



Australian Warbirds Association Ltd

Formation and Safety Team (FAST)

Training and Standard Operating Procedures Manual

Overview

Formation flight is defined as two or more aircraft travelling or manoeuvring together in a disciplined, synchronized, and pre-determined manner. Formation flight is a fun and challenging skill that with proper training, preparation, planning, briefing, and de-briefing can be safely conducted by most pilots. It is a collective effort in which members must meet their individual responsibilities - from start-up through to takeoff, manoeuvring, landing, and shutdown - to ensure the success of the team as a whole. A formation that performs in concert is a thrill to participate in, but a formation that lacks discipline will degenerate into an uncoordinated, haphazard, scary, and dangerous gaggle of aircraft which may or may not be going the same way on the same day.

Scope

This manual describes the AWAL formation standard operating procedures. It is intended as a supplement to FAST documents outlining standard FAST procedures as noted under References.

Objective

The aim is to standardize Formation Flying Procedures and Policies in use within AWAL. Wherever possible all members should operate in accordance with FAST procedures and this manual. Should pilots wish to operate differently it should be thoroughly planned and briefed to all formation members prior to flight.

These procedures are specifically designed for formations of like aircraft types. Formations involving different aircraft types will require specific considerations and briefing to ensure all positions and manoeuvring are safe for all pilots.

Responsibilities

All pilots conducting formation flight operations in conjunction or affiliation with AWAL accept responsibility for adhering to these procedures (unless otherwise briefed before flight). In addition, as part of this program each pilot must accept responsibility for ensuring they are safe to conduct formation flight operations and for the safe conduct of any such flights.

References

- FAST Publications (see www.flyfast.org)
- The Formation Pilot's Knowledge Guide
- FAST Foundations and Principles
- FAST Radio Communication and Visual Signals
- T-34 Formation Flight Manual
- New Zealand Warbirds Formation Flight Training – Standard Operating Procedures

Prerequisites

The following is required to commence formation training using the FAST procedures under AWAL:

At least a Private Pilot's License and all approvals/endorsements applicable to the type of aircraft flown
A formation endorsement recognized by the Civil Aviation Safety Authority
Current 'Flying' membership in the Australian Warbirds Association Ltd

Introduction

- 1.1 General procedures for formation flight maneuvers and communication are in the referenced FAST publications.
- 1.2 These procedures are provided to:
 - a. Clarify, enhance, or supplement general FAST procedures
 - b. State differences adopted by AWAL
 - c. Standardize procedures not defined in FAST
 - d. State any specific procedures

2. General Procedures

2.1 This section lists general FAST-compatible procedures used by AWAL, applicable to all aircraft types. Standard operating practices will utilize the procedures described herein as well as those in FAST publications, including radio communications and visual signals. Any differences must be briefed.

2.2 AWAL Formation Qualifications

The requirements for each qualification and the standards for proficiency are as detailed in the FAST publications.

- 2.2.1 AWAL has adopted the following formation qualifications:
- Wing Pilot
 - 2 Ship Flight Lead
 - 4 Ship Flight Lead
 - Check Pilot

2.2.2 Lead Pilot Role and Responsibilities

Lead pilots are responsible for planning, communicating and conducting the elements of a safe and smooth formation flight. A good Flight Lead is reliable, predictable and consistent. Maintaining these traits, particularly in roll rate and pitch changes, makes it easier for wing pilots to maintain position, thus building confidence as a team. The Lead pilot is responsible for the lookout, safe manoeuvring and radio communication of the entire formation. The Lead should pass on necessary information to maintain the wingman's sense of situational awareness necessary for safe operation of their aircraft.

2.2.3 Wing Pilot Role and Responsibilities

Wing pilots are responsible for the safe operation of their own aircraft and to maintain safe, reliable station keeping. Should the wingman have any difficulties they should be immediately communicated to the Lead, and other members of the formation.

2.2.4 Collision Avoidance

The standard collision avoidance responsibilities are that the higher formation number is responsible for maintaining visual contact, and avoiding, a lower number in the formation. This does not absolve a pilot from the responsibility of safe aircraft operation, and ensuring their flight path is clear. Collision avoidance is a mandatory briefing item that must also include actions in the event of formation members losing visual contact.

2.3 Formation Types

The smallest formation unit is a Section or Element (these terms are interchangeable) of two aircraft comprised of a leader and a wingman. While the next basic formation unit is a Flight that is made up of two Elements, a formation comprising of three aircraft is often flown. The two and four ship formations are the basic military tactical units created for the purpose of providing mutual protection during combat. These have been adopted as they allow for the greatest flexibility, safety and symmetry when increasing the size of the formation (This has been demonstrated effectively in the civilian environment through the large formations seen over various air shows and venues). AWAL has identified three generic descriptions for formation types. They are: **Close** – Aircraft fly very close to each other using specific aircraft cues to remain in an exact position. **Manoeuvring** – A slightly looser formation that allows for gentle manoeuvring and with wingman flying further from other aircraft enabling a lower workload. **Tactical** – These formation positions are specifically designed for use during combat and require additional training due to the dynamic and difficult nature. In almost all cases there is no need for tactical formation types to be flown except to generate a higher level of formation skill for very experienced formation pilots, or a specific formation display. As such, Tactical formation manoeuvres have been deemed to be outside of AWAL standard formation positions and beyond the scope of this manual.

2.3.1 Standard Formation Positions

The standard formation positions to be flown are Echelon and Line-Astern for two ship and four ship formations with Finger four and Box (AKA: Diamond) additional for four ship formations; as described in FAST publications and the Formation Pilot's Knowledge Guide. For three ship formations, a VIC may be flown. Other formation positions may be flown as pilot experience and the occasion dictate but the differences must be specifically briefed by the Flight Lead.

