

# Aircraft Handling – Revision Notes

## Chapter 1: Aircraft Maintenance

### Policy and Objectives

RAF Maintenance Policy is based on a finely judged balance of Preventive and Corrective maintenance. This balance is critical.

Objectives of RAF Maintenance Organisation are in 2 categories:

#### Operational Objectives

- To generate the aircraft and equipment needed to counter surprise attack
- To support intensive flying over a sustained period in NBC (Nuclear, Biological, Chemical) or other hostile environments
- To generate aircraft and equipment needed for NATO and our own National commitments
- To satisfy such contingency plans as may be ordered by higher authority
- The efficient provision of serviceable aircraft and equipment needed for peacetime tasks (e.g. Training, Humanitarian, etc).

Maintenance Objectives require best possible balance of Preventive/Corrective so as to

- Minimise Costs (Manpower and Resources)
- Minimise faults that would hazard an aircraft, or affect its operational capability, or need expensive repairs
- Find ever-better ways of improving reliability and maintainability

### Preventive Maintenance

Aims: to reduce probability of failures; to restore inherent level of reliability of aircraft and equipment after a pre-determined amount of time/use; to ensure time and use do not effect the performance of aircraft and equipment. 4 Types:

*Servicing*: (“flight servicing” for aircraft): The maintenance needed after a period of use (e.g. a flight), plus preparation for next period of use.

*Scheduled Maintenance*: Done at regular, pre-determined intervals. Aims:

1. Keep aircraft in overall sound condition
2. Minimise random faults and so amount of corrective maintenance needed
3. Minimise amount of routine day-to-day attention needed

*Condition-Based Maintenance*: Some parts are given continuous monitoring, not routine checks. When a condition that needs attention is found, repair work carried out is called “condition-based maintenance”. 2 Examples of condition monitoring:

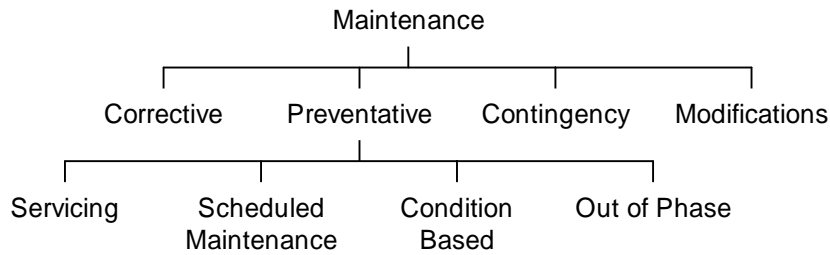
- NDT (Non-Destructive Testing) – e.g. X-rays;
- SOAP (Spectrum Oil Analysed Particles) techniques

Usually servicing of the item can be left until a condition needing attention is revealed, as regular maintenance is more costly and would be more frequent for safety reasons.

*Out-of-Phase Maintenance*: Not all parts need servicing at the same time. Some require serving at intervals outside the normal maintenance cycle. This term describes scheduled or condition-based servicing needed at these intervals.

### Corrective Maintenance

Carried out when a fault occurs, making aircraft serviceable again. This cannot be planned, as faults are random. Condition-monitoring can be used during corrective work to determine extent of the fault and perhaps detect associated faults.



### Contingency Maintenance

War/Transition-to-war – normal standards may need to be relaxed. This is a level of preventative maintenance essential in the circumstances; each aircraft type has its own planned programme.

### Modifications

These may be needed to remedy a design fault, or to incorporate new technology for performance or safety, etc. Must only be undertaken when authorized and under strictly controlled procedures to minimize downtime (period aircraft is out of use) and for safety.

### MOD Form 700 Series “Aircraft Maintenance Data Form”

Each individual aircraft has its own, showing the current condition of the aircraft. They are actually a whole series of forms, some of which are:

- ❖ *Form 701:* Info on permitted fuels and oils, weight, tyre pressures, dimensions (its stats)
- ❖ *Form 703: Onboard Software Log* – identity of software loaded in (if any)
- ❖ *Form 725: Flying Log and Fatigue Data Sheet* – details of each flight, inc. fatigue meter readings where fitted
- ❖ *Form 725A: Air-to-Air Transactions* - Refuelling details
- ❖ *Form 705: Flight Servicing/Fuel Certificate* – details. This includes the previous **Captain’s After-Flight Declaration** returning responsibility for the aircraft to the ground engineers, who record details of flight servicing when completed. The **Flight Services Coordinator** signs the **Flight Services Certificate** to confirm details, then the Captain of the next flight, in due course, signs the **Captain’s Acceptance Certificate** to take responsibility of the aircraft.

