speed in RPM of the engine crankshaft or its equivalent.

Rotorcraft
A heavier-than-air aircraft that depends mainly for its support in flight on the lift from one or more rotors.

Rotorcraft-Load Combination
The combination of a rotorcraft and an external load, including the load attaching means. They are:

- *Class A* - the load cannot move freely, or be jettisoned, not extending below the landing gear.
- *Class B* - the load is jettisonable and is free of land or water.
- *Class C* - the load is jettisonable and remains in contact with land or water.
- *Class D* - the load is other than a Class A, B or C and has been specifically approved. Mostly for human loads.

Route Sector
A flight comprising takeoff, departure, cruise of at least 15 minutes, arrival, approach and landing phases.

Rules of the Air
See article 84(1) and ICAO Annex 2. For EASA, the rules established in Commission Implementing Regulation (EU) No 923/20121.

Runway
A defined area on a land aerodrome prepared for the landing and taking off of aircraft (ICAO says a *rectangular* area).

Runway Condition Report (RCR)
A comprehensive standardised report relating to the conditions of the runway surface and their effect on the aeroplane landing and takeoff performance, described by means of runway conditions code.

Runway Holding Position
A designated position intended to protect a runway, an obstacle limitation surface, or an ILS/MLS critical/ sensitive area at which taxiing aircraft and vehicles shall stop and hold, unless otherwise authorised by the aerodrome control tower.

Runway Incursion
An occurrence involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and takeoff of aircraft.

Runway Visual Range (RVR)
The distance in the direction of takeoff or landing over which runway lights or surface markings may be seen from the touchdown zone by human observation or instruments near it. ICAO: The range over which the pilot of an aircraft on the centre line of a runway can see the runway surface markings or the lights delineating the runway or identifying its centre line.

RVSM Airspace
Reduced Vertical Separation Minimum Airspace. Any between FL 290 - 410 (inclusive) within which a vertical separation minimum of 1000 feet or 300 metres is applied.

Safe Landing
In the context of the fuel/energy policy or fuel/energy schemes, a landing at an adequate aerodrome or operating site with no less than the final reserve fuel/energy remaining and in compliance with the applicable operational procedures and aerodrome operating minima.

Safe Forced Landing
An unavoidable landing or ditching with a reasonable expectancy of no injuries to people.

Safety Belt
A personal restraint system with either a lap strap or a lap strap combined with a shoulder harness.

Safety Catch
A mechanism which locks a control in position, engaging automatically whenever the control is put there but has to be manually taken out to move it away (JAR 25).

SAFETYCOM
A common frequency (135.475 MHz) made available for use at aerodromes where no other frequency is allocated, to enable pilots to broadcast their intentions to other aircraft that may be operating on, or near, an aerodrome.

Safety Investigation
A process conducted by a safety investigation authority for the purpose of accident and incident prevention which includes the gathering and analysis of information, the drawing of conclusions, including the determination of cause(s) and/or contributing factors and, when appropriate, the making of safety recommendations.

Safety Management System
A systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures.

Safety Pilot
One who acts as a lookout for another pilot operating an aircraft in simulated instrument flight.

Safety Recommendation
A proposal from a safety investigation authority, based on information derived from a safety investigation or other sources such as safety studies, made with the intention of preventing further accidents and incidents.

Safety-Sensitive Personnel
Persons who might endanger aviation safety if they perform their duties and functions improperly, including flight crew and cabin crew members, aircraft maintenance personnel and air traffic controllers.

Sailplane
A heavier-than-air aircraft supported in flight by the dynamic reaction of air against its fixed lifting surfaces, the free flight of which does not depend on an engine.

Same Direction Aircraft
Aircraft operating in the same direction on the same track or diverging tracks, or on parallel or non-intersecting tracks that are not laterally separated.

Saturated Vapour
That in contact with its liquid at the same temperature. Vapours used in refrigeration systems are saturated.

Saturation Temperature
The boiling or vaporisation point of a liquid. The boiling point can change with the pressure, for example, water boils at a lower temperature at altitude - in fact, it doesn't even have to be hot in some circumstances. Thus, if you want to stop a liquid boiling, subject it to high pressure.

Scenario-Based Training Phase
A phase of an EBT module focussing on the development of competencies, while the pilot is trained to mitigate the most critical risks for the aircraft generation. It should include the management of specific operator's threats and errors in a real-time line orientated environment.

Scheduled journey
One of a series of journeys between the same two places and which together amount to a systematic service - other conditions may apply in other areas of transport law, such as being open to all classes of passenger, which rules out offshore operations. In short, scheduled flights are planned to fly at set times (that is, established in advance) in a continuous sequence (e.g. to a timetable).

Scheduled maintenance
That performed at predetermined intervals, a maintenance schedule or an AD.

Screening
The application of technical or other means which are intended to identify and/or detect weapons, explosives or other dangerous devices, articles or substances which may be used to commit an act of unlawful interference.

Seaplane
A fixed wing aircraft designed for taking off and landing on water, including amphibians operated as seaplanes. See also section 97 of the Civil Aviation Act 1982.

Secondary Area
A defined area on each side of the primary area located along the nominal flight track in which decreasing obstacle clearance is provided. (See also *Primary Area*).

Secondary Radar
A radar system wherein a radio signal transmitted from the radar station initiates the transmission of a radio signal from another station.

Secondary Surveillance Radar (SSR)
A surveillance radar system which uses transmitters/ receivers (interrogators) and transponders.

Sector
Part of the airspace controlled from an area control centre or other place.

Security
The safeguarding of civil aviation against acts of unlawful interference. This objective is achieved by a combination of measures and human and material resources.

Security Restricted Area
Those areas of the airside of an airport which are identified as priority risk areas where, in addition to access control, other security controls are applied.

Segregated Parallel Operations
Simultaneous operations on parallel or near-parallel instrument runways in which one runway is used exclusively for approaches and the other runway is used exclusively for departures.