2.3.2 Finger Four Formation

The basic 4-ship configuration for manoeuvring and the formation from which all others originate is the Finger-Four formation. Positions in finger four are as follows: #1- Flight Lead, #2 is Lead's wingman, #3 is the Section or Element Lead, and #4 is the Section/Element Lead's wingman. #2 is always Lead's wingman and is positioned on the weak side of the formation. The finger four formation will be described as left or right hand finger four, depending on which side #3 and #4 are flying. The 4-ship flight will always return to the basic finger four formation (left or right finger four as directed by Lead) prior to reforming from any non-finger four formation to any other non-finger four formation. For example, if Lead wishes to reconfigure from Echelon-left to Box, they will first signal #2 to cross under to their right wing. #3 and #4 will close the gap on the left side to establish 'Left Hand Finger Four'. Lead can then signal #4 to move to the Slot position for Box formation. Therefore, any 4-ship formation change from one non-finger four formation to another non-finger four formation will always involve two moves: first to finger four, then to the new formation. Route formation may also be flown and is essentially a finger four formation with double or triple spacing to permit wingmen to relax.

2.3.3 Turning Procedures for Echelon

When a formation has 3 aircraft or less in echelon, turns may be toward or away from the formation and all aircraft are to remain "in plane" with the leader. Belly or "flat" turns are only carried out when there are 4 or more aircraft in echelon, or when they are specifically briefed. Belly turns must always be away from the formation. Belly turns are not suitable for high-wing aircraft or most biplanes.

2.3.4 3-Ship Formation

The standard formation positions flown are Echelon and Line-Astern as described in FAST publications and the Formation Pilot's Knowledge Guide. When both wingman are located in Echelon right or left, the position and procedures as described under four ship are to be adopted. When the wingmen are on opposite sides of Lead, the formation is referred to as a 'Vic'.

2.3.5 Lead Change

The default procedure for a Lead Change is to execute it from Echelon (element) or Fingertip formation while established in level flight.

Lead begins the procedure by spacing the flight into Route formation.

Element Procedure

Lead will advise of the Lead change by pointing to the wingman (new leader) and the pointing forward. This wingman will acknowledge the Lead change instruction with a head nod.

The wingman continues to formate off the existing Lead but moves forward. When the wingman crosses the Lead's 3/9 line (lateral axis), they will accept the Lead by either patting the top of their head and pointing forward or saying "Red 3, passing (Left/Right), taking Lead".

At this time, the new Lead assumes responsibility for and control of the formation, looks forward, and continues to move forward. The new wingman (former Lead) responds with either their callsign or a head-nod, and is now responsible for collision avoidance within the flight.

Once the new Lead has carried out an 'ops' check and set cruise power, they can 'waggle' to close the formation into Echelon.

Finger Four Procedure

Lead will advise of the Lead change by pointing to -3 and then pointing forward.

-3 will acknowledge the Lead change instruction with a head nod.

-3 will continue to formate off Lead but will move his/her element forward. When -3 crosses Lead's 3/9 line (lateral axis) they will accept the Lead by patting the top of their head and pointing forward.

At this time, the new Lead assumes responsibility for and control of the formation, looks forward, and continues to move forward. Also at this point, the new -3 (former Lead) is responsible for collision avoidance within the flight, and joins on the new Lead in Route formation.

Once the new Lead has carried out an 'ops' check and set cruise power, they can 'waggle' to close the formation into Finger Four.

Note: During Lead changes, element integrity is constant so that each wingman will remain with their element leader throughout the sortie.

Re-numbering

At the completion of a Lead Change maneuver, the formation will re-number. The new Lead will call the formation to re-number and then acknowledge the calls. For example:

New Lead calls...	"Red Flight Re-number"
New -2 calls...	"Red 2"
-3 calls...	"3"
-4 calls...	"4"

2.4 Runway Line-up

- 2.4.1 The formation position for runway line-up is normally determined by the direction of the wind. Lead should always position the wing aircraft upwind (If the wind is very light or calm, Lead may elect to place the wingman on the side which will be the inside of the anticipated direction of turn on departure). Tricycle undercarriage aircraft should be aligned with the runway whilst tailwheel aircraft should line up with the tail pointed out by approximately 10-15 degrees.

Lead

Lead will taxi a sufficient distance down the runway to ensure the wingman (and flight, if applicable) has enough room to maneuver into position. Lead will take the centre of their side of the runway, ensuring a minimum of 3 meters' lateral wingtip separation with their wingman.

Wingman

The wingman will line up in the centre of their side of the runway, ensuring a minimum of 3 meters' lateral wingtip clearance with Lead. Positioning shall be forward of the bearing line (acute position).

2.5 Takeoff

- 2.5.1 The default is a 'Stream' takeoff, particularly when runway width, airport restrictions, pilot qualifications, or environmental conditions dictate or when operating with dissimilar aircraft types. Where adequate lateral clearance is assured, aircraft will 'stream' at the pre-briefed interval which should be 5-7 seconds or when the preceding aircraft is positively airborne.
- 2.5.2 If multiple elements of tailwheel aircraft are taking off in stream, the preceding element must be positively airborne before the following element commences its takeoff roll. The type and visibility over the nose will dictate the spacing. Common sense prevails and it will need to be briefed.

- 2.5.3 The maximum crosswind for an element takeoff is:
Tailwheel: Determined by aircraft type, pilot experience, and conditions on the day
Tricycle: Determined by aircraft type, pilot experience, and conditions on the day

2.5.4 **Element takeoff**

When the wingman is lined-up and stopped in the proper position on the runway as defined above, they will give Lead a thumbs-up. At this time, Lead will give the 'Run-up Power' signal, which the wingman will acknowledge with another head nod. The wingman looks inside the cockpit to complete their final checks. When run-up power is stable, all checks are complete, and the wingman is ready for brake release, they will look directly at Lead. The execution command to release brakes is a forward deliberate head nod by Lead. As Lead's chin hits their chest, they are to simultaneously release the brakes and smoothly add power to the briefed takeoff power setting. Unless required for safety, do not retract the gear and flaps until Lead confirms the wingman is safely airborne, in position, and stable. Use the standard (upon Lead's application of brakes) or briefed gear retract signal. If the wingman has fallen back on the takeoff such that visual signals are not applicable, they may retract their gear when safe to do so to assist in achieving an acceleration advantage in regaining position. If the wingman is not able to gain position, they can request a power reduction from Lead (IE: "Red 1, REVS"). In the unlikely event the wingman needs Lead to add power at this stage of flight, the call will be "Red 1, Power".