### RAF Maintenance Data System (MDS):

-Many details from the RAF and Fleet Air Arm Form 700 series are fed into this, providing accurate and rapid info on all servicing work done. This allows engineering managers to obtain better reliability and make best use of resources, while also planning ahead for replacements of aircraft or parts due to fatigue.

6 Elements: Faults/Defects; Modifications; Manpower Utilization; Task Achievement; Technical Costs; Logistics.

## Chapter 2: Ground Handling

### Seeing In and Seeing Off

-Arrivals and departures normally by a handling team of two. They will:

- Marshal the aircraft to a parking area cleared of foreign objects and non-essential ground equipment
- Insert chocks and connect any necessary ground power and equipment
- Position and man fire extinguishers during engine shut down
- Position aircraft steps and assist aircrew with unstrapping
- Fit safety devices, blanks covers and plugs

The reverse order is carried out for departures.

*FOD – Foreign Object Damage* – damage from trivial objects like stones, rags, etc that can be sucked in by the aircrafts engine.

## **Marshalling**

Aim: Assist pilot in safe manoeuvring of the aircraft on the ground.

The marshaller communicates via visual hand signals. The extent of their assistance depends on:

- Pilot's familiarity with airfield
- Number of obstructions
- Size of aircraft
- Field of view from cockpit

Instructions can also be passed by radio. For long, tortuous routes, marshallers may be stationed at intervals or use a "follow me" vehicle.

*Procedure – Day:* (See Manual for diagrams). Marshallers identify themselves to the pilot by energetic circular arm motions and clothing of a distinctive colour.

- If approaches to parking spot are clear – marshaller stands on required spot with arms outstretched facing final destination of aircraft. Pilot is then free to taxi in his own way to the spot indicated
- If obstructions exist – two extra personnel, one on either side, may walk just ahead of the wing tips to ensure sufficient clearance, signalling this to the pilot. This becomes more necessary in large aircraft with restricted fields of view.

*Procedure – Night:*

- Congested area = more assistance needed; taxiing lights used = less assistance needed
- Floodlit dispersal area = assistance can be reduced to day level
- Always use navigation lights

If pilot loses sight of marshaller – stop and wait for marshaller to move and become visible again.

*Responsibility:* The pilot is responsible for the aircraft's safety. He is not required to follow marshalling instructions he feels are unsafe, and can pursue the course of action he thinks best.

## **Chocks, Safety Devices, Blanks and Covers**

Whenever aircraft are shut down and stationary on the ground, and during engine runs, they are to be securely chocked. Safety devices, blanks and covers should be fitted throughout the time that the aircraft is shut down, unless removed temporarily for maintenance.

## **Danger Zones**

-Areas of high risk of injury to personnel when aircraft components or systems are operated on the ground (engine intakes/exhausts, propellers, etc). Propellers should always be considered as "live", where a light movement could cause the engine to fire. Propellers of piston-engined aircraft should be hand swung by trained ground crew using proper procedures. For helicopters, gusts can cause "blade sailing" of the rotors, bringing them closer to the ground than their normal running height.

## **Wheel and Brake Fires**

Aircraft brakes – a heat-resistant and hard-wearing fibre pad presses against a disc on the wheel. Friction slows the aircraft down, but causes heat. This is normally dissipated into the ground, but prolonged taxiing or an abnormal landing can cause overheating and a brake or wheel may catch fire. If aircraft is in or entering dispersal, the safest course for the ground handling team with their extinguishers is:

- ✓ Stand forward/rearward of the wheels depending on wind – never in line with axle (most likely path of debris in an explosion)
- ✓ At limit of fire extinguishers range, spray extinguishant downwards towards wheel, with flow striking ground 0.3m away and so it flows onto the wheels.

## **Manhandling and Towing**

Aircraft may never be taxied into or out of hangars – they must be towed or manhandled to and from the ASP (Aircraft Servicing Platform). Normal method is to tow it, with the vehicle connected via a towing arm to the nose/tail wheel of the aircraft or a handling party may be used instead, pushing only against the strong parts of the aircraft. Handling party consists of:

- ✓ An experienced supervisor
- ✓ A person in the cockpit to operate the brakes

- ✓ A person at each wing tip to ensure obstacle clearance
- ✓ Tow vehicle driver/enough people to manhandle the aircraft

## **Parking**

Normal orders (differs with aircraft type):

- Aircraft facing into wind so no part of one aircraft overlaps any part of another
- Double chock wheels, fore and aft
- Release the brakes
- Check electrical services, ignition switches and fuel cocks are turned off
- Apply control locks
- Fit pitot and static vents covers
- If aircraft left for length of time: lock canopies and doors, fit canopy covers, wheel covers and engine covers and set drip trays

## **Refuelling**

Usually after a flight/end of days flying, aircraft are refuelled before being parked or put away. This prevents condensation inside the empty tank, minimizing water contamination in the fuel, and means aircraft is ready to fly ASAP next time.