SELCAL
Selective Calling System - allows specific aircraft to be called over HF frequencies.

Self Launching Motor Glider (SLMG)
Something like a non power-driven glider with one or more power units, that takes off under its own power.

Sending Unit/Controller
Air traffic services unit/air traffic controller transmitting a message. See *Receiving Unit/Controller*.

Sensible Heat
As opposed to latent heat, that which changes the temperature of a substance without changing its form.

Separate Runways
Runways at the same aerodrome that are separate landing surfaces. These runways may overlay or cross in such a way that if one of the runways is blocked, it will not prevent the planned type of operations on the other runway. Each runway shall have a separate approach procedure based on a separate navigation aid.

Serious Incident
An incident involving circumstances indicating that an accident nearly occurred. Under Annex 13, an incident involving circumstances indicating that there was a high probability of an accident and is associated with the operation of an aircraft which, in the case of a manned aircraft, takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, or in the case of an unmanned aircraft, takes place between the time the aircraft is ready to move with the purpose of flight until such time it comes to rest at the end of the flight and the primary propulsion system is shut down.

Serious Injury
An injury which is sustained by a person in an accident and which:

- Requires hospitalisation for more than 48 hours, starting within seven days from the date the injury was received
- Results in a fracture of any bone (except simple fractures of fingers, toes or nose)
- Involves lacerations causing severe haemorrhage, nerve, muscle or tendon damage
- Involves injury to any internal organ
- Involves second or third degree burns, or any burns affecting more than 5% of the body surface

Serviceable
Fit and safe for flight.

Servicing
Cleaning, lubricating, replenishment of fluids not requiring disassembly.

Shoreline
A line following the general contour of a shore, except that in cases of inlets or bays less than 30 nm wide, the line shall pass directly across the inlet or bay to intersect the general contour on the opposite side.

Shoulder Harness
Any device for restraining the upper torso of a person, with a single diagonal or dual upper torso straps.

Single-Pilot Aircraft
One certificated for operation by one pilot.

SI System
The international system of measurement now recommended for all scientific purposes (SI units have replaced CGS and Imperial units. CGS means *centimetre*, *gram*, and *second*).

SID
Standard Instrument Departure.

SIGMET
Significant Met Warning.

SIGMET Information
Information issued by a meteorological watch office concerning the occurrence or expected occurrence of specified en-route weather phenomena which may affect the safety of aircraft operations.

Signal Area
An area on an aerodrome used for the display of ground signals.

Significant Obstacle
A natural terrain feature or man-made fixed object, permanent or temporary, which has vertical significance in relation to adjacent and surrounding features and which is considered a potential hazard to the safe passage of aircraft in the type of operation for which the individual procedure is designed.

Significant Point
A specified geographical location used in defining an ATS route or the flight path of an aircraft and for other navigation and ATS purposes. There are three categories of significant points, including ground-based navigation aids, intersections and waypoints. An intersection is a significant point expressed as radials, bearings and/or distances from ground-based navigation aids.

Thus, a significant point can be a navaid, a fix derived from one, a named point, or geographical coordinate(s) expressed in degrees of latitude, longitude or both, established for the purpose of providing separation, as a reporting point or to delineate a route of flight.

Simplex
Communication between two stations that takes place in one direction at a time.

Situation Display
An electronic display depicting the position and movement of aircraft and other information as required.

Skill Test
The demonstration of skill for a licence or rating issue, including such oral examination as may be required.

SLMG
Self Launching Motor Glider.

Slush
Water-saturated snow which with a heel-and-toe slap-down motion against the ground will be displaced with asplatter; specific gravity: 0.5 up to 0.8.

Combinations of ice, snow and/or standing water may, especially when rain, rain and snow, or snow is falling, produce substances with specific gravities in excess of 0.8. These substances, due to their high water/ice content, will have a transparent rather than a cloudy appearance and, at the higher specific gravities, will be readily distinguishable from slush.

Small Aircraft
Any unmanned aircraft, other than a balloon or a kite, weighing not more than 20 kg without fuel, but including articles or equipment installed in or attached to it at the start of its flight.

Small Balloon
One not exceeding 2 metres in any linear dimension, including baskets, etc. attached to it.

Small Rocket
One with a total impulse from its engine(s) up to 10,240 newton-secs.

SNOTAM
Or SNOWTAM. A small white Scottish terrier (seriously, a NOTAM about snow, valid for up to 24 hours).

Snow
- *Dry Snow*. Snow which can be blown if loose or, if compacted by hand, will fall apart upon release; specific gravity: up to but not including 0.35.
- *Wet Snow*. Snow which, if compacted by hand, will stick together and tend to or form a snowball; specific gravity: 0.35 up to but not including 0.5.
- *Compacted Snow*. Snow which has been compressed into a solid mass that resists further compression and will hold together or break up into lumps if picked up; specific gravity: 0.5 and over.

Solo flight time
Flight time during which a student pilot is the sole occupant of an aircraft (EASA).

Special
In VFR Comms, a special meteorological report in abbreviated plain language.

Specially Prepared Winter Runway
One with a dry frozen surface of compacted snow or ice which has been treated with sand or grit or has been mechanically treated to improve runway friction.

Special VFR flight
A VFR flight authorised by ATC in a control zone where IFR would normally apply, or conditions are below VMC (see Rules of the Air).

SSR
Secondary Surveillance Radar.

SSR Response
The visual indication, in non-symbolic form, on a situation display, of a response from an SSR transponder in reply to an interrogation.

SST
Supersonic Transport.

Stabilised Approach (SAp)
An approach that is flown in a controlled and appropriate manner in terms of configuration, energy and control of the flight path from a pre-determined point or altitude/height down to a point 50 ft above the threshold or the point where the flare manoeuvre is initiated if higher.

Standard Atmosphere
See *Atmosphere, International Standard*.

Standard Instrument Arrival (STAR)
A designated instrument flight rule (IFR) arrival route linking a significant point, normally on an ATS route, with a point &om which a published instrument approach procedure can be commenced.