2.5.5 **Stream takeoff**

Lead will position aircraft on the runway prior to initiating engine run-up and brake release unless runway width or other restrictions require a feed-on takeoff. When in position and ready, each wingman will give their Element Lead a thumbs-up. No other signals or communications are required. Execute a normal takeoff maintaining position on one side of the runway unless briefed otherwise. To help expedite the rejoin, avoid steep climb angles and climb at a reduced power setting. The wingman will delay their brake release until Lead's main gear have lifted off the runway unless using timed intervals. If using a timed interval between brake release instead of "lift off", the wingman will release their brakes no less than 5 seconds after Lead begins their takeoff roll (Most tail wheel aircraft will be able to use the time technique however, consider your type and brief a common sense takeoff).

- 2.5.6 The minimum altitude for turns after takeoff is 500 feet AGL. The formation leader should extend straight ahead as necessary to ensure all formation members are able to reach 500 feet AGL before having to turn. To help expedite the join-up after takeoff, Lead should avoid steep climb angles and operate at a reduced power setting until the wingmen are in position and stabilized. Clear and monitor the wingmen during join-up. The default join-up formation is Fingertip but this should be briefed. During a turning join-up, -2 joins to the inside of the turn with -3 and -4 joining to the outside. For a straight-ahead join-up, -2 will join on the right side unless otherwise briefed. -3 and -4 will join on the opposite side of -2. The contract is -3 remains visual with -2, -4 keeps visual with -3 and -2, and the rejoin is sequential (-2 joins first, then -3 and then -4).

2.6 Rejoins

2.6.1 **Pitch/Break and Turning Rejoin (2-Ship)**

The standard procedure for 2-ship formations to practice turning rejoins is as follows:

With the formation in Echelon, Lead signals break and turn interval (normally 3 seconds), and waves off. Lead then makes a 45degree AOB turn away from the wingman and rolls out after 180degrees.

After the specified interval (and after ensuring Lead has broken clear), wingman makes a 180degree turn, joins extended trail on Lead and calls "2's in".

Lead waggles and commences a 20degree AOB turn at the pre-briefed power and speed. The wingman sets pre-briefed power, turns inside Lead to achieve a 45degree aspect angle, or AA (top of the vertical stabilizer on the opposite wingtip) and adjust bank angle to maintain AA. Initial airspeed should be 10-15% faster than Lead. The wingman should keep Lead just above

the horizon throughout (one wingspan) and control closure to join the “key position”, about 2-4 aircraft lengths away. Once stabilized at the key position, the wingman joins on the inside of the turn.

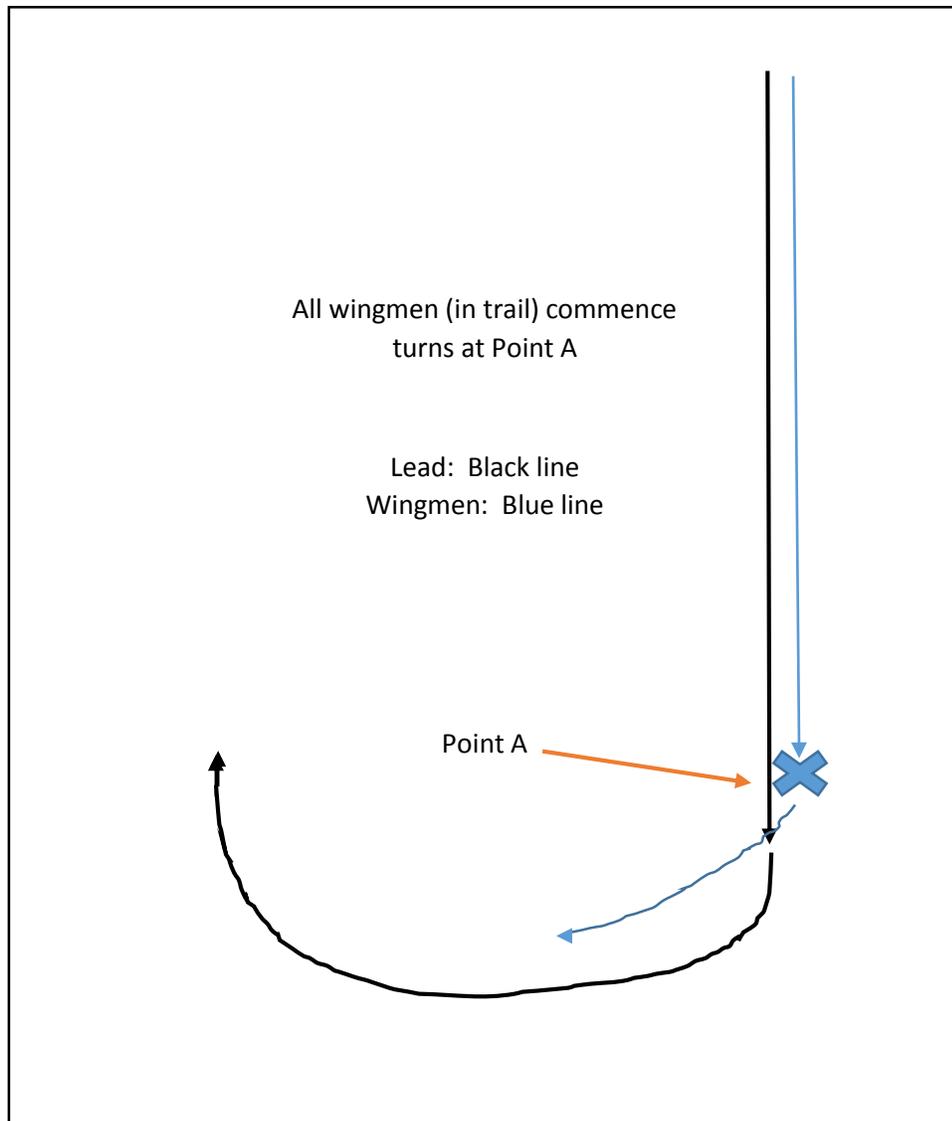
2.6.2 Pitch/Break and Turning Rejoin (3- and 4-Ship)

The standard procedure for 3- and 4-ship formations to practice turning rejoins is as follows:

With the formation in Echelon, Lead signals break, interval, and waves/kisses off. Lead then makes a 45degree AOB turn away from the wingman and rolls out after 180degrees. After the specified interval (and after ensuring the preceding aircraft has broken clear), each wingman makes a 180degree turn and joins extended trail on the preceding aircraft. When the last aircraft in the formation completes their turn and is in trail, they call “(3’s/4’s) in”.