Many methods: hand (cans); bowsers; high pressure from ground installations; portable tanks; or in flight from a tanker aircraft.

Normally, mobile bowsers are used; fuel is pumped through delivery hoses by its main engine or a small donkey engine. These pumps are sometimes reversible for speedy defuelling as necessary.

Risk of fire is a very real one, so

- ❑ Aircraft must be earthed
- ❑ A piece of conducting wire must connect the aircraft to the delivery hose
- ❑ The bowser must be earthed

See Manual for Diagram.

There are also many other precautions against static electricity, some of which are found in the Aircraft Handling Manual.

### ***Pressure Refuelling***

High pressure – reduces refueling time. Very important in air-to-air refueling; most modern aircraft use this method on the ground. Basic difference here is the position of the filling point. For both systems, all tanks are fitted with shut off valves – shutting off fuel flow when desired level is reached.

Important precautions – refueling coupling is correctly connected, bonding is complete, aircraft switches are set and that max refueling pressure is not exceeded.

## **Types of Fuel**

- ❑ AVGAS – Aviation gasoline
- ❑ AVTUR – Aviation turbine fuel (kerosene)
- ❑ AVTAG – Aviation turbine widecut gasoline
- ❑ AVCAT – Aviation turbine fuel, largely used by the Royal Navy

No naked lights/flames within 30m; only flame proof torches to be used.

## **Loading**

Loading and security of loads in large aircraft are responsibility of air quartermaster. He must satisfy Captain that load is securely stowed and evenly distributed – within centre of gravity (C of G) limits.

*Effects of Overloading:*

- ❑ Increases stalling speed and landing/take-off runs
- ❑ Reduces rate of climb
- ❑ Reduces range and endurance
- ❑ Twin/multi-engined aircraft – may be impossible to maintain flight in event of engine failure
- ❑ Lowers aircraft's ceiling (i.e. height to which it can climb).

It is pointless ensuring maximum all up weight is not exceeded if load is not evenly balanced – it must be distributed so that the C of G falls within the aircrafts limits. The aircraft is then correctly balanced fore and aft and may be flown safely.

## Chapter 3: Preparation for Flight

**Aircraft Captain:** takes over supreme charge in an emergency; usually the pilot

**Captain's Personal Prep:** Captain's duty to ensure adequate preparation, including:

- He and the crew are familiar with the aircraft and their role
- He and the crew understand the mission
- Personal fitness of himself and the crew are sufficient
- Relevant orders have been read and understood
  - ✓ Military Flying Regulations
  - ✓ Air Staff Instructions
  - ✓ Station Flying Order Book
- Flying clothing and safety equipment are fit for use
- Flight Planning has been undertaken

**Flight Planning:** Pre-flight planning requires a knowledge of:

- Weather conditions at base and destination, including forecasts
- Air Traffic Control Clearance, availability of diversion airfields, details of airspace restrictions
- Navigation preparation of calculations, maps and charts

Often this preparation is in the form of a “briefing”. Many units have a mass briefing at the start of the day's flying.

**Briefing of Passengers:** Normally done by Air Loadmaster, if there is one, typically covering:

- That the Captain is in command, irrespective of rank
- The correct use of safety straps and the crash position
- Operation of escape hatches
- How to use the oxygen mask
- How to fit and operate the parachute (if appropriate)
- The No Smoking rules
- How to operate any communication system

**Flight Authorisation:** Done in the “*Flight Authorisation Book*”, normally by Flt/Sqn Commander. In an accident, this is used to investigate signatories and their areas of responsibility. It is also the official record of the flight (stats, purpose, etc).

**MOD Form 700:** also used in an investigation into an accident. Tells the pilot:

- Whether aircraft is serviceable for flight
- Fuel and oil quantities in the tanks
- Armament and oxygen state
- Hours flown or run by the engines
- Fltng hours to next scheduled servicing

Captain signs Form 705 before each flight to say he has verified that the above conditions are within regulations.

### Pre-Flight Checks

Details are in the “Aircrew Manual” for the aircraft type, but normally include:

- External Checks
- Cockpit checks before starting engines
- Warming up and running up (piston engines)
- Pre-take off checks

Checks are usually in “card” form, and are carried out in a “challenge and response” basis between captain and another crewmember.

