STANDARD OPERATING PROCEDURES
FORMATION FLYING

FORMATION SOPs

2015

Disclaimer

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SPECIFIC AIRCRAFT ANNEXES (containing aircraft type specific data)

STANDARD OPERATING PROCEDURES

PART 1 - CLOSE FORMATION

INTRODUCTION

1. Formation flying requires high standards of airmanship, aircraft handling, discipline and teamwork. It should not be attempted by pilots, no matter how experienced, without formal instruction from experienced formation pilots or instructors. Formation flying should always be conducted in a structured manner and never be attempted ad-hoc. The Air Navigation Order (ANO) states that aircraft shall not fly in formation unless the commanders of the aircraft have agreed to do so.

2. These Standard Operating Procedures (SOP) are written for ex-military or civilian light aircraft with cruise performance indicated airspeeds (IAS) below 180kts. Increased distances and safety margins should be used for aircraft of higher performance.

3. This SOP details formation procedures that include flight in IMC. If the intention is to penetrate cloud in formation, aircraft commanders must hold a valid instrument rating (IR) or IMC rating, and their aircraft must be equipped and approved for IFR flight. Otherwise, the formation must remain in VMC conditions at all times.

4. Early training of pilots in formation flying will require detailed briefing on the techniques and skills to be learnt and practiced. Briefing may be through the medium of a Mass Brief or Phase Brief to a number of students taking part, or one-to-one with an instructor. The SOP provides the structured framework for the conduct of safe formation flying. A thorough knowledge of the SOP is essential, they are the fundamental rules for formation flying and any deviation from the SOP, when required, must be detailed in the formation briefing.

5. Formation instructors should ensure standardised instruction by referring to the appropriate instructional reference material and Instructor Handbooks for the aircraft in use. Students should be provided with appropriate reference material or Student Study Guides to support the learning process. A separate SOP Annex is provided for aircraft type specific data.

FORMATION LEADER

6. Only those pilots experienced in formation flying should lead formations. During formation training sorties, the lead aircraft instructor should fly the aircraft himself or closely direct the student to ensure the other aircraft have a stable and sympathetic platform on which to formate and experience strict compliance with SOPs and RT procedures. Tailchasing, in particular, requires a high degree of skill, anticipation and forethought. Instructors should not allow their student to fly the lead aircraft in a tailchase until they can demonstrate a high level of ability.

BRIEFING

7. Once the aircraft commanders have formally agreed to conduct a formation sortie, an outline sortie aim and profile should be determined. The sortie aim should match the experience of the instructors and students conducting the sortie. Instructors should then agree the teaching format of the sortie and individually brief their students on the skills and techniques to be learnt.

8. All participants, and where appropriate the host airfield operating authority or ATC representatives, should attend the formation briefing. The leader is to give or supervise the briefing using a briefing format as suggested in this SOP. The briefing should include the following points:

a. Composition of the formation; nomination of leader, deputy leader and/or supervising instructor.

b. Callsigns.

c. Aircraft allocation and loser plan.

d. Weather in the operating area, at base and diversion(s).

e. Fuel states:

(1) Minimum Take-Off Fuel.

(2) Fuel 1, Fuel 2, and Bingo.

(3) Minimum Fuel On the Ground (FOG)

f. RT procedures:

(1) Frequencies to be used.

(2) Collector frequencies.

(3) RT failure actions.

g. Altimeter setting procedures.

h. Transponder, Airborne Collision Avoidance System (ACAS) procedures for the use of TCAS/TAS/PCAS/FLARM systems, and High Intensity Strobe Lights (HISL).

i. Start and taxy procedures.

j. Take-off, join up and climb procedures.

k. Sortie profile:

(1) Air exercise.

(2) Formations and formation changes.

(3) Changes of leader.

(4) Use of hand signals.

l. Tailchase (when applicable):

(1) Limitations.

(2) Lost visual procedure.

(3) "Terminate" and "Knock It Off" calls.

m. Recovery procedures:

(1) RT failure recovery.

(2) Run-in and break interval and height; runway spacing.

(3) Formation circuit / approach and landing.

n. Emergency procedures:

(1) Aborting take-off.

(2) Emergencies in flight.

(3) CRM considerations.

(4) Lost visual in VMC and IMC.

RT PROCEDURES

9. **General**. Formation members who split from the formation should retain their individual formation callsign.

10. **Orders and Check-ins**. The leader should use the callsign "CALLSIGN 1". He is to give orders in the following format: "CALLSIGN, ACTION, ACTION, GO"; wingmen are to respond "CALLSIGN 2", "3", etc. Routine 'actions' need not be repeated twice if they are expected or normal events but should be repeated for service selections and, if required, for clarity. For R/T check-ins, the leader is to use the format "CALLSIGN"; wingmen are to respond "2", "3", etc. Information calls may be given in a simplified form, e.g.: "CALLSIGN, TURNING LEFT" and need not be acknowledged.

11. **Pre-start RT Procedures**. Before start, pilots should listen to the host airfield ATIS/DATIS (if applicable) then listen out on the designated frequency.

The leader should check in the formation on the designated frequency before engine start (Cold check in) and order the formation to start. If required by the host airfield, the leader may call the formation to the ground/tower frequency for start. Where aircraft limitations prevent the use of the radios before start, or where briefed by the leader:

a. Aircraft commanders are to start their engine individually or, if required, at a pre-briefed time.

b. Aircraft commanders should listen to the host airfield ATIS/DATIS (if applicable) then listen out on the designated frequency for the leader to check in the formation (Hot check in).

12. **Selection of Services IMC/VMC**. In IMC the leader should call the selection of services using the RT, "CALLSIGN, FLAP, FLAP, GO." After the executive "GO" pause then select the service. In VMC, handsignals can be used instead of RT calls. On the head nod, the service is selected immediately.

13. **Loss of R/T**. The leader should listen out on the collector frequency, if a second VHF radio is available, to allow a wingman with radio failure to establish contact. If R/T contact is not re-established after a frequency change, pilots should proceed as follows:

a. Attempt check-in: check that the correct frequency, radio and communication switches are selected.

b. Listen out on the previous frequency for up to 30 seconds and attempt to check-in.

c. If no contact, change to the briefed collector frequency and attempt a check-in.

14. **Collector Frequencies**. The following are the SOP collector frequencies and hand signals. *(Note - Military SOPs have UHF Guard as 2 fingers and VHF Guard as three fingers)*

a. One finger - Briefed collector frequency.

b. Two fingers - VHF Guard (121.5 MHz).

c. Three fingers - UHF Guard (243.0MHz) if UHF equipped.

GROUND PROCEDURES

15. **Start Up**. The start up should normally be carried out on the designated frequency and may be initiated by R/T, by hand signal, or at a pre-briefed time. Wingmen experiencing any unserviceability should inform the leader. Where necessary for specific aircraft types, the leader will call a "30 sec to start" for selection of switches and air (pneumatics) and/or a 10 sec to start call for priming of the engine. On the call "CALLSIGN, START, START, GO" start engines.

16. **Taxying**. Aircraft should taxy on the centreline with a minimum spacing of 50 metres between aircraft. If it is necessary to wait at the holding point, wingmen may close up but must avoid the propwash from the aircraft ahead. The leader should position on the downwind side of the taxyway and/or point the aircraft off centreline to assist wingmen to remain clear of propwash.

17. **Engine Testing and Pre-Take-Off Checks**. Tail-dragger aircraft types should always complete engine-testing and pre-take-off checks into wind. An individual pre-take-off safety brief is mandatory. In addition to briefing the actions on an emergency during take-off, this should cover all actions intended in the event of a formation abort or individual abort of any aircraft in the formation. The highest number formation member then gives a thumbs-up to the adjacent aircraft to indicate that he is ready for take-off, with all checks complete. Each aircraft passes the thumbs-up along the line to the leader.

a. **Taxyways**. The formation should close up on the taxyway before conducting engine and pre-take-off checks. All aircraft must ensure their propwash is not affecting aircraft behind them. When ready for take-off, position at 45° to taxyway, or as briefed, and indicate with a thumbs-up.

b. **Operational Readiness Platforms**. Operational Readiness Platforms (ORP) are prepared aircraft operating surfaces attached to the end of the runways at some military and ex-military airfields. An ORP offers an excellent opportunity for the management of a formation, engine test and pre-take-off checks, without blocking a taxyway. ORP procedures should be covered in the sortie briefing. When ready for take-off, position at 90° to the runway, or as briefed, and indicate with a thumbs-up.

THE TAKE OFF

18. **Stream Take-Off**.

a. Aircraft line up in Vic, or Echelon into any crosswind, using the primary (forward) reference. For a 2-ship formation, each pilot should take off in the centre of his own half of the runway.

b. When all aircraft are in position, the leader is to check each aircraft in the formation is configured (nose wheel straight, flap configuration etc) as briefed for take-off and confirm this with a thumbs-up hand signal. The No 2 checks the leader's aircraft and the No 3 if the aircraft are lined up in Echelon and responds with a thumbs-up hand signal. The leader gives the wind-up signal, which wingmen acknowledge by repeating. For a 3-ship lined up in echelon, the No 2 aircraft may need to 'pass' the signal down the line to the No 3. All pilots set the briefed run-up RPM and check engine indications and that any parking brake catch is at release. When wingmen indicate by a thumbs-up that they are ready, the leader starts his take-off roll; again, the thumbs-up may need to be passed up the line to the leader. Wingmen then commence take-off at the briefed interval, which should be a minimum of 5 seconds.

c. All aircraft use full power for take-off. When safely airborne with the After Take-Off Checks complete, the leader should reduce power, if required and detailed in the aircraft type Annex, and fly a profile that will allow the formation to catch up. He should climb straight ahead, ideally to 1000ft, but at least 500ft agl before turning, either level or climbing, to allow wingmen to catch up.

d. Wingmen should not turn below 500ft agl. The last aircraft airborne should complete the After Take-Off Checks and then call "CALLSIGN AIRBORNE".

e. In calm or very light wind conditions, a high-normal-high profile should be flown to avoid wake turbulence. The No 2 flies a normal take-off; No 1 and 3 climb slightly more steeply.

19. **Formation Take-Off**.

a. Formation take-offs should not be flown in crosswind components exceeding 10kts for a Vic and 15kts for a pair. In poor weather, where a radar service has been agreed for a climb through IMC after departure, consideration should be given to switching to the departure radar frequency before take-off.

b. For a 3-ship formation take-off, pilots should line up in Vic using the primary (forward) reference but ensuring there is adequate lateral spacing to avoid wing overlap. For a pair plus a singleton, pilots may line up in Vic for crosswinds up to 10kts, or echelon into wind. For a pair, each aircraft should line up in the centre of their own half of the runway; the wingman should line up using the primary (forward) reference.

c. When all aircraft are in position, the leader should check each aircraft in the formation is configured (nose wheel straight, flaps set, etc) as briefed for take-off and confirm this with a thumbs-up hand signal. The No 2 should check the leader's aircraft and the No 3 if the aircraft are lined up in Echelon and respond with a thumbs-up hand signal. The leader gives the wind-up signal, which wingmen acknowledge by repeating. All pilots set the briefed run-up RPM, check engine indications and that any parking brake catch is at release. Wingmen indicate that they are ready by a thumbs-up. The leader signals rolling either by R/T or by signal (tap the forehead twice and release the brakes on a head nod). After brake release, the leader should increase power smoothly to the briefed power setting for take-off. To ensure adequate separation if the leader aborts, wingmen must maintain their lateral spacing during the take-off roll.

d. If taking off as a pair plus a singleton, the singleton aircraft should roll at an interval of not less than 10 seconds and should use full power.

e. Once safely airborne, wingmen should raise flaps on a signal from the leader. The wingman of a 2-ship should adjust to the standard formation references as soon as possible.

THE DEPARTURE

20. **Climb**. The climb is normally flown at the aircraft's recommended climbing speed. The leader should not take a formation into cloud unless:

a. The aircraft in the formation are cleared to operate in IMC.

b. All aircraft commanders have a current IR/IMC Rating.

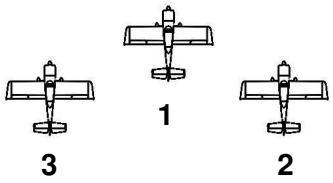
c. All aircraft commanders are competent to formate in cloud.

d. A 3-ship formation is in Vic.

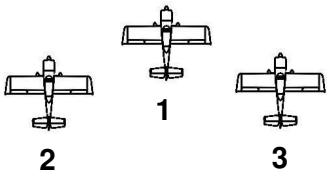
e. The formation is in receipt of a radar service, ideally a Traffic Service or better from ATC.

FORMATION POSITIONS

21. **Vic Formations**. The Vic and Reverse Vic positions are shown below,

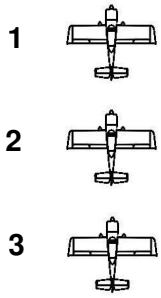


Vic Formation

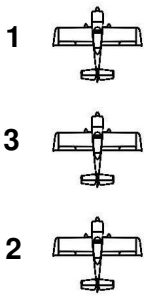


Reverse Vic Formation

22. **Line Astern Formations**. Line Astern and Reverse Line Astern positions are shown below.

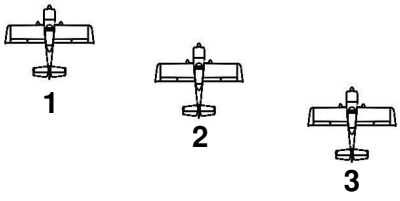


Line Astern Formation

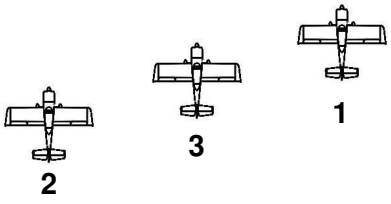


Reverse Line Astern Formation

23. **Echelon Formations**. Echelon positions are shown below,



Echelon Right Formation



Echelon Left Formation

24. Pilots should use the terms LEFT and RIGHT to define lateral positions.

AIRMANSHIP

25. **Airspeeds.** The SOP climb, cruise and descent speeds are to be briefed. These speeds and power settings should be contained in the aircraft type specific Annex.

26. **Altimeter, Transponder, ACAS and HISL**. The altimeter settings procedures are to be briefed for all sorties. Only the leader should squawk, other aircraft in the formation should select transponders to Standby (or OFF if required to prevent auto turn-on when a climb is sensed). Only the leader should operate an ACAS system, if fitted, to ensure mutual alerts are not generated. High Intensity Strobe Lights (HISL) should not be used in close formation due to the dazzling effect, but may be employed in tactical formations or during formation rendezvous up to the point where visual contact has been established.

27. **Routine Checks**. Pilots should complete regular routine checks, and carry out Pre/Post-Aerobatics checks as normal (eg: FREDA/FEEL/HASELL). During their initial sorties, students may move out to the waiting position before carrying out checks.

28. **Fuel**. Wingmen should inform the leader of their fuel state by transmitting Fuel and Bingo R/T calls. The first wingman to reach a Fuel or Bingo fuel state should transmit the appropriate R/T call. On hearing this call, other wingmen should check their fuel states; if they have less than the amount called, they should inform the leader, eg “CALLSIGN 3, FUEL 1 MINUS 10”. The leader should acknowledge all fuel calls. The meanings of the fuel calls are as follows:

a. **Fuel 1**. Usually an information call made early in the sortie to check for abnormal fuel consumption.

b. **Fuel 2**. An extra fuel consumption check, or an action call at which the leader wishes to commence a particular phase of the sortie. It is not necessary to have 2 fuel calls, but they are normally used on training sorties to teach fuel awareness.

c. **Bingo**. The fuel required to commence recovery to land with FOG.

d. **FOG**. The Fuel On the Ground (FOG) is the planned minimum fuel to land at base/destination, allowing for a transit and landing to an alternate airfield (VFR/IFR as required) in the event of runway/airfield closure due to a crash at base/destination. FOG is not called on the RT.

FLAT TURNS

29. Flat turns are normally flown at a minimum of 45° of bank. The leader is to enter flat turns from echelon and should call “CALLSIGN, FLAT TURN LEFT/RIGHT, FLAT TURN LEFT/RIGHT, GO” before rolling in, and ‘CALLSIGN, ROLLING OUT” before rolling out. Wingmen should match the leader’s rate of roll on both the roll-in and roll-out, maintaining echelon spacing with the application of power. All turns are to be away from the echelon, **never towards**.