Standard Instrument Departure (SID)
A designated instrument flight rule (IFR) departure route linking an aerodrome or a specified runway of the aerodrome with a specified significant point, normally on a designated ATS route, at which the en-route phase of a flight commences.

Standard Message Element
Part of a message defined in PANS-ATM (Doc 4444) in terms of display format, intended use and attributes.

STAR
Standard Instrument Arrival. (ICAO)

State of Origin
The Authority in whose territory dangerous goods were first loaded on an aircraft.

State of Registry
The Authority in whose territory an aircraft is registered.

State Safety Program
An integrated set of regulations and activities aimed at improving safety.

Station Declination
An alignment variation between the 0° radial of a VOR and True North, as determined on calibration.

Stationary Airspace Reservation
An airspace reservation whose position in space remains fixed with relation to the surface of the Earth.

Sterile Flight Crew Compartment

Any period when flight crew members are not disturbed or distracted, except for matters critical to the safe operation of the aircraft or the safety of the occupants.

Stopway
A defined rectangular area on the ground at the end of a takeoff run available prepared as a suitable area in which an aircraft can be stopped during an abandoned takeoff.

Standard Deviation
A statistical measure of data about a mean value.

Step Climb
A technique in which higher altitudes or flight levels are flight planned or achieved at a specified point or time.

Steep Tracks
Parallel tracks which are not laterally separated because the tracks exceed the allowable change in latitude for any ten-degree interval of longitude.

Straight Ahead
In departure clearances, the term means *track the extended runway centreline*. In Missed Approach Procedures, it means *continue on the final approach track*.

Student Pilot In Command (SPIC)
A student pilot acting as PIC on a flight with an instructor where the latter will only observe the student pilot and shall not influence or control the flight of the aircraft.

Superheated Vapour
That with temperature above the boiling point of its liquid.

Supplemental Oxygen
Extra oxygen to protect against adverse effects of excessive cabin altitude and maintain acceptable physiological conditions.

Surface
Ground or water, including frozen.

Surveillance Radar
Radar equipment used to determine the position of an aircraft in range and azimuth.

State of the operator
The location of the principal place of business, or permanent residence if there is none.

TACAN
Tactical Air Navigation system A military version of VOR/DME.

TAF
Terminal Aerodrome Forecast.

Takeoff
For other than airships, leaving a supporting surface, including the take-off run, plus acts just before and after. For an airship, freeing it from restraint, including acts just before and after.

Takeoff Alternate Aerodrome
An alternate aerodrome at which an aircraft can land should this become necessary shortly after takeoff and if it is not possible to use the aerodrome of departure.

Takeoff Decision Point (TDP)
The fixed point in Helicopter Class 1 Performance operations used in determining takeoff performance from which, an engine failure having been recognised at this point, either a rejected take-off may be made or a takeoff safely continued.

Takeoff Distance Available (TODA)
In the case of aeroplanes, the length of the takeoff run available plus the length of the clearway, if provided.

Takeoff Distance Available (TODAH)
In the case of helicopters, the length of the final approach and takeoff area plus, if provided, the length of helicopter clearway declared available and suitable for helicopters to complete a takeoff.

Takeoff Distance Required (TODRH)
In the case of helicopters, the horizontal distance required from the start of the takeoff to the point at which takeoff safety speed (V_{TOSS}), a selected height and a positive climb gradient are achieved, following failure of the critical engine being recognised at the TDP, the remaining engines operating within approved operating limits.

Takeoff Flight Path
The vertical and horizontal path, with the critical engine inoperative, from a specified point in the takeoff for aeroplanes to 1500 ft above the surface and, for helicopters, to 1000 ft above the surface.

Takeoff Mass
The mass, including everything and everyone carried at the start of the takeoff run. It consists of the DOM, plus the Disposable Load, which must not be over the maximum weight used for performance reasons, or that in the Flight Manual, so it limits the Traffic Load.

Takeoff Run Available (TORA)
The length of runway that is declared available by the State of the aerodrome and suitable for the ground run of an aeroplane taking off.

Task Specialist
A person assigned by an operator or a third party, or acting as an undertaking, who performs tasks on the ground directly associated with a specialised task or performs specialised tasks on board or from the aircraft.

Taxiing
Movement of an aircraft on the surface of an aerodrome under its own power, excluding take-off and landing.

Taxiway
A defined path on a land aerodrome established for the taxiing of aircraft and intended to provide a link between one part of the aerodrome and another, including:

- *Aircraft stand taxilane.* A portion of an apron designated as a taxiway and intended to provide access to aircraft stands only.
- *Apron taxiway*. A portion of a taxiway system located on an apron and intended to provide a through taxi route across the apron.
- *Rapid exit taxiway*. A taxiway connected to a runway at an acute angle and designed to allow landing aeroplanes to turn off at higher speeds than are achieved on other exit taxiways thereby minimizing runway occupancy times.

TDA
Takeoff Distance Available. The TORA plus Clearway.

TDP
Takeoff Decision Point. The fixed point in Performance Class 1 helicopter operations that is used to determine takeoff performance from which, a power unit failure having been recognised, either a rejected takeoff may be made or a takeoff safely continued.

Technical Crew Member
A crew member in commercial air transport HEMS, HHO or NVIS operations other than a flight or cabin crew member, assigned by the operator to duties in the aircraft or on the ground for the purpose of assisting the pilot during HEMS, HHO or NVIS operations, which may require the operation of specialised on-board equipment.

Technical Harmonisation Regulation
Council Regulation (EEC) No 3922/ 91, on the harmonisation of technical requirements and administration in civil aviation.

Technical Instructions
The latest effective edition of the *Technical Instructions for the Safe Transport of Dangerous Goods by Air* (Doc 9284-AN/905), including Supplement and Addenda, approved and published by ICAO.

Telecommunications System
And public telecommunications system. See sections 4 and 9 (1) of the Telecommunications Act 1984.

