COMMUNICATIONS

LECTURE ONE: EVERYTHING!

1. How does Radio work?
2. Basic Radiotelephony procedures
3. Departure Procedures
4. En-route procedures
5. Arrival / Traffic Pattern Procedures
6. Communications Failures
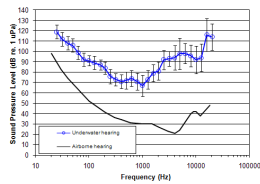7. Distress / Urgency Procedures

---

RADIO BASICS: SOUND

Sounds make vibrations in the air called sound waves

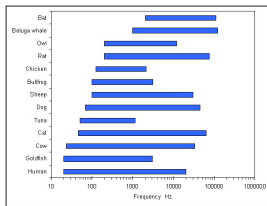Your ear drum then receives the waves and vibrates at the same frequency

Your brain then converts these received sound waves into electrical signals which the brain interprets as sound

RADIO BASICS: FREQUENCY

Frequency is measured in Hertz (Hz)

1 Hertz =
1 cycle past a given point per second

1,000 Hz = 10^3 Hz = 1 kiloHertz (kHz)

1,000,000 Hz = 10^6 Hz = 1 MegaHertz (MHz)

1,000,000,000 Hz = 10^9 Hz = 1 GigaHertz (GHz)
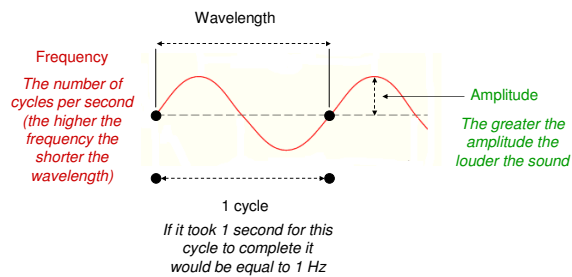
Human ear can hear between
20 - 20,000 Hz

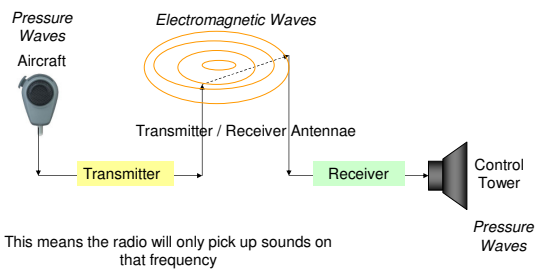"The Audio Frequency Range"

RADIO BASICS: WAVE MOTION

Waves are described by their shape and frequency

Wavelength

Frequency

The number of cycles per second (the higher the frequency the shorter the wavelength)

Amplitude

The greater the amplitude the louder the sound

1 cycle

If it took 1 second for this cycle to complete it would be equal to 1 Hz

---

RADIO BASICS: RADIO WAVES

A radio can be "tuned" to a particular frequency.

Pressure Waves

Aircraft

Electromagnetic Waves

Transmitter / Receiver Antennae

Transmitter

Receiver

Control Tower

Pressure Waves

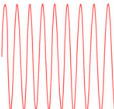This means the radio will only pick up sounds on that frequency

But there is a problem...

RADIO BASICS: RADIO & SOUND WAVES

Sound wave

Carrier Wave

Sound waves are 20 Hz – 20,000 Hz

Suitable radio waves for voice transmission are 30 MHz – 300 MHz (VHF)

Any voice message will need to be superimposed onto a radio frequency – known as a CARRIER WAVE

When you press the transmit switch you transmit a carrier wave

Your microphone then super-imposes your voice onto the carrier wave so that it can be transmitted
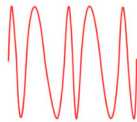

RADIO BASICS: RADIO WAVES: MODULATION

AM

FM

The receiving equipment then "tunes out" the carrier wave so that only the sound wave is heard

The superimposition of a sound wave on a radio wave is called MODULATION and it is achieved in 2 main methods

AMPLITUDE MODULATION (AM) varies the **amplitude** of the carrier wave to match the sound wave

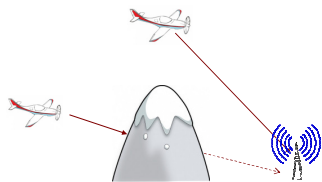FREQUENCY MODULATION (FM) varies the **frequency** of the carrier wave to match the sound wave