Lead waggles and commences a 20degree banked turn.

All aircraft need to stay behind Lead’s 3/9 line and achieve 45degrees AA. Therefore, all wingmen must go to Point A (see diagram below) before commencing their turn.



All aircraft join in numerical sequence.

-2 joins echelon on the inside of the turn. Lead will then normally signal a cross-under so that -3 and -4 can join on the inside of the turn.

Different procedures may be briefed and flown using variations in AOB, timing, and joining positions.

2.6.3 **Straight Rejoin (2-ship)**

Begin in Echelon position. When ready -2 calls "Red 1 turning left/right for rejoin". On that call Lead visually clears the area above and behind the wingman and gives a wave/kiss off. The wingman then pulls up and away from the Lead in a climbing turn using max continuous power to achieve a roughly 60 degree offset heading and higher altitude than Lead. This position is called 'The Perch'. Upon reaching the Perch, -2 should level off, visually acquire Lead, and bank as necessary to fly a parallel heading. The wingman then calls "Red 2 tally, rejoining echelon left/right", with Lead's reply "Red 1". They dive down to the same altitude still paralleling the Lead. The wingman continues on the same heading as Lead until reaching the bearing line, and then works their way in towards Lead. The Wingman should keep Lead just above the horizon throughout and control closure to join the "key position", about 2-4 aircraft lengths away. Once stabilized at the key position, the wingman moves into Echelon on Lead.

2.6.4 **Turning Rejoin (2-ship)**

The procedure for a Turning Rejoin is the same as for a Straight Rejoin until the wingman is established at the Perch. They then call "Red 1 turn right/left for rejoin" (Lead replies "Red 1" and initiates their turn, which should be away from -2). On that call Lead turns in the appropriate direction. The wingman dives down to put Lead on the horizon and using lead/lag flies to the bearing line. The wingman sets pre-briefed power, turns inside Lead to achieve a 45degree aspect angle, or AA (top of the vertical stabilizer on the opposite wingtip) and adjust bank angle to maintain AA. Initial airspeed should be 10-15 knots faster than Lead. The wingman should keep Lead just above the horizon throughout and control closure to join the "key position", about 2-4 aircraft lengths away. Once stabilized at the key position, the wingman joins on the inside of the turn.

2.7 Field Joining Procedures

2.7.1 **Initial and Pitch**

The default procedure is an Initial and Pitch, as follows:

Join through 'Initial' at least 1,500 feet AGL. This is a position approximately 3 nm from the field and may be left, right, or straight in dependent on relative position of the airfield to the flight.

**As the term 'Initial' is a military term and is not commonly used by the Australian GA community outside of warbirds. As such, Lead should call the flight "3 miles to the (east/west/north/south) inbound for arrival overhead on the Dead side to enter the circuit for landing Runway XX"

Formation is in Echelon. Lead will place the wingmen on the side opposite to the circuit direction to be flown.

Descend on the non-traffic (dead) side in the landing direction to circuit height (Normally 1,000' AGL unless otherwise briefed) in Echelon.

When Lead has observed sufficient clear 'space' in the Crosswind and Downwind to accommodate the formation, they will 'wave' off the flight and pitch-out (with at least 45degrees AOB), maintaining a constant turn until established Downwind.

Each wingman will then pitch-out at the briefed interval (the timing of which begins on Lead's pitch-out) to Crosswind and then Downwind. They must ensure the preceding aircraft has

broken clear before commencing their break and should match the preceding aircraft's angle of bank and turn.

Downwind, match Lead's height by ensuring they are on the horizon and then fly level until reaching the Base turn point. Lead should make a formation Downwind (IE: "Red Flight of four Left Downwind, Runway 24, Full Stop") and reduce airspeed to the specified Downwind speed for type.

All Aircraft with retractable undercarriage should lower their gear when abeam the threshold and adjust their Base turn point to achieve the required spacing for landing from the preceding aircraft. All aircraft must fly the specified Base speed for type.

All aircraft should call their formation number on Final and confirm "gear down" (IE: "Red 3 Final Runway 24, gear down", "Red 4 Final Runway 24, gear down").

2.7.2

Downwind Pitchout

This is accomplished from a Downwind position as follows:

Lead positions the formation in the circuit on Downwind in Echelon, with the flight on the side opposite to the direction of the turns within the circuit. Lead calls the pitchout and the interval. At the Base turn point, Lead 'kisses' off and pitches out into the Base turn.

Each wingman follows at the briefed interval.

All aircraft should lower their undercarriage after turning onto Base and as soon as they are below gear speed. They should adjust their Base turn to achieve the required spacing for landing from the preceding aircraft. All aircraft must fly the specified Base speed for type and should call their formation number on Final and confirm "gear down".

**This procedure is rarely used.

2.8 Landings

2.8.1

Tailwheel Aircraft

On runways that are 45 meters wide or greater, the standard procedure for tailwheel aircraft landing in stream is for a staggered landing with 300 meters minimum separation between aircraft. Lead should always land on the 'exit' side of the runway, while wingmen should remain on their side until the following aircraft is under control at taxi speed and calls "-X cleared to cross" (IE: -3 lands on the same side as Lead while -2 lands on the non-exit side. -3 slows to taxi speed, and calls "-2 cleared to cross")

On runways that are less than 45 meters wide, the standard procedure for tailwheel aircraft Landing in stream is for a trail landing with 500 meters minimum separation between aircraft. All aircraft should then roll to the end of the runway or briefed exit point before vacating.

2.8.2

Tricycle Aircraft

On runways that are 30 meters wide or greater, the standard procedure for tricycle aircraft Landing in stream is for a staggered landing using hot and cold lanes with 150 meters minimum Separation between each aircraft. The cold lane will always be the exit side of the runway. If An aircraft has difficulty stopping it must remain in the hot lane and call "-X, HOT LANE, passing on the (left/right)".