Terminal Arrival Altitude (TAA)
The lowest altitude that will provide a minimum clearance of 300 m (1 000 ft) above all objects in an arc of a circle defined by a 46 km (25 nm) radius centred on the initial approach fix (IAF), or where there is no IAF on the intermediate approach fix (IF), delimited by straight lines joining the extremity of the arc to the IF. The combined TAAs associated with an approach procedure shall account for an area of 360 degrees around the IF.

Terminal Control Area
One normally established at the confluence of ATS routes in the vicinity of one or more major aerodromes.

Tethered flight
Controllable balloons in limits from restraining devices.

Threat
Events or errors that occur beyond the influence of the flight crew, increase operational complexity and which must be managed to maintain safety margins.

Threat Management
The process of detecting and responding to the threats with countermeasures that reduce or eliminate the consequences of threats, and mitigate the probability of errors or undesired aircraft states.

Three Dimensional (3D) Instrument Approach
An instrument approach using lateral and vertical navigation guidance (a precision approach).

Threshold (THR)
The beginning of the part of a runway usable for landing.

Time Difference Of Arrival (TDOA)
The difference in relative time that a transponder signal from the same aircraft (or ground vehicle) is received at different receivers.

TLOF
Touchdown and Lift-off Area. A load bearing area on which a helicopter may touch down or lift off.

TMA
Terminal Control Area.

Total Estimated Elapsed Time
For IFR flights, the estimated time required from takeoff to arrive over that designated point, defined by reference to navigation aids, from which it is intended that an instrument approach procedure will be commenced, or, if no navigation aid is associated with the destination aerodrome, to arrive over the destination aerodrome. For VFR flights, the estimated time required from take-off to arrive over the destination aerodrome.

Touchdown
The point where the nominal glide path intercepts the runway. This is only a datum and is not necessarily the actual point at which an aircraft will touch the runway.

Touchdown Zone Elevation (TDZE)
The highest point in the first 3000 ft of the landing surface.

Touring Motor Glider (TMG)
A specific class of powered sailplane with an integrally mounted, non-retractable engine and a non-retractable propeller, capable of taking off and climbing under its own power according to its flight manual.

Track
The projection on the Earth's surface of the path of an aircraft, the direction of which path at any point is usually expressed in degrees from North (True, Magnetic, Grid).

Traffic Alert and Collision Avoidance System (TCAS)
See *Airborne Collision Avoidance System (ACAS)*.

Traffic Avoidance Advice
Advice provided by an air traffic services unit specifying manoeuvres to assist a pilot to avoid a collision.

Traffic Information
Information issued by an ATS unit to alert pilots to other known or observed air traffic which may be in proximity to the position or intended route of flight and to help the pilot avoid a collision.

Traffic Load
The total mass of passengers, baggage, cargo and carry-on specialist equipment, including any ballast.

Traffic Service
A surveillance ATS where, as well as the provisions of a Basic Service, the controller provides specific surveillance derived traffic information to assist the pilot in avoiding other traffic. Controllers may provide headings and/or levels for the purposes of positioning and/or sequencing; however, the controller is not required to achieve deconfliction minima, and the avoidance of other traffic is ultimately the pilot's responsibility.

Training To Proficiency
Training designed to achieve end-state performance objectives, providing sufficient assurance that the trained individual is capable of consistently carrying out specific tasks safely and effectively.

Type A Instrument Approach Operation
One with an MDH or a DH at or above 250 ft.

Type B Instrument Approach Operation
One with a DH below 250 ft. Type B instrument approach operations are categorised as:

- Category I (CAT I): a DH not lower than 200 ft and with either a visibility not less than 800 m or an RVR not less than 550 m.
- Category II (CAT II): a DH lower than 200 ft but not lower than 100 ft, and an RVR not less than 300 m.
- Category III (CAT III): a DH lower than 100 ft or no DH, and an RVR less than 300 m or no RVR limitation.

Transfer Of Control Point
A defined point located along the flight path of an aircraft, at which the responsibility for providing air traffic control service to the aircraft is transferred from one control unit or control position to the next.

Transferring Unit
An air traffic control unit in the process of transferring the responsibility for providing air traffic control service to an aircraft to the next air traffic control unit along the route of flight.

Transferring Unit/Controller
Air traffic control unit/air traffic controller in the process of transferring the responsibility for providing air traffic control service to an aircraft to the next air traffic control unit/air traffic controller along the route of flight. See *Accepting Unit/Controller.*

Transition Altitude
The altitude at or below which the vertical position of an aircraft is controlled by reference to altitudes.

Transition Layer
The airspace between the transition altitude and the transition level.

Transition Level
The lowest flight level available for use above the transition altitude.

True Airspeed
Airspeed relative to undisturbed air.

True Mach number
Ratio of TAS to local speed of sound.

Two Dimensional (2D) Instrument Approach
An instrument approach using only lateral navigation guidance (non-precision).

Type
Aircraft of the same basic design, including modifications, except which result in a change of handling, flight characteristics or crew.

Type A EFB Application
An EFB application whose malfunction or misuse has no safety effect.

Type B EFB Application
An EFB application whose malfunction or misuse is classified as minor failure condition or below, and which neither replaces nor duplicates any system or functionality required by airworthiness regulations, airspace requirements, or operational rules.

Type Of Aircraft
A categorisation of aircraft requiring a type rating as determined in the operational suitability data established under Part 21, and which include all aircraft of the same basic design including all modifications thereto except those which result in a change in handling or flight characteristics (Part FCL).

Unaided NVIS Flight
That portion of a VFR flight performed at night when a crew member is not using NVG.

Uncontrollable balloon
A balloon, not small, incapable of free controlled flight.

Undertaking

Any natural or legal person, profit-making or not, or any official body whether having its own personality or not.

UHF
Ultra High Frequency.

UIR
Upper Flight Information Region.

UN Number
The four-digit number assigned by the United Nations Committee of Experts on the Transport of Dangerous Goods to identify a substance or a particular group of substances.

