TRAINING MANUAL (TM)
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SUBJECT: Controller Training Manual

SCOPE: This document serves as a reference guide for new controllers undergoing training to become a Student Controller 1 (S1). This guide is originally created and maintained by VATSEA and is customized for use at Hong Kong VACC.

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0. Preface

0.1. HOW TO READ THIS TRAINING MANUAL

This manual is intended both for those novice to air traffic control, who want to learn the basics, and to those who want to learn more. The original content was created by VATEUD division and was adopted by VATSEA division.

If you are new to air traffic control, we'd like to point out that this manual is quite comprehensive, and it is absolutely not necessary to know everything in this manual by heart. You will get an idea of what it is all about, and can later use the manual as a reference to get necessary information.

Some sections are more advanced than others. The sections are marked according to what level they correspond to in the following way:

- (unmarked) – Required knowledge for all controllers.
- [S1] – Required knowledge for Student 1 and above.
- [S2] – Required knowledge for Student 2 and above.
- [S3] – Required knowledge for Student 3 and above.
- [C] – Required knowledge for Controller and above.
- [C3] – Required knowledge for Senior Controller and above.
- [Ref] – Reference only for all controllers.

In conjunction to this manual you should also read the GUIDE. The GUIDE contains material that focus more on practical ATC. Additionally standalone manuals covering each ATCO position can be found on this site.

The ATC Training Department of Hong Kong VACC would like to thank VATSEA for allowing us to use and edit the VATSEA ATC training manual, which then becomes this localised training manual for Hong Kong VACC. The VATSEA ATC training manual was originally created for VATEUD division. Some topics within this manual were edited from the VATEUD edition. We would like to

Finally, we would like to point out that our motto is "as real as it gets", but also always remember to have fun while aiming at that goal. Good luck!

HONG KONG VACC ATC TRAINING DEPARTMENT

1. INTRODUCTIONS TO ATC

1.1. VATSIM RULES

The **VATSIM Code of Regulations (CoR)** and **Code of Conduct (CoC)** are designed to maximise everyone's enjoyment of the VATSIM network. Consequently, it is important that you remember the following key points:

- You must provide full and accurate details when registering to VATSIM. If any of your details are incorrect, it is important that you update them as soon as possible via the "Member Services" link on the main VATSIM website.
- You can only have one account with VATSIM. If you have accidentally created another due to a misunderstanding during registration, please inform the central Membership Team via the "Member Services" link on the main VATSIM website.
- You can only connect to the network once, unless you are connecting with an ATIS (Airport Terminal Information Service) facility too. In such instances, if someone is already connected as an ATIS facility, you should not - just 1 per airport. Apart from this, duplicate connections are prohibited.
- You must never give anyone access to your account. If you do, you risk permanent suspension.
- Your controller information in your controller client must not exceed 4 lines (as per www.vatsim.net/EC).
- If you find yourself in online conflict, you should call a supervisor by typing .wallop followed by your message (e.g .wallop I am having problems with ABC123. (Note: This does not work in FSInn)
- You should never use the GUARD frequency (121.50). If you are flying in uncontrolled airspace, please tune UNICOM 122.80.
- A pilot must never simulate a HIJACK (by squawking 7500). Any member doing so will be automatically disconnected from the network.
- You must never control traffic whilst connected as an Observer (OBS).
- An Air Traffic Controller has the right to refuse an emergency aircraft. In such situations, a pilot can either:
  - Disconnect from the network
  - Cancel the emergency and resume normal flight
- Active ATC callsigns are (with reference to VATSIM GRP rating in brackets):
  - Ground Controller (S1) _DEL and _GND
  - Tower Controller (S2) _TWR
  - TMA Controller (S3) _APP and _DEP
  - Enroute Controller (C1) _CTR and _FSS (both radar and non-radar control services)
- All affect flying in one way or another. You are most affected by weather when flying VFR, but also when flying IFR, there are restrictions how bad weather can be before plans must be changed. In this section, we'll look into how weather is reported, but not how weather affects flight.

- There are many acronyms and concepts in weather reporting, which we will learn throughout the rest of this document. Below we'll cover rather completely the weather report. There are many acronyms and concepts. You need not know them all from the beginning, but you must be able to get the name of the airport, wind and air pressure. Since you as a controller read the weather report to the pilots, you'll soon learn the rest of the acronyms.

1.2. THE ROLE AND RESPONSIBILITY OF AN AIR TRAFFIC CONTROLLER

We start with the most important: As a controller, your main task is to separate aircraft. Your responsibility is therefore to make sure no collisions occur. You must at all times avoid any risk of collision.

Now that we have said it in three different ways, we hope that you remember what your main task is, but there are other tasks as well:

- Prevent collisions between aircraft.
- Prevent collisions between aircraft and ground obstacles on ground.
- Expedite and maintain an orderly flow of air traffic.
- Provide advice and information for safe and efficient conduct of flight.
- Make it as real as it gets and at the same time understand that all involved shall have as fun as possible.

As a controller, you have a good overview over the traffic, but you never know how the situation is inside the cockpit where the pilots sit.
Your responsibility is therefore to the traffic situation.
You are not responsible to how the aircraft is flown. Every pilot has a responsibility for his aircraft.

Sometimes, there is a disagreement between you as a controller and the pilot as to what is the right action in the current situation. Remember that it is the pilot who has final word in these situations.

This doesn't mean that he can fly his aircraft the way he pleases, but rather that you cannot give the pilot an instruction which he or his aircraft is physically unable to perform.

To avoid this kind of conflicts, it is always important to give the reason why unusual instructions are given.

It is very rare that disputes occur in our virtual world. We always try to help each other. If you end up in a dispute anyway, try to remember that we are real people in a virtual world.

If you or anybody else makes a mistake, no lives are at stake.This is the most important difference between real life and the virtual world. Try not to get angry, never argue with anybody,

but rather point out the problem in a calm and constructive manner.
The above can be summarized in “common sense” and “humility” - two good characteristics.

If a situation gets unpleasant or hatred, or if a pilot deliberately tries to sabotage our environment, you should try to contact a Supervisor (SUP) or Administrator (ADM).
These people have a responsibility to act in these kind of situations and they are also the only ones who can expel pilots and controllers.

Let's move on from this boring but necessary topic and look closer on your task as a controller. Apart from separation, you should also give service to the aircraft. Simply said, you should guide the pilots from point A to point B.

The pilots are in a never ending need of current information. They need weather and traffic information etc. It is your responsibility to deliver this information as correctly and quickly as possible.

There is one final task which isn't less important than the others. That is to have fun. We want you to enjoy yourself online VATSIM!

1.3. CONTROLLER FUNCTIONS

One of the most common mistakes made in the VATSIM environment is the misconception of a particular facility's function.

A controller can work in many different roles, where maybe Tower is the most well-known. Every role has its own responsibilities and working tasks as described below.
Note that in the online environment we have reduced the number of tasks. In real life there are many more.

A basic summary of what each position does follows below. The usual practice is that a position takes over all of the “lower” when they are unmanned.

Example:
TWR handles all the duties of the position DEL, GND and TWR if none of the “lower” is on-line.
If DEL gets online, then DEL will of course handle DEL and TWR will handle GND and TWR.
Finally (to make things really clear) if GND gets online, then GND handles DEL and GND and TWR only TWR.

Note that some positions require a minimum rating. There may also be stricter local rules that apply for certain controller functions. Please refer to your local vACC for more information.

1.3.1. Clearance Delivery (DEL)

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1.3.2. **Ground (GND)**

Ground Control is responsible for exercising general surveillance on the airport movement area - apron.

Ground gives taxi clearances and restrictions. Note however that Ground isn't responsible for the runways, they are tower’s responsibility. When the aircraft is approaching the active runway, Ground hands over to Tower, who “owns” the runways.

If an aircraft needs to cross a runway, (active or inactive) on its way to it’s destination a specific clearance to do so must be obtained. Ground then needs to coordinate with tower to get approval or hand over the aircraft to TWR for that clearance (the first being the preferable).

There are a few airports that have runways that are used as taxi-ways. They are controlled by GND, if this is clearly stated and coordinated between TWR and GND.

1.3.3. **Tower (TWR)**

Tower is responsible for all take-offs and landings and gives instructions to effect proper sequencing and separation of aircraft for departure.

Tower decides which runways are being used for take-offs and landings depending on wind direction etc. You are also responsible for aircraft on the ground when they are on the runway or are about to cross a runway.

Landing aircraft are handed over to Ground as soon as they leave the runway (or sooner at tower's discretion)

Departing aircraft are handed over to the next controller when they leave your airspace, which normally means 3000-4500ft. The hand-off can also be done earlier if coordinated between TWR and next controller.

1.3.4. Departure Control (DEP)

Departure Control is responsible for ensuring separation between departures once they are handed over from TWR. This controller may also suggest headings or vectors as appropriate to maintain this separation.

APP take care of DEP, when this position isn't manned.

1.3.5. Approach Control (APP)

As the name implies, Approach is responsible that aircraft when they approach the airport.

For arriving aircraft, the hand over point is normally when the aircraft enters the STAR (Standard Instrument Arrival) entry point. Approach is responsible that separation is made in a safe way. In case the STAR doesn't end at the initial approach fix (final), Approach is responsible for vectoring aircraft on to the final with proper altitude and speed. Approach may also vector aircraft away from a STAR or SID (Standard Instrument Departure if this is necessary for safety reasons, or to get a good traffic flow.

Normally Approach also handles departure's responsibilities, taking care of departing aircraft which are handed over to Centre Control.

Arriving aircraft are usually handed over to Tower when they have established ILS (Instrument Landing System) or when on final for visual approach.

1.3.6. Area Control Center (CTR)

Area Control Center (called "Hong Kong Radar (HKG_CTR) in Hong Kong FIR) provides ATC to aircraft on the en-route phase of flight.
This includes giving information that the pilot needs such as weather and traffic information.
It usually includes taking care of departing traffic, climbing to their cruising altitude and

issuing inbound-clearance to traffic that is approaching the final destination of the flight.

ACC is also responsible for all airports where Tower and Approach are not manned.

ACC is a demanding position and requires a great deal of experience.

1.3.7. Flight Service Station (FSS)

Flight Information Centre (sometimes called FSS) is an air traffic facility that provides a myriad of services to the pilot, such as pilot briefings, relaying of clearances and broadcasting of weather information.
At selected locations, FIS also provides en-route Flight Advisory Services

1.4. THE VATSIM COMMUNITY

VATSIM is a huge and quite complex organization.

There is only one sort of membership, but you can say that there are three different kind of activity that you can engage in. Many members participate in more than one of these activities.

- ATC
- Pilot
- Administration

As a pilot or ATCO there is little need to know everything about the organization as such, but from time to time you might want to contact someone from administration to get help or guidance.

Since it isn't always easy to know who to turn to, a brief insight in the organization-tree is presented here for reference. There is also a short description of the history of VATSIM at the end of this section.

It is not in the scope of this manual to describe the VATSIM organization in detail and the best way of finding the right person is to start looking at your own vACCs homepage. There will be a staff-list with contact information on that page. The staff will guide you in the first instance if your request can't be handled within your vACC.

You can also turn to the VATSIM forum and ask for help and further assistance.

1.5. GETTING STARTED

1.5.1. Getting Started

Some say it can be quite a challenge to find all material and all programs that are needed in order to conduct on-line ATC in VATSIM. While we strive to make this process as easy as possible, we do recognize that this is an obstacle that you need to overcome. Please take a look at this step by step guide if you are in need for guidance: http://www.vatsim.net/atc/atctraining/

You can also refer to your local vACC homepage to find more information on the training and upgrading process in it. If you get stuck or are lost in some way, please do not hesitate to contact the one in charge for training in your local vACC or VATSEA ATC Training Department.

1.5.2. Radar Client

First you will need a radar client. There are links to approved software and manuals on VATSIMs Home Page www.vatsim.net(Controller Resources => Controller Software). Since there is more than one radar client available, you might want to check with your instructor which one (s)he will be using in your training. Even though a radar client is all what you need, there are other programs that can be helpful. You may find many of them on www.vatsim.net under links and resources.http://vatsim.net/links/linksandresources.html For ease of members you will also find the links and short descriptions under ATC Resources on the main menu of VATSEA.

1.5.3. Setting Up for an ATC Session

A good advice is to prepare for your on-line session. In some areas you are requested to book a position before you man it. A good habit is to log on to VATSIM as an observer first and coordinate with fellow ATCs controlling sectors adjacent to the sector you are planning to man. This also gives you an overview of the present traffic situation. Make sure you have access to current maps and charts for the area you are planning to give ATC in. Prepare your ATIS and start the session. It is a good practice to send an ATC-message as soon as you get on-line to inform you fellow ATCs that you have opened your position. Please refer to the software manual to see how this is done. Before closing your sector, inform fellow ATCs in the same manner as above and give information to all the pilots that are under your control on how they shall proceed i.e. hand-over traffic to another controller or switch to UNICOM and continue on own navigation.

We have placed links to two excellent and highly recommended manuals explaining how to set up an Observer Session using either ASRC or VRC, these can be accessed **here** for ASRC and **here** for VRC (both are Pdf format)

1.5.4. When in need of help

If you need help “off-line”, the first instance you should turn to is your local vACC. Search for the answer to your question on the local Webpage or forum or write in the forum and ask for help. You can also search/write in the VATSIM forums (http://forums.vatsim.net/). If this isn’t helping you or your question is better dealt with in private, rather on a forum, please look at the staff-listing on your local vACC and write an e-mail to the staff-member in charge for the area which your question concerns. This will usually solve the problem, but if not and if needed please write an e-mail to someone in the VATSEA staff. If you need help on-line, you should contact a more senior fellow colleague on-line and ask for guidance and help. If there is none or if this doesn't solve your problem you should contact a SUPERVISOR. This is done by typing [**.wallop**] in the radar client's command field. The message is sent to all Supervisors on-line and they will do their best to help you sort the problem out. Good Luck with your controlling!

1.6. THE HISTORY OF THE VATSIM COMMUNITY [Ref]

An Introduction into the Great Hobby of Online Flight Simulation and Simulated Air Traffic Control.

It wasn't long ago when the whole world was ours alone. Beginning with Microsoft's Flight Simulator Version 5.0, we could simulate flying to many parts of the world.

Flying, however, was a very lonely proposition. There were no other airplanes in the skies while we flew en-route and our arrivals at major airports were like landing in ghost towns.

There was dynamic scenery and beginning with Microsoft's Flight Simulator 98, multi-player capability to keep you company. But other than that, Flight Simulator, as wonderful a program as it has been throughout its history, fell flat when it came to simulating air traffic control.

In 1997, all of that changed with the introduction of SquawkBox©, an add-on program for Flight Simulator 95/98, and ProController©, a standalone program.

Over time, SquawkBox© has been revised several times and now works with all major Flight Simulation programs including Microsoft Flight Simulators 2002, 2004, FSX, Precision Simulator and the Fly! series of programs.

Through the use of ProController, and later on more advanced versions such as ASRC, VRC and more recently Euroscopeand the internet, people operating as air traffic controllers could track and control aircraft in real time as they flew in Flight Simulator by utilizing a simulated radar screen.

Pilots, using SquawkBox and more recently FSINN, could now talk to and receive air traffic control from people using one of the ATC software platforms in use. Soon thereafter, various organizations were established to bring order and structure to this new nîche in the hobby.

The Virtual Air Traffic Simulation Network, known as VATSIM.net or "VATSIM" was created in 2001 by a group of individuals who came together with a goal of creating an organization which truly served the needs of the flight simulation and online air traffic control community.

With an eye towards more than just providing a network of computers for users to log into, VATSIM is an online community where people can learn and, at the same time, enjoy the pastimes of flight simulation and air traffic control simulation, all while making new friends from all over the world.

VATSIM is not just for individuals who have experience in online flight simulation and ATC. It is perfect for both the new user, and the long time "simmer".

For someone who has just learned about online flight simulation and air traffic control and is interested in real world procedures, VATSIM and its members, many of whom bring real world experience and expertise to our community, offer an ideal environment to learn real world skills.

For pilots, you'll be able to fly with radar service by air traffic controllers who issue instruction and assistance in all phases of flight from getting your clearance to arriving at your destination airport.

For air traffic control enthusiasts, the entire world is simulated meaning you can work ATC virtually anywhere…from a general aviation airport to the busiest airports in the world. Nearly all of the real world positions are available for you to choose and learn to work.

The best part of all of this is that VATSIM brings real people together who share your passion for flight and air traffic control. When you contact that controller or pilot, you aren't contacting a computer generated voice or image - you will be communicating with a real person who shares the same interests as you!

All it takes is a few moments to register and join VATSIM. Once you do, prepare to learn and be rewarded with friendships that will span the globe. In addition, you'll receive the appreciation and thanks of the online flight simulation and air traffic control communities.

2. METEOLOGY

2.1. INTRODUCTION

Weather knowledge is essential in aviation: Visibility, air pressure, thunderstorms, temperature, clouds, rain and dew point etc.

All affect flying in one way or another. You are most affected by weather when flying VFR, but also when flying IFR, there are restrictions how bad weather can be before plans must be changed. In this section, we'll look into how weather is reported, but not how weather affects flight.

There are many acronyms and concepts in weather reporting, which we will learn throughout the rest of this document. Below we'll cover rather completely the weather report. There are many acronyms and concepts. You need not know them all from the beginning, but you must be able to get the name of the airport, wind and air pressure. Since you as a controller read the weather report to the pilots, you'll soon learn the rest of the acronyms.

2.2. METAR – AVIATION ROUTINE WEATHER REPORT [S1]

At major airports, weather observations are made every half hour, day and night. The weather in the METAR is the weather observed 10 minutes before the report.

The following is part of a METAR:
Airport (for example VHHH for Hong Kong)
Observation time (day and time followed by Z)
Wind at ground level: direction, speed and unit (knots)
Meteorological visibility
Runway Visual Range (RVR) if visibility is below 1500 m.
Present weather
Clouds, amount, type and base
Air temperature and dew point
QNH (air pressure), preceded by Q.
Other information, for example wind change.
Landing forecast, trend.
The following is a brief breakdown of some of the basic METAR elements:

METAR VHHH 121755Z 21016G24KT 180V240 1500 R07R/0600U -RA BR BKN015 0VC025 06/04 Q1005 BECMG 9999=		
METAR	TYPE OF REPORT	Either routine (METAR) or non-routine (SPECI). En Route Facilities use either a M or S which follows the time of the report.
VHHH	ICAO IDENTIFIER	Four letter ICAO Code.
121755Z	DATE and TIME	First two digits are the date, followed by the hour and minutes in UTC time (Z).