On runways less than 30 meters wide, the standard procedure for tricycle aircraft landing in stream is for a trail landing with 300 meters minimum separation between each aircraft. All aircraft should roll to the end of the runway or briefed exit point before vacating.

2.9 Briefings and Debriefings

2.9.1 Proper, effective, and thorough briefs and debriefs are an integral, indispensable part of safe formation flight operations. Flights are to be briefed by the formation Lead but all members should be encouraged to ask questions or raise issues if they need clarification or see something that should be discussed. Briefings should be as free from distractions and interruptions as possible. All non-standard procedures and information unique to the mission must be covered in detail. Other information and procedures can be briefed as “standard” to define procedures as laid out in the FAST documents or these SOPs. The following topics should be covered in formation briefings:

- Aim or Objectives of the flight
- Weather & NOTAMs
- Formation composition
- Timings
- Start up, taxi, takeoff, and departure procedures
- Recovery, landing, and shutdown procedures
- Comms/Frequencies
- Fuel
- Emergencies
- Air exercise anticipated sequence of events

2.9.2 After landing and when all of the aircraft are secured, Flight Lead will guide the formation pilots through a debrief. They will restate the objectives and review how the flight performed in all phases from engine start to shutdown, with an emphasis on what occurred, why it occurred, and how to improve in the future.

Debriefs are to be conducted in a nameless (IE: -2 instead of the pilot’s name) and rankless manner. It is recognized that all participants will differ in experience levels, age, and backgrounds. To encourage the communication process, Lead will set the tone that all members of the flight are equals. As such, all are encouraged to comment on good aspects of flight as well as areas they feel need improvement.

2.10 Communications

2.10.1 All communications will be conducted in accordance with FAST guidelines, except where they conflict with local rules/requirements. Aircraft will use formation call signs throughout the flight. When operating from a controlled airfield or one where a flight service or Unicom service operates, Lead will notify the tower of the registrations of all aircraft in the formation as required.

2.11 Knock It Off (KIO)

2.11.1 A Knock It Off (KIO) call can be made at any time when a hazard to flight exists, and can be made by any member of the formation. Examples include but are not limited to:

- A dangerous situation is developing
- Loss of situational awareness (SA)
- Breaching airspace/area boundaries
- Breaching an established minimum altitude
- Recognized radio failure
- Bingo fuel inadvertently overflown

An intruder aircraft straying into the exercise area
Aircraft unserviceability or overstress

If the situation permits, add an advisory message to the KIO call. For example "Red 3, Knock It Off, hard deck!"

- 2.11.2 If an aircraft has a suspected radio failure it should waggle its wings until the Element aircraft joins on it, and then hand signals should be used to communicate intentions or additional failures. Any aircraft that observes another member of the formation waggling wings as such should immediately call a KIO (This does not apply to Lead waggling wings during aspects of formation flight as variously noted above).
- 2.11.3 If a KIO is called, all aircraft must acknowledge the call, clear their flight path, stabilize in their current position and await Lead's instructions or signals.

3. T-6/Harvard Procedures

3.1 Formation Positions

3.1.1 Echelon Position

The Harvard Echelon alignment is:

Bearing: Aileron inner trailing edge on rear of the engine cowl

Fix: Leading edge of the horizontal stabilizer

Elevation: Eye-level bisecting the wing so that both main wheel tyres are just visible

3.1.2 Line-Astern

The Harvard Line-Astern alignment is:

In line with the longitudinal axis. Visually align the tailwheel with the oil cooler scoop.

Spacing between one and two aircraft lengths (No prop-to-tail overlap)

Elevation is below Lead to remain clear of prop wash and to allow for an overshoot.

3.2 T-6/Harvard -Specific Signals

- 3.2.1 After takeoff and when clear of the ground the wingman should apply brakes and then wait for Lead to apply theirs. When Lead's wheels stop spinning the wingman should push "Power Push" and then raise the gear. This is an alternate signal for retracting the undercarriage.

3.3 Power Settings

As briefed, but recommend the following:

Normal formation maneuvers:

Lead: 1850RPM, 24"MAP

Wingmen: 2000RPM, throttle as required to maintain station

Turning rejoins:

Lead: Maintain cruise power settings

Wingmen: 2000RPM, 25"MAP to facilitate the join

3.4 Circuit Speeds

- 3.4.1 The T-6/Harvard target speeds to be flown in the circuit are:
- Downwind: 105 KIAS
- Base: 90 KIAS
- Final: Reducing to threshold speed

4. CA-25 Winjeel Procedures

4.1 Formation Positions

4.1.1 Echelon Position

The Winjeel Echelon alignment is:

Bearing: Aileron inner trailing edge on the rear of the engine cowl
Fix: Forward edge of the horizontal stabilizer in line with the static port
Elevation: Eye-level bisecting the wing

4.1.2 Line-Astern

The Winjeel Line-Astern alignment is:

Visually align the tailwheel with front right seat would be.

Spacing between one and two aircraft lengths (No prop to tail overlap).

Elevation is below Lead to remain clear of prop wash and to allow for an overshoot.

Lead's main gear should be slightly below eye-level.

4.2 Power Settings

As briefed, but recommend the following:

Normal formation maneuvers:

Lead: 1800RPM, 24"MAP

Wingmen: 2000RPM, throttle as required to maintain station

Turning rejoins:

Lead: Maintain cruise power settings

Wingmen: 2000RPM, 28"MAP to facilitate the join

4.3 Circuit Speeds

The Winjeel target speeds to be flown in the circuit are:

Downwind: 100 KIAS

Base: 85 KIAS

Final: Reducing to threshold speed

5. Yak-52 Procedures

5.1 Formation Positions

5.1.1 Echelon Position

The Yak-52 Echelon alignment is:

Bearing: Propeller hub on front point of the wingtip chord

Fix: Aileron inner trailing edge on rear of cowl and abeam the elevator hinge line

Elevation: Eye-level bisecting the elevator

5.1.2 Line-Astern

The Yak-52 Line-Astern alignment is:

In line with the longitudinal axis. Visually align the fuselage with the nosewheel centered between the main wheels. Spacing between one and two aircraft lengths (A fore and aft separation must be maintained at all times. No prop to tail overlap!).

Elevation is below Lead to remain clear of prop wash and to allow for an overshoot.