Uncertainty Phase
A situation in which uncertainty exists as to the safety of an aircraft and its occupants.

Unidentified Baggage
Baggage at an airport, with or without a baggage tag, which is not picked up by or identified with a passenger.

Unmanned Free Balloon
A non-power-driven, unmanned, lighter-than-air aircraft in free flight. Unmanned free balloons are classified as heavy, medium or light in accordance with specifications contained in Annex 2, Appendix 5.

UTA
Upper Control Area.

UTC
Universal Coordinated Time (the initials are the wrong way round because the actual definition is in French). What used to be called Greenwich Mean Time.

V_1
The maximum speed in the takeoff at which a pilot must take the first action to stop an aeroplane within the accelerate-stop distance. V_1 also means the minimum speed in the takeoff procedure, following a failure of the critical engine at V_{EF}, at which a pilot can continue the takeoff and achieve the required height above the takeoff surface within the takeoff distance.

Valuable Consideration
Any right, interest, profit or benefit, forbearance, detriment, loss or responsibility accruing, given, suffered or undertaken pursuant to an agreement, of more than a nominal nature.

VASIS
Visual Approach Slope Indicator System.

VDF
VHF Direction Finding.

Vectoring
Provision of navigational guidance to aircraft in the form of specific headings, based on the use of an ATS surveillance system.

VEF
The speed at which the critical engine is assumed to fail during the takeoff run.

Vertical Path Angle
The angle of the published final approach descent in Baro-VNAV procedures.

Vertical Separation
Vertical separation is the specified spacing of aircraft expressed in altitudes or flight levels.

Vessel
Any ship, boat or other floating structure, other than an aircraft, used for navigation on water.

VFR
Visual Flight Rules.

VFR Aircraft
One operating in VFR flight.

VFR Flight
One conducted under visual flight rules.

VHF
Very High Frequency.

VIP
Very Important Person.

Visibility
The greater of:

- the greatest distance at which a black object of suitable dimensions, near the ground, can be seen and recognised when observed against a bright background.
- the greatest distance at which lights of around 1000 candelas can be seen and identified against an unlit background.

Visiting Force
See the *Visiting Forces Act*, 1952.

Visual Approach
Where only part of an instrument procedure is flown, and the remainder is flown visually with reference to terrain.

Visual Approach Operation
An approach by an IFR flight when either a part or all parts of an IAP is (are) not completed and the approach operation is executed with visual reference to terrain.

Visual Flight Rules
As per the Rules of the Air.

Visual Manoeuvring (Circling) Area
The area in which obstacle clearance should be taken into consideration for aircraft carrying out a circling approach.

Visual Meteorological Conditions
Those permitting flight under VFR. ICAO: Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling, equal to or better than the specified minima in Annex 2.

VMC
Visual Meteorological Conditions. Weather expressed in terms of visibility, distance from cloud and ceiling equal to or better than that specified from time to time.

VNAV
Vertical Navigation.

V_{LE}
The maximum speed to fly with the gear extended.

V_{LO}
The maximum speed at which the landing gear can be operated.

V_{NE}
The speed (or Velocity) Never to be Exceeded.

VOLMET
Meteorological information available over the radio.

VOR
VHF Omnidirectional Radio Range.

VORTAC
VOR and TACAN combination.

Waypoint
A specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation. Waypoints are identified as either:

- *Fly-by*, which requires turn anticipation to allow tangential interception of the next segment of a route or procedure, or
- *Flyover*, at which a turn is initiated in order to join the next segment of a route or procedure.

Weather-Permissible Aerodrome

An adequate aerodrome where, for the anticipated time of use, meteorological reports, or forecasts, or any combination thereof, indicate that the meteorological conditions will be at or above the required aerodrome operating minima, and the runway surface condition reports indicate that a safe landing will be possible.

West Atlantic Route System (WATRS)
The WATRS area is defined beginning at a point 27º North 77º West direct to 20º North 67º West direct to 18º North 62º West direct to 18º North 60º West direct to 38º30' North 60º West direct to 38º30' North 69º15' West thence counterclockwise along the New York Oceanic control area/flight information region boundary to the Miami Oceanic control area/flight information region boundary, thence southbound along the Miami Oceanic control area/flight information region boundary to the point of beginning.

Wet Lease Agreement
For CAT operations, between air carriers pursuant to which the aircraft is operated under the *AOC* of the lessor or, for commercial operations other than CAT, between operators pursuant to which the aircraft is operated under the *responsibility* of the lessor.

Wet Runway
A runway whose surface is covered by any visible dampness or water up to and including 3 mm deep within the area intended to be used.

ABBREVIATIONS/ACRONYMS

A

A	Amber
A/A	Air-to-air
AAC	Army Air Corps
AAI	Angle of Approach Indicator
AAL	Above Aerodrome Level
Abm	Abeam
ABn	Aerodrome Beacon
AGO	Area Control Centre
Accel	Accelerat(e),(ion)
Acft	Aircraft
ACL	Altimeter Check Location
ACN	Aircraft Classification Number
ACP	Airlift Command Post
ACP	Altimeter Check Point
AD	Aerodrome
ADF	Automatic Direction Finder
ADIZ	Air Defence Identification Zone
ADR	Advisory Route
ADS	Automatic Dependent Surveillance
ADVS	Advisory Service