BREAK AND JOIN

30. **Straight Join**. Wingmen must obtain clearance from the leader before practicing a break and rejoin. The leader should clear only one aircraft at a time for a practice break. Pilots should use the following procedure:

a. The wingman simultaneously applies full power, 45° AoB and pulls to break out positively upwards and outwards. He calls "CALLSIGN OUT". The leader should acknowledge.

b. After 3 seconds, the wingman reverses the turn, establishes visual contact with the leader and calls "CALLSIGN VISUAL". The leader acknowledges with his heading. The wingman aims to achieve a perch position between 200ft and 500ft above the leader and on approximately the same heading.

c. The leader clears the wingman to join in the appropriate position and states his speed only if different from the SOP cruise speed, "CALLSIGN, CLEAR JOIN VIC/ECH LEFT/RIGHT, (XXX KTS)". The wingman acknowledges the join clearance and enters a gentle diving turn, using appropriate power, aiming to position behind and below the leader. He reverses the turn to position on his own side of the leader's 6 o'clock with an overtake of 15-20 kts and with the leader just above the horizon. He must not fly through the leader's 6 o'clock.

d. As the wingman closes on the leader, he should use the workcycle LOOKOUT, LEADER, SPEED. He maintains his own side of the leader's 6 o'clock, keeping him above the horizon so that he approaches with vertical and lateral separation. If he misjudges the closure rate and overtakes the leader, he must break out again and rejoin. He reduces power to stabilise in the waiting position. The waiting position is defined as 2 spans out, along the primary (forward) reference line and below the leader's plane. When stabilised, he moves up, then in slowly along that diagonal.

e. During the final part of the join, Instructors may call "CALLSIGN ABOARD" to allow the leader to clear the other wingman to practice a break and rejoin.

f. If the wingman is not visual with the leader after achieving a perch position he calls "CALLSIGN BLIND, LEVEL XXXX FT." The leader acknowledges with his heading and establishes a 500ft separation without flying through the wingman's level and directs the join-up using: a GPS or VOR/DME fix, a visual fix, or a pre-planned RV point, as required.

31. **Turning Join**. The turning join may be used as an alternative to the straight join to achieve the waiting position, usually when a more expeditious join is required. It may be flown as an academic exercise or for joining following a tailchase; the join may be used to change Vic/Echelon position. The following procedures apply to academic turning joins:

a. The leader calls the formation into echelon. To begin the manoeuvre the leader will call “CALLSIGN, TURNING JOIN, TURNING JOIN, GO” and break away level using 45°AoB through 90° before reducing to 20° of bank, maintaining briefed cruise speed throughout. Wingmen follow at 4 sec intervals in order to achieve about 100m spacing. Wingmen must not close to within 50m until cleared. The first wingman should be cleared to join immediately and normally on the outside of the turn, with the leader calling “CALLSIGN, CLEAR JOIN VIC/ECH LEFT/RIGHT, (SPEED XXX KTS, only called if different from SOP speed).” If part of a 3-ship, the second wingman will be cleared to join by the leader once the first joining aircraft has achieved the waiting position. Until cleared to join, the second wingman is responsible for collision avoidance with the aircraft ahead; he should keep the remainder of the formation in sight and maintain at least 50m trail on the leader.

b. The wingman flies towards the centre of the leader’s turn, aiming to position so that the leader appears in the 10/2 o’clock position, above the horizon. The wingman should then adjust his angle of bank so that the leader’s spinner is maintained vertically in line with a position ⅓ or ½ of the way down his lower wing. Wingmen should adjust power and AoB to achieve an overtake of no more than 20kts, monitoring the LEADER and SPEED. Vertical separation is maintained throughout to provide a safe escape plane in the event that the wingman is unable to control his closure. Wingmen should not close within 50m of the leader before positioning their aircraft to ensure that they are below the leader’s plane and looking at the underside of his aircraft, as the waiting position is approached. The techniques for completing the join are as follows:

(1) **Joining to the Outside**. As the wingman approaches the waiting position on the inside of the turn, still with some overtake and the leader above the horizon, he reduces angle of bank slightly and smoothly crosses to the outside of the turn, adjusting power and angle of bank to stabilise in the outside waiting position. Once stabilised, he then joins as in straight flight. Having crossed the leader’s 6 o’clock to achieve the waiting position, this wingman must not cross the leader’s 6 o’clock again.

(2) **Joining to the Inside**. If joining on the inside echelon, as the wingman approaches the leader he adjusts power and angle of bank to stabilise in the waiting position, then joins as in a straight join.

(3) **Join Order**. When the leader sees the first aircraft stabilise in the waiting position, he may clear the next one to join.

c. In the event of excessive overtake when approaching the waiting position, the angle of bank is to be reduced to enable the joining aircraft to pass clear of the other aircraft whilst maintaining height separation. If the first wingman is joining to the inside and overshoots, he is to remain on the outside of the turn until he is cleared to rejoin on the inside by the leader.

CHANGING FORMATION

32. The leader is to initiate all formation changes; all aircraft required to move are to acknowledge. Wingmen are to change formation by moving behind and below the leader, and are to maintain standard lateral or longitudinal separation at all times. Formation changes between Vic and Reverse Vic are only to be made through one of the Line Astern formations. Changes between Line Astern and Reverse Line Astern are only to be made through one of the Vic formations. Wingmen may rejoin formation to Vic or Reverse Vic as directed by the leader. All moves are to be square moves when changing close formation positions. The procedures for changing formation are as follows:

a. **From Vic (or Reverse Vic) to Line Astern**. Both wingmen acknowledge.

(1) No 3 drops back and down and calls “CALLSIGN 3 CLEAR”. He is to maintain a minimum of one length nose/tail separation on No 2.

(2) No 2 maintains position until No 3 calls clear. No 2 then moves back and down to stabilise one aircraft’s length behind the leader, then moves across into line astern.

(3) No 3 moves across when he sees the No 2 stabilise in position, and calls “CALLSIGN 3 IN” when stabilised.

b. **From Vic (or Reverse Vic) to Reverse Line Astern**. Both wingmen acknowledge.

(1) No 2 drops back and down and calls “CALLSIGN 2 CLEAR”. He is to maintain a minimum of one length nose/tail separation on No 3.

(2) No 3 maintains position until No 2 calls clear. No 3 then moves back and down to stabilise one aircraft’s length behind the leader, then moves across into line astern.

(3) No 2 moves across when he sees the No 3 stabilise in position, and calls “CALLSIGN 2 IN” when stabilised.

Note: In each case, the wingman who will become the rearmost aircraft moves first.

c. **From Line Astern to Vic (or Reverse Vic)**. Both wingmen acknowledge.

(1) No 3 moves to the appropriate side, stabilises and calls “CALLSIGN 3 CLEAR”.

(2) No 2 maintains position until No 3 calls clear. He then moves sideways to the appropriate side and then forward, up and into position.

(3) No 3 moves forward, up and into position when he sees No 2 moving into position.

d. **From Reverse Line Astern to Vic (or Reverse Vic)**. Both wingmen acknowledge.

(1) No 2 moves to the appropriate side, stabilises and calls "CALLSIGN 2 CLEAR".

(2) No 3 maintains position until No 2 calls clear. He then moves sideways to the appropriate side and then forward, up and into position.

(3) No 2 moves forward, up and into position when he sees No 3 moving into position.

e. **From Vic (or Reverse Vic) to Echelon**.

(1) Only the moving wingman acknowledges; he moves back and down to stabilise with one length nose/tail separation on the other wingman.

(2) He then moves across, passing behind and below the formation to stabilise on the outside of the formation, before moving forward, up and into position. He is not to join between the leader and the other aircraft.

(3) When changing from Vic to echelon left, the formation will be in the sequence 1, 3, 2.

TAILCHASE

33. Tailchasing is defined as a "follow-the-leader" exercise; pilots are not to allow a tailchase to develop into a dogfight. The leader is to brief a base height and (when operating below controlled airspace) a ceiling height. Pilots are not to break these height limits or allow their spacing to reduce to the extent that safety is prejudiced. Pilots are to apply the following limits to tailchasing:

a. Maintain VMC at all times. (1500m horizontally and 1000ft vertically from cloud, 5km visibility, above 3000ft)

b. Minimum height: 3000ft agl for all formation training sorties. A reduced minimum may be used at the discretion of a supervising DAE or formation leader and wingmen holding Display Authorisations.

c. Minimum vertical clearance from cloud: 1000ft.

d. Minimum vertical clearance from controlled airspace (CAS) is 200ft.

e. Minimum spacing between aircraft is 50m.

f. Leader's limitations: speed - minimum 70kts or 150kph.
g - minimum +0.5g, maximum +3.5g.

g. To ensure leader and rear aircraft deconfliction, a formation of more than 3 aircraft should not loop or vertically manoeuvre in a tailchase.

34. Prior to starting the tailchase, the leader should call the formation into echelon, normally echelon right as this ensures the formation is in numerical order 1, 2, 3. The leader should warn the wingmen in sufficient time for each to complete the HASELL checks. Before starting the tailchase, he is to confirm base and ceiling altitudes by transmitting "CALLSIGN, BASE XXXX FT, CEILING XXXXFT, ON XXXX (hPa)." Wingmen are to acknowledge in turn as follows: "CALLSIGN, BASE XXXX FT, CEILING XXXXFT, ON XXXX (hPa)." The leader then begins the tailchase by calling "CALLSIGN, POWER SET FOR XXX KTS (or actual setting), TAILCHASE, FOLLOW ME, GO" and turning sharply away from the formation. Wingmen follow at 2-second intervals, setting the briefed power and aiming for a spacing of 50 to 100 metres. The leader maintains the turn until the last wingman calls "CALLSIGN IN."

35. If a wingman closes to within 50 metres, or is forward of the 4/8 o'clock lateral limit lines of the immediate preceding aircraft, he is to call "CALLSIGN OUT." If his range from the immediately preceding aircraft increases to the extent that it is not safe to continue, he is to call "CALLSIGN STRETCHED." He may direct the leader (for example, "CALLSIGN ONE, GO LEFT") to assist the join up. If the first wingman breaks out, the second wingman is to follow him, NOT the leader. The leader should decrease the complexity of his manoeuvres and, if necessary, direct the join-up. He may continue the tailchase when the wingman calls "CALLSIGN IN."

36. If a wingman loses sight of the preceding aircraft, he is to call "CALLSIGN OUT BLIND." He should fly into a safe area (if known), level off and call "CALLSIGN LEVEL XXXX FT." The leader is to establish at least 500ft separation without flying through the wingman's level, and direct the join-up. If the first wingman breaks out, the second wingman is to follow him, NOT the leader. When the wingman regains sight of the leader, he is to call "CALLSIGN VISUAL." The leader may continue the tailchase when the wingman calls "CALLSIGN IN."

37. Throughout the tailchase the leader must be aware of his wingmen's positions. While encouraging students to show spirit and tenacity, he should avoid situations likely to overtax their abilities.

38. The leader is responsible for terminating the tailchase. However, wingmen may call "CALLSIGN COMPLETE" when training objectives have been met. In either case, the leader will end the tailchase by calling "CALLSIGN, TERMINATE, TERMINATE." Wingmen are to acknowledge using the format "TERMINATE

CALLSIGN." The leader is to direct the formation to rejoin as required. If briefed, the leader may waggle wings as a signal to terminate the tailchase. The formation is not to reform in line astern.

39. Any member of the formation faced with an emergency or who recognises a hazard to the formation may end the tailchase by calling "KNOCK IT OFF, KNOCK IT OFF, CALLSIGN, KNOCK IT OFF." Wingmen are to acknowledge using the format "KNOCK IT OFF, CALLSIGN." The initiating wingman may need to make a directive action call to bring the leader's attention to the threat. The leader should then direct the formation as required.

RECOVERY

40. The leader should call "CALLSIGN GYROS" to remind wingmen to carry out Post-Aerobatics checks, if applicable, and Pre-Descent/Recovery checks; all pilots are to ensure that instruments are erect and synchronised before recovery. Wingmen should acknowledge altimeter settings with a thumbs-up.

41. Before penetrating cloud wingmen should be settled in close formation. 3-ship formations must only penetrate cloud in Vic.

42. The leader should use more power than for a normal singleton descent in order to allow wingmen a power margin to remain in position. The leader should also avoid rapid reductions of power during the descent recovery. The minimum power setting should be in the aircraft specific Annex and be briefed.

RUN IN AND BREAK

43. At all times formation leaders must be aware of other circuit traffic during the recovery and break into the circuit. Unless formal priority arrangements have been made and are being obeyed by other aircraft, a formation must give way to and fit in with current circuit traffic. It is the leader's responsibility to ensure the formation can safely break into the circuit. If there is any doubt the leader should "Blow-Through" and reposition for a further re-join.

44. The leader should give the formation as straight a run-in as possible, ideally 3 nm and, once lined up with the active runway, should order the formation into the appropriate echelon. The formation should run down the deadside of the centre-line or as required by local procedures. Formations must not break at less than 500ft agl. The leader is to comply with local procedures for RT calls before running in for the break. Note: At civil airfields there is no position or RT call associated with the military term "Initial Point."

45. The leader will initiate a positive break by applying full power or a power setting appropriate for the aircraft type, rolling to 45° to 60° AoB and pulling to achieve a climbing turn to 800ft agl downwind. When the leader breaks, the next aircraft is to assume responsibility for the lookout but must maintain visual contact with the leader. Wingmen break in turn after the briefed interval, which is to be at least 2 seconds, and fly their own circuits, referring to the aircraft ahead to achieve line-astern at 500 m spacing.

46. The leader should call “CALLSIGN, 2/3 AIRCRAFT ON THE BREAK TO LAND / TOUCH & GO / LOW APPROACH” for the formation. Wingmen should fly their final turn to achieve the briefed minimum spacing. To avoid wake turbulence on the final approach, wingmen should not fly below the flightpath of the aircraft ahead; the leader should fly a slightly flat approach, the first wingman a normal approach and the second wingman a slightly steep approach. All pilots are to make individual final calls.

47. Aircraft are not to land at less than 500 m spacing. If a wingman assesses that he will not achieve the minimum separation or encounters wake turbulence, he is to go around and continue as an individual; he should also go around if he fails to achieve the correct threshold speed. All aircraft should land on the centreline and move to the exit side of the runway when down to a fast taxy speed. Unless instructed otherwise, the last aircraft should call “CALLSIGN RUNWAY VACATED” for the formation.

FORMATION APPROACHES

48. **Checks**. Wingmen should lower Undercarriage and T/O flap as appropriate when the leader signals, and should then complete the Pre-Landing Checks. Wingmen give a thumbs-up to the leader to indicate checks complete. Wingmen should lower LAND flap on a further signal from the leader.

49. **Visual Circuit**. The leader should join the circuit in accordance with local procedures, ideally running in from 3 nm on the deadside of the extended centreline. The leader should comply with local procedures for RT calls and advise ATC the formation is running in for a formation circuit. Note: There is no “Initial Point” at civil airfields. The downwind leg should be flown slightly wider than normal. The leader should be aware of the effect of bank on the airspeed of, and power required by, the wingmen. Wingmen on the inside of the final turn may increase Flap autonomously in order to increase drag and power required.

50. **Instrument Approach**. The leader should use standard IFR procedures, and should limit his angle of bank to 20°. In IMC, the leader should use R/T to call the services.

FORMATION LANDINGS

51. **Limits**. The following limitations apply to formation landings:

a. Tail-dragger aircraft are not to attempt formation landings other than as a pair, and the No 2 is to achieve adequate fore and aft spacing by touchdown to ensure no risk of collision during the landing run.

b. The maximum crosswind component is 15kts for a pair, 10kts for a Vic. For a pair, the leader is to position the wingman echelon into wind.

c. Pilots must not carry out formation touch-and-go landings. Pairs landings flown with the intention of one aircraft landing and one touch-and-go are not permitted.

52. **Pairs Landing**. The procedure for a pairs landing is as follows:

a. The leader should aim to fly a slightly flat approach to land in the centre of his half of the runway, a little further down than normal. Flap for landing should be selected on the final approach. At about 200ft agl on final approach, the wingman moves out diagonally along the primary (forward) reference to line up in the centre of his half of the runway. He also puts the leader's head on the horizon to ensure that he is at the same height as the leader. If either one or both of the aircraft are tail-draggers, the No 2 is to start to establish adequate fore and aft spacing for the landing at this point.

b. Each pilot lands his aircraft individually. After touchdown, the wingman commences braking as for a normal landing, but maintaining his half of the runway. The leader should delay his braking action to allow the wingman to space out behind him.

c. When down to a safe speed, the wingman calls "CALLSIGN SLOW SPEED", if applicable, to clear the leader to cross to the exit side of the runway. Unless instructed otherwise, the wingman calls "CALLSIGN RUNWAY VACATED" for the formation.