21016G24KT 180V240 VRB04KT	WINDS	Normally a 5-digit grouping (6-digits if speed is over 99 knots). The first 3-digits is the direction, the next two or three is the speed. **G** indicates gusts with the highest gust report after it. **V** indicates variable wind direction. **VRB** indicates variable wind speed 6 knots or less ***Note: International stations may use meters per second (MPS) or kilometers per hour (KMH) and code the wind speed accordingly.***
1500	VISIBILITY	Prevailing visibility reported in Meters. 2800 represents 2,800 meters and 9999 represents a visibility greater than 10 km.
R07R/0600U	RVR VALUES	"R" indicates the group followed by the runway heading (07R) and the visual range in meters. The report might include a "U" for increasing or "D" for decreasing values.
-RA BR	WX PHENOMENA	This example shows light rain with mist. Some main weather codes: SN=Snow, GR=Hail, SH=Showers, FG=Fog, +=Heavy, -=Light
BKN015 0VC025	SKY CONDITIONS	Shows the amount of sky cover and cloud base height. FEW = less then 1/8 SCT = 1/8 till 3/8 BKN = 4/8 till 7/8 OVC = 8/8
06/04	TEMP/DEW POINT	Reported in two, two-digit groups separated by a slant ("/"), in degrees Celsius. Temperature and dewpoint below zero are prefixed with a "M".
Q1005	ALTIMETER	QNH reported in a four-digit format in HectoPascals (Hpa) preceded with a "Q". In i.e. USA altimeter reports are in inches of mercury.
BECMG 9999=	TREND	How the weather is going to develop in the time the METAR is current (2 hours). You can here find Sky conditions, Visibility, Wind, Weather TEMPO = Temporary change in weather BECMG = Permanent change in weather

2.2.1. Wind

Wind is measured 10 m above ground.

The direction is from where the wind is coming. The precision is 10 degrees.

In the METAR, the wind velocity is a 10 minute average and given in knots (kt). If there are gusts 10 KT over the average value, this is reported as well. The gusts are reported as G17 and should be read “gusting” or “maximum”.

When flying, the wind direction in itself isn't the most important factor, but it’s the side-wind component. If the wind direction varies more than 60 degrees and if there's more than 3 kt wind, it is reported as V (variable). If there is less than 3 kt wind and it varies, this is reported as VRB. Calm is reported as 00000KT.

Example:
VRB02KT – variable two knots
25020KT – two five zero degrees two zero knots
15015G25KT – one five zero degrees one five knots maximum (or gusting) two five knots
24018G35KT 160V290 – two four zero degrees one eight knots maximum (or gusting) three five knots variable between one six zero and two niner zero degrees

2.2.2. Visibility

Visibility is often of vital importance. There are three ways of obtaining the visibility:

Flight Visibility is the visibility forward from the cockpit of an aircraft in flight.

The **Ground Visibility**, which is given in the ATIS and METAR, is the visibility at an aerodrome, as reported by an accredited observer.

Ground visibility reading, which is measured automatically.

The two latter is the distance measured to a large unlit object, where the contours of this object can be seen.

Visibility is affected by moisture, ice crystals, salt or dust in the air.

Visibility in darkness is today most often measured with infrared light.

Visibility is measured in steps up to **10 km**. Visibility below 50 m is written as 0000 and 10 km or more as 9999. Visibility below 5000 m is given in m, and above in km.

Example:
450 – visibility four five zero meters
1500 – visibility one five zero zero (or one thousand five hundred) meters
9999 – visibility more then ten kilometres
Special case: 1800N 7000S – visibility to north one eight zero zero meters, to south seven kilometres.

2.2.3. Runway Visual Range

Runway Visual Range is only measured if visibility is below **1500 m**.

The RVR instruments (transmissometers) are located at both ends, and in the middle of the runway. These are referred to as RVR Touch down zone (TDZ), Midpoint and Stop-end. Most important for the landing is the value of the TDZ.

The RVR report starts with an R followed by the runway designator. If there is more than one runway in the same direction, L, R and C are used.

Other RVR codes:
M: visibility is below what can be measured, or below 50m
P: RVR is more than 1500 m
V: RVR varies
U: RVR is going Up
D: RVR is going Down
Examples:
R29L/0700 – R-V-R two niner left seven zero zero meters
R19R/M0150D – R-V-R one niner right below one five zero meters going down
R26/0350V0600U – R-V-R two six variable between three five zero and six zero zero meters going up

2.2.4. Weather Phenomena

Current weather is included in the METAR. It is abbreviated with two letters. If this isn't enough, the abbreviations can be combined. The abbreviations are listed at the end of this chapter. Some abbreviations can be preceded with a ”+” or ”-”, this lists the intensity. VC means Vicinity, which means within **8 km** from the airport. Exception: thunder and cumulonimbus clouds. Sometimes the recent weather is also reported, in this case ”RE” precedes the weather condition.

Examples:
SN BLSN – Snow and blowing snow
+FZDZ FG – Heavy freezing drizzle with fog
RESN – Recent snow

2.2.5. Clouds

There are a number of reported clouds types, but only two are important to differentiate: **Cumulonimbus (CB)** and **Towering Cumulus (TCU)**. Otherwise, only the fraction of sky covered by clouds is measured. This was previously reported in 1/8's, but nowadays this is described in words:

- 0/8: Sky clear (SKC)
- 1-2/8: Few (FEW)
- 3-4/8: Scattered (SCT)
- 5-7/8: Broken (BKN)
- 8/8: Overcast (OVC)

The cloud base above the airport's reference height AGL (Above Ground Level) is measured in hundreds of feet. 001 means 100 ft, 012 = 1200 ft and 120 = 12000 ft. Vertical visibility is reported as VV, and if this is not measured VV///.

Examples:
BKN002 – Broken two hundred feet
SCT013 BKN120 – Scattered one thousand three hundred feet broken one two thousand feet.
SCT035TCU – Scattered three thousand five hundred feet, towering cumulus.

2.2.6. CAVOK

CAVOK (read CAV-OH-KAY) replaces visibility, weather and clouds if: visibility ≥10km; no cloud below 5000 ft (1500m) or below the highest minimum sector altitude, whichever is greater and no CB or TCU (Cumulonimbus); and no precipitation, TS, DS, SS, MIFG, DRDU, DRSA, or DRSN.

The full readout of CAVOK can be either "**Clouds and Visibility OK**" or "**Ceiling and Visibility OK**". The most common is the latter, but the most correct ought to be the first. This is because 'ceiling' means BKN or OVC when it comes to clouds and the definition of CAVOK is that NO clouds should be present below 5000ft.

2.2.7. Temperature

The air temperature is measured in degrees Celsius.
If below 0, it is preceded by an M.

2.2.8. Dew Point

The **dew point** is defined as the temperature the air must be cooled to, to get saturation, i.e. relative humidity 100%.

If below 0, it is preceded by an M.

Dew point is important to the pilot since this value gives information about visibility, clouds and together with the temperature indicates the risk of ice-formation. The closer the temperature and dew point are, the more humidity is in the air and the worse is the visibility.

The difference between temperature and dew point is called spread. If you calculate SPREAD x 400ft you will get the lowest cloud base.

Example:
02/M04 – Temperature two dew point minus four

2.2.9. Air Pressure

As described in other sections in this manual, the air pressure is vital to know, since it affects the altitude measuring system. Air pressure can be measured in different ways, and relative different levels.

QNH is air pressure at sea level (or reduced to sea level in standard atmosphere if it's measured at another point).

QFE is air pressure at the airport.

A high value means high air pressure and vice versa.

Standard pressure is **1013.25 hPa** or **29.92 inch Hg**.

In the METAR, the value is preceded by a Q if the unit is hPa and A if it's inch Hg. Q is used in Europe.

Example:
Q0987 – Q-N-H niner eight seven

2.2.10. Trend

The trend prognosis should indicate expected changes within next two hours.

There are three MAIN concepts used in Trend:

- Becoming (**BECMG**)
- Temporary (**TEMPO**)
- No Significant Change (stable) (**NOSIG**)

The first two can be given with a time reference.

Examples:
BECMG FM1250 TL1340 – Becoming from 1250 till 1340 (the change will take place between 12:50 to 13:40)
BECMG AT 1400 – Becoming at 1400 (will change at 14:00)
TEMPO FM 1400 – Tempo from 1400 (One or more changes shorter than one hour, from 14:00 to two hours after the METAR was reported.)

Additional Trend prognosis can be From, To and At.

2.2.11. Runway Conditions

Runway Condition is not always included in a METAR. It is only when the conditions on the runway might affect aircrafts landing and departing.

First the runway number is indicated. This is done with the runway two digit numbers. If the report covers all runways at the airport, ”88” is reported. Repeats of earlier given information is indicated with ”99”.

The runway report is given as **AABCDDEE** as follows:

AA: Runway
01 – 36 Runway (Left if parallel)
51 – 86 Right runway (if two parallel)
88 All runways at airport

B: TYPE OF DEPOSIT	C: EXTENT OF CONTAMINATION
0= CLEAR and DRY	1=10% or less of RWY covered
1= DAMP	2=11-25% of RWY covered
2= WET or Water Patches	5=26-50% of RWY covered
3= RIME or FROST (<1mm)	9=51-100% of RWY covered
4= DRY SNOW	
5= WET SNOW	
6= SLUSH	
7= ICE	
8= COMPACTED or ROLLED SNOW	
9= FROZEN RUTS or RIDGES	
/= TYPE of DEPOSIT NOT REPORTED, e.g due to RWY clearance/de-icing in progress	/= NOT REPORTED e.g due to RWY clearance or de-icing in progress.

DD: DEPTH OF DEPOSIT	EE: BRAKING CONDITIONS
00= less than 1mm	FRICTION COEFFICENT
01 to 90= depth in mm, e.g 23=23mm	Reported figures from 01 to 90 represent FC, e.g 05=FC 0.05, 28=FC 0.28
92= 10cm	BRAKING ACTION
93= 15cm	91= POOR
94= 20cm	92= MEDIUM/POOR
95= 25cm	93= MEDIUM
96= 30cm	94= MEDIUM/GOOD
97= 35cm	95= GOOD
98= 40cm	95= GOOD
99= RWY not operational due to snow, slush, ice, large drifts or RWY clearance. Depth not reported.	99= UNRELIABLE, BA and FC not possible to assess, misleading, e.g in case of aquaplaning.
//= Depth operationally not significant e.g with ice or rolled snow, or not measurable e.g RWY wet.	//= RWY not operational, BA and FC not reported.

2.2.12. METAR Reference

CODE	Weather
KT	Knots
G	Wind Gusts / Maximum
V	Variable wind
VV	Vertical Visibility
-	Light (intensity)
+	Heavy (intestity)
VC	In vicinity
MI	Shallow
PR	Partial
BC	Patches
DR	Low drifting
BL	Blowing
SH	Showers
TS	Thunderstorm
FZ	Frezzing
DZ	Drizzle
RA	Rain
SN	Snow
SG	Snowgrains
IC	Diamond dust
PL	Ice pellets
GR	Hail
GS	Snow grain
BR	Mist
FG	Fog
FU	Smoke
HZ	Haze
SKC	Sky clear
FEW	Few
SCT	Scattered
BKN	Broken
OVC	Overcast
CB	Cumulonimbus
TCU	Towering cumulus
NSW	Nil significant weather
CAVOK	Ceiling And Visibility OK
NOSIG	Nil significant change
Q	QNH
BECMG	Becoming
FM	From (time)
AT	At (time)
TL	To (time)
RE	Recent
WS	Windshear

2.3. VMC – VISUAL METEOLOGICAL CONDITIONS [S1]

Please note that the VMC minima differ between countries and you have to refer to your local vACC to get the minimums for your country. If no such values are available you can use the ones below.

During a VFR-flight certain VMC-minima, i.e. certain limits for visibility and cloud base has to be fulfilled. These limits depend on what altitude and in what airspace the flight is conducted. A pilot may not fly VFR if the weather is below these minima.

Clearance to fly below the minima as special-VFR can be obtained by ATC, but such a clearance can only be given for flights within a CTR and is only valid for an approach or departure to or from the airport when the weather is above minima outside the CTR.

The opposite of VMC is instrument metrological conditions (IMC), which is considered to prevail whenever VMC minima aren’t be met.

In our virtual world ATC and pilots may have different weather on the same spot and time because of software and updates from servers. It is therefore good practice to leave the decision if a flight shall be cancelled or postponed due to VMC to the pilot.

3. AIR PRESSURE AND ALTITUDE

3.1. INTRODUCTION

There are a large number of terms concerning the measurement of altitude within aviation. This chapter will deal with the most usual terms and explain in what situations you use them.

3.2. PRESSURE [S1]

The **static pressure** is defined as the pressure that the atmosphere is producing. You've probably heard of high and low pressure, but in aviation you have to be more accurate than that and measure the pressure with digits.

In aviation air pressure is measured in **hectopascal, hPa**. ICAO has defined a standard atmosphere* in which the pressure at sea level is **1013.25hPa**. This is also called 'standard setting' or QNE.

Since the air gets thinner with increased altitude, the pressure is reduced. More precisely with 30hPa / 1000feet*. An aircraft altimeter uses this fact by measuring the pressure around the aircraft and translating it to an altitude.

The pressure at sea level is however not static and an altimeter has to compensate for this in order to show the correct altitude. This compensation is done manually by the pilot by setting a reference that is calculated from the present air pressure. There are two commonly used methods for calculating this reference and they are abbreviated; **QNH** and **QFE**.

QNH is the actual air pressure reduced to sea level in standard atmosphere*. When setting the correct QNH, the altimeter will show the airfield's elevation over MSL (see below), providing that the aircraft is standing on the airfield. QNH is the most common setting in civil and private aircrafts.

QFE is the actual air pressure, not reduced to sea level i.e. the air pressure at the airport. When setting the correct QFE, the altimeter will show zero, if the aircraft is standing on the airfield. QFE is rarely used in commercial civil aviation. VFR-traffic sometimes uses QFE and it is common that military aircraft uses QFE instead of QNH.

To be correct, not only the pressure, but also the temperature has to be taken in consideration in order to measure the true altitude. OAT combined with QNH is used to calculate true altitude.

* In standard atmosphere – as defined by ICAO
Pressure at sea level: **1013.25 hPa**
Temperature at sea level: +15 degrees Celsius (C)
Decline in temperature: 2 degrees C / 1000 ft
Tropopaus altitude: 11km
Temperature in tropopaus: -56.5 degrees C

Temperature is constant between 11-20km

3.3. TEMPERATURE [S1]

Temperature is a measure of the movement of the molecules in the air.

It is measured in Celsius (C), Fahrenheit (F) or Kelvin (K).

In aviation OAT (Outside Air Temperature) is used as the real out temperature and the unit used is Celsius. (To be correct TOAT should be used, but OAT is the same as TOAT if the first letter is omitted).

The temperature drops 2 degrees C / 1000 ft in standard atmosphere.

3.4. MEAN SEA LEVEL [S1]

Mean sea level (MSL) is the average height of the sea, with reference to a suitable reference surface.

Defining the reference level, however, involves complex measurement, and accurately determining MSL can prove difficult.

Lucky for you, this is outside the scope of this manual.

3.5. ALTITUDE [S1]

Altitude is defined as the vertical distance between mean sea level (MSL) and an aircraft. When the pilot has set the correct local QNH he will fly on an altitude.

3.6. HEIGHT [S2]

Height is defined as the vertical distance between the ground (GND) or an airport and an aircraft. Height may be expressed in charts as number of feet above ground level (AGL). If an aircraft is flying on altitude 1000ft and the airports elevation (which means height above MSL) is 300 ft, the aircraft height is 700ft.

3.7. FLIGHT LEVEL (FL) [S2]

Flight levels are expressed in hundreds of feet of vertical distance from the pressure reference 1013.25. Hence, when flying on flight levels, the pilot has to set the altimeter to the standard pressure 1013.25hPa.

If the QNH is 1013.25 FL 130 would be 8000 ft above MSL (in a standard atmosphere).

If the QNH is 1003 hPa (i.e. lower then 1013.25) FL 130 would be less then 13000 ft above MSL. (It would be 1013-1003 = 10 x 30ft =300 ft less = 13000-300ft = 12700ft).

Flight levels are used above a certain altitude called the transition altitude.

This is to avoid that pilots flying en-route have to set their altimeters to local QNH all the time as they fly though areas with different pressure.

If two aircraft are at the same location, one at FL160 and the other at FL170 they are still 1000ft apart, as their altimeters deviate by the same amount from the true altitude.

3.8. TRANSITION LEVEL, ALTITUDE AND LAYERS [S2]

Transition altitude (TA) is always the same at an airport, but differs from airport to airport. When an aircraft is climbing trough the transition altitude the pilot will set the altimeter to standard setting (QNE) 1013.25hPa.

When an aircraft is above the transition altitude it will fly on flight levels. Upon descent the pilot should set the altimeter to local QNH (or QFE if appropriate) when passing the **transition level (TL)** at the latest. This means that below the transition level, altitude will be used.

Transition layer is defined as the airspace between the TA and the TL. In some countries the transition layer has to be 1000 feet or more, but in some it can be thinner.

Whatever the rules, in a specific country are, the TL will thus vary with the air pressure in order to maintain a certain minimum thickness. (This will change, since new rules are soon implemented) You have to look up the local rules in your vACCs operating manual.

Rule of thumb is that the TL is lower when the pressure is above standard 1013.25 Hpa, and higher when the pressure is below standard 1013.25 Hpa.

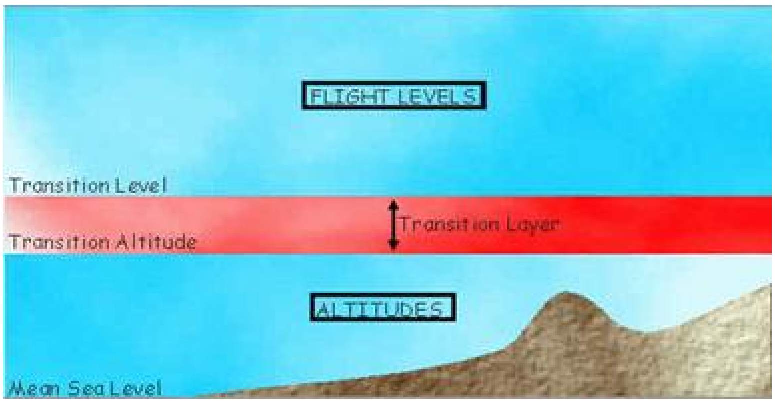


Figure 3.1: Illustration of Transition Level, Transition Layer and Transition Altittude.