*External Checks:*

- Inside cockpit – brakes on; switches off; Walk around aircraft, airframe for damage, ice, leaks, and so on
- Check pitot head and static vent covers removed; external locks removed; Engine covers and/or blanking plates removed
- Inspect undercarriage for serviceability, noting wear and tear on wheels

*Checks before starting:*

- Check crew and passengers correctly seated and strapped in
- Fuel and other services and switches required switched on
- Undercarriage down and locked; brakes locked
- Indicate to ground crew (verbal/hand signal) all clear for starting, then for actually starting up

*Checks after start-up:*

- Check temperatures and pressures ok
- Engine to recommended rpm for warm up
- Power output (running engine higher) and test propeller variable pitch control

Jet engines do not require warming up. But, briefly, there is a winding up stage, when flame in combustion chamber is not fully stable – close monitoring is required.

*Taxiing:*

- Check full range of flying controls for freedom and correct operation
- Check brakes, at low speed, careful for brakes overheating
  - ✓ Nose wheel steering – brakes only used to slow or stop
  - ✓ No nose wheel steering – brakes are used to turn the aircraft (toe brakes on top of rudder pedals for left/right wheels as required). No wheel should be locked still for this – leads to tearing! This is called differential braking.
  - ✓ In tail wheel aircraft, as centre of gravity is behind main wheels, turns tend to tighten up. Nose wheel – stable, so force needs to be kept to maintain the turn.
- Aircraft tend to turn into wind (“weather cock effect”), more so in light aircraft – this needs to be dealt with.
- Keep a look-out for obstructions and other aircraft. Help may be needed in aircraft with a restricted field of view from the cockpit.

If doubt of obstacle clearance arises, stop the aircraft. Distance between taxiing aircraft must not become too small.

*Pre-Take-off Checks:*

The previous checks are necessary for aircraft to operate efficiently, these are essential for safety – called vital actions. Include checking required switches are correctly set, such as fuel, flap positions, etc

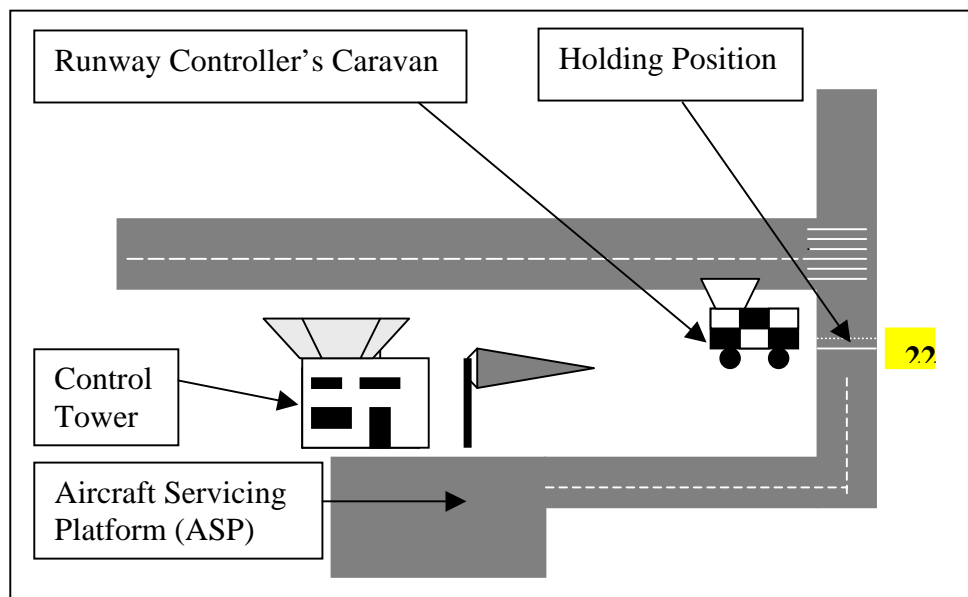
**Marshalling Signals:** See Aircraft Handling Manual for these.

## Chapter 4: General Flying

### Holding Position

Runway used is normally into wind. Unless “scrambling”, aircraft will stop at holding position, a white line across the runway. Good view of runway/approach.

Light aircraft turn 45° into wind while larger aircraft stay pointing down the taxiway.