53. **Vic Landing**. The procedure for a Vic landing is the same as for a pair, with the following differences:

a. The leader lands on the centreline. Apart from putting the leader's head on the horizon, wingmen maintain the standard formation position. On a 150 ft wide runway, this will position them about 2/3 of the way across their half of the runway.

b. After touchdown, the No 2 and the No 3 lower their nosewheels and commence braking. The leader should delay his braking to allow separation from the wingmen.

c. When down to a safe speed, the appropriate wingman calls "CALLSIGN SLOW SPEED" to clear aircraft ahead to cross to the exit side of the runway. The leader maintains the centreline until he hears this call.

d. Unless instructed otherwise, the No 3 calls "CALLSIGN RUNWAY VACATED" for the formation.

LEADING

54. **General Procedures**. The leader is responsible for the safety of the formation, and must therefore pay close attention to lookout, navigation, weather and fuel, as well as handling any emergency that may arise. The leader should make all attitude changes smoothly and must remember that his flexibility of manoeuvre is limited by the experience of his wingmen. He should allow his wingmen some tolerance when setting power, and should not expose them unnecessarily to sun glare. The leader should not exceed 20° AoB in IMC.

55. **Changing the Lead**. When a dedicated lead aircraft is provided, changing the lead and re-numbering is not required, and the use of Reverse Vic and Reverse Line Astern positions provide wingmen the opportunity to fly in all of the basic formation positions. When necessary, lead changes are carried out using R/T or hand signals as follows:

a. The leader should call the formation into echelon left or right depending on, for a 3-ship, which wingman is to take over the lead.

b. The leader should pass the formation's position if required and should transmit "CALLSIGN, POSITION XXX, SQUAWK XXXX, CALLSIGN, YOU HAVE THE LEAD".

c. The wingman taking over the lead is to acknowledge "CALLSIGN." He is to move 2 spans out and accelerate to overtake the leader. In the case of a 3 ship in echelon, he takes the second wingman with him as he moves forward.

d. As the wingman taking over the lead passes abeam the leader, he is to assume the lead by transmitting: "CALLSIGN, SQUAWK XXXX, I HAVE THE LEAD." If required, the new leader transmits CALLSIGN, RENUMBER. The formation members step-forward one number, the original leader assumes the last number in the formation, or alternatively, a position number as allocated at the formation briefing. The new leader should then clear the former leader to join, or alternatively to break and rejoin to take his new position.

e. The former leader acknowledges and breaks or manoeuvres into position as ordered.

f. For pre-briefed lead changes or in a busy R/T environment the leader may indicate a change of lead by the use of the standard hand signal. As the wingman taking over the lead passes abeam, he assumes the lead by clearing the former leader to join the appropriate position.

56. **Hand Signals**. The standard hand signals for formation flying are detailed in these SOPs. These conform to military STANAG 3379. In the early stages of formation training, leaders may use R/T or hand signals freely to call turns. As experience is gained, R/T and hand signals should be progressively phased out.

EMERGENCIES

57. **Aborted Take-Off**.

a. **Formation Take-Off**. If any aircraft aborts the take-off, the other aircraft in the formation should continue. In the case of the leader of a Vic aborting, No 3 initially formates on No 2. A pilot aborting should action the abort and then call "CALLSIGN ABORTING". If the leader decides to abort the take-off for the whole formation he should call "ABORT, ABORT, CALLSIGN ABORT" before he takes abort action.

b. **Stream Take-Off**. If an aircraft aborts a stream take-off, he should call “CALLSIGN ABORTING”. All aircraft behind him should also abort. The aircraft aborting should maintain its line down the runway.

58. **In Flight**. A pilot with an emergency in flight should inform the Leader and/or the other aircraft by R/T and carry out individual actions. He should move out of the formation and request the assistance of other pilots in the formation as necessary. The other aircraft may be able to assist by conducting a visual inspection or making radio calls on his behalf. The key is to support the aircraft with a problem, not to interfere or distract the pilot.

59. **Radio Failures**. The leader or deputy leader should lead an aircraft with a radio failure back to base or destination using the briefed recovery procedure. The leader should listen out on the collector frequency, if a second VHF radio is available, to allow a wingman with radio failure to establish contact.

a. **Total Radio Failure**.

(1) **Wingmen**. If a wingman experiences total radio failure, he should move forward, rock his wings to attract the leader’s attention and indicate the unserviceability using hand signals.

(2) **Leader**. If the leader experiences a total radio failure in line astern, he should gently rock his wings as the signal to re-form Vic. The leader can then indicate the unserviceability and hand over the lead to the deputy leader using hand signals.

b. **Confusion**. If RT contact is lost following a frequency change, the leader and wingmen should:

(1) Attempt to check-in, check that the correct frequency, radio and communication switches are selected.

(2) Listen out on the previous frequency for up to 30 seconds and attempt to check-in.

(3) If no contact, change to the briefed collector frequency and attempt a check-in.

c. **Collector Frequencies**. The following are the SOP collector frequencies and hand signals: *(Note - Military SOPs have UHF Guard as 2 fingers and VHF Guard as three fingers)*

(1) One finger - Briefed collector frequency.

(2) Two fingers - VHF Guard (121.5 MHz).

(3) Three fingers - UHF Guard (243.0MHz) if UHF equipped.

60. **HEFOM / PEFOM Code**. If the pilot of an aircraft with total radio failure experiences a further emergency, he should use the HEFOM / PEFOM code as follows:

a. He attracts the attention of another pilot by rocking his wings.

b. He then raises a clenched fist to the top of the canopy to indicate his intention to use the HEFOM / PEFOM code. The other pilot should acknowledge this signal by repeating it.

c. He indicates the unserviceability by rocking his arm forward and backward extending a finger on each rock, eventually stabilising his arm in the vertical with the appropriate number of fingers extended.

HYDRAULICS	1 finger	**PNEUMATICS**
ELECTRICS	2 fingers	**ELECTRICS**
FUEL	3 fingers	**FUEL**
OXYGEN	4 fingers	**OXYGEN**
MOTOR	5 fingers	**MOTOR**

d. The other pilot should acknowledge by repeating the signal.

61. **Intercom Failure in Tandem Cockpit Aircraft**. In the event of an intercom failure during close formation, move the aircraft to the waiting position (Vic / Echelon) or drop back if in Line Astern. If the problem cannot be rectified, inform the leader and proceed as a singleton aircraft to destination or return to base. The need to establish correct Handover and Takeover of control in the event of an intercom failure is paramount. If shouting above the engine noise proves ineffective, the chart below details the procedure of control column waggles that should be used to ensure safe handover/takeover without a working intercom.

Intercom Failure Handover Takeover of Control - Tandem Cockpit Aircraft

Control Column Waggle	Meaning
Left & Right Waggle	Control is passed to, or assumed by, the Rear Seat
Fore & Aft Waggle	Control is passed to, or assumed by, the Front Seat

62. **Loss of Leader in IMC**. A wingman losing sight of the leader in IMC should proceed as follows:

a. **In Straight Flight**.

(1) Transfer to instruments.

(2) Turn away from the leader using 20° of bank, establish a heading 20° away from the leader and hold for a minimum of 20 seconds, then resume the leader's original heading.

(3) Call "CALLSIGN, OUT BLIND".

(4) If climbing, continue climbing. If descending, level off.

(5) Proceed as instructed by the leader.

b. **Outside Wingman in a Turn**.

(1) Transfer to instruments.

(2) Roll wings level for at least 20 seconds.

(3) Call "CALLSIGN, OUT BLIND, HDG XXX".

(4) If climbing, continue climbing. If descending, level off.

(5) The leader ensures at least a 20° divergence and instructs the wingman on how to proceed.

c. **Inside Wingman in a Turn**.

(1) Transfer to instruments.

(2) Increase to 45° AoB.

(3) Call "CALLSIGN, OUT BLIND".

(4) If climbing, continue. If descending, level off.

(5) The leader rolls out of his turn and instructs the wingman on how to proceed.

These procedures will only give temporary separation between formation elements. If IMC persist, the leader is to pass instructions to maintain safe separation; he may then arrange a join up or individual recovery as appropriate. The leader and wingmen should take account of safety altitude.

63. **Loss of Leader in VMC**. If a wingman loses sight of the leader in VMC, he is to call “CALLSIGN OUT”. He should break away and fly into a safe area (if known), level off and if still not visual call “CALLSIGN BLIND, LEVEL XXXX FT”. The leader is to establish at least 500ft separation without flying through the wingman’s level, and should direct the join-up, if required, using a GPS or VOR/DME fix, a visual fix, or a pre-planned RV point.

64. **Mid-Air Collision**. Despite the very close proximity of other aircraft in close formation, a mid-air collision with another aircraft in the same formation is statistically less likely than a mid-air collision with a third party aircraft. Compared to a singleton aircraft, the risk of a mid-air collision with a third party aircraft is only increased due to the relatively less manoeuvrable nature of a formation, especially a large formation. The issue of a NOTAM, regarding the formation activity with times and areas /routes, increases awareness of other aircraft and airspace users. The use of electronic aids (ACAS etc) and an ATC service can further mitigate the risk but these can only enhance the formation leader’s situational awareness (SA). In the end it is only a disciplined and effective lookout by the leader that will see conflicts and manoeuvre the formation safely around any potential hazard. All formation members should report any aircraft seen to the leader immediately, and thus help maintain the leader’s SA of potential threats to the formation.

65. The following is guidance on the actions to consider in the unlikely event of a mid-air collision. The consequences of such an event break down into 3 scenarios:

a. **Catastrophic Event**. A severe impact between one or more formation aircraft and/or a third party aircraft in flight where the aircraft are destroyed or damaged to the extent that control of the aircraft is lost.

b. **Collision Event**. A collision between one or more formation aircraft and/or a third party aircraft in flight where the aircraft suffer structural or engine damage leading to an immediate forced landing with or without power.

c. **Minor Collision Event**. A collision between one or more formation aircraft and/or a third party aircraft in flight where the aircraft suffer structural or engine damage but are able to maintain controlled flight under power in order to divert to the nearest airfield capable of providing a safe landing.

The only available option to save life in the catastrophic event is the wearing and use of a parachute, but even that may not be successful. A parachute also offers an alternative to a forced landing after a collision event. Parachutes may or may not be available for use on formation aircraft depending on type. What is key to their successful use is having an abandoning drill that works and practicing the drill frequently.

66. The following further considerations are offered in guidance for Collision Events / Minor Collision Events where abandoning the aircraft by parachute is either not an option or simply not the best course of action.

d. **Airborne Inspection**. A formation member not involved the collision should inspect the damaged aircraft from a safe distance and position. The extent of any damage reported can be related to any abnormal handling or eventually the landing characteristics.

e. **Low Speed Handling Check**. Before attempting to land, conduct a low speed handling check clear of built up areas and at height. If parachutes are worn, remain above the minimum abandonment height. Practice all manoeuvres necessary to land the aircraft, including lowering the Undercarriage, to confirm there are no unusual handling difficulties. Flaps, if necessary for landing, should be carefully lowered in stages to check for any asymmetric effects. Once Undercarriage and Take-Off Flap have been lowered, it is generally considered best practice to leave them lowered. Unless the use of Land/Full Flap is essential, a landing with take-off flap should be considered. If there are any abnormal handling characteristics, note the speed these occur and maintain 5-10kts in excess of that speed to ensure good control response.

WAKE TURBULENCE

67. Whenever operating behind or near to other aircraft in flight, pilots should bear in mind the dangers of vortex patterns. Turbulence induced by vortices is most likely to be encountered in light wind conditions. The following techniques are recommended for avoiding wake turbulence:

a. Take advantage of the downward motion of the vortex pattern by staying on or above the flight path of the preceding aircraft during a stream approach and landing. For a stream take-off as a 3-ship, consider the use of a High-Normal-High profile climb-out.

b. In calm conditions or when the wind direction is close to that of the runway heading, take advantage of the outward spread of the vortices close to the ground; stay on the centre line of the previous aircraft's path.

c. When wake turbulence is expected, consider an additional reserve of speed over the normal approach speed. This will provide not only an increased margin over the stall but will increase aileron effectiveness to counter roll caused by the vortices. Alternatively, consider a go-around.

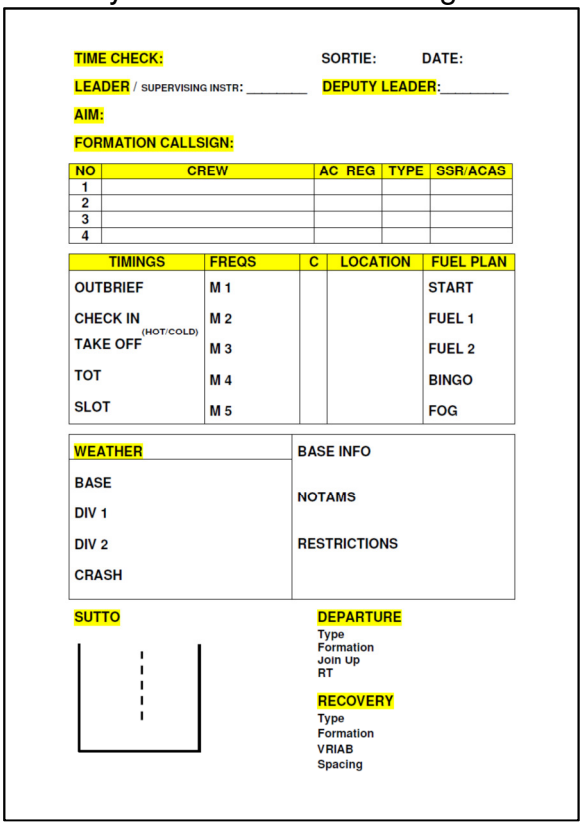
d. Allow adequate separation whether landing behind another aircraft of like type, or behind a larger aircraft.

e. Do not allow the aircraft to drift downwind on short finals or the last part of the finals turn, as this is where the turbulence will drift.

f. On a 2 ship formation approach, always place the wingman upwind.

FORMATION BRIEFING SLIDES FORMATS

68. The briefing format slides below are representative of basic OHP briefing slides which may also be used as table-top briefing sheet. A comprehensive powerpoint presentation may be used where briefing resources allow.



TIME CHECK: SORTIE: DATE:

LEADER / SUPERVISING INSTR: _____ DEPUTY LEADER:_____

AIM:

FORMATION CALLSIGN:

NO	CREW	AC REG	TYPE	SSR/ACAS
1				
2				
3				
4				

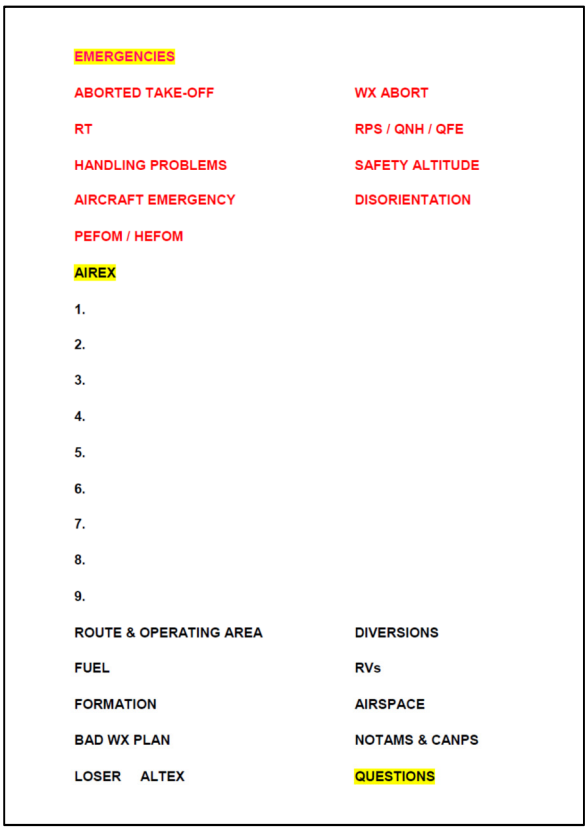
TIMINGS	FREQS	C	LOCATION	FUEL PLAN
OUTBRIEF	M 1			START
CHECK IN (HOT/COLD)	M 2			FUEL 1
TAKE OFF	M 3			FUEL 2
TOT	M 4			BINGO
SLOT	M 5			FOG

WEATHER	BASE INFO
BASE	NOTAMS
DIV 1	
DIV 2	RESTRICTIONS
CRASH	

SUTTO

DEPARTURE
Type
Formation
Join Up
RT

RECOVERY
Type
Formation
VRIAB
Spacing



EMERGENCIES

ABORTED TAKE-OFF — WX ABORT

RT — RPS / QNH / QFE

HANDLING PROBLEMS — SAFETY ALTITUDE

AIRCRAFT EMERGENCY — DISORIENTATION

PEFOM / HEFOM

AIREX

1.