The partially-retracted undercarriage should be slightly above eye-level.

5.2 Power Settings

5.2.1 As briefed, but recommend the following:

Normal formation maneuvers:

Lead: 70%RPM, 700MAP

Wingmen: 82%RPM and throttle as required to maintain station

Turning rejoins:

Lead: Maintain cruise power settings

Wingmen: 82%RPM and 700MAP to facilitate the join

5.3 Circuit Speeds

5.3.1 The Yak-52 target speeds to be flown in the circuit are:

Downwind: 200 KPH (110 KIAS) until abeam the threshold

Base: 150 KPH (85 KIAS)
Final: Reducing to threshold speed

6. CT-4

6.1 Formation Positions

6.1.1 Echelon Position

The CT-4 Echelon alignment is:

Bearing: Inboard aileron hinge lined up with the rear edge of the cowl
Fix: Rear corner of the elevator lined up with the rudder hinge line
Elevation: Eye-level bisecting the wing

6.1.2 Line-Astern

The CT-4 Line-Astern alignment is:

In line with the longitudinal axis

Spacing between one and two aircraft lengths. Tailskid on the canopy bow, or fuel vents/outboard flap bracket in line with the outer edge of the elevator/horizontal stabilizer. Elevation is below Lead to remain clear of the prop wash and to allow for an overshoot. Eye-level should bisect the main wing trailing edge.

6.2 Power Settings

6.2.1 As briefed, but recommend the following:

Normal formation manoeuvres:

Lead: 110-115 KIAS
Wingmen: As required to maintain station

Turning rejoins:

Lead: Maintain cruise power settings
Wingmen: As required to facilitate the join

6.3 Circuit Speeds

The CT-4 target speeds to be flown in the circuit are:

Downwind: 95 KIAS
Base: 80 KIAS
Final: 75 KIAS reducing to threshold speed

7. CJ-6 Nanchang

7.1 Formation Positions

7.1.1 Echelon Position

The CJ-6 Nanchang Echelon alignment is:

Bearing: Inboard front corner of the aileron on the rear of the cowl
Fix: Leading edge of the horizontal stabilizer aligned with the point where the fin meets the fillet
Elevation: Eye-level with the propeller hub

7.1.2 Line-Astern

The CJ-6 Nanchang Line-Astern alignment is:

In line with the longitudinal axis. Visually align the fuselage with the nosewheel centered between the main wheels. The horizontal stabilizer should be visible just inside the canopy arch. Spacing between one and two aircraft lengths (A fore and aft separation must be maintained at all times. No prop to tail overlap!).

Elevation is below Lead to remain clear of prop wash and to allow for an overshoot.

7.2 Power Settings

7.2.1 As briefed, but recommend the following:

Normal formation manoeuvres:

Lead: 1850RPM, 580MAP

Wingmen: 1950RPM and throttle as required to maintain station

Turning rejoins:

Lead: Maintain cruise power settings

Wingmen: As required to facilitate the join

7.3 Circuit Speeds

7.3.1 The CJ-6 Nanchang target speeds to be flown in the circuit are:

Downwind: 230 KPH (120 KIAS) until abeam the threshold

Base: 150 KPH (88 KIAS)

Final: Reducing to threshold speed

8. T-28 Trojan

8.1 Formation Positions

8.1.1 Echelon Position

The T-28 Echelon alignment is:

Bearing: Aileron inner trailing edge on the exhaust pipes

Fix: Outboard leading edge of horizontal stabilizer in line with the opposite wingtip

Elevation: Eye-level bisecting the wing

8.1.2 Line-Astern

The T-28 Line-Astern alignment is:

In line with the longitudinal axis

Spacing between one and two aircraft lengths. The tailplane should fill the main windscreen panel.

Elevation is below Lead to remain clear of the prop wash and to allow for an overshoot. Eye-level should bisect the main wing trailing edge.

8.2 T-28-Specific Signals

8.2.1 After takeoff and when clear of the ground the wingman should apply brakes and then wait for Lead to apply theirs. When Lead's wheels stop spinning the wingman should push "Power Push" and then raise the gear. This is an alternate signal for retracting the undercarriage.

8.3 Power Settings

As briefed, but recommend the following:

Normal formation maneuvers:

Lead: 1800RPM, 26"MAP

Wingmen: 2000RPM, throttle as required to maintain station

Turning rejoins:

Lead: Maintain cruise power settings

Wingmen: 2000RPM, 28"MAP to facilitate the join

8.4 Circuit Speeds

The T-28 target speeds to be flown in the circuit are:

Downwind: 120 KIAS

Base: 100 KIAS

Final: 90 KIAS reducing to threshold speed

9. L-39

9.1 Formation Positions

9.1.1 Echelon Position

The L-39 Echelon alignment is:

Bearing: Rear of the wingtip tank on pilot's (front seat) head

Fix: Lined up with the leading edge of the tail plane

Elevation: Eye-level bisecting the wing

9.1.2 Line-Astern

The L-39 Line-Astern alignment is:

9.2 Power Settings

As briefed, but recommend the following:

Normal formation maneuvers:

Lead: 95%

Wingmen: As required to maintain station

Turning rejoins:

Lead: 90%

Wingmen: As required to facilitate the join

9.3 Circuit Speeds

The L-39 target speeds to be flown in the circuit are:

Downwind: 140 KIAS

Base: 130 KIAS

Final: 120 KIAS

Power setting required: 85-90%

10. Siai-Marchetti S-211

10.1 Formation Positions

10.1.1 Echelon Position

The S-211 Echelon alignment is:

Bearing: Leading edge of wingtip in line with external canopy breaking handle stowage

Fix: Base of outer elevator static wick in line with the tail navigation light

Elevation: Eye-level bisecting the wing

10.1.2 Line-Astern

The S-211 Line-Astern alignment is:

Just below the jet wash with the tips of the tailplane touching with the wing fences for vertical and longitudinal alignment. The speedbrake is NOT to be selected OUT in Line-Astern

formation.