## Checks

- Complete vital actions
- Receive permission from controller
- Check approach is clear
- Runway controller checks exterior of aircraft for danger signs

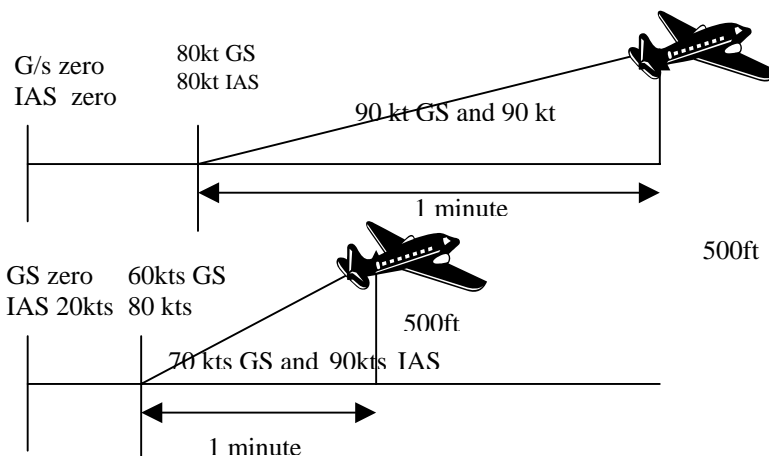
Full throttle is always used for take off, applied in a smooth and firm manner. Gauges are constantly monitored so as not to exceed limits. If re-heat is used, be prepared for increased acceleration.

## Factors Affecting Length of Take-off Run

- All-up weight
- Amount of flap used
- Engine power
- Wind velocity
- Runway gradient
- Condition of runway surface (snow, slush, etc)
- Air temperature
- Airfield elevation (pressure height!)

## Advantages of taking off into wind:

- Shorter take-off run
- Steeper angle of climb, even though climb rate is constant (but ground speed is slower; this also reduces stress on undercarriage)
- No drift; improved directional stability at take-off
- Safer touchdown in case of an engine failure



## Take-off Technique – Nose Wheel Aircraft

- Line-up on runway, taxi forward to straighten nose wheel
- Open throttle smoothly to full, checking instruments
- Rudder becomes more effective for keeping aircraft straight as speed increases
- When elevators become effective, pull back on control column to raise nose wheel – but just a little!
- When flying speed is reached, a smooth backward movement of the stick makes the aircraft fly off. At a safe speed, flaps are raised and instruments checked.

## Take-off Technique – Tail Wheel Aircraft

- Line-up on runway, taxi forward to straighten tail wheel; locked if necessary
- Hold stick back; open throttle smoothly to full, checking instruments
- Tendency to swing correct by rudder – if not corrected, it will increase (as said earlier)
- Speed increases => pilot brings aircraft into the flying attitude by moving stick forward
- At flying speed, a smooth backward pressure on the stick will cause the aircraft to unstuck

**Scrambling** – take-off at a moments notice; aircraft pre-prepared in all aspects.

## **Actions When Airborne**

- Brakes applied
- Undercarriage is retracted
- Shallow climb maintained and IAS allowed to increase to the initial climbing speed
- Once at a safe height, the flaps are raised
- Power is reduced to normal climbing power
- When climbing speed has been obtained, nose is lifted to prevent further acceleration and maintain it

**Use of Reheat:** Undercarriage and flaps raised ASAP – limiting speeds reached very quickly.

## **The Circuit**

Normally, entering the circuit is done visually.

*Procedure for joining:*

- Various checks are carried out while a look-out is maintained
- When cleared, join overhead, min of 1000ft above normal circuit height
- Reduce to circuit joining speed before reaching airfield boundary

*Pattern:* (Diagram is in the Manual)

- Pilot lets down on “dead” side in a wide curve; continuous checks for other aircraft
- Aim is to reach downwind leg at circuit height and speed, without disturbing other aircraft
- Pilot flies downwind leg, parallel to runway in use; calls “downwind”
- Completes pre-landing checks
- At a suitable position (depending on wind strength, etc), pilot begins a gradual turn onto final approach, ending up in line with the centre of the runway; calls “finals”

## **The Approach**

- Good approach is an essential pre-requisite for a good landing
- Must be able to adjust for cross-winds, engine failures, etc

Jet engines do not respond as quickly – must be careful until sure power is no longer needed.

*Flaps:* Gives the pilot:

- A steeper path of descent at a given speed
- Lower stalling speed; allows lower airspeed on approach
- A better view over the nose

Amount used depends on aircraft type and prevailing conditions; usually partial flap used in initial stages, full flap for final approach and landing

*Effect of Wind:* 2 main advantages of approaching and landing into wind:

- Ground speed is reduced to a minimum for a given airspeed
- Drift is eliminated

*Wind Gradient and Gusts:*

Wind is slowed up near the earth’s surface; sudden drop in wind close to the ground. This causes a sudden decrease in lift and airspeed – heavy landing!

Gusts may create similar effects, or may alternate with sudden lifts and sudden sinks. A pilot must allow for this.