2.

3.

4.

5.

6.

7.

8.

9.

ROUTE & OPERATING AREA — DIVERSIONS

FUEL — RVs

FORMATION — AIRSPACE

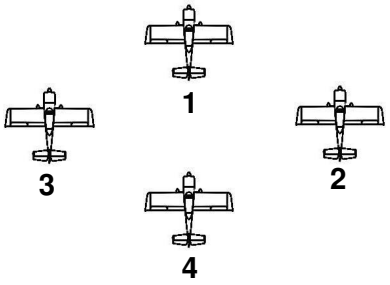
BAD WX PLAN — NOTAMS & CANPS

LOSER ALTEX — QUESTIONS

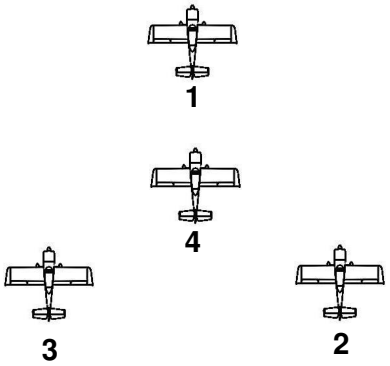
4-SHIP FORMATIONS

69. Formations larger than 3-ships impose greater demands on formation leaders and wingmen and should be introduced cautiously. Formation leaders must not take formations of more than 3 aircraft into cloud. A typical 4-ship formation may be split further into sections (eg. Red and Blue sections) to allow further training objectives to be met as pairs: The following are the standard 4-ship formations:

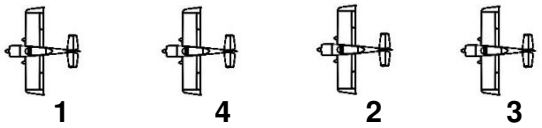
a. Box.



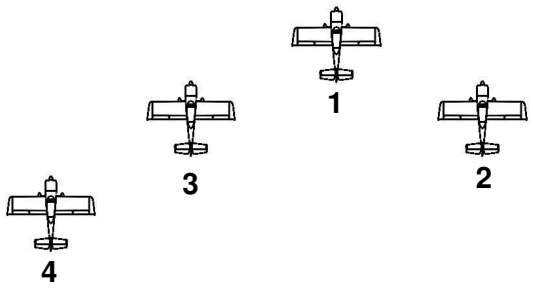
b. Swan.



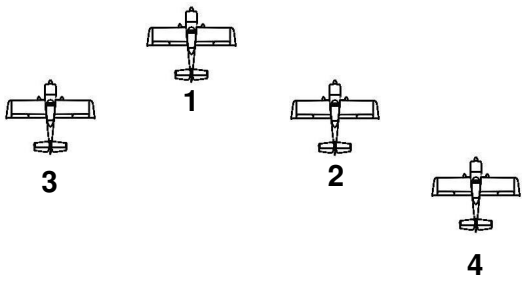
c. Line Astern.



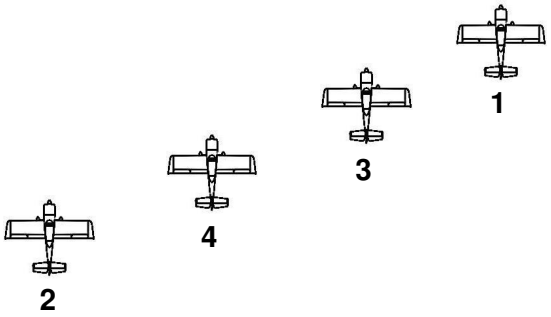
d. Finger-4 Left



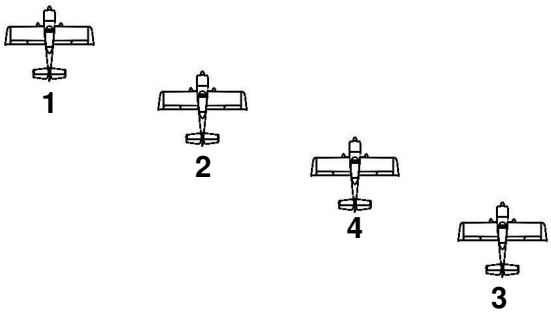
e. Finger-4 Right



f. Echelon Left.

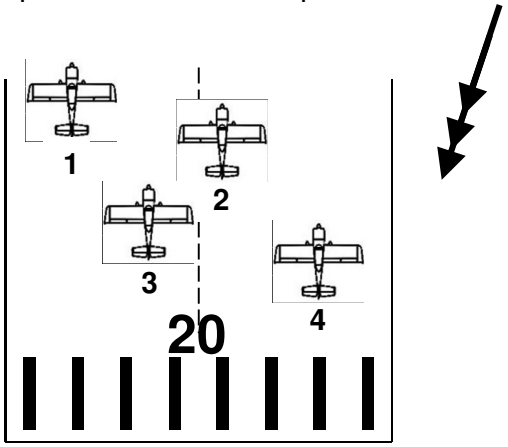


g. Echelon Right.



70. **4-Ship Take-Off**.

a. The SOP 4-ship line-up and take off is as 2 pairs; the minimum spacing between pairs is 10 seconds. Aircraft line up in 2 echelons into wind, as shown below. No 2 places his wheel nearest the leader on the runway centreline. After take-off, element leaders individually call their wingmen into the required echelon, if required, before the formation joins up.



Four Aircraft Runway Line-Up

b. Alternatively, the take-off may be flown as a Vic with the No 4 as a singleton. The singleton pilot is to take-off using full power at an interval of not less than 10 seconds.

c. If the wind is outside pairs limits, pilots should fly individual stream take-offs using a minimum of 5 seconds.

d. If the crosswind is from the left, the formation should line up in mirror image of that described above. Nos 1 and 3 remain the element leaders with Nos 2 and 4 echelon left on their respective leader.

e. **Aborting Take-Off**. For an individual stream take-off, normal procedures apply. For a 4-ship take-off, normal pairs formation procedures apply to each element. If either aircraft in the lead element aborts, the second element should also abort. If either aircraft in the second element aborts normal pairs formation procedures apply, with No 1 and No 2 getting airborne.

71. **Join Up**. Pilots are to join up in Finger-4 formation as briefed. Nos 3 and 4 may be briefed to join the formation either individually or as a pair. Once joined in Finger 4, the leader may call the formation into Box.

72. **Climb**. Close formations of more than 3 aircraft must not penetrate cloud.

73. **Formation References**. Formation references for positions other than Box are the same as for Vic, Line Astern and Echelon. For Box formation, No 4 adopts a position directly behind the leader using a balanced scan between Nos 2 and 3 to obtain echelon references. This position for No 4 will be slightly lower than normal to remain clear of slipstream from No 1.

74. **Formation Changes**. Pilots are to make all formation changes through box, except from finger-4 to echelon on the same side and swan to line astern. Pilots are to change formation as follows:

a. **Box to Finger 4**. No 4 moves back and across into echelon on the appropriate side.

b. **Finger 4 to Box**. No 4 moves back, down and across into the box position and calls “CALLSIGN IN”.

c. **Finger 4 to Echelon**. The No 2 (for echelon left) or No 3 (for echelon right) moves back and down until he can see all 3 aircraft, and then moves across into position on the outside of the echelon.

d. **Box to Echelon.**

(1) No 4 moves back and across into echelon on the appropriate side and calls “CALLSIGN IN”.

(2) When the No 2 (for echelon left) or No 3 (for echelon right) hears the No 4 call in, he moves back and down until he can see all 3 aircraft, then moves across into position on the outside of the echelon.

Note: 4-ships in echelon left will be in the sequence 1, 3, 4, 2.
4-ships in echelon right will be in the sequence 1, 2, 4, 3.

e. **Echelon to Box.**

(1) The pilot on the outside of the echelon moves back, down and across into position on the opposite side and calls “CALLSIGN IN”.

(2) On hearing this call, the No 4 moves back and down until he can see all 3 aircraft, then moves across into the box position and calls “CALLSIGN IN”.

f. **Box to Line Astern.**

(1) The No 3 moves back and down and calls “CALLSIGN CLEAR”.

(2) On hearing No 3 call clear, No 2 moves back and down and across into position behind No 4, who smoothly adjusts to a line astern position.

(3) When he sees No 2 in position, No 3 moves across into position behind No 2 and calls “CALLSIGN IN”.

Note: 4-ships in line astern will be in the sequence 1, 4, 2, 3.

g. **Line Astern to Box.**

(1) No 3 moves left and calls “CALLSIGN CLEAR”.

(2) No 2 moves right, forward, up and into position.

(3) No 3 moves forward, up and into position when he sees No 2 moving in.

(4) No 4 smoothly drops back to his box position.

h. **Box to Swan.**

(1) Nos 2 and 3 move back then down into position on the No 4; timing is taken from the No 2.

(2) The No 4 moves forward and up into a line astern position on No 1.

j. **Swan to Box.**

(1) Nos 2 and 3 move up then forward into position on the No 1; timing is taken from the No 2.

(2) No 4 moves down and back into his box position.

k. **Swan to Line Astern**.

(1) No 3 drops back and down and calls “CALLSIGN CLEAR”.

(2) On hearing No 3 call clear, No 2 moves back, down and across into position.

(3) No 3 moves across when he sees No 2 stabilised in position, and calls “CALLSIGN IN” when in position.

l. **Line Astern to Swan**.

(1) No 3 moves left and calls “CALLSIGN CLEAR”.

(2) No 2 moves right, forward, up and into position on the No 4.

(3) No 3 moves forward, up and into position on the No 4 when he sees No 2 moving in.

75. **Recovery and Normal Break**. A 4-ship formation should normally recover for a run in and break from echelon. If an IFR recovery is necessary, formations should split into either 2 pairs, a Vic and a singleton or 4 individual aircraft. Once VMC below cloud, they may either continue individually or join up again, as briefed.

76. **Opposition Break**. An opposition break may only be flown from Box and only if it has been specifically briefed, the circuit is clear and the crosswind is less than 15kts. Pilots are to use the following procedure:

a. The leader calls the break as follows: “CALLSIGN, BREAK, BREAK, GO (2 second pause) BREAK, BREAK, GO”

b. On the first “GO” Nos 2 and 3 break right and left respectively.

c. On the second “GO” Nos 1 and 4 break left and right respectively.

d. The leader calls downwind for the formation: “CALLSIGN, 4 AIRCRAFT LEFT AND RIGHT DOWNWIND TO LAND”

e. No 2 turns final first, right-hand. No 3 turns in left-hand as No 2 is halfway round the turn. No 4 turns final right-hand when No 3 is halfway round the turn, and No I turns final left-hand as No 4 is half way round the turn. Individual aircraft call final in the sequence No 2, No 3, No 4, No 1.

f. The minimum spacing at touchdown is 500 m.

77. **Box Breaks**. Box Breaks may only be flown when specifically briefed. They are an alternative to a normal run in and break from echelon or where an opposition break is not feasible due to airfield regulations or traffic intensity. The leader positions the formation in Box and runs in as per a normal break. One of the following two methods may be used for the break and must be briefed prior to the sortie. The minimum spacing at touchdown is 500 m.

a. **Sequential Box Break**. The Sequential Box Break allows the aircraft to break in number order 1, 2, 3, 4 and is best utilised in a quiet circuit environment due to the requirement for RT calls.

(1) When the leader assesses the Box Break can be safely completed he commences the break, pitching up out of the formation with the RT call "CALLSIGN 1."

(2) When No 2 observes No 1 clear of the formation and at the briefed interval he pitches up out of the formation with the RT call "CALLSIGN 2." When No 3 observes No 2 clear of the formation and at the briefed interval, he pitches up out of the formation with the RT call "CALLSIGN 3." When No 4 observes No 3 clear of the formation and at the briefed interval he pitches up with the RT call "CALLSIGN 4."

(3) On seeing or hearing No 4 break, the leader calls downwind for the formation: "CALLSIGN, 4 AIRCRAFT DOWNWIND TO LAND"

(4) As the aircraft ahead in the sequence breaks, the next aircraft becomes responsible for lookout for the remaining formation. As the leader breaks No 3 maintains formation reference on No 2 in line abreast until No 2 breaks.

(5) The minimum break interval for a Sequential Box Break is to be detailed in the briefing. Typically the minimum interval can be 2 seconds, however, when the aircraft ahead has to break over the remaining aircraft in the formation the minimum interval for the next aircraft is to be 3 seconds.

b. **Non-Sequential Box Break**. The Non-Sequential Box Break allows the leader to control the break with hand signals. When ordered by the leader, by hand-signal or RT call, the wingman on the "live" circuit side of the formation is the first to break. The other wingman breaks second, followed by the leader, then No 4. The order of break into a left hand circuit will be 3, 2, 1, 4. For a right hand circuit it is 2, 3, 1, 4. The advantage of a Non-Sequential Box Break is the potential lack of RT calls.

c. **Box Break Technique**. Each aircraft in the formation executes the box break by an initial positive pitch up to clear the formation, then rolls to

60° AoB in the direction of the break, then pulls to complete the break onto the downwind leg. Notwithstanding any briefed minimum break interval, the aircraft breaking must ensure any preceding aircraft is clear before initiating the break. Before breaking each aircraft MUST have and maintain sight of all aircraft that have broken before that aircraft.

FORMATION RENDEZVOUS

78. **Rendezvous Datum**. When planning the Rendezvous (RV), the leader will consider the geography of the area, the meteorological conditions at the time of the RV and the availability of suitable electronic navigation aids (VOR/DME/ GPS etc). Based on this information he may select a prominent ground feature for the RV datum if the weather conditions are good and there is sufficient height below cloud for a safe join-up; otherwise an electronic navigation fix (VOR/DME/ GPS) may be required.

79. **Lookout**. It is essential that both leader and wingman are thorough in their lookout. Other aircraft may be in the vicinity of the intended RV and identifying the correct aircraft is crucial. Careful use of ACAS (if fitted) may also assist in identifying formation elements.

80. **Reforming Formation**. The leader should not reform the formation unless all the elements of the formation are in RT contact and all elements can maintain a vertical separation of 500ft until visual contact is made.

a. At the pre-arranged RV location and time, the leader will set up an orbit using 20° to 30° AoB whist ensuring that the wingmen will have sufficient terrain clearance during the RV. If the leader is unable to achieve the briefed RV time, the briefed RV Datum or the briefed height sanctuaries, he must contact the wingmen and relay the changes. During the RT call, the leader will state, not only the amended time, datum or height sanctuaries but clear the wingmen to RV; the wingmen must acknowledge.

b. If the RV is flown as briefed, the wingmen should fly towards the RV datum at 120kts or the pre-briefed IAS and at their briefed height sanctuaries. The height separation between the leader and the wingmen should be multiples of 500ft (normally from 500ft below the leader's height so that it is easier to see the leader above the "sky-line") and must be maintained until visual contact is made and the leader is positively identified. The wingmen are responsible for collision avoidance. Although the wingman needs to concentrate his lookout towards the leader's position and the RV datum, he must maintain a thorough lookout all round to ensure safe separation from other aircraft in the area. Wingmen should use navigation heading and time, VOR/DME/GPS, ACAS, and if necessary ATC to aid visual acquisition with the leader. When a wingman believes he is visual with the leader, he should ask the leader to "Waggle." If the aircraft waggles, (ie. rocks his wings left and right), it confirms that it is the correct aircraft and the wingman should call "Visual." At this point, the leader will clear the wingman to join into close formation.

c. Once cleared to join, a wingman should start to climb straight away to approximately 50ft to 100ft below the leader's altitude and direct the leader to "Roll out now" or "Turn left/right now" in order to position and establish a safe distance between aircraft.

d. During the later stages of the rejoin, the leader will control the rollout heading in readiness to proceed in the intended direction. Meanwhile the wingman should expedite the join into close formation using either a turning or straight join as required. While High Intensity Strobes Lights (HISL) should be reselected to OFF or to RED once visual contact is regained, the wingman should consider retaining ACAS and Squawk until the latter stages of the join in order to enhance positional SA.

BALBO FORMATIONS

81. Balbo formations are formations larger than 4 aircraft and are formed from sections of Pairs, Vic and/or Box formations joining together to form the required size and shape of formation. Balbo formations require planning, briefing and leadership of the highest order and should only be conducted after the intended formation participants have demonstrated high levels of competency in basic formation flying. A work-up programme of gradually increasing aircraft numbers is recommended until the required formation size can be flown.

82. **9-Ship Formation**. The following procedures should be used, for a 9 Ship formation intending to fly in Diamond 9 and Typhoon shaped formations. These procedures cover the general principles which should be used for any size of Balbo formation.