---

RADIO BASICS: VHF RANGE

VHF communications are line of sight

The higher your aircraft is, the further away your receiving station can be

There may be more than one station with the same frequency (such as Sywell and Compton Abbas) which are far enough apart not to interfere with each other

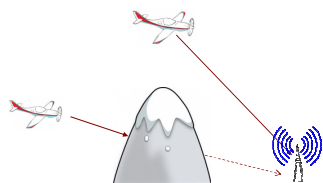In mountainous areas relay stations may be used to extend the effective VHF range

RADIO BASICS: VHF RANGE

There is a formula to work out your effective VHF range

VHF range = 1.23 * (√(Height of the transmitter) + √(Height of the receiver))

For example:
An aircraft at 5000 ft AMSL and a
receiver at 500 ft AMSL:
1.23 * (√5000 + √500) = 114 nm

RADIO BASICS

Up to date frequencies are found in the UK
AIP (or national AIP)

Most pilots will use a flight guide (AFE
or Pooleys) to get the information
required in a more user-friendly
format but this is an unofficial source

RADIO BASICS: MICROPHONE TECHNIQUE

Headsets serve 3 main functions:

1. To reduce the ambient noise for the wearer

2. To allow clearer understanding of received messages

3. To allow no-hands communications / transmissions

Sidetone allows you to hear yourself when you talk
(like on a landline telephone) – it helps you to talk
clearly and to talk at the correct volume!

The best technique is to have your microphone just
above your top lip and to speak slightly more slowly
than normal but at NORMAL VOLUME!

α β γ δ ε ζ
η θ ι κ λ μ
ν ξ ο π ρ σ
τ υ φ χ φ ω

Developed since 1886 to avoid confusion between transmitted letters

Has been altered on a number of occasions but the current format which is the international standard is:

A lpha	J uliet	S ierra
B ravo	K ilo	T ango
C harlie	L ima	U niform
D elta	M ike	V ictor
E cho	N ovember	Whiskey
F oxtrot	O scar	X -ray
G olf	P apa	Y ankee
H otel	Q uebec	Z ulu
I ndia	R omeo	

RADIO BASICS: NUMBERS

Numbers should be transmitted with the following pronunciation:

0 Zero
1 Wun
2 Too
3 Tree
4 Fow-er
5 Fife
6 Six
7 Seven
8 Ait
9 Niner

In addition:

Decimal   "Day-see-mal"
Thousand "Tousand"

RADIO BASICS: NUMBERS

Transmitting frequencies:

121.5 MHz   "wun two wun dayseemal fife"

126.555 MHz   "wun two six dayseemal fife fife fife"

124.275 Mhz   "wun two fower dayseemal too seven fife"

Use single digits for:

Time, altimeter settings, transponder codes, callsigns, wind information, runways

e.g. Time two seven / QFE niner niner fife / Squawk fower seven tree zero /
Runway two fower, etc.

RADIO BASICS: TRANSMISSION OF TIME

When transmitting time we do not transmit the hour…

At 0930 we are asked for our ETA which is at 10:04 – we should reply:

"ETA minute 04"

But… if our ETA was 09:56 – we should reply

"ETA 56"

PRACTICE QUESTION!

"How should the frequency 132.750 MHz be transmitted?"

"Wun tree two dayseemal seven fife zero"

RADIO BASICS: AIRCRAFT CALLSIGN

Use full aircraft callsign on first communication with a new frequency

Only shorten the callsign once it has been shortened by ATC

If you leave the circuit and stay on frequency, use full callsign again when calling for rejoin into the circuit

Always use the full callsign if you believe that confusion may exist

---

RADIO BASICS: AIRCRAFT CALLSIGN

At Booker Aviation we tend to use the aircraft registration as the callsign

The initial call will use this registration in full

i.e. "G-WACU"

If you are flying an aircraft where a callsign is used (for example "Wycombe 01") then the short version would be "Wycombe 01"!