3.9. MINIMUM USABLE FLIGHT LEVELS [S3]

Aircraft that are flying at Transition Altitude (TA) or above, set their altimeter to a standard pressure of 1013 Hpa. Because the pressure changes en route, they are actually flying at different altitudes as they travel through areas with differing atmospheric pressure. This works fine for all aircraft at TA or above, because regardless of their actual altitude above mean sea level, they are still separated from each other by 2000 feet.

Unfortunately this does not always work between two aircraft assigned an altitude close to TA, and a Flightlevel close to Transition Level (TL). If the local altimeter ever drops below 1013 Hpa, then the 1000 foot separation required between the two aircraft (called Transition Layer) is lost. For this reason, the Transition Level is variable to assure that the Transition Layer is the minimum 1000 feet.

Rule of thumb is that the TL is lower when the pressure is above standard 1013 Hpa, and higher when the pressure is below standard 1013 Hpa (as discussed in previous paragraph). To have more idea about Transition Level, please check the below figure.

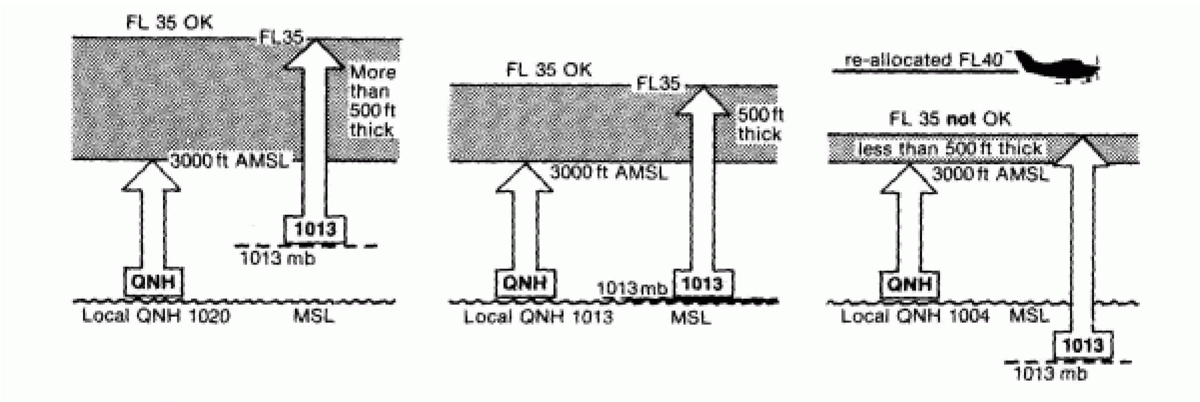


Figure 3.2: Illustration of Minimum Usable Flight Levels.

3.10. MINIMUM ALTITUDES MOCA, MRVA & MSA [S3]

MOCA = Minimum Obstacle Clearance Altitude

This is the lowest altitude that an aircraft can fly in IMC (Instrument Meteorological Conditions) and still keep safe clearance from terrain and obstacles. MOCA is often lower then MEA (se below). It is only used in emergencies, especially to get below icing.

MRVA = Minimum Radar Vectoring Altitude

MRVAs are established where ATC vectors are initiated or requested frequently. They are often lower than other applicable minimum IFR altitudes because they can be more focused in specific areas rather than general like a 25 NM safe altitude around a final approach fix, for example. As a result, these are not published on any instrument approach procedure, but may coincide with published values.

Since ATC is responsible for obstacle clearance of an aircraft on radar vectors, the MRVA will, by definition, provide a number of issues like cold weather altimeter errors, terrain and obstructions, restricted airspace, etc. The MANOPS Definition for an MRVA also includes radio coverage, but oddly enough, not radar coverage. It is also supposed to consider the base of controlled airspace in a given area, so the radar vectoring altitudes are often lower in terminal areas where the airspace classification is better designated to include lower transition areas. On this note, ATC may provide vectors to an aircraft in uncontrolled airspace (class G) if requested by the pilot, or if ATC suggests it and the pilot accept it.

MSA = Minimum Safe/Sector Altitude

Minimum Sector Altitude is the minimum altitude that may be used under emergency conditions which will provide a minimum clearance of 1000ft above obstacles and terrain contained within a sector of 25 NM radius centred on a radio navigational aid. MSA can be given as areas between radials from a VOR at the airport.

3.11. MINIMUM EN-ROUTE ALTITUDES (MEA) [C1]

MEA's takes into account both navigational aid limitations and obstruction clearance. This is important to you for two reasons.

First, if you clear an aircraft below the MEA in your area, and the pilot discovers rocks in the clouds ahead, he may be cranky.

Second, in case of radio failure, be aware that the pilot will climb to the MEA if he has not received a new altitude clearance prior to the radio failure.

You need to become familiar with the MEA's in your VACC area to the extent that you will not inadvertently clear an aircraft below them.

The MEA's can be found on the low altitude en route charts along airways. The number starting with an asterisk is the MOCA, which can be assigned under certain circumstances, but will not be useful in our environment (see above).

3.12. FURTHER READING [Ref]

MSL :
http://en.wikipedia.org/wiki/Sea_level
Altitude and Flight Level :
http://en.wikipedia.org/wiki/Flight_level
http://www.auf.asn.au/groundschool/umodule3.html

4. AIRSPACE

4.1. INTRODUCTION

The airspace is divided into different classes and areas.

The different airspaces are important to know because different services are provided within them. Please note that the airspace differs a lot in the European countries and you have to refer to your local vACC for more specific information. Here is however the general concept.

4.2. TYPES AND CLASSES OF AIRSPACE [S2]

There are four types of Airspace; controlled, uncontrolled, special use and other.

The type of airspace is dictated by the complexity and density of aircraft movements, the nature of the operations conducted, and the level of safety required.

In the uncontrolled airspace separation to other aircraft is solely the responsibility of the pilot. It is a matter of “see and be seen”. Pilots keep a good look out for other traffic and may use the radio to send blind transmissions. With “blind” transmission we mean that no answer is expected.

There are seven different types of airspace classes, named A to G.
Class A-E is **controlled airspace** and here air traffic control service is provided.
Class F and **G** are **uncontrolled airspace** and only flight information service (FIS) is provided.
The differences between the airspace classes are described in the next section.

Nations and/or states may not introduce all classes of airspace, but will select those appropriate to their needs. Refer to local manuals for the area in which you will provide ATC for more information regarding airspaces in use.

For the new students the important thing to remember about airspace classes is the fact that they are divided in controlled and uncontrolled airspace. When flying in controlled airspace a clearance is required, with exception of Class E which even if controlled does not require a clearance. For a controller to be able to issue a clearance, it is required that the pilot has submitted a flight-plan, and maintains two-way communication with a controller. It’s allowed to send a flight-plan via radio for VFR-flights, even though it is very seldom used on-line.

4.3. AIRSPACE CLASSES [S2]

Controlled airspace is the airspace within which all aircraft operators are subject to certain pilot-qualifications, operating rules, and equipment-requirements.

For IFR operations in any class of controlled airspace, a pilot must file an IFR flight plan and receive an appropriate ATC clearance. Standard separation is provided to all aircraft operating under IFR in controlled airspace.

Pilots flying VFR are responsible to ensure that ATC clearance and radio communication requirements are met prior to entry into Class B, C, or D airspace.

Traffic advisories will be provided to all aircraft as the controller's workload permits.
Safety Alerts are mandatory services which are provided to all aircraft. There are two types; Terrain/Obstruction Alerts and Aircraft Conflict Alerts.

The following paragraphs are simplified to be more easily read.
For full description of the different airspace classes and the rules within, please refer to ICAO Annex 11 or to your local vACCs manual.

<u>CONTROLLED AIRSPACE</u>

	Service/ Requirements	Class A	Class B	Class C	Class D	Class E
IFR	Separation between	All	All	IFR/IFR IFR/VFR	IFR/IFR	IFR/IFR
	Max. Speed	--	--	**	250 KIAS below FL100	250 KIAS below FL100
	Radio required	Yes	Yes	Yes	Yes	Yes
	Clearance required	Yes	Yes	Yes	Yes	Yes
VFR	Separation between	x **NO VFR ALLOWED**	All	VFR/IFR	None	None
	VMC minimums		See VFR section X.X.X			
	Max. Speed		--	250 KIAS below FL100	250 KIAS	250 KIAS
	Radio required		Yes	Yes	Yes	No
	Clearance required		Yes	Yes	Yes	No

UNCONTROLLED AIRSPACE

	Service/ Requirements	Class F	Class G
IFR	Separation between	IFR/IFR as far as possible	None
	Max. Speed	250 KIAS	250 KIAS
	Radio required	Yes	Yes
	Clearance required	No	No
VFR	Separation between	None	None
	VMC minimums	See VFR section X.X.X	
	Max. Speed	250 KIAS	250 KIAS
	Radio required	No	No
	Clearance required	No	No

4.3.1 Class A (controlled)

In Hong Kong FIR, Class A airspace extends from 8000ft or 9000ft to UNL (Unlimited). For a detailed list of classification of the Hong Kong airspace, controller shall refer to Section 1 of Hong Kong AIP ENR1.4.

Unless otherwise authorized, all pilots must operate their aircraft under IFR.

4.3.2 Class B (controlled)

Class B airspace is generally the airspace from the surface to FL100, surrounding the busy airports in terms of airport operations or passenger emplacements.

The configuration of each Class B airspace area is individually tailored and consists of a surface area, and two or more layers (some Class B airspace areas resembles upside-down wedding cakes), and is designed to contain all published instrument procedures once an aircraft enters the airspace.

Hong Kong FIR does not contain any Class B airspace.

4.3.3 Class C (controlled)

Separation between IFR flights and between IFR and VFR is provided in class C airspace.

Separation between VFR and VFR is not provided, but traffic information is provided by ATC and can also be requested by VFR traffic when needed.

4.3.4 Class D (controlled)

Class D airspace provides standard separation between IFR/IFR, and provides traffic information about VFR.

Separation between VFR and VFR is not provided, but traffic information is provided by ATC and can also be requested.

Hong Kong FIR does not have any Class D airspace.

4.3.5 Class E (controlled)

Class E airspace provides standard separation between IFR/IFR, and provides traffic information about VFR.

Separation between VFR and VFR is not provided and traffic information is provided as far as practical.

Hong Kong FIR does not have any Class E airspace.

4.3.6 Class F (uncontrolled)

Class F airspace provides Advisory Service between IFR/IFR separation as far as practical.

Flight information service (FIS) is provided between VFR/IFR and VFR/VFR.

Hong Kong FIR does not have any Class F airspace.

4.3.7 Class G (uncontrolled)

Class G airspace provides FIS to all flights.

4.4. TYPES OF AIRSPACE – CONTROLLED AIRSPACE [S2]

The different airspace classes determines what kind of service and requirements that ATC and aircraft has to give and meet.

The airspace is also divided into different types of airspace.

We start with the controlled airspace, which can be divided into three different types.

Please note that there are big differences between countries regarding the airspace structure!

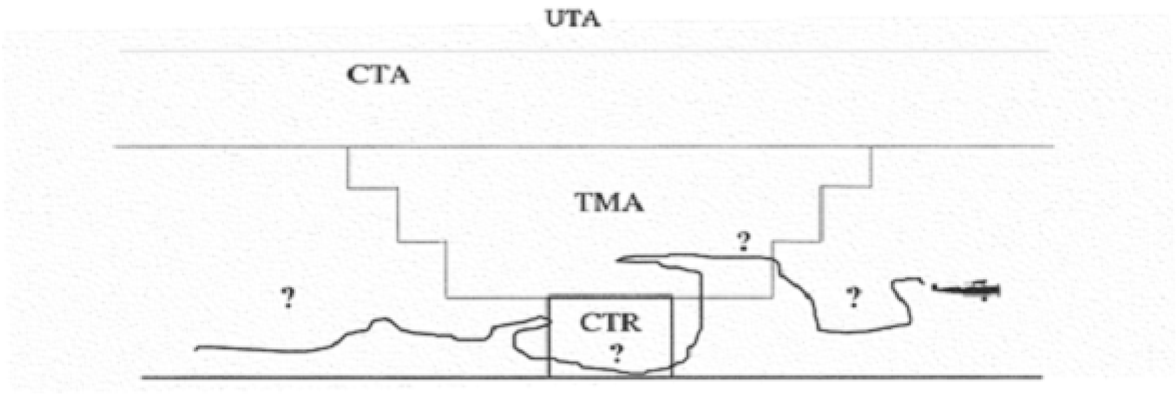


Figure 4.1: Types of controlled airspace illustrated.

4.4.1 Control Zone (CTR)

Around all controlled aerodromes (airports) there are control zones.

A control zone is established to protect the aerodrome traffic.

The coverage of a CTR is usually about 10 to 15 kilometres horizontally from the airport and vertically from the ground up to 1000-5000ft above ground level (AGL).

This can however differ quite substantially from airport to airport and you have to take a closer look at the AIP over the airport you are manning to make sure you know the boundaries of the airspace.

Controllers shall refer to the SOP documents and both Hong Kong AIP and Macau AIP for information regarding Aerodrome Traffic Zones (ATZ) within Hong Kong FIR.

4.4.2 Terminal Area (TMA)

Above and/or laterally to the control zone is a TMA.

A TMA is usually of class C airspace.

The construction of the TMA differs a lot from country to country, so you have to refer to your local vACC for more information. Information regarding Hong Kong TMA can be found in HKVACC-SOP004 or in the Hong Kong AIP.

4.4.3 Control Area (CTA)

The Control Area covers a bigger area in the air and is situated above and around TMA.

4.5. TYPES OF AIRSPACE – UNCONTROLLED AIRSPACE [S2]

That the uncontrolled airspace is 'uncontrolled' means that no air traffic control is provided, only **flight information service (FIS)**. Pilots are not required to request clearance to fly in uncontrolled airspace. It is the pilot's responsibility to keep separated to other traffic.

Flights in uncontrolled airspace can request information about other traffic from ATC – "traffic information".

Please note that rules regarding how to handle traffic in uncontrolled airspace differ from vACC to vACC. And TIZ and TIA are non-existent in many countries.

4.5.1 Traffic Information Zone (TIZ)

A TIZ can be found closest to the ground around some airports. Information service is provided here and not control.

This also means that special phraseology is used when communicating with pilots.
Emergency assistance is also provided.

4.5.2 Traffic Information Area (TIA)

TIA is situated above a TIZ and functions in the same way; no control of traffic, just traffic information.

4.6. AIRWAYS AND ROUTES

There are two fixed Airway systems established for Air Navigation.

These are the Low Altitude Airways (Lower) and the High Altitude Airways (Upper).

In addition, we are also talking about VOR and LF/MF routes.

In Hong Kong FIR, there is not a clear definition of low airways and high airways. For altitude restrictions of all airways within the FIR, controller shall refer to ENR3.1 of the Hong Kong AIP.

The following is a brief description of the three.

4.6.1 Low altitude Airways [Ref]

Low Altitude Airways is a system consisting of designated airways, ranging from FL055 (in some cases higher) up to FL195-285*. These airways are depicted on En Route Low Altitude Charts, e.g. "G1" or "Golf One".

** The lower and upper level varies from country to country.*

4.6.2 High altitude Airways [Ref]

High Altitude Airways is a system consisting of designated airways, ranging from FL195-285* and upwards. These airways are designated with a preceding "U" in front of the standard route number, e.g. Route "G1" for Upper airways would be "UG1" or "Upper Golf One". These airways are depicted on En Route High Altitude Charts.

** The level varies from country to country.*

4.6.3 VOR and LF/MF Routes [Ref]

VOR and LF/MF Routes consist of airways designated from 1,500 feet above the surface (in some cases higher) up to, but not including FL195. These airways are depicted on En Route Low Altitude Charts.

VOR Routes are based solely on VOR airways, and are identified by the airway number.
Except to effect transitions within or between route structures, the altitude limits of airways should not be exceeded.

LF/MF airways are based on LF/MF navigation aids, and are depicted brown on charts. You will find these airways mostly over the ocean. They are colored Green and Red for East/West routes, and Amber and Blue for North/South routes.

4.6.4 Route Directions [Ref]

Some routes are one-way-only, meaning that traffic can only go in one direction on that route. This is to facilitate separation. On some routes traffic is allowed both ways.

In some countries the routes are numbered according to a special system– i.e. odd routes going from south to north and even from north to south. Exceptions are quite common however and some countries don’t have that kind of system at all.

4.7. REDUCED VERTICAL SEPARATION MINIMUM (RVSM) [C1]

A long time ago, when instruments were not as reliable as they are now, it was decided to apply a minimum vertical separation of 2000 ft above the FL 290, keeping a 1000 ft spacing below this level. So until now, we had the **CVSM (Conventional Vertical Separation Minimum)** as follows:

1000 ft spacing below FL 290
2000 ft spacing above FL 290

From January 24th, 2002, this rule was changed with the implementation of RVSM (Reduced Vertical Separation Minimum). This was due to the quality of flight instruments now installed onboard aircraft. They are more reliable and more accurate than those of the previous decades.

Considering this fact, in addition to the necessity of increasing the control capacity in upper airspace sectors, it was decided to **reduce the spacing from 2000 ft to 1000ft between FL 290 and FL 410**.

4.8. MNPS/RVSM APPROVAL [C1]

MNPS stands for **Minimum Navigation Performance Specifications**, representing those requested for an aircraft to be RVSM approved. These MNPS are for aircraft able to fly between FL 290 and 410. According to these rules the aircraft can fly into RVSM airspace if is equipped with:

- Redundancy altitude device, with high standards of accuracy and reliability.
- New generation TCAS. (TCAS II Version 7 and later on).
- Autopilot with advanced altitude hold features. (no oscillations over 75ft at ALT HOLD mode)

All aircraft which came out from factories these last 5 years match with these specifications. Most of other planes have been modified to be RVSM approved, thus bringing to about 95% the rate of aircraft concerned by RVSM which are effectively RVSM approved.