83. **Line Up**. For a 6000ft runway, using suitable runway markers as references, No 1, No 2 and No 3 (Red Section) line up echelon into wind at 4500ft to go. No 4 and No 5 (Grey Section) line up echelon into wind at 5000ft to go. No 4 will be the leader of Grey Section. No 6, No 7 No 8 and No 9 (Blue Section) line up as a 4 ship at 5500ft to go. No 6 will be the leader of Blue Section. Finally, any whip or spare aircraft should line up at 6000ft to go. Once the last aircraft is lined up in position he should inform the leader.

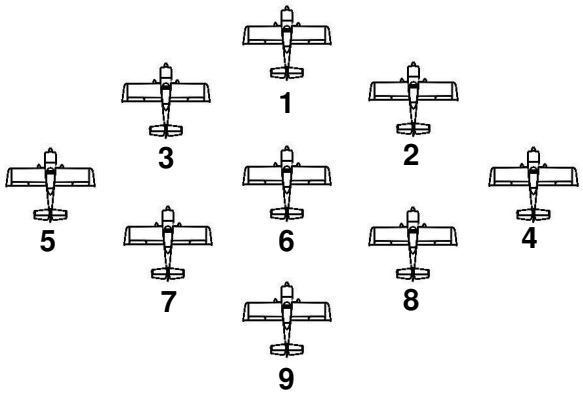
84. **Take-Off**. A stream take-off is flown with 5 second intervals between each aircraft in each section and 10 seconds between each section. Thus, the spare should roll 65 seconds after the leader. When weather/wind conditions allow, sections may take-off as individual formations with a minimum of 15 seconds between each section take-off, providing the line-up distances above are used.

85. **Diamond 9 Join Up**. Once airborne Nos 1-5 join to form Red Section with Nos 1-3 in Vic and No 4 and No 5 out-board of No 2 and No 3 respectively. Nos 6-9 join up to form Blue Section in Box. As Blue Section approaches Red Section from behind, Blue section leader calls "BLUE SECTION ABOARD." The leader will then call "CALLSIGN FORM DIAMOND." Blue Section leader will acknowledge and leads his formation into position calling "CALLSIGN - BLUE SECTION IN." The leader will acknowledge.

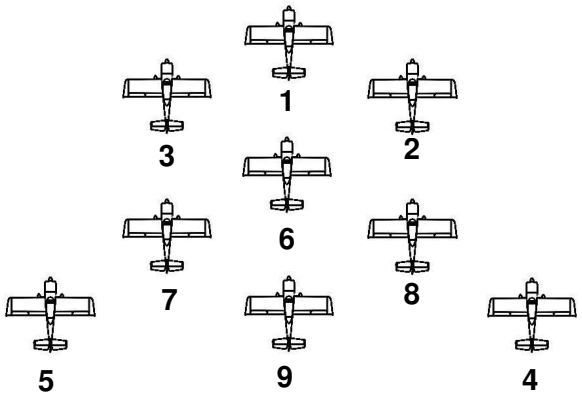
86. **Diamond References**. No 2 and No 3 fly standard echelon references on the leader; No 4 and No 5 fly Echelon on No 2 and No 3 respectively. No 6-9 fly the references for a Box 4 but modifying their positions slightly to ensure No 6 is behind No 1, and No 8 and No 7 are behind No 2 and No 3 respectively. To ensure symmetry, if No 6 has to sit low then No 7 and No 8 match his height. Note that in the diagram below all the odd Nos of the formation are on the right and the even Nos are on the left. This position layout is designed to be intuitive and assist situational awareness for formation recovery and emergency procedures.

87. **Typhoon References**. Typhoon is formed from Diamond 9. The only movers are No 4 and No 5 who both move out and then back to clear No 8 and No 7 respectively. They then move forward up and in to fly echelon on No 8 and No 7, achieving line abreast on No 9. The return to Diamond 9 is achieved by flying the reverse manoeuvre to clear No 8 and No 7 and then move into echelon on No 2 and No 3. Both No 4 and No 5 are responsible for collision avoidance whilst manoeuvring around the formation.

88. **Manoeuvring in Diamond 9 or Typhoon**. The leader should use information calls as required to assist his wingmen – "ROLLING IN," "ROLLING OUT," "TIGHTENING." During any rolling manoeuvre the outside wingmen (No 4 and No 5) must anticipate with power to stay in position. The maximum AoB as a 9-Ship, or in any formation where a wingman is 2 outboard of the leader, should not exceed 20°.



DIAMOND 9 FORMATION



TYPHOON FORMATION

89. **Recovery**. If the crosswind is 15kts or less a 9-ship may recover for an opposition break. This is flown at 500ft in Diamond 9. The leader will position over the runway and call "CALLSIGN, BREAK, BREAK, GO…GO…GO…GO." There is to be a minimum 2 second gap between each command of "GO" On the command "GO" aircraft break in the following order.

OPPOSITION BREAK ORDER	
5 LEFT	4 RIGHT
3 LEFT	2 RIGHT
7 LEFT	8 RIGHT
9 LEFT	6 RIGHT
1 LEFT	

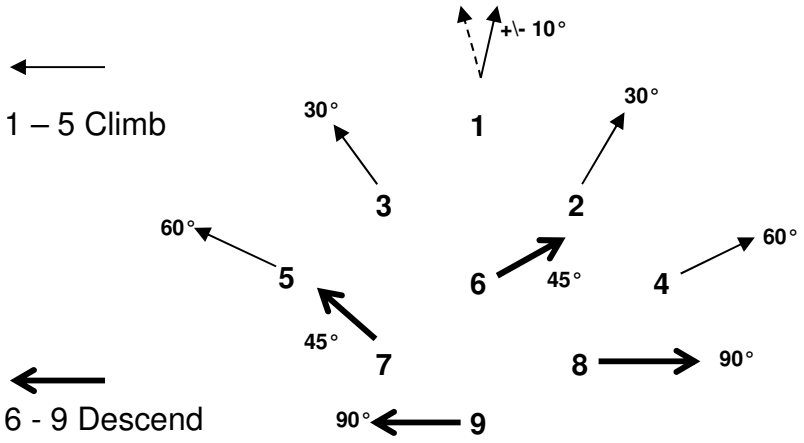
Aircraft should fly a normal break into the circuit to land, turning final when aircraft ahead in the opposition stream has turned through 45°. The landing order will be 5-4-3-2-7-8-9-6-1. Aircraft are to call "FINAL – VISUAL NO X AHEAD." In the event of a go-around the aircraft should maintain the runway centreline, climb to circuit height and turn downwind only when clear of other formation members. The minimum spacing at touchdown is 500m. Aircraft should avoid rapid decelerations and clear to the exit (slow) side of the runway as soon as possible. If the crosswind is greater than 15kts, the leader will order "BLUE SECTION DROP BACK, CALL CLEAR." Once clear the leader will order, "GREY SECTION DROP BACK, CALL CLEAR." Once the diamond has been split into 3 sections, each section leader will call the section into echelon. Each section will fly an echelon break with a minimum break interval of 2 seconds.

BALBO FORMATION EMERGENCY PROCEDURES

90. **Take-Off**. With a 15 second stream between elements, subsequent aircraft will have time to stop if a section or aircraft ahead aborts.

91. **Cloud Penetration**. Cloud must not be penetrated in any formation larger than a 3 ship in Vic.

92. **Breakouts**. A breakout plan is to be briefed and must cater for the worst case scenario of all aircraft needing to split. Below is a standard breakout plan for a Diamond 9 which also works in Typhoon formation. .



The breakout plan gives each aircraft a safe direction, which allied to a climb or descent, allows the formation to split up in a pre-planned manner. The breakout plan might be called for by the leader in order to avoid a near imminent collision with a third party aircraft or following an aircraft emergency declared by one of the formation aircraft. In this circumstance the Leader would call "CALLSIGN, EMERGENCY, BREAK, BREAK, GO." In the event of an aircraft in the formation suffering an engine malfunction causing it to decelerate and/or descend, the breakout plan provides a directional escape route away from the formation albeit probably in a descent. The plan also provides other aircraft affected by the emergency aircraft a pre-planned exit route if required. It should be stressed by the leader in the formation briefing that the breakout plan is a tool of last resort.

CLOSE FORMATION AEROBATICS

93. **Introduction**. Close formation aerobatics should only be conducted by a leader and wingmen who have demonstrated aerobatic skill and ability as a singleton, and the ability to maintain close formation positions in manoeuvres beyond 60° AoB and Angle of Pitch (AoP).

94. **Collision Avoidance**. Collision avoidance responsibility rests with the wingman or wingmen at all times.

95. **Limitations**. The only permitted manoeuvres are the Loop, Barrel Roll and Stall Turn.

a. **Loops**. Loops may be flown as a pair in Echelon or as a 3 ship in Vic.

b. **Barrel Rolls**. Barrel Rolls should only be flown as a pair, either in Echelon with the direction of roll "away" from the wingman or in stretched Line Astern.

c. **Stall Turns**. Stall turns should be flown from a wide Echelon, with both aircraft diverging from each other during the entry acceleration dive so they achieve a minimum of 50m spacing - line abreast at the point of pull up to the vertical. Closure to Echelon should not be commenced until both aircraft have recovered to level flight.

96. **Formation References**. Close formation aerobatics should be flown using the standard close formation references. However, a more swept echelon position, or the waiting position 2 spans out, may be used initially, as an aid to training and until confidence and ability has been achieved. A stretched Line Astern position should be used for barrel rolls flown in Line Astern.

97. **The Loop**. The Loop should be flown as follows:

a. **Entry**. The leader should enter at a speed 10kts to 30kts in excess of the normal singleton Loop airspeed with power set as per a standard Aerobatic Tailchase.

b. **RT**. RT should be used to give notice of the next manoeuvre. The leader should call “CALLSIGN, POSITIONING FOR A LOOP” and “CALLSIGN PULLING **UP**” (**UP** being the executive word). “LETTING **OUT**” may be used if reducing the pitch rate.

c. **Parameters**. Progressively pull to achieve 3g to 3½g by 20° to 30° nose up. Although g will reduce through the top of the loop, maintain positive g throughout the manoeuvre and ensure 3g to 3½g is smoothly regained during the recovery to level flight.

d. **Escape Manoeuvre**. If the wingman loses visual with the leader he is to pull to the light buffet while rolling away from the leader and call “CALLSIGN OUT BLIND.” He should fly into a safe area (if known) and call “CALLSIGN, LEVEL XXXXFT.” The leader, if still visual, is to call “CALLSIGN VISUAL” and direct the rejoin. If the leader is also blind he is to immediately establish a 500ft separation without going through the wingman’s level, then direct the rejoin.

98. **The Barrel Roll**. The barrel roll is flown as follows:

a. **Entry**. The leader should enter at a speed 10kts to 30kts in excess of the normal singleton Barrel Roll airspeed with power set as per a standard Aerobatic Tailchase.

b. **RT**. The leader should call “CALLSIGN, POSITIONING FOR A BARREL ROLL,” “CALLSIGN PULLING **UP**” and “CALLSIGN ROLLING **LEFT**/**RIGHT**” as required.

c. **Pitch and Roll**. Progressively pull to achieve 3g. At 30° to 40° nose up start to roll. Inverted the nose should be 15° to 20° above the horizon, and with ¾ of the roll completed the nose should not be lower than 30° nose down.

d. **Corrections**. If the nose is lower than expected, the roll rate should be increased and the g slightly eased to achieve a flatter barrel roll.

e. **Escape Manoeuvre**. If the wingman loses visual with the leader he is to pull to the light buffet while rolling away from the leader and call “CALLSIGN OUT BLIND.” He should fly into a safe area (if known) and call “CALLSIGN, LEVEL XXXXFT.” The leader, if still visual, is to call “CALLSIGN VISUAL” and direct the rejoin. If the leader is also blind he is to immediately establish a 500ft separation without going through the wingman’s level, then direct the rejoin.

99. **The Stall Turn**. Initial attempts at the stall turn should be flown in the direction easiest to stall turn the aircraft, which is dependent on propeller rotation.

a. **Entry**. The direction of stall turn dictates which side the wingman should be positioned in Echelon. The leader should stall turn away from the wingman. The leader should enter at normal stall turn speed with power set as per a standard Aerobatic Tailchase.

b. **RT**. The leader should call "CALLSIGN, ECHELON LEFT/RIGHT, ECHELON LEFT/RIGHT, GO. Once the wingman has acknowledged and moved to the correct side, the leader should call CALLSIGN, POSITIONING FOR A STALL TURN LEFT/RIGHT," "CALLSIGN PULLING **UP**" and "CALLSIGN RUDDER **LEFT**/**RIGHT**."

c. **Separation**. At the RT call "CALLSIGN, POSITIONING FOR A STALL TURN LEFT/RIGHT" both aircraft initiate a separation using a minimum of 10° AoB away from each other to ensure that 50m separation exists before the RT call "CALLSIGN PULLING **UP**."

d. **The Stall Turn**. Progressively pull to achieve 3½g to the vertical. The wingman should use the leader as the wingtip reference while yawing and take timing from the leader and his RT call for rudder. Maintain the leader as primary reference until recovered from the vertical down line.

e. **Escape Manoeuvre**. If the stall turn is mis-flown or if the wingman loses visual with the leader, he is to complete the vertical recovery or stall turn, recovering from the vertical into a safe area and call "CALLSIGN OUT BLIND, LEVEL XXXXFT." The leader, if still visual, is to call "CALLSIGN VISUAL" and direct the rejoin. If the leader is also blind he is to immediately establish a 500ft separation without going through the wingman's level, then direct the rejoin.

100. **STANDARD FORMATION HAND SIGNALS (* Denotes STANAG 3379)**

Ser	ACTION	DESCRIPTION OF SIGNAL	ACTION TO BE TAKEN AT
1	Acknowledgement of an airborne instruction	Thumb up or nod the head forward and back	
2	Running up	Hand raised, forefinger extended upwards and revolved in horizontal plane	Commencement of signal
3	Ready for take-off	Thumb up	
4	Commence formation take-off	Tap of the head followed by nod of the head as the brakes are released.	Nod of head
5	a. Increase power b. Decrease power	Positive forward movement of head. Positive backward movement of head.	Cessation of signal Cessation of signal
6	Turning	Forearm vertical, hand flat and parallel with line of flight, then moved right or left as appropriate	Cessation of signal
7	Straightening out	Chopping motion forward with edge of flat hand	Cessation of signal
8	* Flaps up or down	Hand flat, fingers forward; downward motion of hand from wrist to lower flaps; reverse motion to raise flaps	Nod of head
9	* Landing gear up or down	Closed hand held near top of canopy then moved vertically down and up 3 times	Nod of head
10	* Lead Change	Point with an index finger at the pilot who is to take the lead, then hold an open hand vertically at eye level with fingers together, and then move it horizontally forward with rotation to finish with hand held horizontally and arm fully extended. The pilot who is to take the lead acknowledges with a head nod and then manoeuvres to take the lead	Cessation of signal
11	Close formation or reform basic formation as briefed	Lateral rocking of aircraft	Cessation of signal
12	Relax close formation	Hand raised with palm outward, fingers together, palm pushing outwards towards wingman/men	Cessation of signal
13	* Go into echelon left or right	Point with an index finger at the pilot who is to change position, and then point at the new position to which this pilot is to move The pilot who is to change position acknowledges with a head nod and then manoeuvres to take the new position	Cessation of signal

Ser	ACTION	DESCRIPTION OF SIGNAL	ACTION TO BE TAKEN AT
14	Line astern	Clenched fist, thumb extended to rear, moving back and forth	Cessation of signal
15	Climbing	Forefinger pointing upwards	Cessation of signal
16	Descending	Forefinger pointing downwards	Cessation of signal
17	Levelling out	Sideways movement of either hand, palm down, fingers extended at face level	Cessation of signal
18	Break formation	Rapid sweeping movement of the open hand, palm forward, fingers upwards in front of the face	Cessation of signal
19	I am returning / you are to return to base	Point self/aircraft concerned, then point downwards	
		INFORMATIVE SIGNALS	
20	Your aircraft is on fire	Fly alongside and rock wings to attract attention of the pilot, then draw the edge of the hand across the throat in a cutting motion, afterwards pointing to the area of the fire	Continue this until acknowledged by a thumbs up
21	* Fuel state: a. Demand b. Reply	 Hold a closed hand in front of the face with thumb extended to touch the mouth and then rotate the hand slightly to simulate drinking from a cup. To indicate less than 10 minutes of fuel remaining, give the signal for "Desire to Land as soon as possible". To indicate a greater amount of fuel remaining, hold a closed hand at or above eye level with the appropriate number of fingers extended vertically as follows: 10 - 19 minutes I finger (index) 20 - 29 minutes 2 fingers 30 - 39 minutes 3 fingers 40 - 49 minutes 4 fingers 50 minutes or more 5 fingers (open hand)	
22	Engine Oil Temp not yet warm enough/ or in limits	Two Handed Capital T (T = Temp). Used to indicate not yet ready to taxy or not yet ready for engine test / run-up.	Followed by Thumbs Up when Ready.