10.2 Power Settings

10.2.1 As briefed, but recommend the following:

Normal formation maneuvers:

Lead: 200 KIAS (75% low-level, 80-85% mid-level ops)

Wingmen: As required to maintain station

Turning rejoins:

Lead: 200 KIAS (75% low-level, 80-85% mid-level ops) 30degree AOB

Wingmen: Max 30kts overtake speed (About 5% additional power)

10.3 Circuit Speeds

The S-211 target speeds to be flown in the circuit are:

Downwind: 150 KIAS
 Base: 130 KIAS
 Final: 130 KIAS reducing to threshold speed of 100-105KIAS

11. Other types

Other types of aircraft not included here will brief their bearing- and sight-lines, power settings, and performance figures prior to flight.

11.1 Flights of similar types

Other types of aircraft which may participate in formation training will advise their procedures as part of the pre-flight briefing, to include a discussion of their bearing- and sight-lines, power settings, and performance.

11.2 Flights of Dissimilar types

All formations composed of dissimilar-type aircraft will as part of their pre-flight briefing discuss each type’s bearing- and sight-lines, power settings, and performance. It will then be the responsibility of all pilots in the flight to make a determination whether or not they can safely conduct the mission with the different aircraft types.

12. Safety

It is important to note that an effective formation involves a high degree of trust between Lead and all wingmen; that each member will operate for the benefit of the whole. A call or signal from Lead which is then acknowledged/accepted by the wingmen is a contract, stating that they understand exactly what is requested of them and will execute their duties accordingly in a safe and efficient manner. If a wingman does not understand a call or signal, or did not see it properly, it is their duty to hold position. Lead will soon note this and re-issue their request. If a wingman is unsure, they should never guess! If any member of a formation sees an unsafe situation developing, it is their duty to call “Knock It Off” (see section 2.11). There is plenty of room for fun, and it is a very rewarding experience to operate as part of an effective flight. However, there is no room for cavalier or careless operations!

Unsafe flying, to include but not limited to overly aggressive maneuvering within the formation, or going “belly-up” on other aircraft are serious matters that directly impact on the safety of all members within the flight and will be grounds for immediate exclusion.

While perfection is strived-for, it will never be attained, nor is it expected. Each flight should be approached with the goal of conducting it in the best and safest manner possible, and the post-flight debrief should be used to identify areas for improvement.

13. Formation Visual Signals

	Action	Signal	Response	Execution
1	Affirmative or “OK”	To indicate “OK and ready to proceed”, use a thumbs-up. Do not use thumbs-up to replace the head nod for in-flight formation signals, to include formation takeoff signals.		

2	Wilco (wingman acknowledging instruction)	Nod head in response to hand signals to indicate that you are clear on the meaning and can/will comply. If unclear, do nothing until the signal is repeated.		
3	Negative	Thumbs-down		
4	Act Now (from Lead)	Head nod		
5	Numbers	1-5: fingers held up vertically 6-9: fingers held out horizontally 10: clenched fist		
6	Ready to Start	Thumbs-up from all wingmen		
7	Energize Starter	Hand raised, forefinger extended upwards and revolved		At start of the signal
8	Engage Starter	Drop hand		When hand is dropped
9	Run-up complete	Thumbs-up from all wingmen		
10	Power up	Hand raised, forefinger extended upwards and revolved	Increase to 'run-up' power	At start of the signal
11	Ready for take-off	When power is stabilized and quick scan is complete, the wingman will look at Lead		
12	Commence take-off	One big head nod from Lead	Release brakes, add power for take-off	On head nod
13	Increase power (in flight)	Forward movement of clenched hand (as if opening throttle)		After signal
14	Reduce power (in flight)	Rearward movement of hand with open palm rearward		After signal
15	Gear up	When brakes are applied to main wheels		After brake application
16	Gear down	Clenched fist, thumb down	Head nod	On head nod
17	Flaps	Biting motion with thumb and forefingers	Head nod	On head nod
18	Finger-four formation	Wing waggle		After signal
19	Reform formation	Wing waggle		After signal
20	Cross under (Wing)	Forearm vertical with clenched fist	Head nod	After signal
21	Cross under (Element)	Forearm vertical with clenched fist, double-pump forearm	Head nod	After signal
22	Route formation	Lead gently yaws their aircraft	Head nod	After signal
23	Line-Astern (Close trail)	Lead porpoises their aircraft	Head nod	After signal
24	Box (Diamond)	Signal to -3, four fingers held up, followed by clenched fist with thumb extending aft with aft motion of the hand. -3 will pass relay it to -4	Head nod by -3 and in turn -4	After signal
25	Climbing	Flat hand, palm down, motion upwards		After signal
26	Descending	Flat hand, palm down, motion downward		After signal

27	Leveling	Flat had, palm down, motion sideways		After signal
28	Break formation (Pitchout)	Lead's hand raised, fingers open/spread, followed by a fore-aft 'wave-off'		On the wave-off and at the briefed interval thereafter
29	Frequency change	Tap helmet/headset near the ear. Extend fingers vertically or horizontally (as per signal No. 5 above) to indicate frequency. Pull hand down out of sight between digits. Signal Zero with a clenched fist. If changing to a briefed channel or tactical frequency, tap helmet and extend the appropriate number of fingers (IE: "Go to second tactical frequency" is two fingers)	Head nod	After signal
30	Fuel/Ops check	Close fist with thumb extended and perform drinking motion with thumb near mouth		
31	Wingman response to Fuel/Ops check (Given as time above BINGO)	1 finger: 10-19 minutes 2 fingers: 20-29 minutes 3 fingers: 30-39 minutes 4 fingers: 40-49 minutes 5 fingers: Greater than 50 minutes		
32	Speed brake extend/retract	Hand flat, palm forward	Head nod	On head nod
33	Turn Squawk off	Place hand around neck as if choking oneself	Head nod	After signal
34	Turn Landing lights On/Off	For On, use little and index fingers extended vertically with clenched fist at eye level. For Off, same signal with fingers pointed down. Do not confuse with the signal for Echelon turns	Head nod	After signal
35	Lead Change	Point to wingman to assume Lead, followed by pointing forward.	Head nod	Move to Route then move forward
36	I have the Lead	When forward of the previous Lead's 3/9 line and stabilized, tap head and point forward to signal to all flight members "I have the Lead"		