Some old generation aircraft (DC-8, DC-3, B707...) haven't been updated because their operators found it to be too expensive.

Also, some military aircraft, and particularly combat aircraft, are not RVSM approved (technical and operational imperatives are different from commercial aircraft).

5. AERODROME

5.1. INTRODUCTION

A plane should be in the air and not on the ground, but eventually they all come down – preferably at an airport.

Hence it's important for an air traffic controller to have good knowledge about how the airport is built. All airports are built on the same principal, regardless of size. Take a closer look at the chart below and study the design.

5.2. RUNWAY DESIGNATORS (NUMBERS) [S1]

A runway is a strip used for take-off and landing.

The runways are numbered according to the compass-direction they are headed, rounded off to the closest tenth degrees. A runway that has the "course" 180 degrees is hence named 18 and one with "course" 154 is named 15. Since you can use a runway from both directions, it's named with the contra-course from the other side (18/36).

Some airports have parallel runways, i.e. more than one runway that has the same number. They are named with the suffixes **R (right), and L (left)** after the number to tell them apart if they are two and **R, C (centre) and L** if there are three.

There are two pairs of numbers that aren't used in some countries; 02/20 and 13/31, even though the runway might have those headings. The reason for this is the risk for mix-up if the figures are reversed. (Kai Tak Intl Airport VHHX is an exception of course!)

5.3. TRAFFIC CIRCUIT [S2]

The traffic circuit is a "race track" around the airport where every side has its own name. If a plane is doing an instrument-guided approach to the airport, the traffic circuit isn't used. But for visual approaches some parts or the whole pattern is used. The traffic circuit usually goes anti-clock-wise, called left-(hand)-traffic-pattern/circuit. At some airports it's the other way (right-hand), in those instances this has to be clearly stated by ATC.

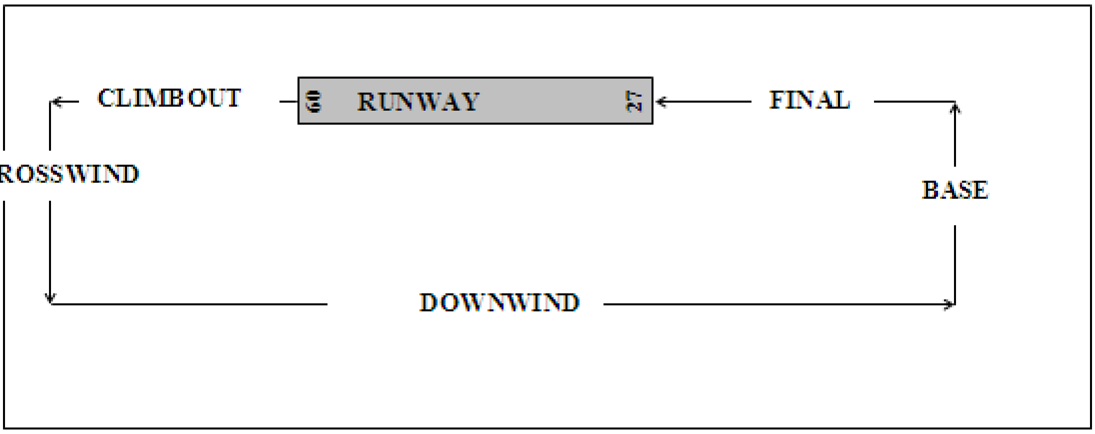
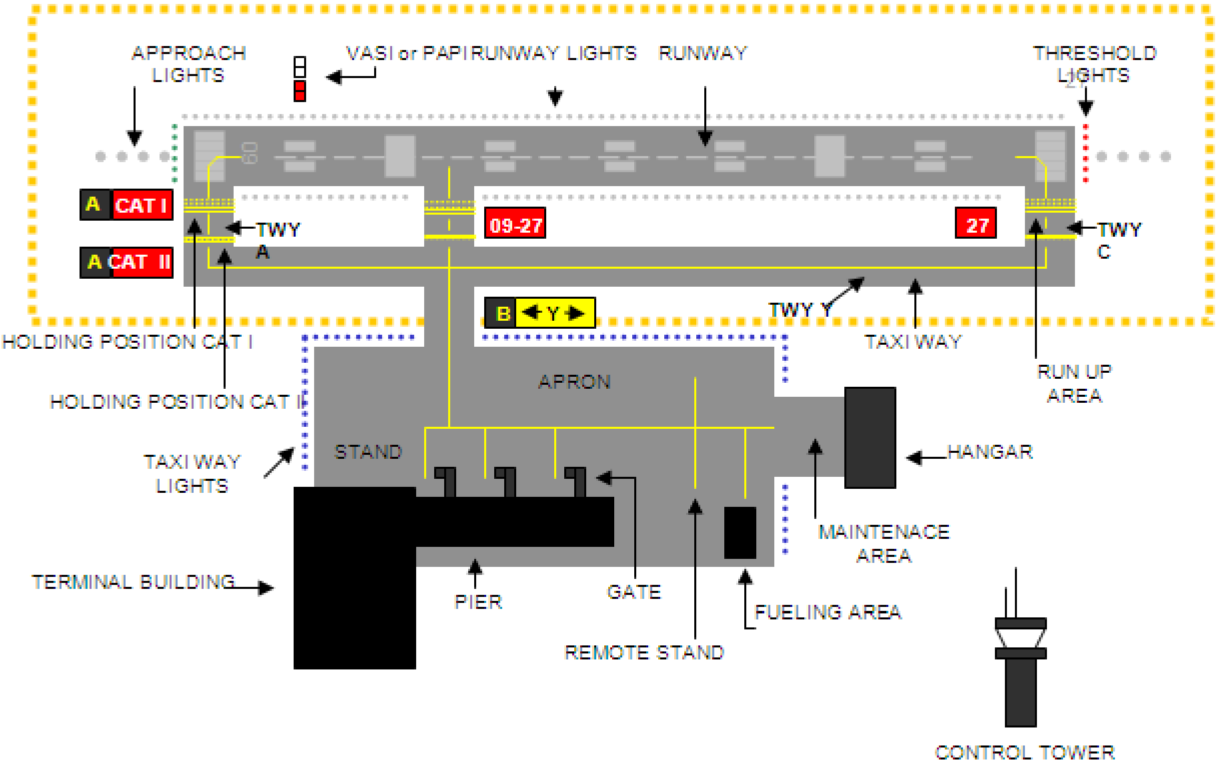


Figure 5.1: A typical left-hand circuit.

5.4. CHART OVER TYPICAL AIRPORT [S1]



Orange dotted area = Manoeuvring area

5.5. INSTRUMENT LANDING SYSTEM (ILS) [S3]

Instrument Landing System (ILS) operates between 108 and 111.95 MHz, **on odd tens**. So 108.20 MHz must be a VOR frequency, and 108.10 can be an ILS frequency.

The system consists of three elements; Localizer, glide path and marker beacons.

5.5.1 Localizer

Localizer gives information about the **lateral navigation**, and will guide the pilot straight ahead on the final approach course towards the runway.

Basically it transmits a 90 Hz signal on one side (left side of runway) and a 150 Hz on the other side (right side) of the runway.

If the instrument in the aircraft senses a stronger 150 Hz signal, it will deflect to the left, and visa versa with 90 Hz.

If the instrument senses equal 90 Hz and 150 Hz signal, the needle is in the middle position, and the aircraft is centred on the extended centreline.

The localizer signal is usually accurate till 25 nm out.

5.5.2 Glide path

Glide path operates between 328.6 till 335 MHz. Again a 90 Hz and a 150 Hz signal is generated. 90 Hz is above the glide path, 150 Hz is below.

The glide path angle may vary, but is generally between 2.5 and 3.5 degrees (3 degrees is common).

This angle is chosen so that airliners can make a smooth stabilized approach and not have to dive down with high rate of descend. Standard is 300 ft per nm.

Again the Glide path frequencies are coupled to the Localizer frequencies.

5.5.3 Marker Beacons

Marker beacons operate on a fixed frequency of 75 MHz. The purpose is to have a fixed altitude/distance check on the ILS. It is a beacon that transmits straight up.

The Outer Marker (OM) is usually around 4 nm out on final, and should therefore be passed at (4 x 300 ft) 1200 ft AGL. The Outer Marker has a 400 Hz signal that triggers a blue flashing light in the cockpit, together with a dah-dah-dah audible tone.

Some ILS's have also a Middle Marker (MM). It is positioned 1/2 nm in front of the runway, and has a 1300 Hz signal. It triggers a yellow light in the cockpit, together with a dah-dit-dah audible tone.

5.5.4 ILS Classification

ILS Classification is used to determine the accuracy of the landing system.

Category one (CAT I) is the least accurate, and CAT III is the best. This means you can fly the approach to lower limits (decision heights) on a CAT III ILS than on a CAT I ILS.

When you reach the appropriate limit you need to see the runway, otherwise you have to go around and fly the missed approach procedure. We are only talking about the ground facilities here. In real life there are more factors which can change your lowest limit.

- Pilot qualification
- Airplane qualification
- Ground facility qualification
- Categories of precision approach and landing operations:
  (As specified in ICAO EUR Doc 013, second edition April 2005)
  http://www.paris.icao.int/documents/pdf/eur_doc013_2ed_en.pdf

Category I (CAT I):
Decision height not lower than 60 m (200 ft) and with either a visibility not less than 800 m or a runway visual range not less than 550 m.

Category II (CAT II):
Decision height lower than 60 m (200 ft), but not lower than 30 m (100 ft), and a runway visual range not less than 350 m.

Category IIIA (CAT IIIA):
a) a decision height lower than 30 m (100 ft) or no decision height; and
b) a runway visual range (RVR) not less than 200 m.

Category IIIB (CAT IIIB):
a) a decision height lower than 15 m (50 ft) or no decision height; and
b) a runway visual range (RVR) less than 200 m but not less than 50 m.

Category IIIC (CAT IIIC):
No decision height and no runway visual range limitations.

An airport needs to meat several requirements before it can be approved for the higher CAT-procedures. We will not go into detail regarding these requirements.

If the weather minima for CAT I isn't fulfilled the airport has to reorganize into "low visibility procedures". This has effect on the whole airport and uses more resources. Many of these changes don't affect us in the virtual world, but some do and are described in the GUIDE. If "low visibility operation" are in use CAT II holding point should be used instead of CAT I holding point.

If the airport isn't approved for higher approach categories it has to close. Traffic will then be diverted to other airports.

Note.— Where decision height (DH) and runway visual range (RVR) fall into different categories of operation, the instrument approach and landing operation would be conducted in accordance with the *requirements of the most demanding category (e.g. an operation with a DH in the range of CAT IIIA but with an RVR in the range of CAT IIIB would be considered a CAT IIIB operation or an operation with a DH in the range of CAT II but with an RVR in the range of CAT I would be considered a CAT II operation).*

5.6. AVAILABLE RUNWAY LENGTH [S2]

The length of the runway is very important when determining if it enough to land and start from. Different airplanes require different length of runway in order to land and take off. This is of course affected by the weight of the aircraft, but also by weather-conditions. The pilot must make sure that the available runway-length is sufficient and the ATC should have knowledge as to what the abbreviations mean and where the information can be found, if needed.

The ICAO requires that the first four of the following full runway declared distances be calculated and promulgated for each runway intended to be used by aircraft operators engaged in international commercial air transport:

- **Take-off run available (TORA)**
  The runway length declared available and suitable for the ground run of an airplane taking off.
- **Take-off distance available (TODA)**
  The TORA plus the length of any remaining runway or clearway beyond the end of the TORA. The usable TODA length is aircraft performance dependent and, as such, must be determined by the aircraft operator before each takeoff.
- **Accelerate stop distance available (ASDA)**
  The runway plus stop way length declared available and suitable for the acceleration and deceleration of an airplane aborting a takeoff.
- **Landing distance available (LDA)**
  The runway length declared available and suitable for a landing airplane.
- **Clearway**
  A defined plane extending from the end of the runway with an upward slope not exceeding 1.25 percent, above which neither object nor any terrain protrudes. The ability to use a clearway in runway length calculations is dependent on air carrier policy.
- **Stopway**
  A defined rectangular surface beyond the end of a runway prepared or suitable for use in lieu of runway to support an airplane, without causing structural damage to the airplane, during an aborted takeoff.

5.7. LIGHTS [Ref]

An airport may look like an over-decorated Christmas-tree during night with all its different lights of different colours. Since we can't control the lights in our virtual environment, (at least yet) it will only be covered briefly.

The lightning-system should be turned on when:

- During darkness, or when the centre of the sun-disc is more then 6° under the horizon.
- During daylight, if the visibility and/or cloud-base is under certain minimums.
- On the request from an aircraft.

5.7.1 PAPI – Precision Approach Path Indicator

PAPI is a light system positioned beside the runway that consists of two, three, or four boxes of lights that provide a visual indication of an airplane's position on the glide path for the associated runway.

Each box of lights is equipped with an optical apparatus that splits light output into two segments, red and white.

Depending on the angle of approach, the lights will appear either red of white to the pilot.

Ideally the total of lights will change from white to half red, moving in succession from right to left side.

The pilot will have reached the normal glide path (usually 3 degrees) when there is an even split in red and white lights.

If an airplane is beneath the glide path, red lights will outnumber white; if an airplane is above the glide path, more white lights are visible.

5.7.2 Runway Lights

Runway Edge Lights are used to outline the edges of runways during periods of darkness or restricted visibility conditions. There are also runway centre lights.

These light systems are classified according to the intensity they are capable of producing**; High Intensity Runway Lights (LIH or HIRL)**, **Medium Intensity Runway Lights (MIRL)** and **Low Intensity Runway Lights (LIL or LIRL).**

The HIRL and MIRL systems have variable intensity controls, wheras the LIRL normally have only one setting. The controller in the tower alters the intensity depending on the weather and pilots requests.
Runway edge lights are white.

Lights marking the ends of the runway emit red light toward the runway to indicate the end of the runway to a departing aircraft and emit green outward from the active runway to indicate the threshold to landing aircrafts.

5.7.3 Taxiway Lights

Generally taxiways are marked with yellow lines (or sometimes white). A continuous yellow line marks the centerline of the taxiway. Taxiway edges are usually marked with doubble parallel yellow (or white) lines.

For night operations, taxiways are usually edged with blue lights, to distinguish them from the white lights of a runway. Larger airports sometimes add additional green centerline lighting. The centerline lighting is embedded in the taxiway, and an aircraft landing gear can thus roll over the lights.

The taxiway ids are shown on black and yellow signboards along the taxiway that are lit during darkness.

5.8. AREAS OF INTEREST [S1]

The airport is divided in different areas with different names in order to create a system that is similar on all airports.

Different rules apply for the different areas, hence the importance to have knowledge about them.

5.8.1 Movement area

These are the areas on which aircraft can be moved around, are named. This includes the runway, taxiways, apron and other areas intended for aircraft and maintenance vehicles.

5.8.2 Manoeuvring Area

This is the part of the airport that is used for start, landing and taxiing.

In most countries, this is the only area where you need a clearance before you are allowed to move the aircraft.

5.8.3 Runway

This is the area intended for take-off and landing.

Note that inactive runways (i.e. those that are not used with a certain runway configuration) also are to be considered a runway for the purpose of clearance.

All movement on runways need clearance – whether it is active or not.

5.9. ICAO AND AIRPORT NAMES [Ref]

ICAO was founded in 1944 and is since 1947 a UN organization.

ICAO stands for International Civil Aviation Organization.

ICAO mission is to make flying safer. Its work is regulated by the Chicago convention.

ICAO has introduced a 4 letter naming system for all airports worldwide.

The first letter is the ICAO region. The second is the country, the third the FIR and the fourth the city or airport.

There are of course exceptions to this rule; KJFK (John F Kennedy) is one.

Example:
EDDF: E=Northern Europe, D=Germany, D=International airport, F=Frankfurt
LFPG: L=Southern Europe, F=France, P=Paris, G=de Gaulle.

6. AIRCRAFT

6.1. INTRODUCTION

All aircraft do not have the same performance. Weight, weather and winds can make the same airplane have different performance on different flights.

As a controller, you should have knowledge about the performance of aircraft under normal circumstances in order to be able to plan traffic flow and give the pilots relevant instructions.

At the end of this section, you will find a table which lists the performance of the most usual aircrafts. Use this table as reference.

6.2. WAKE TURBULENCE [S2]

All aircraft generate turbulence called **vortex wake**. Large aircraft flying at slow speeds create the most severe wake turbulence. This turbulence can cause problems for following aircraft, which in severe cases can cause the pilot of the following aircraft to lose control. In addition to separation minimum above, the following spacing minima therefore needs to be taken into account. The wake turbulence categories are based on the certified maximum take-off weight (MTOW) of the aircraft.

Aircraft Category	MTOW
Light Aircraft (L)	7 000 kg
Medium Aircraft (M)	7 000 – 136 000 kg
Heavy Aircraft (H)	>136 000 kg

6.2.1 Separation Due to Vortex

This leads to the following minimum separation that needs to be maintained at all times on arrival.

Leading Aircraft	Following Aircraft	Separation in NM
Heavy	Heavy	4
Heavy	Medium	5
Heavy	Light	6
Medium	Light	5

Vortex separation is required when a lighter aircraft follows a heavier aircraft.

No vortex separation is required between aircraft of same category, except between heavies.

If parallel runways are being used and they are closer to each other than 760 meters, then they should be considered as one single runway so far as wake turbulence is concerned.

Any aircraft performing a Touch and Go or a Stop and Go is considered a departing aircraft on the climb out phase.

For departing aircraft, 2 minutes separation (3 minutes if the succeeding aircraft departs from an intersection) is applied when an aircraft in wake turbulence category LIGHT or MEDIUM departs behind an aircraft in wake turbulence category HEAVY, or when a LIGHT category aircraft departs behind a MEDIUM category aircraft.

Any Helicopter under your control must be kept clear of any light aircraft due to the Rotor Down-wash it produces when hovering and the vortices it produces in forward flight.

If you have a heavy and a light aircraft both ready for departure, you should clear the light aircraft for take-off first in order to avoid wake delay. However this only applies if it does not create any undue delay to the heavy aircraft. If this is the case, then the rule applies in that the faster aircraft is released first.