Ser	ACTION	DESCRIPTION OF SIGNAL	ACTION TO BE TAKEN AT
		DISTRESS SIGNALS (DAY)	
23	* Bailing out	Hold closed hand(s) above the head and then move it (them) downward across the face to simulate pulling the ejection blind	
24	* Desire to land ASAP	Hold an open hand horizontally above the shoulder and then move it forward and downward to shoulder level finishing with a movement to simulate rounding out for landing	
25	Systems failure * HEFOM / PEFOM	Pilot will clench fist and hold it in to the top of the canopy; after passing this signal he will count out the required number of fingers to denote the system involved. The pilot receiving the signal will repeat it to show acknowledgement Hydraulics/Pneumatics - 1 finger Electrical - 2 fingers Fuel - 3 fingers Oxygen/Oil - 4 fingers MOTOR - 5 fingers Note: The HEFOM/PEFOM signals are to be used when radio contact is not possible. If either one finger is received or the intercepting pilot is unable to understand the signals of the pilot requiring assistance, then the intercepting pilot is to assume that the aircraft has one or more systems inoperative and is to proceed with extreme caution	
26	* Radio failure	Receiver failure — Tap earphone with an open hand and then move hand forward and backward over the ear position Transmit failure — Tap microphone with an open hand and then move hand up and down in front of the face	

RT AIDE MEMOIRE

101. This aide memoire is designed to provide an example of the RT calls on a typical early formation training sortie. It is not intended to be a substitute for SOPs, but a summary of the RT calls. The SOPs must be referred to in order to understand the significance and requirement for each specific RT call. The general principle is to keep the RT calls to the minimum number and length, to comply with the SOP and ensure clarity and understanding. In this example **FIREBIRD** is the callsign (CS) of a 3 ship formation.

Check In / Start / Frequency Change

1	2	3	ATC	Notes
Firebird	2	3	-	Note the CS transmitted alone is the request for the check in. Wingmen respond immediately with just their number.
Firebird, Loud and Clear	-	-	-	1 acknowledges he has heard. Acknowledgement is implied if 1 immediately transmits to a ground station.
Firebird, 30 secs, Air On, Switches On	-	-	-	Pre-Start warning to select Pneumatics and Electrics ON (Yak type aircraft)
Firebird, 10 secs, Prime	-	-	-	Pre-Start warning to prime the engine (most aircraft types)
Firebird, Start Start, GO	-	-	-	Press Start Button on word GO
Firebird, Manual 2, Manual 2, GO	-	-	-	Select briefed Manual 2 frequency and wait.
Firebird	2	3	-	1 checks in the formation on the new frequency.
North Weald Radio, Firebird Formation, 3 aircraft for Taxy	-	-	Firebird, North Weald Radio, Runway 20, QNH 1020, nothing to affect.	Normal RT call to ATC for the whole formation. The words Firebird Formation are used on the first RT call to ATC. Subsequently, the CS is just Firebird. Details of the aircraft in the formation are normally passed to ATC on booking out by phone/fax.
Firebird, Runway 20, QNH 1020.	-	-	-	Aircraft now taxy as briefed.

Break and Join

1	2	3	Notes
Firebird 2, clear break.	Firebird 2	-	1 has looked and cleared the airspace for 2 to break into.
-	Firebird 2, Out	-	2 breaks out to practice the break and join. He expects to get visual immediately so does not call Blind.

Firebird, Roger	-	-	-
-	Firebird 2, Visual	-	2 regained visual with 1 as expected, after the 3 sec break.
Firebird, Hdg 320° Firebird 2, Clear Join Vic (125kts)	Firebird 2, Clear Join Vic	-	2 joins the formation. (1 only calls his speed if it is different to the briefed cruise IAS)
Or			
-	Firebird 2, Blind, Level 3300ft	-	2 is not visual with 1 so calls Blind and his actual altitude/height
Firebird, Roger	-	-	1 now establishes a 500ft separation from 2 avoiding a climb or descent through 2's altitude/height. 1 directs 2 until he is visual and can rejoin.
Firebird 2, Turn left 190°, look 10 o'clock low 2 miles	Firebird 2, Visual	-	-
Firebird, Hdg 240°, Firebird 2 Clear Join Vic	Firebird 2, Clear Join Vic	-	-

Formation Change from Vic to Line Astern

1	2	3	Notes
Firebird, Line Astern, Line Astern, GO.	Firebird 2	3	It is a Formation Change Order. All movers acknowledge the Order and the first to respond uses the CS. (Firebird 2, 3).
-	-	Firebird 3, Clear	2 waits in position until he hears this call. Then he moves into the Line Astern position.
-	-	Firebird 3, In	1 now knows that 2 and 3 are in position in Line Astern

Formation Change from Line Astern to Vic

1	2	3	Notes
Firebird, Vic, Vic, GO.	Firebird 2	3	It is a Formation Change Order. All movers acknowledge the Order and the first to respond uses the CS. (Firebird 2, 3).
-	-	Firebird 3, Clear	2 waits in position until he hears this call. Then he checks he can see 3 clear, then moves into Vic. No need for an "In" call as 1 can see 2 and 3.

Formation Change from Vic to Echelon Right

1	2	3	Notes
Firebird, Echelon Right, Echelon Right, GO.	-	Firebird 3	It is a Formation Change Order. All movers acknowledge the Order and the first to respond uses the CS. (Firebird 3). Note only 3 is moving. No need to call "In" as 1 can see 3.

Formation Change from Vic to Echelon Right – wrong RT response example

1	2	3	Notes
Firebird, Echelon Right, Echelon Right, GO.	Firebird 2	-	It is a Formation Change Order. Only movers acknowledge the Order. Firebird 2 acknowledged by mistake.
Firebird, Stop Stop Stop Acknowledge.	Firebird 2	3	1 cancels the order and debriefs the error if necessary. Then re-issues the order.
Firebird, Echelon Right, Echelon Right, GO.	-	Firebird 3	Correct response.

Fuel RT Call

1	2	3	Notes
-	Firebird 2, Fuel 1	-	Fuel or Bingo calls are not initiated by 1.
Firebird 2, Your Fuel 1 Acknowledged .	-		1 now knows 2 has the lowest fuel level.
-	-	Firebird 3, Fuel 1 minus 5	3 realises he has missed calling Fuel 1 and is at a lower fuel than 2. "If you can't be accurate you must be honest"
Firebird 3, Your Fuel 1 minus 5 Acknowledged	-	-	1 now knows 3 has the lowest fuel level and 1 can plan the remaining sortie accordingly..

Tailchase

1	2	3	Notes
Firebird, 1 minute to Tailchase, HASELL	-	-	**Preparation call**. 1, 2 and 3 complete HASELL checks
Firebird, Base 3200ft, Ceiling 5300ft on 1024 hPa, Acknowledge	Firebird 2, Base 3200ft, Ceiling 5300ft, On 1024 hPa	Firebird 3, Base 3200ft, Ceiling 5300ft, On 1024 hPa	**Limitation call**. Limits declared and acknowledged. Ceiling only declared if tailchasing below Controlled Airspace (CAS)

Firebird, Power set (for xxx), Follow Me for Tailchase, GO	-	-	**Execution call**. 1 breaks on the order GO. 2 and 3 follow at briefed interval normally 2 secs. Power set depends on aircraft type. (Full power, specific power, or power for specified speed S+L).
-	-	Firebird 3, In	3 calls in indicating that 2 and 3 are established in the tailchase.
Firebird, Roger	-	-	1 starts briefed manoeuvres.
-	Firebird 2, Out, 1 Go left	*(follows 2)*	2 is Out if <50m or the 4-8 o'clock cone limit. 3 follows 2. 2 should direct 1 to allow him to get In. (Firebird 2, Out, 1 Go left)
Firebird, Roger Turning left.	-	-	-
-	Firebird 2, In	-	-
Firebird, Roger	-	-	1 continues with tailchase as briefed
-	Firebird 2, Out Blind	*(follows 2)*	2 is Out Blind (having lost 1)
Firebird, Roger	-	-	2 flies to safe area
-	Firebird 2, Level 3500ft	*(follows 2)*	In a safe area S+L with his height/altitude declared 2 searches for 1.
Firebird, Roger	-	-	1 establishes 500ft separation from 2 without going through his height/altitude. 2 finds 1.
-	Firebird 2, Visual, 1 Turn left	*(follows 2)*	2 directs 1 to allow him to get In promptly.
Firebird, Roger Turning left.	-	-	-
-	Firebird 2 In	*(follows 2)*	-
Firebird, Roger	-	-	1 continues tailchase as briefed
Knock it Off, Knock it Off, Firebird, Knock It Off	Knock it Off, Firebird 2	Knock it Off, Firebird 3	Emergency Cessation of the Tailchase – called by anyone in the formation in response to a threat or aircraft emergency.
Firebird, Terminate, Terminate.	Terminate, Firebird 2	Terminate, Firebird 3	Normal Cessation of Tailchase.
Firebird, Turning Join Left. Firebird 2 clear Join Vic	Firebird 2, Clear Join Vic	-	1 clears 2 to join then 3 to join in turn.

Change Lead – (in Echelon Right)

1	2	3	Notes
Firebird 2, Position 5 nm North of Clacton, Squawk 7004, You Have the Lead	Firebird 2	-	2 eases out to 2 spans and accelerates to overtake 1. 3 goes with 2. On passing 1, 2 makes the next call to accept the lead. Only the leader squawks and should be transferred with Lead.
-	Firebird 2, Squawk 7004, I have the Lead	-	If required Firebird renumbers
3	Firebird, Renumber	2	2 now becomes 1 and the other aircraft move up one, the former leader becoming 3, or the aircraft renumber in a pre-briefed sequence.
Firebird 3, Clear Join Vic	-	Firebird 3, Clear Join Vic	The former leader now rejoins as 3 or the pre-briefed number.

Recovery for RIAB (Run In And Break), Landing, Taxy and Shutdown at an airfield with an Aerodrome Flight Information Service (eg North Weald)

1	2	3	ATC	Notes
Firebird, Manual 2, Manual 2, GO	-	-	-	Change frequency for recovery to North Weald
Firebird	2	3	-	Leader calls for check-in on new frequency
North Weald, Firebird Formation, Inbound from the East, request airfield information	-	-	Firebird, Runway 20, QFE 1016, Circuit clear	-
Firebird Roger, Runway 20, QFE 1016	-	-	-	1 looks at 2 and 3 who give thumbs up to indicate QFE is set
North Weald, Firebird, 3 mins from the East, Request circuit traffic.	-	-	Firebird, 1 aircraft on finals. Nothing further to affect	1 checks circuit traffic
Firebird Running In/ /Left Base for the Break	-	-	Firebird, the aircraft has landed. Nothing to affect	-

Firebird, Echelon Left, Echelon Left, GO	Firebird 2	-	-	1 calls 2 to go into echelon in preparation for the break. 1 might use a hand signal if the RT is busy.
Firebird, 3 aircraft on the Break to Land	-	-	Firebird, nothing to affect.	This call replaces the Downwind RT call for the whole formation
Firebird, Landing in the order 1 3 2	-	-	Firebird Roger	An information call, so ATC is not confused by subsequent final calls.
Firebird 1, Final	-	-	Firebird 1, nothing to affect	Individual Final Calls
-	-	Firebird 3, Final	Firebird 3, nothing to affect	-
-	Firebird 2, Final	-	Firebird 2, nothing to affect	-
-	Firebird Runway Vacated	-	Firebird Roger	Last aircraft to vacate calls vacated for the formation.
Firebird, Manual 1, Manual 1, GO	-	-	-	After arriving in dispersal, change to formation frequency for formation shutdown. Alternatively can be done by hand signals while remaining on ATC frequency
Firebird	2	3	-	-
Firebird, 15 secs to shutdown	-	-	-	Information call, run up engine if required by shutdown procedure.
Firebird, Idle, Idle, GO	-	-	-	Idle engine
Firebird, Cut, Cut, GO	-	-	-	Mixture to Cut Off / Shutdown engine

RT Pro-words and their Meanings

Pro-Word	Meaning	Notes/Context
Buster	I have full power and cannot stay in or Select full power	Called by wingman if leader is not giving sufficient power margin to wingmen
Bullseye	The pre-briefed reference location or navigation position.	Used for position reporting with reference to the Bullseye. Eg. "Bullseye 100/12"
Tumbleweed	Loss of SA, Overloaded, Confused	Used to express that you have "lost the plot"
Bogey	Unknown aircraft	-
Bandit	Enemy aircraft	-
Tally	Visual with Bogey/Bandit aircraft	-
No-Joy	Not Visual with Bogey/Bandit ac	-
Visual	Visual with Friendly aircraft	-
Blind	Not Visual with Friendly aircraft	-
Counter	Buster & turn into the Bogey/Bandit	-
Ziplip	Silence Please	-

PART 2 - TACTICAL FORMATION

INTRODUCTION

102. Tactical formation is entirely the domain of military flying, much of which leads naturally onto the art of Air Combat Manoeuvring (ACM). Since the techniques and procedures can have valid application for formation flying in general they are included in this SOP for both completeness and interest. Tactical Formation should be taught as required by military or ex-military instructors with relevant experience.

103. Tactical formations are planned and flown to achieve as good a defensive posture as possible. Such a posture will depend on how many aircraft are involved and the profile of the sortie. A 2-Ship in line abreast at 500 to 1000m spacing may achieve good rearwards lookout but is relatively unwieldy in turns. The same 2-Ship in long line astern is easily manoeuvred but cross cover is severely limited. Compromise formations are selected, therefore, to give optimum defensive cover and many are developed as the most appropriate for a task or particular aircraft type. The following procedures detail three simple tactical formations from which more advanced tactical formations are developed. In the civilian flying domain, tactical formation can improve lookout, situational awareness and hence reduce the risk of mid-air collision.

CONSIDERATIONS

104. **Range Estimation**. Range estimation improves with experience. Even so, exact distances tend to be a matter of opinion and cannot be assessed with any degree of accuracy. Distance may more readily be described as “a bit too close” or “rather wide.” The correct spacing will become second nature with practice. Since this terminology cannot be used in a written description, distances are described here more precisely.

AIRMANSHIP

105. **Lookout**. The purpose of tactical formation is to take advantage of good lookout. The No 1 is responsible for the conduct and safety of the formation but relies on his wingmen to give warning of other aircraft be they benign or represent a threat. Reports to the leader must be quick and accurate giving all the essential information in a dispassionate and unemotional manner.

106. **Slipstream**. Aircraft in formation should take care to avoid the slipstream of other formation members, especially when passing behind a manoeuvring aircraft that may be generating strong wing-tip vortices and create dangerous control difficulties.

107. **Terrain and Collision Avoidance**. Every pilot in a tactical formation is responsible for maintaining a safe distance from other aircraft in the formation and from the terrain. It is particularly important to be aware of the briefed formation minima and minimum altitudes or heights.

108. **Sighting Reports**. A thorough lookout for threat aircraft must be maintained. All aircraft, whether believed to be a threat or not, must be reported to the leader on the formation discrete frequency. When operating on an ATC frequency, only those aircraft sighted that represent a collision risk should be reported. Sighting reports should be given as follows:

a. Callsign of reporting aircraft

b. Left/Right and Clock Code.

c. High, low or level.

d. Range.