*Techniques:*

Classic: Height, Speed and Power gradually reduced until touchdown

Common Alternative: Constant starting speed; descent controlled by throttle

Aim is to maintain a constant and moderate rate of approach.

## **Landing**

Easier with nose wheel aircraft rather than tail wheel.

**Definitions:**

*Final Approach:* starts when turned into line with runway

*Round-out:* level of approach is changed to level with the ground

*Hold-off/Float:* flying parallel to the ground; airspeed decreases until

*Touchdown:* 3-point landing (tail wheel), main wheels landing (nose wheel)

#### *Nose Wheel Aircraft Landing Technique*

- Gentle back pressure on control column; throttle gradually closed
- Airspeed decreases and aircraft lowers gently onto its main wheels
- Nose should be lowered, as required, to avoid floating
- Nose wheel is held off ground. Centre of gravity is ahead of main wheels, so aircraft will drop onto nose wheel
- Only when nose wheel is on the ground should the brakes be applied
- Brake to decelerate and maintain a straight landing run

#### *Tail Wheel Aircraft Landing Technique*

Three-point Landing:

- Check rate of descent by rounding out and reducing power
- Control column is moved progressively back; speed decreases and aircraft lowers gently – too rapid a round out = floating; too slow = bouncing on main wheels
- Well-judged landing is when aircraft lands on all three wheels simultaneously

*Advantages:*

- ✓ Lowest possible touch down speed and maximum aerodynamic braking; gives shortest possible landing run
- ✓ Brakes may be used early
- ✓ Less danger of aircraft nosing over if brakes are used too fiercely

Wheel Landing:

- Main wheel is placed on ground before tail wheel
- No hold-off; main wheels are placed deliberately on the ground

*Advantages:*

- ✓ Change of attitude is less and no hold-off so easier judgement
- ✓ Certain advantages when landing in a cross-wind
- ✓ Safer means of landing a heavily laden aircraft

### **Cross-wind Approach and Landing**

Aircraft will tend to drift off the runway line. To counter this, the pilot points the nose a few degrees into the cross-wind. Then the aircraft, with wings level, will track down the runway centre-line.

If aircraft lands like this, the undercarriage will be sheared off or damaged. So, just before touchdown, the pilot yaws the aircraft to point down the runway. The judgement of this is very fine. Needs training and practice.

### **Landing Run**

*Brakes:* brakes applied when all wheels are on the ground – used wisely, depending on amount of run available, to extend their life. Care is needed in icy/wet conditions. Some high speed aircraft have special brakes to prevent skidding. Alternative braking methods are; reverse thrust, parachutes, etc.

*Effect of flaps:* Flaps shorten the landing run – lower touchdown speed and more drag.

After landing, the pilot aims to clear the runway without delay.

## **Chapter 5: Aerobatics and Formation Flying**

### **Aerobatics**

Before any aerobatic exercise, the pilot carries out his “HASELL” checks:

Height

Airframe

Security

Engine

Location – clear of Active airfields, Built up areas and Controlled airspace (ABC)

Look-out

## **Basic Manoeuvres**

Three planes of movement: (Diagram in the Manual)

- ✓ Looping or Pitching
- ✓ Rolling
- ✓ Yawing

*Basic Aerobatics:*

The Loop

The Barrel Roll

The Slow Roll

The Stall Turn

Roll off the Top (Roll of the top of a loop)

*Advanced Aerobatics:* Variations or combinations of basics

Half Roll and Pull Through (First half of a slow roll, second half of loop)

Upward Roll (Rolling vertically upwards, followed by a stall turn)

Aileron Turn (Vertical roll downwards and round out)

Derry Turn (Moving from a steep turn in one direction to a steep turn in the other by rolling inverted)

Vertical Eight

Horizontal Eight

Hesitation Rolls

Inverted Flight

For diagrams and descriptions, see the Aircraft Handling Manual.

In inverted flight (which most aircraft are not designed for for prolonged periods of time), controls respond normally, but the movements relative to the horizon are opposite. The aircraft also has a higher stalling speed. It also may be very sensitive laterally – any dihedral wings will have a destabilising effect.

## **Formation Flying**

Defined as an ordered arrangement of two or more aircraft proceeding together as an element. An appointed No 1 controls them. Two categories:

- Close Formation: Used mainly for
  - ❖ Take offs, cloud penetration and landings – mainly training and fighter aircraft
  - ❖ Display and show purposes
- Tactical Formation – for tactical fighter operations (all round search, mutual fire support and crossover fire)

We only deal with close formations.

Pilots ignore their instruments and concentrate on their positions relative to the leader. Formations can be treated as one unit, making life easier for air traffic controllers: they can be brought back (“recovered”) together, and instructions only need to be relayed to the leader.