Occasionally if a callsign confusion exists you may be asked to use "Cessna CU" – follow the instructions from ATC

RADIO BASICS: AIRCRAFT CALLSIGN

If you initiate a call, the station addressed is the first thing to say, then your callsign

If you are responding to a call your callsign comes at the end to indicate you have finished talking

In this way terms such as "Over" and "Out" are unnecessary

RADIO BASICS: STUDENT CALLSIGN

When you are a solo student pilot it is helpful some of the time for ATC to be aware of that fact!

If ATC know you are a student then they will not issue you with confusing clearances and will give you a priority over non-student traffic if necessary.

Your callsign on initial contact with any new ATC officer should be "Student G-WACH" for example.

You do not need to keep using the "student" prefix unless you believe that the ATC officer needs reminding!

It is useful though at all times so that other traffic is aware of your solo student status.

RADIO BASICS: SOME BASIC WORDS

"Negative"	No / That is incorrect / Permission refused
"Affirm"	Yes / That is correct (Note! Not "affirmative")
"Standby"	"Wait and I will call you" (i.e. Be quiet, do not acknowledge this call)
"Roger"	I have received your transmission (Note! This does not mean "yes")
"Wilco"	I will comply with your instruction

RADIO BASICS: SOME BASIC WORDS

"Break Break"	Use to separate messages between aircraft in a busy RT environment
"Disregard"	Ignore the last transmission you were given
"Correction"	Ignore my last transmission and this is what I meant to say…

There are many more! – Check either CAP413 (RT Manual) or Pilots Manual Book 7 for details

PRACTICE QUESTION!

"If are asked by ATC "can you maintain altitude 2500 feet", what is the correct response? Is it Roger, Wilco, Affirm / Negative or Comply?"

Affirm or Negative

LISTENING OUT & READING BACK

Always monitor the frequency in use – they may be trying to contact you!

By listening to other transmissions you will be able to build up a mental picture of what is going on in the area

This aids your Situational Awareness

LISTENING OUT & READING BACK

A "Critical Read Back" is a phrase which you MUST read back to the air traffic controller

This is so that ATC know that you received and understood what they have said to you

You are <u>required</u> to read back:

Runway clearances
Runway in use
Altimeter settings
Frequency changes
Clearances (take off, land, en-route)
Transponder codes
Taxi instructions
Level / altitude / heading / speed instructions

AIR TRAFFIC SERVICES

Remember though, that ATC are there for your benefit and not the other way around!

You think a radar controller is seeing this…

The radar controller sees…

ATC is like Tetris – the sooner the screen is clear the better!

If ATC instruct you to do something you are unable to do, would be illegal to comply with, or you don't want to – tell them! You are entitled to ask for an alternative clearance.
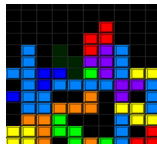
AIR TRAFFIC SERVICES: GENERAL

So why do we need Air Traffic Control?

Plus – someone to talk to!

Prevention of collision between aircraft on the ground or in the air

Prevention of collision between aircraft and objects at aerodromes

Expedite and maintain an orderly flow of traffic

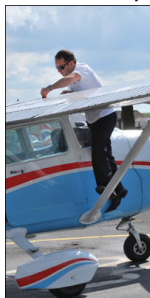Provide advice and information for the safe and efficient conduct of flights

Notification of and cooperation with Search and Rescue

DEPARTURE PROCEDURES: ATIS

Before taxy you will need to know information about the runway in use, pressure settings and weather

The Air Traffic Control Service Unit (ATSU) may give this to you

There may also be an Automated Terminal Information Service (ATIS)

ATIS: A frequency with rolling airfield information (usually timed with "information A", "information B", etc.)

When you contact ATSU for taxy you would state "information B received"

DEPARTURE PROCEDURES: RADIO CHECKS

Prior to taxy you may request a radio check from ATC or at any time you feel it necessary. Ask for a "readability check".