AF	Air Force
AFB	Air Force Base
AFIS	Aerodrome Flight Information Service
A/G	Air/Ground
A Gear	Arrestor Gear
AGL	Above Ground Level
AGNIS	Azimuth Guidance for Nose-in-Stand
AGU	Azimuth Guidance Unit
AIAA	Area of Intense Air Activity
AIDU	Aeronautical Information Documents Unit
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Services
ALS	Approach Lighting System
Alt	Altitude
Altn	Alternat(e),(ive),(ing)
AMSL	Above Mean Sea Level
APAPI	Abbreviated PAPI
APATC-1	Allied Procedures ATC
App	Approach
Apprx	Approximate, Approximately
Apr	April
APU	Auxiliary Power Unit
ARA	Air Restricted Area/Airborne Radar Approach
ARP	Aerodrome Reference Point
Arr	Arrival, arrive
ASDA	Accelerate-Stop Distance Available
ASHTAM	NOTAM for volcanic ash
ASR	Aerodrome/ Area Surveillance Radar Altimeter Setting Region
ATA	Actual Time of Arrival
ATC	Air Traffic Control
ATCC	Air Traffic Control Centre
ATCRU	Air Traffic Control Radar Unit
ATD	Actual Time of Departure
ATIS	Automatic Terminal Information Service
ATOC	Air Terminal Operations Centre
ATS	Air Traffic Services
ATZ	Air Traffic Zone
Aug	August
Auth	Authority, authorized
Auto	Automatic
AUW	All Up Weight (gross)
Aux	Auxiliary
Avbl	Available, Availability
AVASIS	Abbreviated VASIS

Awy A/W	Airway
AZ	PAR Azimuth Element Only Approach

B

B	Blue
BAe	British Aerospace
BAF	Belgian Air Force
BAOR	British Army of the Rhine
BB(m)	Back Beam (ILS)
BC	Back Course(ILS)
BCP	Break Cloud Procedure
Bcst	Broadcast
Bdry	Boundary
Bldg	Building
Bn	Beacon
Brg	Bearing
BS	Broadcast Station (Commercial)
Btn	Between

C

C	Centre (Runway Identification)
C	Degrees Celsius/Centigrade
CAA	Civil Aviation Authority
CAC	Centralised Approach Control
CAS	Controlled Airspace
Cat	Category
Cct	Circuit
CD	Calvert Approach Lighting System
CDN	Canadian
CF	Canadian Forces
CHAG	Chain Arresting Gear
Ch	Channel
Circ	Circling (App)
Civ	Civil, Civilian
Ck	Check
C/L	Centre-line
Clnc	Clearance
Clr	Clear
Clsd	Closed
CMATZ	Combined MATZ
CMDA	Circling Minimum Descent Altitude
CMDH	Circling Minimum Descent Height
Com	Communication(s)
Con	Control

CON	Console Beacon
Conc	Concrete
Cont	Continu(e), (ed), (al), (ous)
Copter	Helicopter (App Proc)
CPDLC	Controller/Pilot Data Link Communications
CRP	Compulsory Reporting Point
C/S	Callsign
CTA	Control Area
Ctc	Contact
Ctl	Control
CTR	Control Zone
CTZ	Control Zone
CWY	Clearway

D

d	DME Distance
D	Danger Area, (Followed by Indent Nr)
DA	Decision Altitude
dB	Decibels (noise levels)
Dct	Direct
Dctd	Directed
Dctr	Director
Dec	December
Deliv	Delivery
Dep	Depart, Departure
DER	Departure End of Runway
Desc	Descent, Descend(ing)
DF	Direction Finder (finding)
DH	Decision Height
Dist	Distance
Dly	Daily
DME	Distance Measuring Equipment
DND	Department of National Defense
Doc	Document
DOC	Designated Operational Coverage
DOD	Department of Defense
DOT	Department of Transport
DR	Dead-Reckoning
D THR	Displaced threshold
DVOT(TAC)	Doppler VOR(TAC)

E

E	East
EAT	Expected Approach Time
EET	Estimated Elapsed Time

Elev	Elevation
Emerg	Emergency
EOA	Engine Out Allowance
EOBT	Estimated Off-Block Time
ERC	En Route Chart
ERS	En Route Supplement A
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
Exc	Except

F

Fac	Facility, Facilities
FAF	Final Approach Fix
FAF	French Air Force
FAP	Final Approach Point
FAT	Final Approach Track
FATO	Final Approach and Takeoff Area
FEB	February
FIC	Flight Information Centre
FIH	Flight Information Handbook
FIR	Flight Information Region
FIS	Flight Information Service
FL	Flight Level
Flg	Flashing
FLIP	Flight Information Publication
Flt	Flight
FM	Fan Marker, Frequency Modulation
FNY	French Navy
FOD	Foreign Object Damage
FPL	Filed Flight Plan
FPD	Flight Planning Document
FPM	Feet Per Minute
FPR	Flight Plan Route
Freq	Frequency (radio)
FRI	Friday
Ft	Feet
FTU	Flying Training Units

G

g	Above Ground (ARAs)
G	Green
GA	General Aviation
GAF	German Air Force
GAR	German Army
GAT	General Air Traffic
GCA	Ground Controlled Approach

Gen	General
GMT	Greenwich Mean Time
Gnd	Ground
GNSS	Global Navigation Satellite System
GNY	German Navy
GP	Glidepath
Gp	Group
Grad	Gradient
Grvl	Gravel
GS	Ground Speed, Glide Slope
GSE	Ground Serving Equipment

H

H24	Continuous Day and Night Service
HAA	Height Above Aerodrome
HAAP	Helicopter Approach Aiming Point
HAF	Hellenic (Greek) Air Force
HAPI	Helicopter Approach Path Indicator
HAS	Hardened Aircraft Shelter
HAT	Height Above Touchdown
HBn	Hazard Beacon
Hdg	Heading
Hel	Helicopter
HF	High Frequency (3000-30000KHz)
Hgr	Hangar
HGT	Height or Height Above
HIRTA	High Intensity Radio Transmission Area
HJ	Sunrise to Sunset
HLS	Helicopter Landing Site
HN	Sunset to Sunrise
HO	Service Available to meet Operational Requirement
Hol	Holiday(s)
HP	Holding Point
HPA	Hectopascal
Hr	Hour(s)
HS	Service Available during Hours of Scheduled Operations
Ht	Height
HT	High Tension
HTZ	Helicopter Traffic Zone
Hvy	Heavy
HZ	Hertz