## **Leadership**

-A vital aspect. No 1 commands the formation and is responsible for all aspects of it. He has to be able to communicate with all of its members, and must have a deputy, able to take his place as easily as possible. When possible, standard service-wide positions and procedures should be used and the principle of “minimum change” employed – smallest number of aircraft movements for any formation change.

## **The Section**

The basis of all formations: 2 or more aircraft under a nominated leader. Larger formations arise from merging 2 or more sections, under an overall leader (usually leader of the lead section).

## **Section Formations**

See manual for diagrams:

- ❑ Vic-three
- ❑ Echelon
- ❑ Line Abreast

- ❑ Line Astern
  - ❑ Box (can only be done with 4 aircraft)
- Cloud penetration – max size is normally 3 aircraft.

#### *Close formation flying technique*

Relative Speeds: Only way for a pilot to judge is via his ASI (air speed indicator)

Apparent Size: Aircraft viewed from afar don't change noticeably in size until within 1 mile. So rate of approach, even at a high closing speed, appears very low from long range, but will increase very rapidly at critical range, when true speed of approach can be judged – too fast = possibility of overshooting.

Distance: Judging this is a matter of experience. Helpful if No 1 flies at known constant airspeed and joining aircraft adjust appropriately (50 knots overtake speed is suitable if closing range is not too long or too short – varies for aircraft types).

#### *Joining formation (For Diagram, see Aircraft Handling Manual)*

Should be done with least possible delay. No 1 flies straight for 800 yards – 1 mile and commences a gentle turn. Rest turn to intercept him as soon as possible, keeping lowered numbered aircraft in sight. Final join up should be in numerical order.

Leader should settle to agreed cruising speed quickly, and rest fly small overtake – 10/20 knots – to close up. Too much means large alterations needed and time and fuel are wasted. On turning to join up, the pilot maintains an interception course until able to fly to correct position in the formation – a positive clearance in the vertical plane must be established in the later closing stages.

#### *Positions in Basic Formation*

Distances between aircraft are laid down in relevant instructions and must be strictly observed.

- ❑ Vic/Echelon – pilot maintains station by reference to agreed features on adjacent aircraft (i.e. lining up wing tip and nose of aircraft ahead). Varies with type.
- ❑ Line Abreast – Fore and aft position judged by cockpit of next aircraft. Separation distance is difficult to judge, esp. on aircraft with highly swept wings – extra caution is needed.
- ❑ Line Astern – Fore/aft position can be judged by relative size of aircraft ahead, or a part of it. Amount of vertical clearance (stepping down) depends on slip-stream of aircraft, but should be kept to a minimum – too large gives huge difference between leader and last aircraft, and turns become difficult.

#### *Keeping Station*

Aim: to fly smoothly. If inside aircraft flies roughly, then outside aircraft suffer for it. Only option then is to keep station on the leader, not one in between – reduces “whip” effect. Needs keen anticipation to keep correcting movements to a minimum.

- ❑ **Longitudinal Station Keeping:** Use throttle to change speed. Results in a change in lift, so may need elevators, too – co-ordinated controls. Remember, clean aircraft accelerate faster than dirty ones, and jet engines accelerate poorly, esp. at low speeds.
- ❑ **Lateral Station Keeping:** Use gentle movements of ailerons, co-ordinated with the rudder, to keep station laterally.
- ❑ **Vertical Station Keeping:** The elevators control vertical positioning. May require co-ordination with throttle controls.

## **Chapter 6: Emergency Procedures**

### **Degrees of Emergency**

*Distress:* “The aircraft (calling station) is threatened by serious or imminent danger and is in need of immediate assistance”

*Urgency:* “The calling station has a very urgent message to transmit concerning the safety of an aircraft, or of persons on board or within sight”

## Emergency Transmissions

2 Parts: emergency call and emergency message

*Emergency Call:*

Degree of Emergency	Pro-word (R/T)	Pro-Sign (W/T)
Urgency	“Pan, Pan, Pan” Aircraft callsign (once)	“XXX, XXX, XXX” Aircraft callsign (once)
Distress	“Mayday, Mayday, Mayday” Aircraft callsign (3 times)	“SOS, SOS, SOS” Aircraft callsign (3 times)

*Emergency Message:* Should include as much as possible, if time permits. Aircrafts position is the most important, though. Remember: PAT HAS ATNIE:

Position And Time

Heading And Air Speed

Altitude

Type of Aircraft

Nature of Emergency

Intention of Captain

Endurance Remaining

## Emergency Procedure and Fixer Services

- In contact with Air Traffic Control (ATC) – transmit on frequency in use
- Not in contact with ATC – use emergency frequency 243.0MHz, with 121.5MHz as a back up, or on HF frequency 500KHz.