A "readability" scale is used to communicate how easily a transmission is heard:

1	Unreadable	(transmission garbled and/or unintelligible)
2	Readable now and then	(voice is coming and going)
3	Readable but with difficulty	(concentration and quiet required to hear)
4	Readable	(may have a small issue such as strength)
5	Perfectly readable	(no difficulties)

AIR TRAFFIC SERVICES

Area Control Centre (ACC) Services:

Air Traffic Control Service for IFR traffic in airways
Air Traffic Advisory Service for traffic on advisory routes
Flight Information Service and Alerting Service
Distress and Diversion Service

Aerodrome Traffic Services:

Air Traffic Control for traffic in ATZ or in the vicinity
Aerodrome Control / Approach Control at busy aerodromes

Flight Information Services: (FIS)

Air / Ground Radio Stations
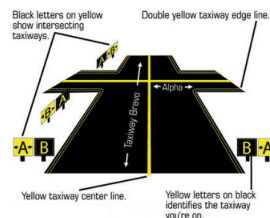Safetycom (135.475 MHz)

Open FIR Air Traffic Services

Lower Airspace Radar Service (LARS)
Available up to and including FL195 within 30nm of the nominated unit

---

DEPARTURE PROCEDURES: TAXI

When you request taxi you will be given instructions, usually with a clearance limitation

For example:

"G-CB taxi to holding point alpha three, runway 24 right hand, QFE 1012"
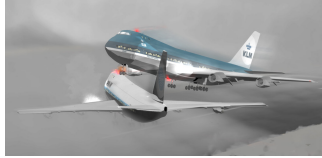
You need to read back ALL this information!

Having a pen ready to take down taxi instructions is very helpful – especially at unfamiliar airfields. If in doubt, ask to clarify!

DEPARTURE PROCEDURES: READY TO GET AIRBORNE

The phrase to use is "Ready for Departure" – the term "take-off" is only ever used as a positive clearance to take off and is only initiated by ATC

This is the outcome from the enquiry into the 1977 Tenerife disaster where an aircraft took off without clearance to do so and hit another which was crossing the runway

Investigators noted how the term "take-off" was used excessively and when communicating a clearance and a cancellation of clearance

---

DEPARTURE PROCEDURES: READY TO GET AIRBORNE

Responses by the tower may be one of the following:

"G-CB Hold Position"
Don't move!

"G-CB Line up (or Line up and Wait)"
Cleared to enter the runway but not to get airborne

"G-CB Backtrack"
Taxy along the runway to the other end and turn around

"G-CB Cleared for Take off"
Enter runway and take off!

"G-CB Take off at your discretion"

Used at "uncontrolled" airfields where the controller is not licensed to give you a clearance – it is not an indication that it is safe to take off – it is still your responsibility to check all is well

---

DEPARTURE PROCEDURES: READY TO GET AIRBORNE

You may get what is known as a "conditional clearance"

"G-CG: Taxy to Alpha, runway 24, QFE 976, after the landing tug, cross to the 24 holding point"

Your clearance is:

"G-CG: Taxy to Alpha, runway 24, QFE 976, ~~after the landing tug, cross to the 24 holding point~~"

The conditional bit:

"~~G-CG: Taxy to Alpha, runway 24, QFE 976,~~ after the landing tug, cross to the 24 holding point"

DEPARTURE PROCEDURES: BASIC SERVICE

Once airborne and either inside the ATZ or within the vicinity of the ATZ you will receive a "Basic Service" from the ATSU

If venturing further afield you will need to change the service received – more of which later!

PRACTICE QUESTION!

Is the phrase "G-WACE behind the landing Warrior line up runway 24 behind" a conditional or unconditional clearance?

Conditional – a clearance is given but the conditions under which you may accept it were given <u>first</u>

PRACTICE QUESTION!

"What does ATIS stand for"

Automated Terminal Information Service

EN-ROUTE PROCEDURES

Normally you will be advised when to change frequency but you can initiate a frequency change as well if you wish

"G-CB frequency change Sywell Information 122.705"

"G-CB change frequency to Wycombe Tower 126.555"

Remember if you don't want to change frequency and there is no reason why you should – tell them!

FLIGHT INFORMATION REGIONS

UK airspace is divided into 2 Flight Information Regions – Scottish and London

FIRs extend up to 24,500 ft (FL245)

Upper Information Regions (UIRs) extend above this with the same sub-divisions

Within this, airspace is sub-divided into 7 classes (A-G) and then also other areas and zones…

SCOTTISH FIR

LONDON FIR

AIR TRAFFIC SERVICES

The type of ATC provision depends upon types of traffic involved, density of traffic and meteorological conditions

At Wycombe Air Park we have a full tower provision due to the mix of traffic – high wing light aircraft, low wing light aircraft, helicopters and gliders

Sometimes at weekends and on other busy days / periods there are two frequencies in use – Ground and Tower

Wycombe Air Park is regularly logged as being busier than London Heathrow airport!