6.2.2 Waiving Wake Turbulence Separation

You may issue a take-off clearance to an aircraft that has waived wake turbulence separation, except, if it is a light or medium aircraft departing as follows:

- Behind a heavy a/c and takeoff is started from an interception or along the runway in the direction of take-off
- Behind a heavy a/c that is taking off or making a low or missed approach in the opposite direction on the same runway
- Behind a heavy a/c that is making a low or missed approach in the same direction of the runway

6.3. AIRCRAFT APPROACH CATEGORIES [S2]

A different way to differentiate categories is by their minimum Approach Speed. This is what the different Cat A, B, C, etc. refers to on various Approach Charts.

Aircraft Category	Approach Speed
A	Up to 90 kt
B	From 91 to 120 kt
C	From 121 to 140 kt
D	From 141 to 165 kt
E	Above 165 kt

6.4. AIRCRAFT CLASSIFICATION [Ref]

The pilot of an aircraft must have detailed knowledge about the aircraft's performances.

As ATCO it is hard to know all details about all aircrafts by heart. There are however, situations where you need to know some certain performances in order to issue correct clearance and instructions. Hence you need to know where to find the information.

One way is asking the pilot if (s)he is able to comply with a certain instruction, but that takes extra time and you cannot ask all pilots all the time.

There are several abbreviated listings of different aircraft and their performances on the Web. One of the most comprehensive and up to date is found on ICAOs homepage:
http://www.icao.int/anb/ais/8643/index.cfm

The list over performances should be seen as a guide and it deserves to be stressed that it is the pilot that has the last word when it comes to judging if (s)he is able to comply with a certain instruction.

6.5. EQUIPMENT SUFFIX

These suffixes denote what navigation and transponder equipment is available for the aircraft, as filed in the flight plan by the pilot.

Be alert as to the equipment available on the aircraft and issue vectors accordingly. A list over the most common codes for equipment can be found in Appendix A of this manual.

7. NAVIGATION

7.1. INTRODUCTION

To be able to fly from point A to point B it is important for the flight crew to know where they are and where they're headed.

Before radar, air traffic control was dependent on pilot position reports via radio. Today, most of the time, we have radar, which makes it possible to closely track the position of aircraft.

Good knowledge about navigation and navigation aids is important for air traffic controllers and therefore we will start with a basic review of this area.

7.2. POSITION REFERENCE SYSTEM

Positions on the earth are often given as coordinates in a coordinate system consisting of two parts, latitude and longitude.

Latitude is the coordinate giving the position in north-south direction and longitude is the coordinate giving the position in west-east direction. The earth is divided into 360 parallels of longitude or meridians. The reference or zero-meridian is located at a longitude equal to the position of Greenwich in the UK.

The **longitude** is expressed as the number of longitudinal degrees east (E) or west (W) of the reference meridian. In north-south direction the earth is divided into 180 parallels of latitude. The reference parallel of latitude is the equator. The latitude is expressed as the number of latitudinal degrees north (N) or south (S) of the equator.

To be able to define positions more accurately the smaller units minutes and seconds have been introduced. These units are based on the 1/60-system, which means one degree of latitude or longitude is equal to 60 minutes and one minute is equal to 60 seconds.

Position coordinates: N59°02′12″ W032°39′55″
N590212 is the latitude and means that the position is 59 degrees, 2 minutes and 12 seconds north of the equator. W0323955 is the longitude and means that the position is 32 degrees, 39 minutes and 55 seconds west of the zero meridian.

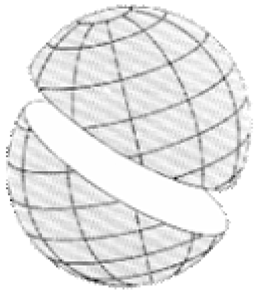
One minute of latitude is equal to the distance of one nautical mile (nm), which is equal to 1852 meters.

One minute of longitude is not equal to the same distance everywhere on earth because the circumference of the earth is varying with latitude.

7.3. LOXODROME AND GREAT CIRCLES [Ref]

A Great circle is a circle on the surface of a sphere that has the same circumference as the sphere, and devides the sphere into two equal hemispheres. It is the largest circle that can be drawn on a given sphere.

The Equator is one example of a great circle as are all meridians.



In navigation, a loxodrome (or rhumb line) is a line crossing all meridians at the same angle, i.e. a path of constant bearing.

If you follow a given compass-bearing on Earth, (having taken into account magnetic deviation) you will be following a rhumb line, which spirals from one pole to the other, with the exception of 90 and 270 degrees, lines of constant latitude, e.g. the equator.

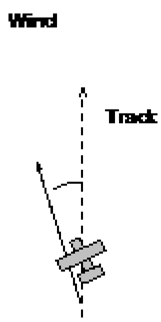
Near the poles, they are close to being logarithmic spirals, so they wind round each pole an infinite number of times but reach the pole in a finite distance.

The pole-to-pole length of a rhumb line is (assuming a perfect sphere) the length of the meridian divided by the cosine of the bearing away from true north.

7.4. DIRECTIONS

All directions in aviation are expressed with the **360-degree system**.

The horizon is divided into 360 equal parts and one revolution equals 360 degrees.
A direction of due north means a direction of 360, due east direction 090 and so on.



In aviation there are two (2) basic definitions of directions: **Heading** and **track**.

Heading is defined as the direction where the aircraft nose points (the longitudinal axis of the aircraft).

When adding the effect of wind the direction of the path of the aircraft over the ground will be slightly different then the aircraft heading and that is called track.

7.5. VARIATIONS

All directions will be given relative to the North Pole. The magnetic North Pole is not located on the same position as the true North Pole and this results in two possible references of directions. If the direction is given with reference to magnetic north it is expressed in **degrees magnetic**, and if the direction is given with reference to true north it is expressed in **degrees true**.

The heading indicator in the aircraft will show the direction relative to magnetic north and consequently all headings assigned to aircraft should be in degrees magnetic.

7.6. SPEED [S2]

In aviation speed is normally measured in **nautical miles (knots)**, which are defined as nm/hour. 100 knots equals 185 km/h.

There are different ways to measure speed.

7.6.1 Speed for the pilot

The conventional airspeed indicator depends on the effect of air being forced into a small tube mounted on the outside of the aircraft (**pitot tube**). This airspeed indication is affected by the density of the air, which **changes with altitude and ambient air temperature**. As the aircraft climbs, the air becomes less dense, and the airspeed indicator shows a lower speed than the aircraft is actually moving through the air.

There are other ways of measuring the speed, that aren't affected by the temperature and air-pressure, such as GPS.

Pilots rely on indicated airspeed to control the aircraft, because it is a true representation of how the aircraft will behave in respect to stall speeds and other known aircraft characteristics.

7.6.2 Indicated Air Speed (IAS)

IAS is the speed that the pilot can read in the cockpit and **speed restrictions issued by air traffic control is normally given in IAS in the lower airspace** (see Mach below).

IAS is based on measurements of how many particles of air that hit the aircraft in a given period of time.

The faster the aircraft flies and the higher the density of the air is, the more particles will hit the aircraft.

An aircraft keeping the same groundspeed (see below) will get a lower IAS when the aircraft climbs.

7.6.3 True Air Speed (TAS)

True airspeed is the speed at which the aircraft is moving through the air. It has no relation to the wind. In some aircraft, a true airspeed indicator is provided along with the conventional "indicated airspeed" gauge.

Most pilots estimate their true airspeed prior to a flight, and calculate the actual true airspeed during the flight. This data is needed for flight planning purposes. It is used along with wind data to arrive at, you guessed it, ground speed.

A thumb of rule, which can be used to obtain TAS is to increase IAS by 2% for every 1000’ of increase in altitude.

7.6.4 Ground Speed (GS)

While true airspeed is the speed at which an aircraft moves through the air irrespective of the wind, **ground speed** is the speed the aircraft is moving over the ground.

If an aircraft is flying at a TAS of 250 knots with a 30 knot tailwind the GS will be 280 knots.

That said, just remember that **the speed you see on your radar is ground speed**, and **the speed the pilot normally sees is indicated airspeed**. Your speed will usually show a **higher** value than the pilot's, depending on his altitude, unless he has a strong headwind.

7.6.5 Mach (M)

In the upper airspace Mach is normally used to express speeds.

Mach is a quotient of the local speed of sound and Mach 1.0 is equal to the speed of sound.

7.7. WIND

The wind direction is given in degrees just like it is given for aircraft direction.

The direction of wind is always given as the direction from where the wind comes.

In a weather report for an airport (METAR) the wind direction and strength is given as for example 18003KT, where 180 is the direction (south) and 03 is the strength in knots.

7.8. TIME

When giving time in aviation, it is important to define what time you refer to since an aircraft often flies trough many time zones. Hence time is always given in UTC (Universal Time Co-ordinated) in aviation.

The big difference between UTC and other time format is that UTC doesn't change with DST (Daylight Saving Time or summertime). Adding the letter "Z", which is pronounced "Zulu", marks times given in UTC.

7.8.1 Date and reading time

Dates can also be added in the format 211020Z, which means time 10:20 UTC on the 21:st.

In radio communication time is often given with only the number of minutes, for example time 14:54 is expressed as "time 54". Time 16:00 is expressed as "on the hour" and 11:30 can be expressed either "time 30" or "on the hour and a half".

7.9. NAVIGTAIONAL AIDS (NAVAID)

Navigation aids are used by flight crew to navigate between different positions on the earth and may consist of transmitters on the ground, receivers in aircraft and most recently also satellites.

The crew navigates between different navigation aids and points called VOR, NDB and intersections. With a joint name these are called waypoints.

7.9.1 Non Directional Beacon - NDB

NDB is a radio beacon transmitting non-directional radio signals.

The pilot can determine the direction or "bearing" to the beacon with an instrument called **ADF** indicator.

NDBs have a maximum range of about 50-100 miles, depending on equipment. NDBs with three letters have a longer range then NDBs with two letters.

7.9.1.1 More on NDB [Ref]

The NDB operates between 200 and 1750 kHz, but in Europe most frequencies are between 255 and 455.

The ADF receiver can be used when line-of-sight transmission becomes unreliable, or when there is no VOR equipment on the ground or in the aircraft.

It is used as a means of identifying positions, receiving low and medium frequency voice communications, homing, tracking, and for navigation on instrument approach procedures.

The low/medium frequency navigation stations used by ADF include Non-Directional Beacons, ILS radio beacon locators, and commercial broadcast stations.

The ILS radio beacon is a beacon which is placed at the same position as the outer marker of an ILS system (or replaces the OM).

7.9.2 Very high freq. Omni-directional Radio range – VOR

A **VHF Omni-directional Range (VOR)** is transmitting directional radio signals and is more accurate then a NDB.

With the navigation instruments the pilot can intercept and fly with a specified direction towards or from the beacon. These directions are called radials. If you fly due south from a VOR, you fly on radial 180. If you are due south of the VOR and point the aircraft towards the VOR (north) you are still on radial 180, but flying on heading 360.

If you fly towards the VOR it is common to say you are flying on a radial inbound it, and if you fly away from it you are flying on a radial outbound it.

The maximum range of a VOR is about 100-200 miles.

7.9.2.1 More on VOR (Optional)

VHF Omni-directional Range (VOR) operates between 108 and 117.950 MHz.

The range of a VHF-signal can be calculated using the formula [1.25 x √ (height of the transmitter in feet) + 1.25 x √ (height of the receiver in NM)]. The signal is weakened by several factors such as terrain and different weather-phenomena.

The VOR works on a "light-tower" principle. Imagine that it has a rotating light bundle, and a steady 360 degree light. The light bundle swings around one time per minute (1 RPM = 6 degrees/sec). If the light bundle hits the magnetic North, the steady light flashes once. Take a stopwatch and start timing when the steady light flashes, stop timing when the light bundle hits you.

In practice, the steady 360 degree light is actually a steady 30 Hz signal on the VOR, and is modulated (pasted) on the VOR frequency. The rotating bundle is also a 30 Hz signal. The receiver will compare both signals and determine the difference in phase, and in this way the position relative to the VOR is determined.

A VOR usually also includes a Morse Ident, and sometimes there is also a VOICE channel (ATIS) pasted on the VOR frequency.

A VOR is often accompanied by a DME.

The accuracy of a VOR is about 2 degrees.

7.9.3 Distance Measuring Equipment – DME

Distance Measuring Equipment (DME) is another type of beacon with which the range between the aircraft and the transmitter can be measured and presented to the pilot.

A DME does not make it possible to see the direction from the aircraft to the DME station, only the range.

7.9.3.1 More on DME (Optional)

Distance Measuring Equipment (DME) operates between 962 and 1213 MHz.

The measuring is initiated from the aircraft. The interrogator sends out two pulses which are received by the DME station. After a 50 microsecond delay, the ground station sends a pulse back, which is 63 MHz higher or lower than the original frequency. The further the DME station is away, the longer the pulse needs to travel. By timing the time difference between sending and receiving the signal (minus the 50 microsecond delay) you can determine the distance.

This is the direct distance from the aircraft to the ground station, and not the distance over the ground. If an aircraft fly at 10 km overhead a VOR/DME, the DME will read 5.5 nm!

A lot of VOR frequencies are coupled with a DME frequency. Every VOR frequency has a fixed DME frequency.

7.9.4 Intersection / Fix

An **intersection** or **fix** is not a ground-based navigation aid, but only a position on the surface of the earth defined with the position reference system.

As an intersection is not a transmitter it cannot be flown to with conventional navigation instruments. To fly to an intersection the aircraft has to be **RNAV (area navigation)** equipped.

RNAV means that the aircraft will calculate its position and the direction to the next waypoint by means of different ground based navigation aids (VOR/DME) as well as by positions from GPS and INS/IRS.

7.9.5 Global Positioning System – GPS

GPS is a satellite positioning system developed by the United States Department of Defense (DOD) for use on land, sea and in the air.

It will likely be the major component of the ICAO - designated **GNSS - Global Navigation Satellite System**.

The full GPS constellation has 24 operational satellites to provide continuous, highly accurate three-dimensional position information globally.

7.9.5.1 More on GPS (Optional)

GPS is operating in 1,900 NM orbits, each satellite continuously transmits signals on 1227.6 and 1575.42 MHz.

The GPS receiver automatically selects the signals from four or more satellites to calculate a three-dimensional position, velocity and time.

Using the un-encrypted coarse acquisition navigational signal (C/A code) which will be available to all civil users, system accuracy will be at least 100 meters horizontally and 140 metres vertically, 95% of the time.

Unlike ground based navigation systems, GPS provides global coverage with virtually no signal inaccuracies associated with propagation in the earth's atmosphere. Signal masking can occur with mountainous terrain, man-made structures and with poor antenna location on the aircraft.

7.9.6 Inertial Navigation System (INS)

Inertial Navigation Systems (INS) are completely self-contained and independent of ground based navigation aids. After being supplied with initial position information, it is capable of updating with accurate displays of position, attitude, and heading. It can calculate the track and distance between two points, display cross error, provide ETAs, ground speed and wind information. It can also provide guidance and steering information for the pilot instruments.

The system consists of the inertial platform, interior accelerometers and a computer. The platform, which senses the movement of the aircraft over the ground, contains two gyroscopes. These maintain their orientation in space while the accelerometers sense all direction changes and rate of movement. The information from the accelerometers and gyroscopes is sent to the computer, which corrects the track to allow for such factors as the rotation of the earth, the drift of the aircraft, speed, and rate of turn.
The aircraft's attitude instruments may also be linked to the inertial platform.

The accuracy of the INS is dependent on the accuracy of the initial position information programmed into the system. Therefore, system alignment before flight is very important. Accuracy is very high initially following alignment, and decays with time at the rate of about 1-2 NM per hour. Position updates can be accomplished in flight using ground based references with manual input or by automatic update using multiple DME or VOR inputs.

7.9.7 ATS Routes

ATS routes are pre-determined routes connecting waypoints to each other, which the aircraft will follow.

ATS routes are named using a letter followed by two or three numbers. Some ATS routes are for aircrafts flying in one direction only.

ICAO states that: "The designation of specific ATS routes within the network should be made so that the majority of recurring flight operations can identify them in flight plans with the least number of designators."

For routes forming part of the basic ATS route network:

A, B, G, R – routes which form part of the regional networks of ATS routes and are not area navigation routes.

L, M, N, P – area navigation routes (RNAV) which form part of the regional networks of ATS routes.

For routes not forming part of the basic ATS route network:

H, J, V, W – for routes which are not area navigation routes.

Q, T, Y, Z – for area navigation (RNAV) routes.

7.9.8 Flight Management System – FMS [Ref]

Flight management system (FMS) is the term used to describe an integrated system that uses navigation, atmospheric and fuel flow data from several sensors to provide a centralized control system for flight planning, and flight and fuel management.

The system processes navigation data to calculate and update a best computed position based on the known system accuracy and reliability of the input sensors.

This system may also be referred to as a multi-sensor RNAV.

FMS controls differ widely between aircraft types and manufacturers, but the Typical FMS Control Unit figure, to the right, gives a typical arrangement.

The heart of any FMS is the navigation computer unit. It contains the micro processor and navigation data base. A typical base contains a regional or worldwide library of navaids, waypoints, airports and airways.

FMS sensor input is supplied from external DME, VOR, air data computer (ADC) and fuel flow sensors. Depending on the capabilities of the navigation sensors, most flight management systems are approved for en route IFR in most classes of RNAV airspace.

7.10. NAVIGTAIONAL AIDS LIMITATIONS

Navigational aids can be classified as almost anything, visual or otherwise, as long as it provides an aircraft with positional data.

For our purposes in the VACC, the limitations we are concerned with are the useful range of VOR's, VORTAC's, VOR/DME, and NDB's. VOR's without DME are becoming a rarity, and most navaids, except for NDB's, have distance information available.

Navaids are classified by their useful altitude and distance. This takes into consideration signal strength, their protection from navaids on the same frequency, and other factors. The classes of navaids are depicted on a low altitude chart. The symbology shows the type of navaid, and it can be assumed to be classified as at least "L"-class unless the notation (T) for TVOR appears in the communications box next to the navaid, where name, frequency, and identifier appears. Look at a low altitude chart and try to find a TVOR. The navaids on high altitude charts can be assumed to be "H"-class unless a (L) or (T) appears in the communications box.