*Secondary Surveillance Radar (SSR)*

Code 7600 indicates an emergency. If in contact with ATC, SSR code already set should remain in use unless instructed otherwise. All other cases, transponder should be set to code 7700.

*Final Transmission*

Ditching, crash landing or abandoning – aircraft callsign should be transmitted and, if possible, control switch left on transmit. Life saving takes priority, though.

*UHF Emergency Fixer Service*

Within UK FIRs (Flight Information Regions), a network of stations pick up emergency transmissions on 243MHz within range, and transmit a bearing of the aircraft to the ATCC (Air Traffic Control Centre) displayed on a screen, giving controller an instant “fix” on it.

*Cancellation:* Emergency ceases to exist – transmission to cancel original call is vital.

*Search and Rescue Satellite Aided Tracking (SARSAT):*

-an alert and location system detecting transmissions on 406, 243 and 121.5MHz. Highly sensitive – inadvertent transmissions should be reported immediately to appropriate ATCC to avoid wasting search and rescue efforts on false alarms.

## Emergencies Involving Other Aircraft

- Keep aircraft in sight; switch IFF/SIF (Identification, Friend or Foe/Selective Identification Feature) to emergency. At sea, guide personnel to any nearby surface vessel, if possible.
- Transmit an emergency message on their behalf, if it is believe they haven’t done so or need further help.
- Comply with any special instructions given by the controlling authority; remain in sight of distressed aircraft/personnel until circumstances dictate otherwise.

If a distress message is heard, the Captain or crew should:

- Attempt to take a bearing on the transmission and plot the position of the sender
- Listen out on frequency used

- ❑ If no acknowledge of distress message is heard, call aircraft in distress and acknowledge receipt
- ❑ Listen for instructions and act as necessary
- ❑ (At Captain's discretion) Proceed to position in distress message while awaiting instructions from the ground station

### **Communications Failure**

Losing 2-way communications – set transponder to Mode 3A code 7600.

- ❑ In VMC (Visual Met. Conditions) and in visual contact with the ground, land at nearest suitable airfield
- ❑ In IMC (Instrument Met. Conditions) (or anticipated IMC), if safe to do so, continue with flight according to current flight plan

If only receiver is operative, comply with any ATC instructions; set transponder back to 7700. May try to alert ground station via:

- ❑ Equilateral triangle to the right, if only transmitter has failed; ATC will relay instructions to aircraft
- ❑ Equilateral triangle to the left if both transmitter and receiver have failed; ATC will send out a shepherd aircraft, if possible, to assist. Shepherd will rock its wings, receiving a wing rock in acknowledgement and guide aircraft in.

### *Speechless Procedure*

When transmit button is pressed, carrier wave will be transmitted and is observable on ATC direction finding equipment. It is possible to communicate via the speechless code:

- ❑ Initial contact – 4 transmissions (Morse “H”) – means “request homing”
- ❑ Yes/Acknowledgement – 1 transmission
- ❑ No – 2 transmissions
- ❑ Say again – 3 transmissions
- ❑ “X” in Morse ( - • • - ) – An additional/greater degree of emergency has arisen

### **Speechless Let-Down:**

- ❑ Initial contact is made (as above) on emergency frequency, if possible
- ❑ Receiving station acknowledges; passes a course to steer; speechless aircraft acknowledges
- ❑ Aircraft is homed overhead and given controlled descent
- ❑ Controller determines aircraft state using “yes/no” questions

Completion of an instruction is indicated by a 2 second transmission, among other things.

## **Emergency Organisation**

### **ATCC Distress and Diversion Cell**

Aircraft in distress may make contact with ATCC or ATCRU (Air Traffic Control Radar Unit) by

- ❑ Transmitting emergency message on frequency in use
- ❑ Transmitting on emergency frequency
- ❑ Relay transmission from another aircraft
- ❑ Flying triangular patterns described earlier

When ATCC identifies aircraft in distress, executive authority is passed to the Emergency Controller in the ATCC Distress and Diversion Cell. Aircraft is normally transferred to 243/121.5 MHz.

### **Search and Rescue Services**

Crash/abandonment – Emergency controller will advise Rescue Co-ordination Centre (RCC) so necessary rescue services can be alerted. RCC co-ordinates all search and rescue facilities – helicopters, lifeboats, mountain rescue teams, ambulances, etc. Two RCCs in UK – within Maritime HQs at Plymouth and Edinburgh.

*The End!*