AIR TRAFFIC SERVICES: EN ROUTE

Air Traffic Services Outside Controlled Airspace (ATSOCAS)

There are 4 levels of service you can request from a controller:

BASIC SERVICE

TRAFFIC SERVICE

DECONFLICTION SERVICE

PROCEDURAL SERVICE

Which service you ask for depends on the level of service you require, your flight conditions and the station you are communicating with

---

EN-ROUTE: BASIC SERVICE

Advice and information useful to the safe and efficient conduct of flights

Aimed to give the pilot maximum autonomy

Pilot responsible for:	ATC responsible for:
Avoidance of Traffic	No requirements for monitoring flights or giving traffic information
Terrain Clearance	
Change heading, route or level without advising the controller	Have pressure setting information if asked

Available to IFR and VFR but probably not appropriate for IMC

EN-ROUTE: TRAFFIC SERVICE

Radar Based Service where the basic service is added to by radar-derived traffic information

Only available from controllers with radar

Pilot responsible for:	ATC responsible for:
Traffic Avoidance	Identification of Aircraft
Terrain Clearance	Relevant traffic information
Navigation	Headings / Levels for sequencing but not for deconfliction
Level selection	

Available to IFR and VFR – advise controller if you are VMC if given a heading or level that requires flight into cloud

EN-ROUTE: DECONFLICTION SERVICE

Surveillance based service so controller can control traffic through heading or level instructions and to achieve separation minima

Requires 5nm lateral separation and 3,000 feet vertically

Pilot responsible for:	ATC responsible for:
Terrain Avoidance	Identification of aircraft
Traffic Avoidance (if instructions are not followed)	Traffic information and avoiding action
	Heading and Level instructions
Own navigation or controlled navigation	

Available to IFR and VFR – you will need to accept any heading or level instruction so not really suitable if you are VMC-only

---

EN-ROUTE: PROCEDURAL SERVICE

Controller provides additional heading, level and time instructions to achieve deconfliction from PARTICIPATING traffic

No radar facility so not all traffic will be avoided

Pilot responsible for:	ATC responsible for:
Terrain Clearance	No identification required
Obtain clearance to change heading or level	Deconfliction minima for participating traffic
	May issue squawks for other radar controllers

Available to IFR and VFR but may require IMC flight - do not accept a procedural service if IMC is not legal for you

---

EN-ROUTE: POSITION REPORTS
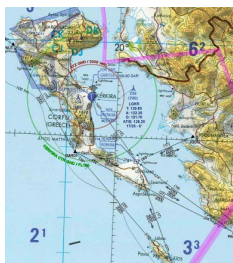
If you are not covered by radar, position reports may be required at regular intervals

Aircraft Callsign

Position

Time

Level

Next Position

Example:

"G-WACH, Aylesbury 42, 2300 feet, estimate Silverstone 54"

△ On-request reporting point

▲ Mandatory reporting point

EN-ROUTE: VOLMET

VOLMET is a broadcast which gives weather information for a group of airfields on a continuous loop

Each airfield will have information including:
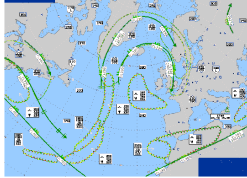
Aerodrome name
Time of Report (Zulu)
Surface Wind
Visibility
RVR (if applicable)
Weather (rain / snow etc)
Cloud
Temperature
Dewpoint
QNH
Any significant trend
Other Information

EN-ROUTE: VOLMET

Useful prior to flight to get an overall picture of the weather situation

Useful on longer flights to keep updated on weather trends

Main one we at Booker would use is London South which continuously transmits 24 hours a day on 128.600 MHz for Birmingham, Bournemouth, Bristol, Cardiff, Jersey, Luton, Norwich, Southampton, Southend & Exeter

You may also hear it overlaid onto a VOR frequency

EN-ROUTE: SAFETYCOM

135.475 MHz

Not an air traffic control frequency – there is no ground station!