The table below shows the useful range of navaids at various altitudes. Naturally, **you do not need to commit this to memory, or even keep it for reference**, but be aware of the limitations of navigational aids. You are not required to reference the following tables when assigning routes and altitudes, because you are always monitoring the flights on radar. However, the tables may explain why aircraft do not always receive the signal when you expect they should. It may also prevent you from embarrassment when clearing a high altitude aircraft over a TVOR, and wondering why the pilot is too lame to navigate .

VOR/VORTAC/TACAN:

Class	Altitude	Distance
T	12,000 and below	25
L	Below 18,000	40
H	Below 14,500	40
H	14,500 – 17,999	100
H	18,000 – FL450	130
H	Above FL450	100

LF/MF RADIO BEACON (NDB)

Class	Power (watts)	Distance
CL	Under 25	15
MH	Under 50	25
H	50 – 1,999	50
HH	2,000 or more	75

7.11. FURTHER READING [Ref]

If you wish to learn more on the topics covered above we list a number of external links which we believe could be of interest to members in general.

Time and date:

http://www.timeanddate.com/

GPS - Positioning system:

http://www.colorado.edu/geography/gcraft/notes/gps/gps.html

http://www.gps.oma.be/

Speed:

http://www.womanpilot.com/past%20issue%20pages/2000%20issues/jan%20feb%202000/airspeed.htm

https://ewhdbks.mugu.navy.mil/mach-as.htm

Calculate between IAS, CAS, TAS:

http://www.flightplan.za.net/trueAirspeed.php

NDB:

http://en.wikipedia.org/wiki/Non-directional_beacon

VOR:

http://en.wikipedia.org/wiki/VHF_omnidirectional_range

DME:

http://en.wikipedia.org/wiki/Distance_Measuring_Equipment

Naviagtional Aids:

http://www.centennialofflight.gov/essay/Government_Role/navigation/POL13.htm1

8. CONTROLLING

8.1. INTRODUCTION

We will end this theoretical manual with a description about what you need to know about call-signs, transponder, charts and things that are related to your radarscope. The more practical aspects will be found in the guide and this section is closely related to some of that material.

8.2. RADAR CLIENTS

The **radar client** is the software that you will work with as a controller.

At the time this manual is written there are three clients available; **ASRC, VRC** and **Euroscope**. It is not in the scope of this manual to describe them in detail, since both already have excellent manuals.

The “radar-part” of the clients is maybe the most important and it gives you information about the traffics movement through the sky and on the ground. But there are numerous other functions built in to the software that will help you control and give information to the traffic. It is well-spent time to read the manual of the client that you will be using closely.

8.3. CLEARANCE [S1]

All instructions regarding the movement of aircraft in air or on ground are called **clearances**. You can issue clearances both en-route and before the aircraft is airborne.

A pilot who wants to fly in controlled air space (except for Class E) is required to get permission from a controller. To be able to give permission, you as a controller need to know what intention the pilot has. The pilot can send this information to the ATC in a so-called **flight plan**. In some countries, aircraft flying VFR can ask for clearance without having sent a flight plan. Within Hong Kong FIR, all VFR flights must file a flight plan prior to departure. When no flight plan is filed, the pilot must in that case send all relevant information via radio. This is very unusual in our on line environment. Clearances can vary in content and can contain restrictions of different sort. Before issuing a clearance, you need to ascertain that it doesn't lead to a conflict between two aircraft. A good strategy is to give as few restrictions as possible in the clearance. More about clearance will be found in the GUIDE.

8.4. CALLSIGN

All aircraft need to have a **call sign** in order to establish radio contact. There are difference forms of callsigns.

CPA345, CAL574, HKE1771 are examples of large companies' call signs. HKE1171 isn't the name of a specific aircraft but rather the ICAO code of a company (Hong Kong Express) followed by a number that is specific for flight path.

British Airways uses the acronym BAW, but this is read as “Speed bird”. There are tables over these acronyms; you don't have to know them by heart.

B-6011, B-GTD and OH-SLT are examples of specific aircraft. B stands for Greater China Area (including mainland China, Taiwan, Hong Kong and Macau) and OH stands for Finland. The country letter(s) are followed by letters or numbers to designate the aircraft. Even though all aircrafts have specific call signs like the one above, they are almost only used when flying private and not for a company. Smaller aircraft that flies VFR are one example where the aircraft specific call sign is used.

When writing call sign into the flight plan, the pilot can either use the full aircraft specific name (BGTD, OHSLT) or the acronym for the flight-operator followed by the flight-specific numbers/letters (BAW554D, KLM574).

When using the call sign on radio, you are allowed to make some abbreviations after the first contact has been established and the quality of the radio transmission is good; When reading OH-SLT you can omit the second letter or both the second and third letter, if the above criteria are met and there’s no risk for confusion with other aircrafts in your airspace.

- *Oscar Hotel, Sierra, Lima, Tango*
- *Oscar, Sierra, Lima, Tango*
- *Oscar, Lima, Tango*

8.5. TRANSPONDER

On ordinary radar, you can see the position of the aircraft, but not their height. You also can't differentiate one blip from the other. This has been solved by installing one (or often more than one) transponder in the aircraft. This box transmits a signal which contains information on the height together with a four digit code.

As controller, you give the pilot this unique four-digit transponder code. This is done at clearance, but the transponder code can also be changed en route. Two aircraft cannot have the same transponder code if they are in the same area. This is not a problem on line, but you should try to give every aircraft a unique transponder code. You will get an error message (CODE) is this isn’t done, but you will still be able to see the correct call sign on your scope.

Transponders can be set in different modes:

- **Stb (Standby)** – Means that the transponder doesn't give information about the code entered or the height. **(Default mode on VATSIM when on ground)**
- **Mode A** – Only the code, and not the height is transmitted.
- **Mode C** – Code and height is transmitted **(Should be used on VATSIM when flying)**
- **Mode S** – Used together with TCAS*. Gives same information as mode C

Each division reserves a range of codes for each FIR. This has been done in order to minimize the risk of two planes being assigned the same code. The list can be found on the main website.

The exception to unique code is VFR aircraft which sometimes are given the same transponder code (7000 or 1200 in some countries).

A transponder works with **binary digits** and can't use the digits "8" and "9". Hence a transponder code can't contain these two digits.

**Traffic alert and Collision Avoidance System (or TCAS) is an implementation of the Airborne Collision Avoidance System mandated by ICAO to be fitted to all aircraft over 5700 kg or authorised to carry more than 19 passengers, designed to reduce mid-air collisions.*

8.5.1 More about transponders [Ref]

Primary radar works best with large all-metal aircraft, but not so well on small, composite aircraft. Its range is also limited by terrain and rain or snow and also detects unwanted objects such as automobiles, hills and trees. Furthermore it cannot estimate the altitude of an aircraft. Secondary radar overcomes these limitations but it depends on a transponder in the aircraft to respond to interrogations from the ground station to make the plane more visible.

An airborne Transponder transmits a reply signal on a frequency of 1,090 MHz in response to the SSR interrogation which is transmitted on a frequency of 1,030 MHz.

Due to the technique that the transponder is built with, only the digits 0 to 7 can be used (8 and 9 can't be entered). This means that there are 8x8x8x8 = 4096 unique codes. Some codes are reserved for special use.

8.6. UNDERSTANDING CHARTS

Charts are the maps of the skies. They contain information about airports, airways, airspace and much more. Hence, they are essential for both flying and controlling.

All official vACCs are required to publish charts over the airspace they govern. These charts might be simplified, but should at least contain the essential information needed to control and fly in the area. Many countries have published the real charts for their airspace on Internet for easy reference. There are also companies like Jeppsen that are selling charts for profit. Regardless of how you find the charts you must be able to interpret them.

A short description about some essential parts is given below.

8.6.1 Standard Instrument Departure SID

SID stands for **Standard Instrument Departure**.

It is a pre-defined route which has been named using a special system. OCEAN2A is an example of a SID where OCEAN is the waypoint where the SID ends. 2A is a version number. Next time the SID is updated it gets version number 3. Changes are quite rare and when done they are mostly minor adjustments.

If you want a pilot to fly OCEAN2A but the pilot only has charts for OCEAN1A, then this is normally not a problem, but you have to make sure that no big changes has been made between the two versions. The ending letter of the SID is usually, but not always connected to a specific runway. For example, all SIDs ending with ”A” at Hong Kong depart from runway 07R.

There are obvious advantages with the SID system. Most SID are quite complex, and to give the instructions to fly them step by step would indeed be time consuming. Since the autopilot usually is used to fly the SID, all aircraft flying the same SID will do it in the (close to) exact same way, making it predictable. Moreover, the SIDs and STARSs (see bellow) are designed in a way to minimise potential conflict situations.

8.6.2 Standard Instrument Arrival STAR

As the name implies, this is a standard procedure when arriving at an airport. It's like a route to the airport. This road has a name that has three parts. The first part is the navigational point where the route starts, the second is the version number, and the third is usually but again not always coupled to a certain runway(s). An example is ABBEY3A. The point at which the STAR ends is called **Initial Approach Fix (IAF).** In some cases, the STARs continue and end at **the Final Approach Fix (FAF)**, and that means that you as controller don't need to vector the aircraft unless there is other traffic in the way. The only thing you have to do is to instruct the pilot how to descend the aircraft. This simplifies the arrival considerably for both pilots and controllers.

There are exceptions of course, where the STARs don't end at the final, but at a navigational point some distance away from the runway. You as a controller must give vectors the last part to the runway. If you for some reason don’t give vectors, the pilot must enter holding at the STAR's ending point (clearance limit). Make sure to avoid this.

8.6.3 Transition [C]

There is a defined transition point at which an airway and a SID or STAR intersect. Some STARs and SIDs have more than one transition that are best thought of as branch routes feeding the main procedure.

8.6.4 Routes [S1]

ATS routes are pre-determined routes connecting waypoints to each other, which the aircraft will follow. ATS routes are named by a character followed by two or three numbers. Some ATS routes are for aircrafts flying in one direction only.

8.6.5 Approach [S2]

There is much information on the charts regarding the approach.

There will be some kind of navigational aiding system in use if the approach isn't visual. When talking about approach aids, they are often divided into two categories: precision and non-precision. A non-precision approach only gives you guidance in one axis; mostly horizontally but on rare occasions can also be vertically, while a precision approach gives you guidance in both the horizontal and vertical axis.

8.6.6 Precision approaches [S3]

The most usual type of precision approaches is an **ILS approach**, and that is the only precision approach covered in this manual. An ILS guides a pilot on the approach by indicating the vertical and horizontal deviation from the correct approach path.

Information about how the ILS is constructed, frequencies, glide slope etc can be found on the chart. Please note that not all airports are equipped with ILS. Other types of approaches must then be used. See below.

8.6.7 Non-precision approaches [S3]

The most usual types of non-precision approaches are VOR, VOR/DME and NDB approaches.
The VOR approach is performed by flying towards a VOR beacon. The VOR is in this case located at the airport.

A VOR/DME approach is also an approach into a VOR, but the pilot can use the distance to the airport given to him from the DME.

A NDB approach is done by flying to a NDB beacon which is located on the runway extension and then flying on a certain heading which directs the pilot to the runway. We have only covered the non-precision approaches briefly here, but it is important to know that they exist since not all airports are equipped with ILS.

All information about how to perform the non-precision approach is found on the specific charts for the airport.

8.6.8 Visual approach [S3]

A visual approach is an approach by an IFR flight when either part or all of an instrument approach procedure is not completed and the approach is executed in visual reference to terrain.

8.6.9 Minima [S3]

At the approach, it is required that the pilot has visual contact with the runway or runway lights at a certain height specified at the chart, to be able to continue the approach and eventually land. The reason for this is that the pilot needs visual reference in order to make a safe landing. Depending on type of approach and approach aids used, the lowest height a pilot can descend to will vary. This height is called the **decision height (DH),** or **decision altitude**.

At this height the pilot must have **visual contact** with the runway or runway lights. If not, a missed approach must be executed.

Since the different approach aids leads the aircraft to the runway with varying precision, the different approach types will have different “minima’s”. For example, a NDB approach has relatively high minima, approximately a height of 400- 500 ft, while a typical ILS approach has minima of 200 ft. A VOR approach has normally a minima of 300-400 ft. Note that “height” is ft over ground and “altitude” is ft over sea level.

Decision height/altitude (DH/DA) is used for precision approaches and **Minimum Descent Height/Altitude (MDH/MDA)** is used for non-precision approaches.

8.6.10 Runway Visual Range (RVR) [S3]

RVR is the **Runway Visual Range**.

The Pilot may commence an instrument approach regardless of the reported RVR/Visibility but the approach shall not be continued beyond the outer marker, or equivalent position, if the reported RVR/visibility is less than the applicable minima.

If, after passing the outer marker or equivalent position in accordance with the above, the reported RVR/visibility falls below the applicable minimum, the approach may be continued to DA/H or MDA/H.

The approach may be continued below DA/H or MDA/H and the landing may be completed provided that the required visual reference is established at the DA/H or MDA/H and is maintained.
RVR is measured only if the visibility is below 1500 m. RVR indicates the visibility of the runway lights, and will thus often give a larger distance than actual meteorological visibility.

8.6.11 Missed approach Point (MAP) [S3]

For non-precision approaches, a **Missed Approach Point (MAP)** is indicated. MAP is the point where the pilot at latest must increase thrusters (i.e. a go-around) if he hasn't a visual on the runway. The MAP can be a DME distance, a timed distance or a navigational aid.

8.6.12 ILS categories [S3]

The reason for going back to ILS approach is that we have now covered RVR and visibility, which is needed to understand the different ILS categories.

The different ILS categories have different precision, and there are different visibility requirements when using them. The categories are named CAT I, CAT II, CAT III a, CAT III b and CAT III c. The category for each runway is given on the airport charts.

During normal ILS CAT I, minimum RVR is 550 m. If RVR is below 550 meter, the visibility is too low, and an approach cannot be initiated unless the airfield is equipped with a higher precision ILS. If there isn't a higher precision ILS, the pilot can either wait or see if the weather improves, or land on an alternative airfield where the visibility is better.

ILS Classification is used to determine the accuracy of the landing system. Category one (CAT I) is the least accurate, and CAT III is the best. This means you can fly the approach to lower limits (decision heights) on a CAT III ILS than on a CAT I ILS. When you reach the appropriate limit you need to see the runway, otherwise you have to go around and fly the missed approach procedure. We are only talking about the ground facilities here. In real life there are more factors which can change your lowest limit.

1. Pilot qualification
2. Airplane qualification
3. Ground facility qualification

The one which has the highest limit is the limiting factor for an approach. Standard limits are:

	CAT I	CAT II	CAT III-A	CAT III-B	CAT III-C
Limit	200 ft *	100 ft	50 ft	0 ft	0 ft
Visibility/RVR	550 m	300 m	100 m	50 m	0 m

The visibility is the limiting factor in an approach.

If the Cloud base is at 50 ft, but the visibility is 600 meters, you may fly and land with a CAT I ILS. The chances that you can see the runway at 200 ft are very limited, but maybe the approach lights are very bright.

So, if a pilot is not qualified for CAT II, the visibility is 400 meters, the ILS (ground) is CAT III-B, the airplane is CAT III-A, the limiting factor will be the pilot, so CAT I is your lowest limit.
If the pilot is CAT III-B qualified, the airplane as well, visibility is 100 meters, but the ILS (Ground) is CAT II Only, CAT II is your limit.

If the pilot is CAT II qualified, the airplane CAT III-A, visibility is 10 km, but the ILS (Ground) is CAT II Only, you have no problems, because the weather is perfect!

8.7 Flight plan and Route [S1]

The main reason for filing a flight plan and route is the pilot is informing the ATC units along the way his/her requests to complete the journey; this will include the speed, cruise level waypoint and airways to be flown.

And one other major reason in non-Radar equipped regions (these are becoming much less in the real world and non-existent in the simulated environment) if you haven't arrived at your destination in the allowed time limit, the emergency services will have a good idea where to look for you. Flying isn't as easy as jumping into your car and going from point A to B.

The Basic format for a flight plan route is;
Waypoint RouteDesignator Waypoint DCT Waypoint RouteDesignator.... etc.

In some circumstances where a Waypoint doesn't cross from a designated route the letters "**DCT**" meaning “**direct**” are used (there are no waypoints in the world with this name or code). Some countries do not allow deviation from designated routes, or if allowed for short distances only.

8.7.1 Example of route [S1]

A simple Flight Plan between VHHH (Hong Kong) and RCTP (Taipei) might look like this:

OCEAN2A OCEAN V3 ENVAR M750 TONGA

OCEAN2A is the SID of this flight plan route. All IFR departures within Hong Kong FIR with RNAV capabilities shall be assigned a SID.

OECAN is the first navigational aid and depending on the pilot's and ATC's choice this can be a vector or SID departure (i.e. OCEAN2A). Remember that a pilot has the choice of refusing a SID/STAR and may request radar vectors.

V3 in the route is a transition route from the waypoint OCEAN to the boundary of Hong Kong FIR. All SIDs in Hong Kong FIR lead to an initial waypoint, often times followed by a transition route to the boundary of Hong Kong FIR (the only except to this is departure to BEKOL). Some initial waypoint may lead to multiple transitions (for example, OCEAN can be followed by V2, V3 V4 and V5 transitions). ENVAR is the waypoint on the Hong Kong FIR boundary in this case. Any ATS routes in this flight plan beyond ENVAR are outside Hong Kong FIR.

Airway M750 goes from ENVAR to TONGA, where the flight begins STAR into RCTP.

The complete list of waypoints does not have to be specified as shown in the route above, but if included this will also be acceptable, but will usually take very long to fill and read and is not good practice.

8.7.2 Speed and cruising level [S3]

You will also find information about speed and cruising level in the flight plan that the pilot sends. This information can be given in different formats as specified in the table below.

Cruising Speeds		**e.g.**
Km/h	Kxxxx	K0830
Knots	Nxxxx	N0456
Mach	Mxxx	M075
Cruising Level		**e.g.**
Flight Level	Fxxx	F320
Altitude	Axxx	A045
Standard Metric Level in tens of meters	Sxxxx	S1100
Metric Altitude in tens of meters	Mxxxx	M0120
VFR (unspecified)	VFR	VFR

8.7.3 Changes in speed and cruising level [C1]

Speed and Level change format is:
RouteDesignator Waypoint/SpeedLevel...
either if a speed or a cruise change is requested both are supplied.

Cruise Climb format is:
RouteDesignator C/Waypoint/SpeedLevelLevel...
Begins with the letter "C" and waypoint, the speed is the intended cruise speed to be maintained during the cruise climb and the layer of the two levels during the climb. If the second level is specified by the letters "PLUS" this indicates the level above which the cruise climb is planed for.