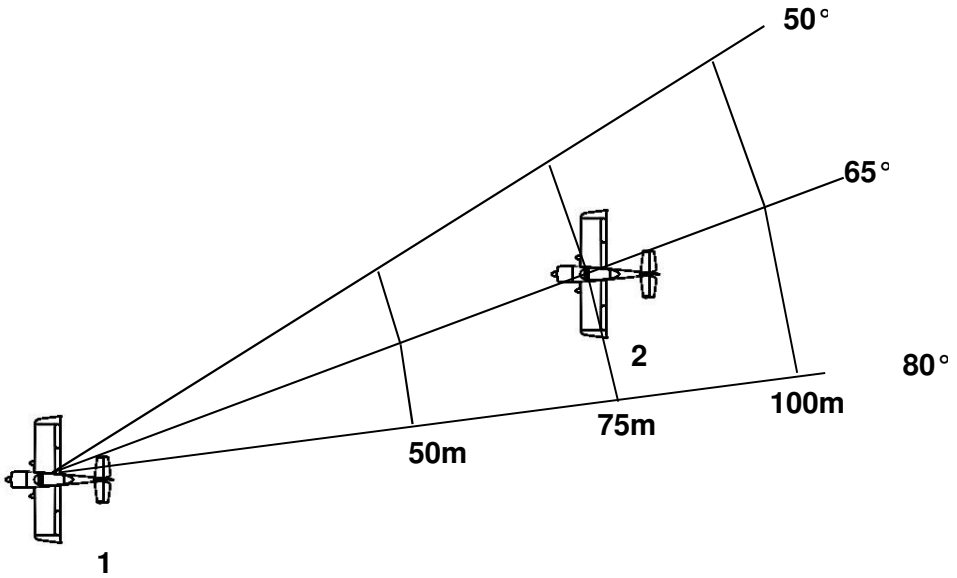
e. Type and Number of aircraft.

f. What the sighted aircraft are doing or assessment of the threat.

FIGHTING WING

109. **General Procedures**. Pilots should not fly fighting wing in formations of more than 2 aircraft. The principle of fighting wing is to provide the formation pair with improved manoeuvrability and lookout whilst maintaining a planned airspeed. Fighting wing is a useful formation for long transits or could be utilised when escorting an aircraft with an emergency.

110. **Station Keeping – The Fighting Wing Cone**. The fighting wing cone is 50 to 100 metres range and 50° - 80° sweep. The No 2 should aim to fly at 65° swept on the leader at an ideal range of 75 metres. The wingman is free to manoeuvre within the cone but at low-level (below 2000ft agl), the wingman must remain above the leader. The wingman may position on either side of the leader and may cross-over during turns to maintain formation integrity.



111. **Collision Avoidance**. The leader will not always call turns in fighting wing; the wingman is responsible for avoiding the leader. However, the leader must take care when initiating turns towards the wingman, who may not be monitoring the leader at that moment. The leader should also provide a reasonably stable platform, avoiding any unpredictable manoeuvres. In side-by-side seating aircraft, there is the possibility of the wingman losing sight of the leader during a turn due to the wide coaming of the aircraft. It is essential to maintain visual contact with the leader or break clear if visual contact is lost. When instructing fighting wing, good in-cockpit communication is vital. If either pilot or instructor loses sight he should inform the other occupant immediately.

112. **Lookout**. Both leader and wingman are responsible for lookout. Pilots should use the clock-code relative to their own aircraft to report other aircraft. The work-cycle for maintaining fighting wing as the wingman is: Lookout, Leader, Speed. The duty of the wingman is to: Stick, Search and Report any other aircraft seen to the leader.

113. **Aircraft Lights, Transponder and ACAS Procedures**. High Intensity Strobe Lights (HISL), if fitted, should be selected ON during Fighting Wing formation. The leader should squawk and have ACAS selected ON (if fitted). The wingman should select squawk to SBY or OFF and ACAS OFF to reduce the number of ACAS alerts within the formation.

114. **Changing the Lead**. Lead changes are done using an in-place turn of at least 90° to alter the relative positions of the leader and wingman. This may occur at a pre-planned turning point or away from a route as an “in-place” turn:

a. As the formation approaches the turning point, the wingman positions on the inside of the impending turn. Over the turning point, the leader hands over the lead by calling “CALLSIGN, YOU HAVE THE LEAD.” For off-route lead changes the leader will call “CALLSIGN IN PLACE 90 LEFT/RIGHT, CALLSIGN YOU HAVE THE LEAD.”

b. The new leader acknowledges by saying “CALLSIGN, I HAVE THE LEAD.” As the new leader is now behind the new wingman, it is essential to turn without delay. The new wingman is now responsible for collision avoidance; he initiates his turn when he sees the new leader turn. As he is on the outside of the turn and flying a larger radius, he will drop back. If required, the formation may then renumber although this is not essential.

115. **Weather Avoidance at Low Level**. Early decision making to avoid poor weather is always preferable to rejoining close formation and climbing as a pair.

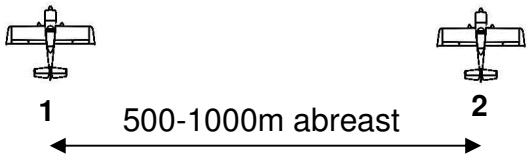
116. **Joining Close Formation**. If flying below 2000ft agl, joining formation is the only time the wingman flies below the leader, and the leader must ensure that it is safe for the wingman to close up slightly low. The techniques for joining close formation are identical to those for medium level joins. As the wingman closes within 50m, High Intensity Strobes Lights (HISL) should be selected OFF or to RED.

117. **Fighting Wing Run-in and Break**. The wingman positions on the opposite side to the break direction and the leader breaks first and away from the wingman. The wingman breaks at the briefed interval but not less than 2 seconds after the leader.

DEFENSIVE BATTLE

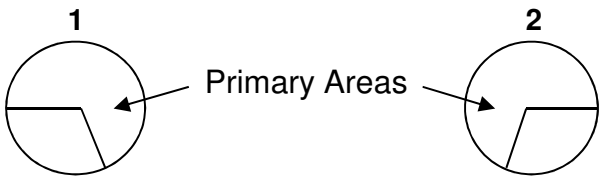
118. **General Procedures**. Defensive battle formation may be flown by 2, 3 or 4 aircraft. Where more than 2 aircraft are involved the additional aircraft fly in fighting wing on one of the aircraft in defensive battle. The principle of defensive battle is to provide the formation with improved lookout and cross cover whilst maintaining a planned route and airspeed. Defensive battle is a useful formation for long transits at medium altitudes or at low level over flat terrain.

119. **Station Keeping Line Abreast**. The defensive battle configuration for 2 aircraft is shown below. The actual distance apart depends on visibility (and in the military context the expected weapons threat). Once the distance has been set, any convergence or divergence must be countered continuously. For civilian formations a suitable spacing is shown below and should be defined more precisely in the aircraft specific Annex.



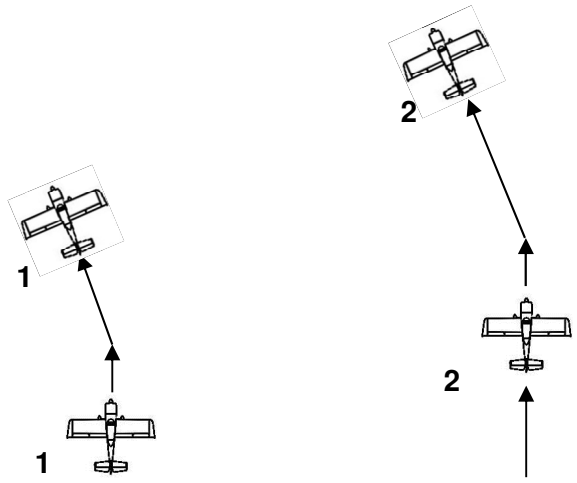
120. **Collision Avoidance**. A Minimum Separation Distance (MSD) of 50m should be maintained at all times between aircraft or elements in defensive battle formation. This especially applies during crossover turns and manoeuvring. The general principle is that the No 2 or subordinate element in defensive battle is responsible for collision avoidance with the leader or lead element. However, the "Outside Man" is responsible for collision avoidance in turns and should go High if necessary. It is essential for each aircraft or element to maintain visual contact with each other. If visual contact is lost it should be reported immediately. When instructing battle formation, good in-cockpit communication is vital. If either pilot or instructor loses sight he should inform the other occupant immediately.

121. **Lookout and Search Areas**. Areas of responsibility and lookout sectors are shown below. Pilots should spend ¾ of their time searching their primary area and the rest searching the remainder of the sky. The lookout scan must include the entire sky, vertically as well as level.



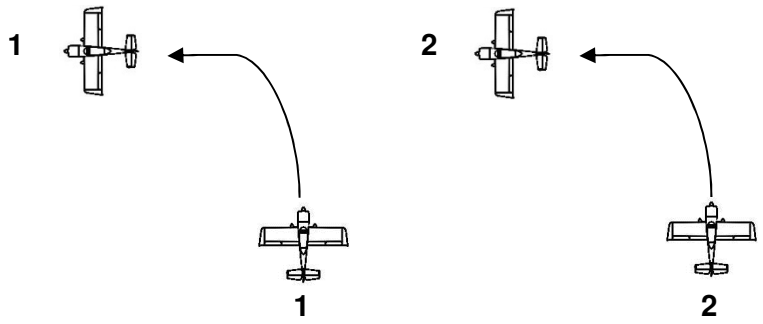
Lookout Responsibilities

122. **Defensive Battle Turns**. All turns and manoeuvres in defensive battle should be flown at the same angle of bank (AoB) and speed by all aircraft in the formation. 45° AoB using power to maintain speed is the normal SOP, however, when experienced or flying high powered aircraft 60° AoB, 2g turns may be used. The specific aircraft type Annex should detail the SOP for that aircraft and it should be detailed in the formation briefing. On a pre-planned route, turns will not normally be called. The leader will fly the briefed route and the other aircraft or elements should anticipate the turns and remain on station. A 2-aircraft turn through 25° to the left, with No 2 anticipating the turn is shown below. This is an in-place turn.



Pre-planned In Place Left Turn

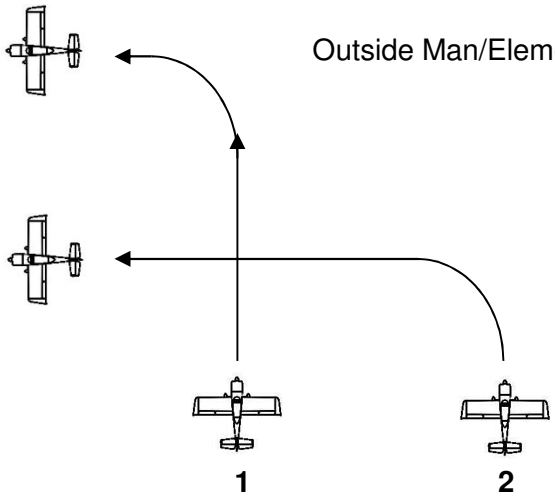
123. **In Place Turns**. 'In Place' turns involve all aircraft turning simultaneously through the appropriate number of degrees. Navigational turns will normally be of 30° or less and will require a small amount of manoeuvring if it is intended to remain in place. Larger turns require more anticipation to remain in place or may be used to regain formation integrity. A 90° in place turn is illustrated below.



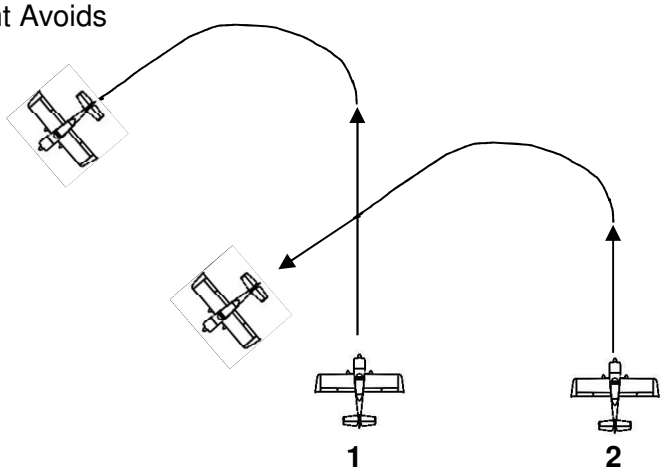
In Place 90° Left Turn

124. **Crossover Turns**. A crossover turn involves the aircraft or elements switching sides during the turn and so flying the same length of ground track. The 2 main techniques are outlined below.

a. **Variable Delay Turns**. When making turns of greater than 60° and up to 180°, a variable delay may be employed as shown below. For a 2 aircraft formation, the outside aircraft initiates the turn and is responsible for collision avoidance. The inside aircraft delays, commencing the turn based upon the visual aspect and position of the other aircraft. For a 180° turn (a turnabout) no delay is necessary and both aircraft turn simultaneously. It follows that the delay becomes progressively greater for turns of less than 180° down to 61°. The 90° delay may be used as a yardstick for judging the time to allow initially but accurate timings will come with increasing experience. Variable delay turns of 90° and 150° are illustrated below. When initiated by RT the call "CALLSIGN, 90 LEFT, 90 LEFT, GO" (or appropriate no of degrees) is used. The "Outside Man" is always responsible for collision avoidance and goes High if necessary.



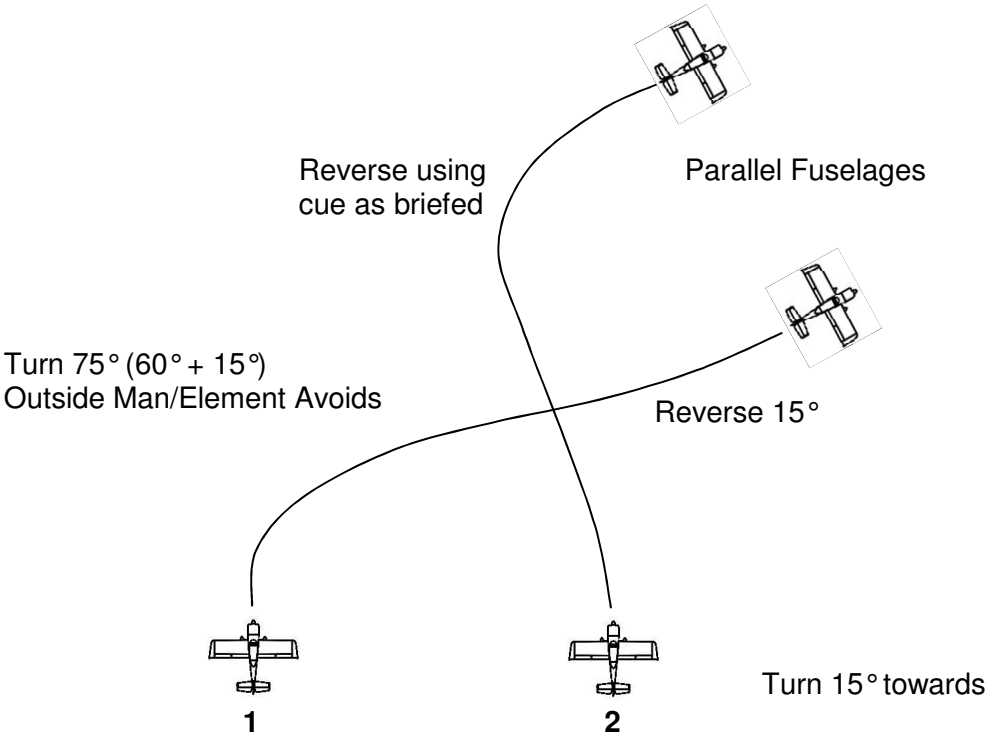
Variable Delay Turn 90° Left



Variable Delay Turn 150° Left

b. **Assisted Turns**. Assisted turns are generally used for turns between 30° and 60°. Assistance in this context, is defined as an additional compensatory turn to assist in final positioning. By applying the right amount of assistance, the length of ground track is the same for both aircraft and the manoeuvre ensures both roll out close to the correct spacing. As a rule of thumb, the amount of assistance needed is calculated by halving the difference between the required turn and 90°. As shown in the table below. A 60° right assisted turn is also illustrated below.