I

IAC	Instrument Approach Chart
IAF	Initial Approach Fix

IAF	Italian Air Force
IAM	Instrument Approach Minima
IAP	Instrument Approach Procedure
IAS	Indicated Air Speed
IBn	Identification Beacon
ICAO	International Civil Aviation Organisation
ICF	Initial Contact Frequency
Ident	Identification
IF	Intermediate Fix
IFF	Identification Friend/Foe
IFR	Instrument Flight Rules
ILS	Instrument Landing System
ILS(V)	ILS with Emergency Voice Facility
IM	Inner Marker
IMC	Instrument Meteorological Conditions
Inbd	Inbound
Incl	Including, Inclusive
Info	Information
Inop	Inoperative
INS	Inertial Navigation System
Instr	Instruction(s)
IntcP	Intercept
Int	Intersection
Intl	International
IP	Initial Point
ISA	International Standard Atmosphere

J

Jan	January
J Bar	Jet Barrier
JBI	James Braking Index
Jul	July
Jun	June

K

Kcs	Kilocycles
Kg	Kilograms
KHz	Kilohertz
Km	Kilometres
Kt	Knots
KW	Kilowatts

L

L	Locator (NDB with Published Procedure)
LARS	Lower Airspace Radar Advisory Service
Lat	Latitude

LB	Lead Bearing
Lb	Pound(s)
LDA	Landing Distance Available
Ldg	Landing
LF	Low Frequency (30-300 KHZ)
Lgt	Light
LHC	Left-Hand Circuit
LIH	Light Intensity High
LIL	Light Intensity Low
LIM	Light Intensity Medium
LHS	Left-Hand Side
LITAS	Low Intensity Two-colour Approach Slope System
Llz	Localizer
LM	Locatorr, middle marker
LMT	Local Mean Time
LO(M)	Locator, outer marker
Long	Longitude
LR	Lead Radial
Ltd	Limited
Lvl	Level
LVP	Low Visibility Procedures

M

M	Mach Number (followed by figures)
m	Metres
MAC	Military Aircraft Command
Mag	Magnetic
MAPt	Missed Approach Point
M/App	Missed Approach Procedure
Mar	March
MATZ	Military Aerodrome Traffic Zone
Max	Maximum
Mb	Millibar
MCA	Minimum Crossing Altitude
MDA	Minimum Descent Altitude
MDH	Minimum Descent Height
MEA	Minimum En Route Altitude
MEDA	Military Emergency Diversion Aerodrome
MEHT	Mean Eye Height above Threshold
Met	Meteorology, Meteorological
METRO	Pilot-to-Metro Voice call
MEXE	Moveable VTOL platform
MF	Medium Frequency (300-3000KHZ)
MHz	Megahertz
Mil	Military

Min	Minutes
Mkr	Marker Radio Beacon
MLS	Microwave Landing System
MM	Middle Marker
Mnm	Minimum
MNPS	Minimum Navigation Performance Specifications
MNR	Minimum Noise Route
MNT	Mach Number Technique
MOCA	Minimum Obstacle Clearance Altitude
MOD	Ministry of Defence
Mon	Monday
MORA	Minimum Off Route Altitude
MRA	Minimum Reception Altitude
MSA	Minimum Sector Altitude
MSD	Minimum Separation Distance
MS	Minus
MSFL	Minimum Safe Flight Level
MSL	Mean Sea Level
MTOW	Maximum Take-off Weight

N

N	North
NAS	Naval Air Station
NAT	North Atlantic
Nav	Navigation
NCRP	Non-Compulsory Reporting Point
NDB	Non-Directional Radio Beacon
NE	North-East
NFLD	Newfoundland
Nm	Nautical Mile
NMT	Noise Monitoring Terminal
NOTAM	Notice(s) to Airmen
Nov	November
Nr	Number
NTZ	No Transgression Zone
NW	North-West

O

OAT	Operational Air Traffic
OAT	Outside Air Temperature
Obst	Obstacle
OCA	Obstacle Clearance Altitude
Occ	Occulting (light)
OCH	Obstacle Clearance Height
OCL	Obstacle Clearance Limit

Ocnl	Occasional
Oct	October
Ohd	Overhead
OM	Outer Marker
Opr	Operator, Operating, Operational
Ops	Operations
O/R	On Request
ORP	Operational Readiness Platform
Oubd	Outbound
Ovrn	Over-run

P

P	Prohibited Area (Followed by dent Nr)
PAF	Portuguese Air Force
PALS	Precision Approach Lighting System
PANS	Procedures for Air Navigation Services
PANS/ ATM	Procedures for Air Navigation Services/Air Traffic Management (ICAO Doc 4444)
PAPI	Precision Approach Path Indicator
PAR	Precision Approach Radar
Para	Parachute, (ing)
Pax	Passengers
PCN	Pavement Classification Number
Perm	Permanent
PF	Pilot Flying
PFSV	Pilot-to-Forecaster Service
PLASI	Pulse Ught Approach Slope Indicator
Pln	Flight Plan
PMP	Provost Marshal Prohibited Area
PMR	Provost Marshal Restricted Area
PMSV	Pilot-to-Metro Service
PN	Prior Notice Required
PNF	Pilot Not Flying
PNY	Portuguese Navy
POL	Petrol, Oil & Lubricants
Poss	Possible
PPO	Prior Permission Only
PPR	Prior Permission Required
Prob	P'robability
Proc	Procedure
Prop	Propeller
PS	Plus
Psn	Position
psi	lbs per square inch
PSP	Pierced Steel Planking
Pt	Point

PUAG	Purpose Use Arrestor Gear

Q

QDM	Magnetic Heading (to Facility)(Zero wind)
QDR	Magnetic Bearing (from Facility)
QFE	Atmospheric Pressure at Aerodrome Elevation or at Runway Threshold
QFU	Magnetic Orientation of Runway
QNE	Altimeter sub-scale setting 1013mb
QNH	Altimeter Sub-scale Setting for Elevation when on the Ground
QTE	True Bearing