14. Emergency Visual Signals

	Action	Signal	Response	Execution
1	Nil Transmit	Open palm waved across microphone	Head nod	
2	Nil Receive	Open palm waved across earphone	Head nod	
3	No Radio (NORDO)	Perform both Nil Transmit and Nil Receive signals	Head nod	

4	Systems Failure (H.E.F.O.E.) *Only used if R/T is not available	Clench fist and hold to forehead, then hold up number of fingers to indicate system with failure: 1: Hydraulic 2: Electric 3: Fuel 4: Oxygen 5: Engine	The aircraft receiving will repeat the signal to acknowledge	
5	Wish to Land	Move hand, palm down from above head forwards and down, ending in simulated round-out. Alternatively, lower undercarriage	Head nod	
6	Returning to Base (RTB)	Point at self (or aircraft concerned) and point downwards	Head nod	RTB
7	Bail out	One or both clenched hands pulled downward across face to simulate blind ejection		Bail out
8	Your aircraft is on fire	Fly alongside and rock wings to gain attention. Draw hand across throat then point at the area on fire. Continue until acknowledged.		
9	Aircraft damage check	Hold clenched fist with index finger and thumb extended, back of hand towards canopy		
10	I must land on your wing	Use hand, palm down, and tap opposite shoulder. Distressed aircraft lands, Lead goes around when all landing coordination is complete and normally no lower than 300 feet	Head nod	

15. Formation Glossary

Acute

To be in a position too far forward in the formation or on a bearing (angle) that would place the aircraft too far forward during rejoin, creating an uncomfortable closure rate and angle for the joining aircraft.

Sucked

The opposite of Acute. To fall behind Lead; to be too far out of position to re-acquire the bearing line and join up on available engine power.

Aspect Angle (AA)

Angle from Lead to the wingman, measured from Lead's Six o'clock. Wingman heading has no bearing on AA. Flying directly in trail from Lead is Zero degrees AA, abeam is 90degrees, etc...

Bearing

The horizontal angle off Lead as flown by -2, based on recognized indicating points/markers on Lead's Aircraft.

Re-join

Also called Rendezvous. To join the flight onto Lead, whether after take-off or in flight.

Nose-to-Tail overlap

As viewed from above, the nose of -2 is farther forward than the tail of Lead (or -3, -4 overlapping the tail of the aircraft they are formatting on). Naturally, as long as there is lateral separation between aircraft – including the nose to tail – no danger exists.

Wing overlap

Under this scenario, no lateral separation exists. It demands high levels of skill and concentration; as

the level of risk is elevated.

Step down

Wingmen are slightly lower than the aircraft they are formatting on, which allows for room to manoeuver in case of turns into them.

Step up

The opposite of Step down. This is not advisable as it increases the risk of wingmen losing sight of the aircraft they are formatting off of (going belly-up).

Going belly-up

Wingman losing sight underneath them of the aircraft they are formatting off of. This is highly dangerous and grounds for an immediate KIO command and the wingman being told to RTB.

Belly turn

Belly turns are only used when a flight is in Echelon and the turn is away from the wingmen. They are never used on turns towards the wingmen. When turning away from the flight, if -2 decides to remain in belly then the other wingmen will do the same. In a Belly turn, wingmen keep Lead on the horizon.

Initial

As in Initial Approach. Refers to the approach on runway heading used when doing a 360-degree overhead pitchout. Lead will call the position on Initial as "Whisky Flight of four Winjeels, 2 miles to the East at 1,500, inbound on the Initial for a 360-degree Overhead Runway 24...."

The Pitch

Also called a Break. The breakup of the formation over the runway when the flight does a 360-overhead entry into the circuit for landing. Also executed in training to facilitate a re-join scenario.

Section or Element

A flight of two aircraft. This is the basic fighting element and is self-supporting, covering each other's Six o'clock and providing backup with radio or equipment malfunctions.

Flight or Division

Four aircraft, consisting of two Sections or Elements, each with its own leader but under the command of the lead element's leader who is designated "Flight Lead".

Formation

A disciplined flight of two or more aircraft under the command of a Flight Lead, using a standardized set of signals and commands to direct the wingmen.

Gaggle

An undisciplined group of aircraft, milling about in roughly the same piece of sky, sometimes attempting to impersonate a formation.

Kiss-off

Signal passed by Lead to the rest of the flight as he symbolically "kisses" them off immediately prior to their break.

"REVs"

Wingman's call to Lead when they have insufficient power to catch up or hold station, asking Lead to reduce power.

"POWER"

Wingman's call asking Lead to add power

Vic

A three ship formation with -2 in Echelon right

Reverse Vic

A three ship formation with -2 in Echelon left

Slot

Position flown (typically by -4) in a Box formation, in-trail behind Lead

Overshoot

A maneuver to allow a wingman to pass behind and under Lead's plane of motion when closure is

excessive during a re-join.

Call sign

The code word or words that designate a flight (IE: Dragon Flight, Red Flight, Whisky Flight, etc...).

Joker

The fuel state at which formation time must be prioritized to meet mission objectives. Joker will be briefed by Lead and may be in time or volume.

Bingo

Fuel state at which the flight must return to base. Bingo allows for a safe RTB with legal reserves on Arrival. Bingo will be briefed by Lead and may be in time or volume.

Smash

Airspeed or energy. Usually used to denote energy available to accomplish a given maneuver or task. A wingman wants smash available to execute an effective and efficient re-join.

Tally

"I can see the bogey or non-formation aircraft"

Visual

"I can see the friendly or same-formation aircraft. A number or description can also be added to indicate which aircraft you have a tally on ("Visual 3" or Visual Lead)

No Joy

Used to indicate a pilot has Not visually acquired what they are looking for.

Blind

Call when a wingman has lost sight of Lead or the aircraft they are forming on.

Go

Used to direct the flight to switch to a new frequency. (IE: "Whisky Flight, Go to 2")

Bugging Out

A wingman performing an emergency separation manoeuvre to avoid a dangerous situation.

16. Amendments Procedure

AWAL's FAST Formation Manual is a living document and therefore subject to review and revision as necessary. To ensure consistency and accountability, any request for modification must be submitted to either an AWAL representative to FAST or one of the association's qualified check pilots. It will then be discussed by the full compliment of check pilots and, if acceptable to or recommended by them, adopted accordingly.