The speed and level formats should be quite obvious depending in what part of the world you are e.g. Km/h and metric cruise levels are used in Russian Federation Countries.

A route from LTBA (Atatürk) to EGLL (Heathrow) might look like this:
N0440F300 FENER A16 VADEN UL610 BATTY UL608 LOGAN

If a climb was requested, the route may appear like this:
FENER A16 VADEN UL610 ABETI/M075F340 UL610 BATTY UL608 LOGAN

If the waypoint where a speed/level change is required the following airway designator will be supplied, even if on the same route designator UL610 in this case.

A long haul route from LTBA(Atatürk) to KORD(Chicago) might be similar to this:

N460F280 FENER A16 VADEN UL610 C/TIMOT/N0455F300F320 UL610 BATTY UL608 C/BUB/M080F340PLUS UA24 NIK UL610 LAM/M080F360 UB29 CPT UG1 STU UN546 DEVOL UN544 DOGAL/M081F360 54N020W/M081F370 55N030W 55N040W/M081F390 54N050W CARPE REDBY YNA YRI YXI ECK J94 FNT PMM4

8.7.4 RVSM Transitions [Ref]

Since the introduction of RVSM (Reduced Vertical Separation Minima), the pilot flying in and out of RVSM airspace will require a cruise level change to comply with correct Flight Levels for the airspace in which they are operating.

A Route from OEJN(Jeddah) a non-RVSM airspace to LTBA(Atatürk) a RVSM approve airspace, there will be a need for a transition between the two:

N0460F310 EPLOM A424 PMA B544 TUSYR/M080F340 VB36 GAZ DCT TOROS VW75 BAG UL614 YAA

In the above route the initial cruise level is FL310, this is the correct level for non-RVSM airspace at TUSYR the entry/exit point into RVSM, the level requested is FL340, also correct for RVSM airspace.

The speed and level change format is exactly the same as for step climb.

8.7.5 A Real Flight Plan [ref]

A real world ICAO coded flight plan contains much more information than what we are usually accustomed to in the simulated environment, here's an example.
CODED ICAO FLIGHT PLAN

(FPL-N100A-IG
-GLF4/M-SXWHIGRY/S
-KEWR2315
-N0465F370 DCT MERIT DCT HFD J42 BOS DCT VITOL/M080F410 N27A
 NANSO/N0459F410 N27A RAFIN/M080F410 DCT 45N050W 47N040W 49N030W
 49N020W DCT BEDRA/M080F410 UN491 TAKAS/N0459F410 UN491 VMP UL851

MELKO UM606 BLM DCT
-LSZH0652 LSGG
-EET/KZBW0003 KZNY0040 CZQM0041 CZQX0141 EGGX0342 EISN0457
EGTT0531 LFRR0534 LFFF0606 LFEE0631 EDFF0645 LSAZ0646
RAFIN0156 45N050W0204 47N040W0253 49N030W0342 49N020W0432
REG/N100A SEL/GQEK DOF/020214 RMK/TCAS EQUIPPED AGCS EQUIPPED)
KZNYZQZX KZBWZQZX CZQMZQZX CZQXZQZX EGGXZOZX EBBDZMFP LFPYZMFP
This can be decoded as (FPL-N100A(Aircraft Call Sign or Flight Number)-I(FR)G(eneral flight)

GLF4(Gulfstream 4)/M(edium Wake Category)-Equipment/S (transponder equipment do not confuse with equipment suffix)
Departure Airport and Time in Zulu
Route N0465F370 (KTAS465 initial speed and FL370).... at VITOL/M080F410 a climb to FL410.. etc
Arrival Airport (Zurich) and duration of Flight 6hours and 52minutes Alternate Airport (Geneva)
Estimated enroute time for crossing FIR regions... EGTT0531 London FIR in 5hours and 31minutes and other info the pilot wants you to know.

8.8 Separation [S3]

As mentioned before, this is your most important task. How much should you separate? What should be done in order to avoid accidents, or as it is called in aviation, conflicts? Since this is such an important task it will be covered here and in the GUIDE.

1. Have a clear strategy what you want the pilot to do. Order and contrary orders leads to confusion and frustration.
2. Consider what implications your instructions have. It's not a good idea to give a pilot clearance to land if you at the moment before gave another pilot instruction to line up on the same runway.
3. Talk clearly and not too fast. It may sound “cool” talking fast but it often leads to misunderstanding which makes it slower.
4. Use standard phraseology. This reduces the risk of misunderstanding and confusion.
5. Listen to the readback carefully as it was the first time the instruction was given. Mistakes happen easily.
6. Act immediately if a conflict can occur. Don't wait until the conflict is developing. An aircraft doesn't turn immediately when given the instruction, the pilot needs to hear the instruction, act on it and then the aircraft starts turning.
7. Don't take on more than you can manage. Take a position which you feel you manage and ask for help if you need it and there is someone available. That was the ”software” which always is the most important.

8.8.1 Vertical separation [S3]

Vertical separation should at least be:

RVSM: 1000 ft

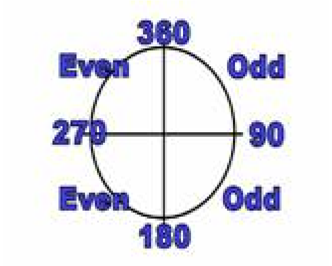
Non-RVSM: 2000ft

You are allowed to climb or descend an aircraft to a level previously occupied by another aircraft provided that vertical separation is maintained. This is done by observing the transponder echo in mode C.

To make sure vertical separation is maintained, it has been decided that aircraft eastbound use odd flight levels and aircraft westbound use even flight levels.

This, so called semi-circle-rule applies when no other rules override it.

Some airways/routes have specific flight levels assigned to them that contradict the semi-circle-rule. There are areas where the rule isn't applicable due to local restrictions etc. Please refer to your local vACC and charts for this local information.



8.8.2 Horizontal separation [S3]

There are several ways of maintaining horizontal separation, but as long as aircrafts are in radar covered area and use a transponder that transmits pressure altitude (mode C (Charlie)) the following rules apply.

There are other conditions not covered here that applies for example when crossing oceans.

The basic rule is that there should be at least **5 nm horizontal separation** in all directions. You can therefore imagine a circle around all aircraft with 2.5 nm radius to reach the 5 nm requirement.

There are situations when the 5 nm separation can be overruled. One situation is when two aircraft are on the final for landing. In this case **3 nm separation** is sufficient. (not regarding wake turbulence separation) Other rules may apply.

It is however not recommended to use this small separation even in this situation.

Depending on the airspace class you are in most instances required to separate IFR traffic from all other traffic in controlled airspace, so it's often your responsibility to separate IFR from VFR and vice versa.

8.8.3 Separation between departing traffic [S2]

It is often difficult to know the speed and vertical climb rate of a departing aircraft. It depends of course on the type of aircraft, but also on current weight and weather. You should avoid giving departing aircraft speed restrictions. Instead, use climb rate and vectoring as means of separation during climb.

A rule of thumb is to always separate at least traffic by one minute for departing aircraft, in some cases even more. This depends on the performance of the aircraft. If you cannot separate using radar, use the below table as reference.

Minimum Separation	Condition
1 Minute	The first aircraft turns more than 45° compared to following traffic headings.
2 Minutes	The first aircraft's speed is 40 KTs higher than following traffic.
3 Minutes	The heading difference is less than 40° and the first aircraft is similar or slower than the following aircraft.

8.8.4 Wake turbulence spacing minima [S2]

All aircraft generate turbulence called vortex wake. Large aircraft flying at slow speeds create the most severe wake turbulence. This turbulence can cause problems for following aircraft, which in severe cases can cause the pilot of the following aircraft to lose control.

In addition to separation minimum above, another spacing minimum therefore needs to be taken into account.

The wake turbulence categories are based on the maximum take-off mass of the aircraft. See 7.2.1 for more details.

8.8.5 Speed and height [S2]

Speed can be used for separation, but it should be used with restriction. The only exception is when separating traffic inbound for arrival. Climbing traffic and en route traffic should instead be separated using vectors and height.

Using speed for separation for inbound traffic is however important since all inbound aircraft sooner or later will have the same height at the same place, but not at the same time.
To descend and at the same time reduce speed can be difficult, especially for turbo jets. Therefore, it is essential to inform the pilot which of the two instructions has priority.

8.8.6 Minimum Speed [S2]

An aircraft needs to maintain a certain speed not to fall to the ground.

The minimum speed is mainly dependent on the weight of the aircraft. There are also other factors, so it is not always possible for a pilot to slow down or speed up to the instructed speed. It is the pilot's responsibility to inform you of this.

In that case, you must separate him from other aircraft by other means. In aircraft performance tables, there are several speed restrictions given, but only two are of interest for the controller.
The first is “minimum clean” which is the lowest speed an aircraft can maintain without using flaps or spoilers.

The second is “minimum approach speed” which is the lowest speed an aircraft can maintain using both flaps and spoiler.

Avoid giving a pilot, who is flying using his flaps, a speed instruction which forces him to again retract his flaps.

Apart from the specific aircraft's speed restrictions; there are speed restrictions common for all aircrafts. By following these, you need not study the specific aircraft's specifications:

Aircraft at FL280 – FL100:
Do not give a speed restriction below 250 knots or corresponding Mach.

Aircraft below FL100:
Turbo jet: not slower than 210 knots, except when within 20 nm from runway, in that case not slower than 170 knots.
Turbo prop: not slower than 200 knots, except when within 20 nm from runway, in that case not slower than 150 knots.

Departing traffic (if speed restrictions really are necessary):
Turbo jet: not slower than 230 knots.
Turbo prop: not slower than 150 knots.
Helicopter: not slower than 60 knots.

8.9 ATIS [S1]

ATIS (Automatic Terminal Information System) is in real life a recorded message that is transmitted on a specific radio frequency. All major airports have ATIS and all pilots approaching the airport are required to monitor the ATIS.

What information that is put into the ATIS depends on which position you man, but please note that an ATIS must never be more than 4 rows with a suggested maximum at 3 rows. This is a VATSIM requirement.

Information that should be included regardless of what position you man:

Voice channel (Note that this is now automatic for users of VRC or ASRC 1.3)
The name of your position
The ATIS version. You start with ALPHA, and every time you change anything you use next letter in the alphabet. When you reach ZULU you start over with ALPHA. When pilot calls you for the first time he should inform you which ATIS version he has received. This way you know he has the latest information.
Date and time (more about this below)
Active runways used. Always specify landing (arrival) first. (the exception being a DEP controller who does not need to include this information

APPENDIX A: AIRCRAFT EQUIPMENT SUFFIX TABLE

Code	Equipment
No DME Equipment on board	
/X	No Transponder
/U	Transponder with Mode C
DME Equipment Available	
/D	No Transponder
/A	Transponder with Mode C
TACAN ONLY (usually Military Aircraft)	
/M	No Transponder
/N	Transponder with no Mode C
/P	Transponder with Mode C
AREA NAVIGATION (RNAV)	
/Y	LORAN, VOR/DME, or INS with no Transponder
/I	LORAN, VOR/DME, or INS, Transponder with Mode C
ADVANCED RNAV WITH TRANSPONDER AND MODE C (If an aircraft is unable to operate with a transponder and/or Mode C, it will revert to the appropriate code listed above under Area Navigation)	
/E	Flight Management System (FMS) with en route, terminal, and approach capability. Equipment requirements are: 1. Dual FMS 2. A flight director and autopilot control system capable of following the lateral and vertical FMS flight path 3. At least dual inertial reference units (IRU's) 4. A database containing the waypoints and speed/altitude constraints for the route and/or procedure to be flown that is automatically loaded into the FMS flight plan 5. An Electronic map
/F	A single FMS with en route, terminal, and approach capability that meets the requirements of /E 1-4 above
/G	Global Positioning System (GPS)/Global navigation Satellite System (GNSS) equipped aircraft with en route, terminal, and GPS approach capability
/R	Required Navigational Performance. (Denotes capability to operate in RNP designated airspace and routes)
/W	Reduced Vertical Separation Minima (RVSM)

APPENDIX B: ABBREVIATIONS

ALPHA

AAE: Above Aerodrome Elevation
A/FD: Airport/Facility Directory, a book updated very 54 days with detailed information about airports within its coverage area.
ABEAM: An aircraft is abeam a fix, point or object when that point is approximately 90 degrees to the right or left of the aircraft track.
ABORT: To terminate a planned aircraft manoeuvre.
ACKNOWLEDGE: An expression used in radio communication meaning "let me know that you have received and understood the message"
A/C: Abbreviation for Aircraft.
ACC: Area Control Centre.
ACFT: Another possible abbreviation for Aircraft
ACTIVE RUNWAY: Another expression for Runway in use.
ADF: Automatic Direction Finder, a radio system that senses and indicates the direction to an NDB
ADVISE INTENTIONS: An expression used in radio communication meaning "tell me what you are planning to do"
AGL: Above Ground Level, the Height expressed in feet measured above Ground Level.
AIRCRAFT CALL SIGN: A group of alphanumeric characters used to identify an aircraft in air-ground communications.
AIP: Aeronautical Information Publication
AIRMET: A weather advisory concerning hazardous weather conditions such as icing, turbulence, low ceilings, etc.
AIRWAY: A corridor between radio navaids.
ALT: Abbreviation for Altitude, the vertical distance of a level or an object considered a point, measured from Mean Sea Level
ALTIMETER SETTING: The barometric pressure reading used to adjust the pressure altimeter for variations in atmospheric pressure or to the standard setting of 1013 hectoPascal. (Hpa)
AMSL: Altitude above Mean Sea Level
APPROACH: An ATC facility that provides control for aircraft arriving and departing an airport.
ARC: A curved ground track of an aircraft flying at a constant distance from a navaid referenced by distance measuring equipment.
ARTCC: Air Route Traffic Control Centre, or just "Centre", the en-route air traffic control facility.
ATC: Air Traffic Control, a control facility at airports and other controlled airspace.
ATIS: Automatic Terminal Information Service, a recorded message with information about an airport's active runways, weather conditions, etc.

BRAVO

BACKTRACK: To taxi on the active runway in the direction opposite to landing aircraft, usually to

position the aircraft for takeoff at an airport with no taxiways.
BASE: The part of the landing traffic pattern where the plane flies at a 90 degree angle to that of the landing runway.
BEARING: The horizontal direction to or from any point, usually measured clockwise from true north. Magnetic north or a reference point through 360^0.
BRAKING ACTION REPORT: A report of conditions at the airport movement area providing information to a pilot about the degree of braking quality that can be expected (good, fair, poor, nil)

CHARLIE

CAVOK: Ceiling and Visibility OK, visibility is 10km or more, no clouds under 5000Ft (or highest minimum sector altitude) no fog or mist, and no precipitation, thunderstorm or drifting snow.
CDI: Course Deviation Indicator, the vertical needle on the OBI which indicates deviation from the desired VOR radial
CEILING: The height above earth of the lowest cloud layer reported as broken, overcast or obscuration.
CENTER: Air Route Traffic Control Centre, or ARTCC, the enroute air traffic control facility.
CLASS-A: Controlled airspace, generally any airspace between 18000' MSL up to and including FL600 (roughly 60000').
CLASS-B: Controlled airspace around the busiest airports, usually including several rings with different altitude limits and extended 20 miles from the centre.
CLASS-C: Controlled airspace around moderately busy airports, generally in two rings extended out 10 miles and up to 4000 feet.
CLASS-D: Controlled airspace around any airport with an active tower, generally extended out 5 miles and up to 2500 feet.
CLASS-E: Any controlled airspace that does not fall under Class A through D.
CLEARANCE: Another expression for Air traffic control clearance
CLEARANCE LIMIT: The point to where an aircraft is granted an ATC clearance
CLEARED AS FILED: Another expression for Cleared via flight-planned route
CLEARED FOR TAKE OFF: An expression used by ATC to authorize an aircraft to depart. The clearance includes the specific aircraft call sign and the latest known airport conditions.
CLEARED TO LAND: An expression used by ATC to authorize an aircraft to land. The clearance includes the specific aircraft call sign, latest known airport conditions and runway designator.
CLEARED VIA FLIGHT PLAN ROUTE: An expression used by ATC to indicate that an aircraft is cleared to proceed in accordance with the route filed in the Flight Plan.
COMPOSITE FLIGHT PLAN: A flight plan that specifies VFR operation for part of the flight and IFR for another part.
CONTROLLED AIRSPACE: An airspace of defined dimensions within which ATC service is provided
COORDINATED UNIVERSAL TIME: The time system used in aviation and given to the nearest minute given from 0000 to 2359. Written abbreviation Z or UTC. Spoken expression Zulu or Universal.

CORRECTION: An expression used in radio communication to indicate that an error has been made in the transmission and that the correction follows.
COURSE: The intended direction of flight along the ground horizontally.
CROSSING TRACKS: Used in the application of separation, indicating tracks that converge or divert at an angle of 45 to 125 degrees.
CROSSWIND: In reference to wind conditions, a wind not parallel to the runway or the path of an aircraft.
CROSSWIND LEG: The part of the traffic pattern when the plane flies at right angles to the landing runway at the takeoff end.
CTAF: Common Traffic Advisory Frequency, a radio frequency used at non-controlled airports for pilots to self-announce their position and intentions.

DELTA

DEP: Departure Control, a function of an approach control facility providing ATC service for departing IFR and under certain conditions departing VFR aircraft.
DEVIATION: The departure from a current clearance, to avoid weather, turbulence or similar.
DEVIATION: The angular difference between Magnetic and True headings.
DH: Decision Height, the height on an ILS approach at which the pilot must decide if he can complete the approach or must do a missed approach.
DISPLACED THRESHOLD: A threshold not located at the end of the runway.
DME: Distance Measuring Equipment, radio equipment that allows the pilot to determine the distance to a navaid; usually coupled with a VOR.
DOWNWIND LEG: The part of the landing pattern where the plane flies parallel to the runway (usually to the right of the runway) opposite the direction of landing.