Used for aircraft to communicate for collision avoidance and traffic intentions near airfields with no air traffic control

Only use if below 2000 ft (or below 1000 ft above circuit height) and only within 10nm of the intended airfield

This avoids congestion and "breakthrough" on a nationwide frequency

PRACTICE QUESTION!

"What is a Procedural Service?"

A Basic Service with the addition of an element of traffic information and avoidance for other traffic operating in the procedural service (as long as everyone is complying with instructions!)

AIR TRAFFIC SERVICES: EMERGENCIES

The transponder in the aircraft sends information regarding the aircraft position to an interrogating ground station

7000 is used as the code in the UK for conspicuity

7500	Hijack / Unlawful Interference	"75 taken alive"
7600	Radio Failure	"76 in a fix"
7700	Emergency	"77 going to heaven"

AIR TRAFFIC SERVICES: EMERGENCIES

Mode A

Information transmitted giving horizontal position only

Mode C

Information transmitted giving horizontal position and vertical position based on pressure altitude (1013.25 hPa)

Mode S

Embedded information transmitted regarding type, speed, callsign and provides TCAS resolution advisories and traffic warnings between Mode S aircraft

AIR TRAFFIC SERVICES: EMERGENCIES

Standby

Transponder is on but not transmitting. This MUST be selected before changing transponder codes to avoid inadvertently selecting a emergency code!

Ident

Only use if requested to "squawk ident". Briefly depress the ident button once!

EMERGENCIES: COMMUNICATIONS FAILURE

A radio-failure DOES NOT mean the aircraft won't fly! Fly the aircraft as 1st priority

If your radio fails check:

Frequency Selection
Intercom Selection
Volume Control
Squelch Setting
Headset Jacks
Stuck microphone button
Range of frequency
Station not open
Circuit Breaker popped (reset once only)

Meanwhile the ground station may be trying to contact you – they will check their equipment then ask another aircraft to try to contact you .

They will then transmit "blind calls"

EMERGENCIES: COMMUNICATIONS FAILURE: OPTIONS

You may be able to receive only, transmit only or neither

If the transponder works squawk 7600

If you can transmit carrier wave only you can use the speechless code
(more of which in a moment)

You can use light signals to communicate at an airfield
(more of which later)

EMERGENCIES: COMMUNICATIONS FAILURE: PROCEDURE

Fly the aircraft

Check you know where you are and where you're going

Squawk 7600 if possible

Transmit blind (in case it's only the receiver that is broken)

Stay VMC

After landing contact your frequency by telephone to let them know you have landed safely

Get the radio fixed!

EMERGENCIES: COMMUNICATIONS FAILURE

Transmitting blind:

"Wycombe Tower, G-WACB transmitting blind due to radio failure Overhead Princes Risborough and returning to the overhead"

"Wycombe Tower, GWACB transmitting blind, in the overhead joining downwind"

Etc etc...

EMERGENCIES: COMMUNICATIONS FAILURE

Once back at a busy airfield, the tower will need to have some way of communicating to you and vice versa
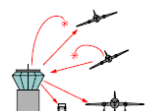
Steady **red** from tower:

"Do not land, continue to circle"   (if airborne)

"Stop"   (if taxiing)
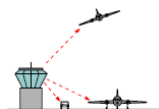
Flashing **red** from tower:

"Do not land, go away"   (if airborne)

"Move clear of landing area"   (if taxiing)

EMERGENCIES: COMMUNICATIONS FAILURE
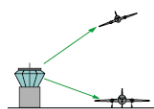
Steady **green** from tower:

"Cleared to land if safe" (if airborne)

"Cleared take off if safe" (if taxiing)
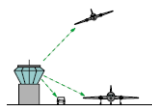
Flashing **green** from tower:

"Return to airfield, await clearance" (if airborne)
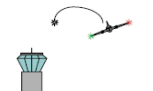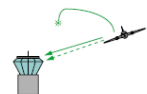
"Cleared to taxi if safe" (if taxiing)

EMERGENCIES: COMMUNICATIONS FAILURE
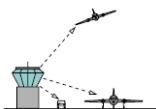
Flashing white light from tower to aircraft:

"Return to airfield and await clearance" (if airborne)
"Return to the starting point on the airfield" (if taxiing)

Green light from aircraft to tower:

"May I land / May I land in a different direction to that indicated?"