R

R	Radial
R	Red
R	Restricted Area (Followed by Indentification)
R	Right (Runway Identification)
RAAF	Royal Australian Air Force
Rad Alt	Radio Altimeter
RADHAZ	Radiation Hazard
RAI	Runway Alignment Indicator
RAS	Radar Advisory Service
RCF	Radio Communication Failure
RCL	Runway Centre-line
RCLL	Runway Centre-line Lights
RCR	Runway Condition Reading
RDAF	Royal Danish Air Force
RDH	Reference Datum Height (for ILS)
RDO	Radio
Rdr	Radar
REDL	Runway Edge Lights
RENL	Runway End Lights
REP	Report, Reporting Point
Req	Request(ed)
RHAG	Rotary Hydraulic Arrestor Gear
RHC	Right Hand Circuit
RIAP	Revised Instrument Approach Procedures
RLCE	Request Level Change En-Route
RLLS	Runway Lead-In Lighting System
RLG	Relief Landing Ground
RMI	Radio Magnetic Indicator
RN	Royal Navy
RNAS	Royal Naval Air Service/Station
RNAV	Area Navigation
RNLAF	Royal Netherlands Air Force

RNLAS	Royal Netherlands Naval Air Service
RNoAF	Royal Norwegian Air Force
RNZAF	Royal New Zealand Air Force
ROC	Rate of Climb
ROD	Rate of Descent
RPI	Runway Point of Interception
Rqr(d)	Require(d)
RSAF	Royal Swedish Air Force
Rte	Route
RTF	Radio Telephone
RTHL	Runway Threshold Lights
RTR	Radar Termination Range
RVA	Radar Vectoring Area
RVR	Runway Visual Range
RVSM	Reduced Vertical Separation Minimum
Rwy	Runway

S

S	South
SALS	Simple Approach Lighting System
SAR	Search and Rescue
Sat	Saturday
SATCOM	Satellite Communication
Sby	Standby
SOF	Step-Down Fix
SE	South-east
Sec	Second
SELCAL	Selective Calling System
Sep	September
Sfc	Surface
SHF	Super High Frequency (3000-30000MHZ)
SID	Standard Instrument Departure
SIF	Selective Identification Feature
Simul	Simultaneous
Sked	Schedule(d)
SLP	Speed Limiting Point
SM	Statute Miles
SMC	Surface Movement Control
SMR	Surface Movement Radar
SOP	Standard Operational Procedure
SR	Sunrise
SRA	Special Rules Area
SRA	Surveillance Radar Approach
SRE	Surveillance Radar Element
SRZ	Special Rules Zone
SS	Sunset

SSA	Sector Safe Altitude
SSB	Single Side-band
SSR	Secondary Surveillance Radar
SST	Supersonic Transport
STAR	Standard (Instrument) Arrival Route
Std	Standard
STOL	Short Take-oft and Landing
STWL	Stopway Lights
Sun	Sunday
Svcbl	Serviceable
SW	South-west
SWY	Stopway

T

°T	Degrees True
TA	Transition Altitude
TAC, TACAN	Tactical Air Navigation Equipment
TAP	Terminal Approach Procedure
TAR	Terminal Area Surveillance Radar
TAS	True Airspeed
TC	Terminal Chart
TCA	Terminal Control Area
TCH	Threshold Crossing Height
TD	Touchdown
TDP	Takeoff Decision Point
TDZ	Touchdown Zone
TDZE	Touchdown Zone Elevation
TERPS	Terminal Procedures (USA)
THR	Threshold
Thu	Thursday
TKOF	Take-oft
Tlkdwn	Talkdown
TMA	Terminal Control Area
TOC	Top of Climb
TODA	Take-oft Distance Available
TORA	Take-oft Run Available
Tr	Track
TRA	Temporary Reserved Airspace
TRL	Transition Level
Tue	Tuesday
Turb	Turbulence
Trng	Training
TuAF	Turkish Air Force
T-VASIS	T Visual Approach Slope Indicator System
TVOR	Terminal VOR

TWR	Aerodrome Control
Twy	Taxiway
Twyl	Taxiway Unk
Tx	Transmit, (ter)

U

UAR	Upper Air Route
UAS	University Air Squadron
UDF	UHF Direction Finder
UFN	Until Further Notice
UHF	Ultra High Frequency (300-3000MHz)
UIR	Upper information Region
UK	United Kingdom
Unltd	Unlimited
Unrel	Unreliable
u/s	Unserviceable
USA	United States of America
USAF	United States Air Force
USMC	United States Marine Corps
USN	United States Navy
UTC	Co-ordinated Universal Time

V

(V)	Emergency Voice Facility (ILS)
VAD	Visual Approach & Departure (Charts)
Var	Magnetic Variation
VASIS	Visual Approach Slope Indicator System
VDF	VHF Direction Finding Station
VFR	Visual Flight Rules
VHF	Very High Frequency (30-300 MHZ)
VIP	Very Important Person
Vis	Visibility
VLF	Very Low Frequency (3-30KHZ)
VMC	Visual Meteorological Conditions
VOLMET	Meteorological Information for Aircraft in Flight
VOR	VHF Omni-directional Radio Range
VORTAC	VOR and TACAN Combination
VOT	VOR Airborne Equipment Test Facility
Vrb	Variable
VSTOL	Vertical & Short Takeoff and Landing
VTOL	Vertical Takeoff and Landing
v/v	Vertical Velocity
V/v (fpm)	Vertical Velocity in Feet per Minute

W

W	West
W	White
WATRS	West Atlantic Route System
WBAR	Wing-bar Lights
WDI	Wind Direction Indicator
Wed	Wednesday
WEF	With Effect From
Wkend	Weekend
WIE	With Immediate Effect
WIP	Work In Progress
Wh	White
Wkday	Weekday
WPT	Waypoint
Wt	Weight
Wx	Weather

X

XBAR	Crossbar (of Approach Lighting System)

Y

Y	Yellow

Z

Z	Co-ordinated Universal Time