ECHO

EAT: Expected Approach Time, the time at which an ATC expects an arriving aircraft following a delay, will be able to leave the holding fix.
EAC: Expected Approach Clearance Time
ELT: Emergency Locator Transmitter.
ENTRY FIX: The first reporting point, determined by a navigation aid, over which an aircraft is expected to pass upon entering a control area.
ETA: Estimated Time of Arrival, the time of day when a flight is expected to be completed.
ETD: Estimated Time of Departure, the time of day when a flight is expected to commence.
ETE: Expected Time En-route, the amount of time a flight is expected to take from beginning to end.
EXECUTE MISSED APPROACH: An expression used by ATC to instruct a pilot on an Instrument Approach Procedure to initiate a climb, continue to the Missed Approach Point and follow the missed approach procedure as described or as assigned by ATC.

EXIT FIX: The last reporting points, determined by a navigation aid, over which an aircraft is expected to pass upon leaving a control area.
EXPEDITE: An expression used by ATC when immediate action is required by the pilot in order to avoid the development of a situation.

FOXTROT

FAF: Final Approach Fix, a specific position ("fix") from with an instrument approach to landing is begun.
FAP: Final Approach Point, a specific position on a non-precision instrument approach where the plane is established inbound on the final approach course.
FINAL APPROACH SEGMENT: On an instrument approach, the segment from the final approach fix to the runway.
FINAL: The part of the landing pattern just before the plane lands, where the plane is lined up with the runway.
FIR: Flight Information Region
FIS: Flight Information Service
FIX: A specific geographic position, determined visually or relative to radio navaids.
FL: Flight Level, an altitude based on standard instead of actual air pressure; used for flights climbing above the transition altitude. Flight Levels correspond to 1000 foot increments in altitude.
FMS: Flight Management System, a computer system in large aircraft used to aid in navigation of pre-programmed routes.
FSS: Flight Service Station, a facility that provide pilot briefings, en-route communication, NOTAMS, weather and other information.

GOLF

GLIDE: Slope or Path, a system providing vertical (altitude) guidance to a landing airplane; for example a VASI or ILS.
GO-AROUND: Other expression for Overshoot
GPS: Global Positioning System, a system of navigation using a large group of satellites to determine position.
GND: Ground Control, and ATC service provided to prevent collisions on the manoeuvring area and to ensure the orderly flow of aircraft on the ground.

HOTEL

HAA: Height Above Airport, the height of the MDA (Minimum Descent Altitude) above the published airport altitude.

HANDOFF: The process of transferring the radar identification of an aircraft target and radio communications to another controller.
HAT: Height Above Touchdown, the height of the DH (Decision Height) or MDA (Minimum Descent Altitude) above the highest runway elevation in the TDZ (Touchdown Zone).
HDG: Heading, the direction in which the nose of the aircraft is pointed, expressed in degrees.
HEAVY: An aircraft capable of takeoff weight of 300,000 pounds or more.
HEIGHT: Elevation above a ground reference point
HF: High Frequency, the radio frequency band between 3 and 30 MHz.
HIGH SPEED TAXIWAY: A long radius taxiway that is designed to expedite aircraft turning off the active runway after landing traveling at high speed up to 60kts. (Also called, High Speed Exit, High Speed Turnoff, Long Radius Exit, Rapid Exit Taxiway and/or Turnoff Taxiway.
HIWAS: Hazardous In-flight Weather Advisory Service, continuous recorded hazardous weather information broadcast over certain VOR stations.
HOLD: A procedure in which a plane flies a racetrack shaped pattern relative to a fix while awaiting clearance to proceed.
HOLDING PATTERN: A predetermined racetrack pattern flown as part of holding procedure.
HOLDING PROCEDURE: A predetermined maneuver keeping an aircraft within a specified airspace whilst awaiting further clearance.
HOLDING STACK: Multiple aircraft holding at a common fix with Vertical separation
HOLD SHORT: An expression used by ATC to instruct aircraft to hold away from the edge of a runway whilst waiting for permission to cross or proceed onto a runway.

INDIA

IAF: Initial Approach Fix, the fixes on an instrument approach chart that identify the beginning of the initial approach segment.
IAP: Instrument Approach Plates, a book of charts defining instrument landing approaches.
IAP: Instrument Approch Procedure, a series of predefined maneuvers that transfer a plane on an instrument flight to the point where a landing can be made visually.
ICAO: International Civil Aviation Organization
IDENT: A request from ATC for a pilot to activate this function on his transponder.
IF: Intermediate Fix, the fix that starts the intermediate approach segment of an instrument approach procedure.
IFR: Instrument Flight Rules, the set of rules governing flight solely through the use of instruments; often used to mean weather conditions that require instrument flight.
ILS: Instrument Landing System, a two part radio navigation system consisting of a localizer for left/right guidance and a glide slope for vertical guidance.
IM: Inner Marker, a radio beacon used during an ILS landing approach located near the end of the runway.
IMC: Instrument Meteorological Conditions, weather conditions that are such that instrument (IFR) flight is required.

IMMEDIATE TAKE-OFF: An expression used by ATC to indicate the pilot is expected to taxi onto the runway and take off in one continuous movement, also called a Rolling Take-Off.
IAS: Indicated Airspeed.
INITIAL APPROACH SEGMENT: On an instrument approach, the segment between the IAF (initial approach fix) and the intermediate fix.
INTERMEDIATE APPROACH SEGMENT: On an instrument approach, the segment between the intermediate fix and the final approach fix.
INTERSECTING RUNWAYS: Two or more runways that cross or meet.
INTERSECTION: A defined geographic point (defined via navaids) used as a reference point during instrument flight.
INTERSECTION: At an airport, the point where two runways, a runway and taxiway or two taxiways cross.

JULIETT

JET ROUTE: Air routes, usually from VOR to VOR, used to serve aircraft operating at higher Flight Levels.
JET STREAM: A stream of high-speed winds present at high altitudes.

LIMA

LANDING MINIMUMS: The minimum visibility (due to clouds, etc.) under which an instrument approach can be legally completed.
LATERAL SEPARATION: The separation between aircraft at the same altitude expressed in terms of distance between tracks.
LDA: Localizer Type Directional Aid, an instrument landing aid similar to a localizer but not aligned with the runway.
LEVEL: The vertical position of an aircraft in flight and variously height, altitude or flight level.
LF: Low Frequency, the radio frequency band between 30 and 300Khz
LOCALIZER: An instrument landing aid, used to provide horizontal alignment with the runway; similar to a VOR but with only a single radial and more accurate.
LORAN: Longe Range Navigation, a system of ground based radio stations that can be used to determine an exact geographic location.
LOW APPROACH: An approach at a low altitude over a runway, without the airplane actually touching down.

MIKE

MACH: The ratio of true airspeed to the speed of sound; varies with altitude.
MAINTAIN: An expression used by ATC meaning that the aircraft must reach or remain at the Altitude or Flight Level specified, or that the aircraft must maintain a given minimum or maximum

speed as specified.

MAP: Missed Approach Point, a point along an instrument approach at which as missed approach must be started in the required visual reference has not been seen.

MARKER: A navaid beacon transmitting straight up, allowing a plane with the proper equipment to determine when a specific point on an instrument approach has been passed.

MCA: Minimum Crossing Altitude, the lowest altitude at which a plane on an instrument flight can cross a specific fix.

MDA: Minimum Descent Altitude, the lowest altitude (MSL) to which an instrument landing approach may go before visually acquiring the airport or beginning a missed approach.

MEA: Minimum Enroute Altitude, for instrument flight the lowest altitude between navaids which assures acceptable navaid signals and safe obstacle clearance.

MHA: Minimum Holding Altitude, the lowest altitude for a specific holding pattern which assures navaid reception and obstacle clearance.

MIA: Minimum IFR Altitudes, minimum altitudes for instrument flight as published on IFR charts.

MINIMUMS: weather condition requirements for a particular type of operation.

MINIMUMS: Weather conditions that determine whether flight is possible; when below minimums landing and taking off is not allowed.

MISSED APPROACH: A predefined manoeuvre used when an instrument approach fails.

MM: Middle Marker, a radio beacon along an ILS landing approach, normally located at or near the decision height.

MOCA: Minimum Obstruction Clearance Altitude, the minimum published altitude within 22 nm of a VOR meeting obstacle clearance requirements.

MRA: Minimum Reception Altitude, the lowest altitude at which an intersection can be determined using the navaids that define the intersection.

MSA: Minimum Safe Altitude, the minimum altitude that meets legal requirements, typically 1000 feet above obstacles.

MSL: Mean Sea Level

NOVEMBER

NAVAID: Navigational Aid, a radio transmitter such as a VOR, NDB, beacon, etc. that is used for radio navigation.

NDB: Non-Directional Beacon, a radio navaid that simple transmits a signal usually received by a plane's ADF to determine the direction from the plane to the NDB.

NEGATIVE: An expression used in radio communication meaning NO, Permission Not Granted or That is Not Correct.

NO COMPASS APPROACH: A radar approach or vector provided in the event of compass of directional indication malfunction. ATC instead of providing heading instructions will observe the radar track and issue control instructions "Turn Right", "Turn Left" "Stop Turn" as required.

NONPRECISION APPROACH: An instrument approach where no electronic glide-slope is provided.

NORTH ATLANTIC ORGANIZED TRACK SYSTEM: A variable track structure developed daily by

appropriate Oceanic Area Control Centers (Gander west and Shanwick east) to create a series of minimum time tracks across the North Atlantic (NAT)
NOTAM: Notice To Airmen, news of interest to pilots regarding hazards, changes in service, procedures, etc.

OSCAR

OBI: Omni-Bearing Indicator, the dial that displays information from the VOR receiver radio, indicating radial, TO/FROM and glide-slope.
OBS: Omni-Bearing Selector (course selector knob), the control used to select the radial on the OBI dial.
OBST: Obstacle, all fixed and mobile objects that are located on an area intended for the surface movement of an aircraft or that extend above a defined surface intended to protect aircraft in flight.
OCA: Obstacle Clearance Altitude, The lowest altitude above the elevation of a runway threshold used in establishing compliance with the appropriate published criteria.
OCA: Oceanic Control Area
OCL: Obstacle Clearance Limit, the height above the field elevation below which the minimum prescribed vertical clearance cannot be maintained either on approach or in the event of a missed approach.
OL: Obstacle Light, Anti Collision lights on buildings, towers, antennas or terrain close by an airfield giving visual reference to pilots.
OM: Outer Marker, a radio beacon along an ILS landing approach typically near the point where the ILS glide slope is intercepted and about 4 to 7 miles from the runway.

PAPA

PAPI: Precision Approach Path Indicator, similar to a VASI but using four lights to more accurately indicate the glide-slope.
PIC: Pilot In Command, the person actually responsible for the operation of the aircraft in flight.
PIREP: Pilot Weather Report, a report of weather conditions encountered during flight.
POSITION AND HOLD: Taxi onto the runway, into takeoff position, but do not take off until clearance from ATC is received.
PRECISION APPROACH: An instrument approach where electronic glide-slope guidance is provided (e.g., an ILS approach).
PROCEDURE TURN: A manoeuvre used on instrument approaches to reverse direction and establish an aircraft on the intermediate approach segment or final course.
PULL UP AND GO AROUND: An instruction given by ATC when in the controller's judgement, the aircraft landing procedure cannot safely be continued to touchdown.
PUSH BACK: An expression used to indicate the rearward movement of an aircraft being towed

QUEBEC

QNH: Atmospheric Pressure at Mean Sea Level, in Millibars
QFE : Atmospheric Pressure at Aerodrome Elevation, in Millibars
QNE: Atmospheric Setting at Standard Barometric Pressure
QDM: The Magnetic Track to a station, usually a NDB, but could also be used for a VOR or VHF station
QDT: The Magnetic Track outbound from a station, usually a NDB but could be used for a VOR or VHF station.

ROMEO

RADIAL: A magnetic bearing extending from a VOR station.
RADAR: A radio detection device that provides information on range, azimuth or elevation of objects.
RADAR APPROACH: An approach executed by an aircraft under the direction of a radar controller.
RADAR CONTACT: Another expression for Radar Identified, used by ATC to inform a pilot that radar identification is established.
RADAR CONTROLLED AIRSPACE : A controlled airspace within which radar control service is provided.
RADAR CONTROL SERVICE : The control of aircraft by ATC through the provision of vectors or speed control or both, to establish the required separation between aircraft.
RADAR SERVICE TERMINATED: Expression used by ATC to inform a pilot that the provision of radar services has ceased.
RADAR VECTORING: Other expression for vector
REIL: Runway End Identifier Lights, a pair of white flashing strobe lights located at each corner of the end of a runway.
REPORTING POINT: A specific fix where the position of an aircraft can be reported.
RMI: Radio Magnetic Indicator, an aircraft navigation instrument coupled with a gyro compass that indicates the direction to a navaid plus bearing with respect the aircraft heading.
RUNWAY HEADING: the exact magnetic heading of the runway centerline to the nearest degree.
RUNWAY NUMBER: determined from the runway magnetic heading rounded to the nearest ten degrees (i.e., a runway with a heading of 274 degrees would be runway 27).
RVR: Runway Visual Range, the distance that a pilot can see down the runway from the approach end; needed for instrument landings in reduced visibility.
RATE ONE-HALF TURN: The turn rate of 1.5' per second normally used by aircraft operating in 250kts or more.
RATE ONE TURN: The turn rate of 3' per second normally used by aircraft operating at less than 250kts.
RVSM: Reduced Vertical Separation Minimum. The application of 1000ft vertical separation

between flight levels FL290 and FL410 between RVSM certified aircraft.

SIERRA

SAY AGAIN: An expression used to request a repetition of the last transmission.
SAY ALTITUDE: An expression used by ATC to request an aircraft's specific altitude or Flight Level
SECTIONAL: A chart using a scale of 1:500,000 used for VFR flight.
SEPARATION: The spacing between aircraft, altitudes, Flight Levels or Tracks.
SID: Standard Instrument Departure, a specific airport departure route usually used for instrument flights.
SIGMET: A weather advisory concerning conditions of significant interest to all aircraft, such as severe turbulence, severe icing, etc.
SPEED ADJUSTMENT: An ATC procedure used to request pilots to adjust speed as directed to provide the desired separation.
SQUAWK: Activate and set the aircraft's transponder to a specific four-digit code.
SSR: Secondary Surveillance Radar, a back-up system integral to the proper operation of the transponder.
STANDARD RATE TURN: A turn of three degrees per second; also called a two minute turn because a complete circle takes two minutes to complete.
STAR: Standard Terminal Arrival, a specific airport arrival route that begins some distance away and puts the plane into a standard instrument landing approach.
STOP AND GO: A procedure where an aircraft will land, make a complete stop on the runway, and then take off again.
STRAIGHT IN: An approach and landing where the normal traffic pattern is skipped and the plane intercepts the runways heading and lands straight ahead.
SVFR: Special VFR Flight. A visual flight authorized by ATC to operate within a control zone under meteorological conditions that are bellow VFR weather conditions.

TANGO

TARGET: The indication on a radar display of a primary radar echo or a transponder reply.
TCAS: Traffic Alert and Collision Avoidance System.
TCH: Threshold Crossing Height, the height above the runway that an aircraft should cross the runway threshold on an ILS approach.
TDZE: Touchdown Zone Elevation, the highest elevation in the first 3000' of the landing runway.
THRESHOLD: the beginning of the portion of the runway that is usable for landing.
TOUCH AND GO: A practice landing where the plane touches downs, continues rolling, and takes off again.
TOUCHDOWN ZONE: The first 3000' of the runway, beginning at the threshold.
TRACK: The actual path of the aircraft over the surface of the earth.

TRAFFIC PATTERN: The traffic flow of airplanes landing and taking off from an airport, consisting of upwind, crosswind, downwind, base and final legs.
TRANSITION ALTITUDE: The Altitude above Mean Sea Level, used for departing aircraft, where the QNH needs to be set to local Atmospheric Pressure.Above the TA the aircraft altimiter pressure setting should be adjusted to the standard pressure setting and Flight Levels are used.
TRANSITION LEVEL: The Flight Level used for decending aircraft at which, the pilot start to refer to altitude of the aircraft by setting the altimeter to the QNH for the airfield or region.
TRANSPONDER: A device in a plane that responds to ground signals and returns information such as the squawk code, altitude, etc.
TRSA: Terminal Radar Service Area, airspace surrounding certain airports where ATC provides radar vectoring, sequencing and separation.

UNIFORM

UHF: Ultra High Frequency, the frequency band between 300 and 3000 MHz
UNABLE: An expression used indicating the inability to comply with a specific request, clearance or instruction.
UNICOM: A radio facility that may provide airport information at certain airports.
UPWIND: The part of the traffic pattern where the plane flies parallel to the landing runway in the direction of landing.
UTC: Universal, spoken Expression for Coordinated Universal Time another expression for ZULU time.

VICTOR

VASI: Visual Approach Slope Indicator, a system of lights place adjacent to a runway that allow the pilot to maintain a proper glide-slope for landing.
VECTOR: A heading given by ATC to pilots to provide navigational guidance.
VERTICAL SEPARATION: The separation between aircraft expressed in units of vertical distance.
VFR ON TOP: ATC authorization for an IFR aircraft to operate in VFR conditions at an appropriate VFR altitude above the clouds.
VFR: Visual Flight Rules, the rules that govern flight under visual conditions; also used to indicate that weather conditions are suitable for visual flight.
VHF: Very High Frequency, the band between 30 and 300 MHz.
VISUAL APPROACH: An approach conducted on an IFR flight plan which authorizes the pilot to proceed visually and clear of clouds to the airport.
VISUAL DESCENT POINT: A defined point on a non-precision instrument approach from which normal descent from the MDA to the runway can be commenced.
VMC: Visual Meteorological Conditions, weather conditions where visibility and cloud ceiling allows legal VFR flight.
VOR: Very High Frequency Omni Directional Range Station, a ground based navigation aid transmitting VHF navigation signals, 360 degrees in azimuth, oriented from magnetic north.

VORTAC: VHF Omni Directional Range/Tactical Air Navigation, a radio navaid providing VOR azimuth, TACAN azimuth and TACAN distance measuring (DME) at one site

WHISKEY

WAKE TURBULENCE: Turbulent Air behind an aircraft caused by one or any of the following:
a) Wing tip Vortices
b) Rotor tip Vortices
c) Jet engine blast
d) Rotor down-wash
e) Propeller wash
WAYPOINT: A geographical fix position used for routing or instrument approach or reporting point.

ZULU

ZULU or Z: Another term for Coordinated Universal Time.

RECORD OF REVISION

DATE	REV.	REVISION CONTENT	APPROVAL