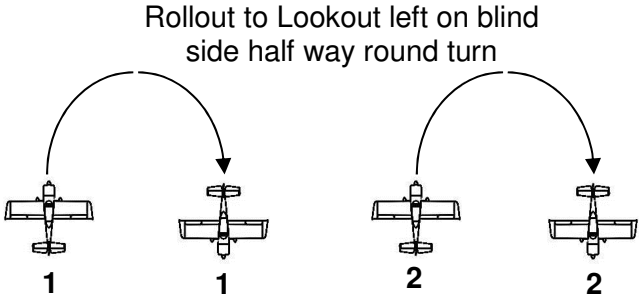
Degrees of Turn	Assistance Required
30	30
45	20
60	15



60° Right Assisted Turn

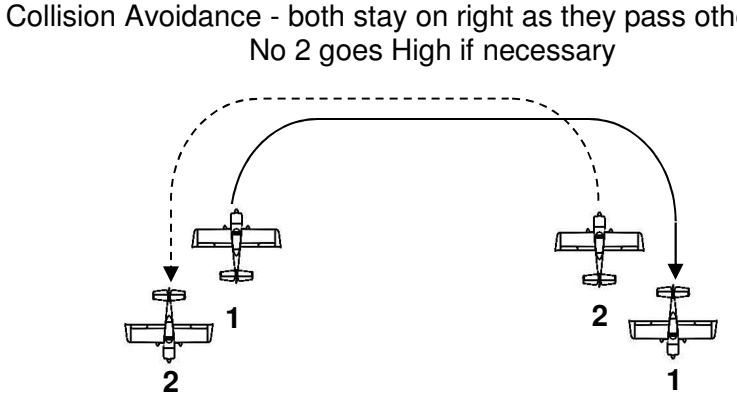
125. **Defensive Battle Manoeuvring**. Whilst turns may be planned or called during a specific navigation route, there will be times the leader will need to positively control the formation and execute turns. In the military context this might be to counter the threat from enemy ground or air assets. In the civil context, it may be the need to re-route the formation due to weather, ATC requirements, or in order to avoid an Airprox with a third party aircraft. The following are the SOP manoeuvres:

a. **Turnabout**. A turnabout is a 180° turn with both aircraft turning in the same direction simultaneously. Initiated by the RT call "CALLSIGN, TURNABOUT RIGHT, TURNABOUT RIGHT, GO" for a turnabout right. At the 90° point both aircraft should roll out briefly to lookout and check the blind side. There is also a risk in the second half of the turnabout, if the outside aircraft (now belly up to the other aircraft) slackens the turn significantly. The inside aircraft must lookout into the turn to ensure separation is maintained. This issue should be emphasised in the formation briefing.



Turnabout Right

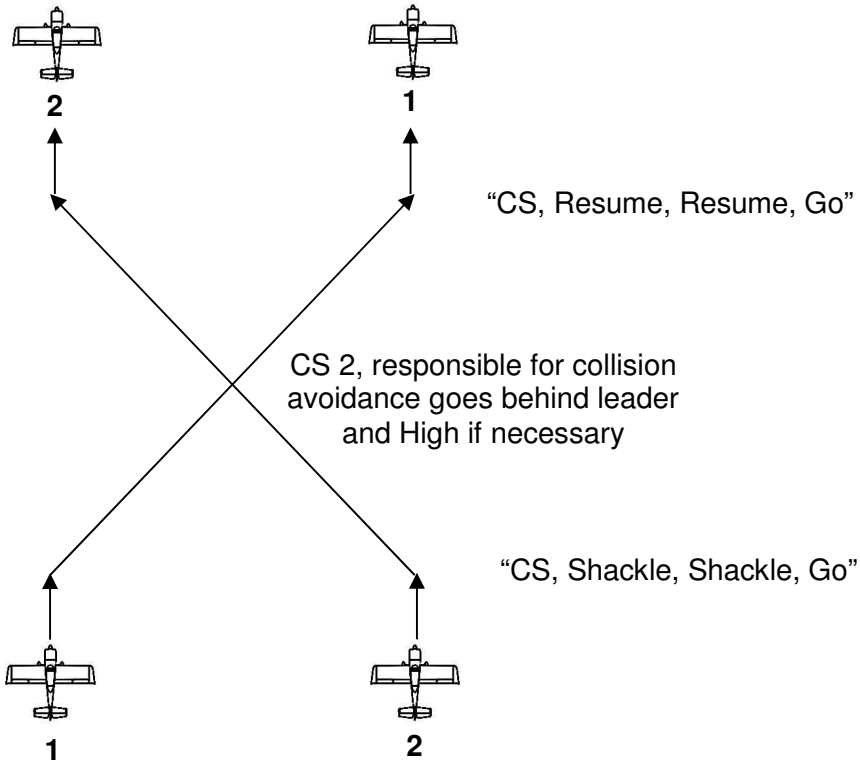
b. **Rotate**. A rotate is similar to a turnabout except both aircraft turn towards each other. Normal rules of the air apply for collision avoidance and each aircraft passes to the right of the other. No 2 has ultimate collision avoidance responsibility and goes High if necessary. A rotate is initiated by the RT call "CALLSIGN, ROTATE, ROTATE, GO"



Rotate

c. **Track**. Following any manoeuvre the leader may need to adjust the formation's direction for navigation purposes. For example the leader simply calls "CALLSIGN TRACK 270" to indicate the direction being maintained. This assists the formation maintain position. Alternatively, a track call may be included in a manoeuvre call such as, "CALLSIGN, ROTATE, ROTATE, TRACK 270, GO."

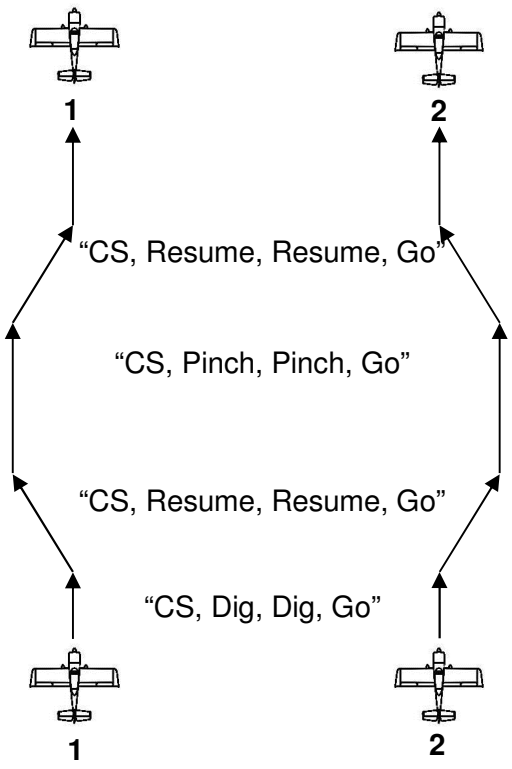
d. **Shackle**. A shackle is used to swap line abreast positions while maintaining track. It is initiated by calling "CALLSIGN, SHACKLE, SHACKLE, GO." Both aircraft turn simultaneously through 45° towards each other; the subordinate aircraft has collision avoidance responsibility and should pass behind and above the leader. The leader initiates a rollout by making a positive turn back onto the original track. Alternatively, the leader may call "CALLSIGN, RESUME, RESUME, GO."



Shackle

e. **Dig**. A dig call is used to widen the lateral spacing between aircraft. Both aircraft turn 30° away from each other until instructed to "RESUME." A dig is initiated by RT with the call; "CALLSIGN, DIG, DIG, GO."

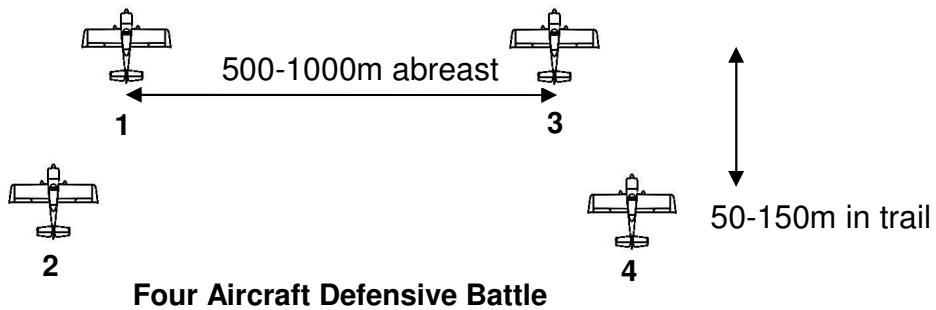
f. **Pinch**. A pinch call is used to reduce the spacing between aircraft. Both aircraft should turn 30° towards each other until instructed to "RESUME." A pinch is initiated by RT with the call; "CALLSIGN, PINCH, PINCH, GO."



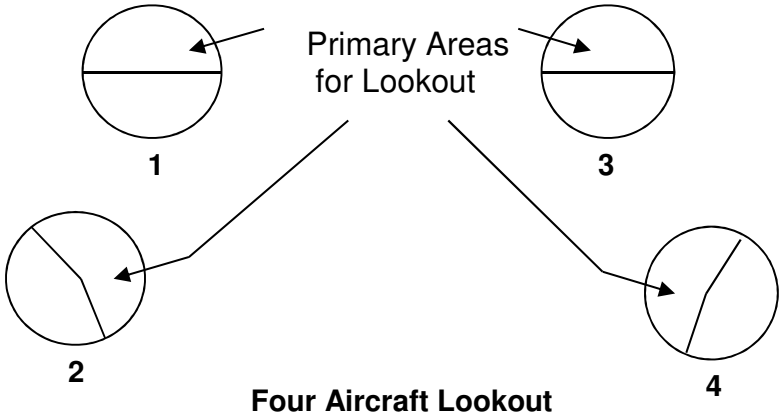
Dig, Pinch and Resume

g. **Resume**. A resume call is normally used to cancel a dig or pinch manoeuvre. It may also be used to resume track after a shackle or any other manoeuvre. A resume is initiated by RT with the call; "CALLSIGN, RESUME, RESUME, GO."

126. **Four Aircraft Profiles**. The 4 aircraft battle formation is, essentially, 2 mirrored elements of fighting wing abreast in which the Nos 2 and No 4 may, if required, assume a slightly longer trail position. The principles for turns and manoeuvring in 4 ship Battle Formation remain the same as for a 2 ship formation. The element wingmen remain on the outside of the formation and comply with the same collision avoidance rules as per a 2 ship formation. The profile and lookout areas of responsibility are illustrated below.



Four Aircraft Defensive Battle



Four Aircraft Lookout

127. **Defensive Battle Run-in and Break**. If required by time or circuit pattern limitations, a defensive battle formation should change to close formation for recovery and RIAB as per close formation procedures. Otherwise defensive battle formations should maintain position when joining the circuit but should close up to not more than 800m abreast. The formation breaks in numerical order or as briefed.

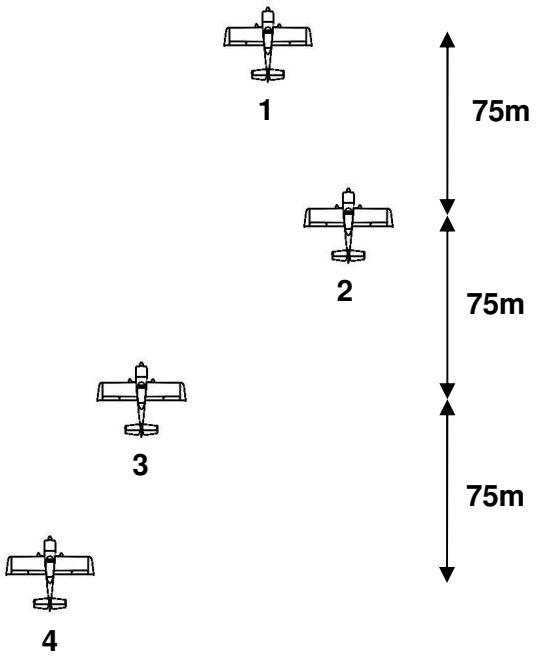
a. **2-Ship Formation**. For a 2-ship formation, with the No 1 on the inside of the formation, both aircraft break at the same time. When No 1 is on the outside of the formation, No 2 should delay for the briefed interval or until the leader has cleared the 12 o'clock.

b. **4-Ship Formation**. For a 4-ship formation, the No 2 should delay his break for the briefed interval or until the leader has cleared the 12 o'clock position. If on the outside, the No 3 should break at the same time as No 2; if on the inside, the No 3 should delay until both the Nos 1 and 2 have cleared the 12 o'clock position. The No 4 should delay for the briefed interval or until the No 3 has cleared the 12 o'clock.

ARROW

128. **General Procedures**. Arrow formation is used for manoeuvring a 4 aircraft formation in poor weather conditions or restricted airspace and is illustrated below. Rearward lookout is restricted but flexibility remains high. The No 2 should position at 65° to 75° sweep at 75m spacing. This is similar to fighting wing but the No 2 is now fixed to that sweep and spacing and must not change sides. No 3 positions on the other side of the leader at 65° to 75° sweep and double the rearwards spacing of No 2 (150m in this example). No 4 spaces himself outside the No 3, again at 65° to 75° sweep and 75m spacing behind No 3.

129. **Turns**. Individual aircraft maintain longitudinal separation, do not normally change sides when turning and will manoeuvre in plane. This makes Arrow less manoeuvrable than Fighting Wing and the leader must plan turns within the available height to avoid units changing sides.



ARROW FORMATION

130. **Arrow Run-in and Break**. If required by time or circuit pattern limitations, an arrow formation should change to close formation for recovery and RIAB as per close formation procedures. Otherwise arrow formations should maintain arrow formation and break in numerical order. The No 2 breaks after the briefed interval or when the leader has cleared the 12 o'clock, the remaining aircraft break after the briefed intervals.

JOINING CLOSE FORMATION FROM A TACTICAL FORMATION

131. **General**. Occasions may arise when it is desirable to close up a tactical formation for: ease of manoeuvre in difficult terrain, cloud penetration, or a set-piece break into the visual circuit. A simple technique for changing into Close Echelon from a 4-ship Defensive Battle and Arrow is described below. The techniques may be applied to other tactical formations. The guiding principle is that separate elements always stay together as a unit (eg. No 2 with No 1 and No 4 with No 3). For this reason, the sequence of aircraft will be seen to differ from that produced by manoeuvring a basic close formation into Echelon from Vic or Box. This is not a departure from the principle of 'minimum change', but it produces sequential numbering as a by-product of retaining integrity of tactical formations.

132. **Defensive Battle to Fighting Wing** / **Arrow**. A 2-ship formation in Defensive Battle should be called into Fighting Wing. A 4-ship formation should be called into Arrow.

133. **Arrow to Close**. A 4-ship formation in Arrow may be called into Finger Four or Echelon as required. If called into Finger Four, a subsequent move into Echelon may result in non-sequential numbering (1,3,4,2) for the break, as per close formation procedures. If the formation is called into Echelon directly from Arrow, the numbering for the break will be in numerical sequence (1,2,3,4). On the call into Echelon from Arrow, No 2 moves into Close Echelon on the side required, No 4 moves to the Echelon side required and then No 3 and 4 move into Close Echelon formation on No 2.

134. **Fighting Wing to Close**. A 2-ship formation in Fighting Wing may be closed up into close formation for a break from Echelon, or conduct a Fighting Wing break, as required by the leader.

BOUNCE

135. **General Procedures**. A single bounce aircraft may be used to test a tactical formation's lookout and formation integrity. A bounce is not intended to attack a formation but present itself at points along the formation's planned route to represent a threat aircraft. The formation may then practice sighting reports and the leader should initiate a formation manoeuvre to counter the potential threat. In the civilian domain this should represent a single turn to eliminate the simulated threat of an airprox.

136. **Briefing**. The use of a bounce aircraft during tactical formation requires a face-to-face briefing between the bounce pilot and the formation leader. The following items must be covered at the briefing:

a. **Formation Domestics**. The number of aircraft, description and registration details of all aircraft in the formation and those of the bounce aircraft.

b. **Bounce Box Locations**. The point locations or box areas where the bounce aircraft may encounter the formation and the timings at those locations or box areas.

c. **Sanctuary Altitudes or Heights**. The altitude or heights the bounce may operate at the point locations or box areas. The minimum deconfliction sanctuary height should be 500ft higher or lower than the formation's intended altitude or height. The bounce must not approach the formation at less than the briefed sanctuary vertical separation.

d. **Radio Procedures**. The formation operating frequencies and callsign and the callsign of the bounce aircraft are to be briefed.

e. **Safety Procedures**. The following procedures should be adhered to when operating a formation with a bounce aircraft and must be covered in the face-to-face brief:

(1) **Weather**. The minimum weather conditions for operating a bounce aircraft with a tactical formation are, 8km visibility, 1000ft clear of cloud vertically and 1500m clear of cloud horizontally. If the formation or the bounce aircraft cannot maintain these criteria the bounce is not to attempt to approach the formation.

(2) **Radio**. The bounce must establish RT contact with the formation leader before each individual attempt to approach the formation. The leader is to confirm the sanctuary altitudes or heights and positively clear the bounce to approach the formation. If the sanctuary altitudes or heights have to be changed due to weather this must be relayed to the bounce aircraft and a positive acknowledgement obtained.

(3) **Terminate and Knock it Off Calls**. At the end of the final bounce approach, or earlier if the formation leader requires, he is to inform the bounce the exercise is terminated by the call "CALLSIGN BOUNCE, TERMINATE, TERMINATE." The bounce is to acknowledge by responding with his callsign "CALLSIGN BOUNCE, TERMINATE, TERMINATE." In the event of an emergency need to cease the bounce exercise the leader or any callsign may transmit "KNOCK IT OFF, KNOCK IT OFF, CALLSIGN, BOUNCE, KNOCK IT OFF" The bounce is to acknowledge by responding with his callsign "CALLSIGN BOUNCE KNOCK IT OFF"