White light from aircraft to tower:

"I am compelled to land"

EMERGENCIES: COMMUNICATIONS FAILURE

Speechless code (use if you can transmit carrier wave)

·	"Yes"	1 short
··	"No"	2 short
···	"Say again"	3 short
····	"Request Homing"	4 short (H)
–	"Manoeuvre complete"	1 long
– ·· –	"Another emergency has occurred"	

EMERGENCIES

**Distress and Diversion Cell
(D&D)**

Callsign
"London Centre"

Emergency Calls should be made on the frequency in use or on the emergency frequency – 121.5 MHz

If you are already squawking you should retain this unless requested to change

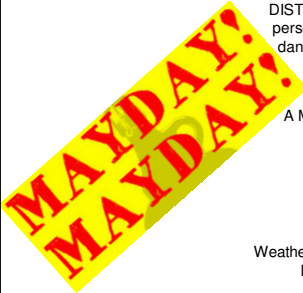If you have a transponder and you are squawking 7000 – change it to an emergency code

If you hear a Mayday call or Pan call, radio silence MUST be observed

It's a good idea to copy down the call if you hear it – in case you need to relay information

---

EMERGENCIES : DISTRESS

MAYDAY! MAYDAY!

DISTRESS is a situation where the aircraft or person is in grave (serious) and/or imminent danger and requires immediate assistance

A MAYDAY call is the correct response to a situation of distress

Examples of distress:

Pilot incapacitation
Engine Failure
Weather conditions deteriorating beyond safe limits
Darkness if unqualified / un-equipped

EMERGENCIES : DISTRESS

MAYDAY Call content:

Mayday, Mayday, Mayday
Name of Station Addressed

Callsign

Type of aircraft

Nature of Emergency

Intentions

Present or last-known position

Pilot Qualifications

Other useful information

Example Mayday Call:

Mayday, Mayday, Mayday

Wycombe Tower

G-WACB

Cessna 152

Engine Failure

Intend Forced Landing in Field
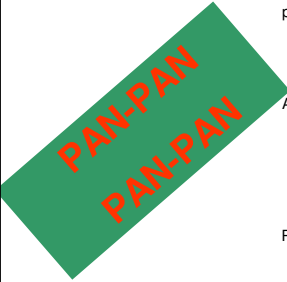
2 miles west Aylesbury 2000 feet heading north

Low Hour Pilot

2 on board

EMERGENCIES : URGENCY

PAN-PAN
PAN-PAN

URGENCY is a situation where the aircraft or person is experiencing an emergency but does not require immediate assistance

A PAN-PAN call is the correct response to a situation of urgency

Examples of urgency:

Navigational Difficulty (Lost)
Seriously ill passenger
Rough running engine / technical problems
Deteriorating weather / light with no IR

EMERGENCIES : URGENCY

PAN-PAN Call content:

Pan-Pan, Pan-Pan, Pan-Pan
Name of Station Addressed
Callsign
Type of aircraft
Nature of Emergency
Intentions
Present or last-known position
Pilot Qualifications
Other useful information

Example PAN-PAN Call:

Pan-Pan, Pan-Pan, Pan-Pan
London Centre
G-WACB
Cessna 152
Unsure of Position
Intend Return to Wycombe Air Park
Last known position overhead Stokenchurch, 3000 feet heading 020
Student Pilot

EMERGENCIES: RELAYING CALLS

121.5

If you hear a Mayday call that is not replied to...

1. Wait an appropriate amount of time to double-check a station did not receive the call

2. Relay the message starting as usual but after callsign: "Have intercepted Mayday call from..." then relay the details

If your emergency is resolved you may cancel the emergency, e.g. "G-WACB, Cancel Mayday, engine restarted, diverting to Oxford"

PRACTICE QUESTION!

"What are the two states of an emergency message and which message type would be appropriate?

States are Distress and Urgency.
Distress would be a Mayday Call.
Urgency would be a Pan-Pan Call.

PRACTICE QUESTION!

"What is the content and order of an emergency message?"

Mayday x 3 / Pan-Pan x 3
Callsign, Type, Nature of Emergency, Position, Intentions

Syllabus complete
Any Questions?