

'WINGING-IT' WITH THE DELTAS

RAAF Jubilees

With the RAAF's centenary not too far away it behoves me to chronicle my part in its Golden Jubilee nearly 50 years ago, while some readers may still recall the events.

Preamble

'Winging-it' is a colloquialism for 'having a go without any forethought'. Nothing could be further from the truth regarding the preparation for the Deltas and their participation in the RAAF's Golden Jubilee displays in 1971. I have used the term as a metaphor for my slot as Delta4 in the middle of the five-ship close formation element.

This post is intended to be read as a supplement to Dave Robson's excellent 'The Deltas' on the 77SQN ASSOCIATION website. Dave was Solo 2 and while his accounts are extremely comprehensive' my experiences and recollections are obviously going to be of a different slant in some respects. Also, putting down thoughts so long after the event possibly blurs fact and fantasy.

Genesis

Once 77 Sqn had been assigned the task of forming an aerobatic team, the 'powers that be' (OPCOM/DEFAIR) did not take much convincing that a 5-ship formation offered significantly more 'punch' than a 4-ship, and that a Solo would be a good way of filling in the gaps while the formation manoeuvred for the next pass. Ultimately, of course, we ended up with two, opposing solos, with spectacular effect.

The Squadron then decided that those pilots who would be surplus to the aeros task would either be absorbed within C Flight with its dedicated photo-recce role utilising the KA56B1 horizon-to-horizon camera, or be temporarily attached to our 'opposition', 76 Sqn, just down the road. As it turned out only one pilot, PLTOFF Steve Low, newly arrived from OCU, was sent packing.

Close Formation

All fighter pilots routinely fly in close formation, but the 'moves' involved are surprisingly quite limited, being primarily to get multiple aircraft out on task away from the base and then recover them to base at the end of the sortie. This consisted of pairs take-offs (with 10 seconds between pairs if more than two aircraft are in the 'package') then, during the latter part of the recovery, joining up in echelon right (usually no more than four) to the right of and stepped back from the leader, for the run in to the airfield and individually breaking away for individual landings. In a perfect world as each aircraft approached the landing threshold the one ahead would be 1500feet away, firmly 'planted' on the runway.

Having said that, our definitive display routine was for Deltas 1,2&3 to take-off in Vic, followed by Deltas 4&5 in echelon. The Solos would then line up at opposite ends of the runway (on their respective halves!), roll in unison, with their first cross-over immediately after getting airborne. Spectacular!

Working Up

My first practice formation sortie was on 28 Oct 70. This would have been a 2-ship and would have involved nothing more demanding than some gentle wingovers (a climbing, then descending turn, in the same direction), a lead change, then the other guy having a go. The first aeros followed five sorties later and would probably have been with the CO or the B Flt Commander in the lead. Obviously, we had to be assessed as possessing sufficient quantities of 'the right stuff' to achieve the end objective – something I was all too well aware of being the 'boggie' who had completed Mirage OCU only six months previously.

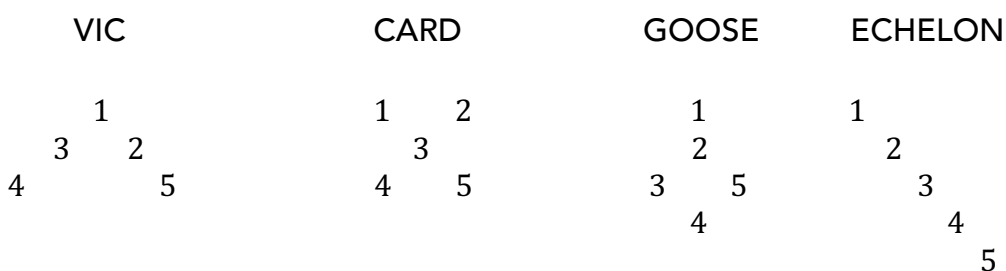
After four of these sorties I am supposing we were all assessed as being fit to continue and then a series of various composition sorties followed until 25 Nov 70 when we settled into a 5-ship routine, presumably with our formation positions assigned and the nucleus of a display formulated. For my sins as Delta 4 I spent most of my time in echelon left – 'for my sins' because seated in the cockpit with left hand on throttle and right hand on the stick, one feels more comfortable looking to the left – as in echelon right

Next was the need for the formation to reference to a ground position and in the first instance a small coastal headland in our practice area – immediately north of Tea Gardens – was chosen. We then needed someone on the ground to critique us, and I believe SQNLDR Hugh Collits was choppered out to 'crowd centre'. But now we really needed a runway to reference to, particularly once the solos joined with us, and the only one available was Williamtown. Thus, from then on almost all of our practices were overhead the Base, which must have been at considerable inconvenience to 76Sqn, 2OCU, 5OTU and the occasional RPT service.

There were, however, many hurdles to be cleared before we displayed at the Base for the first time...

Formation Positions

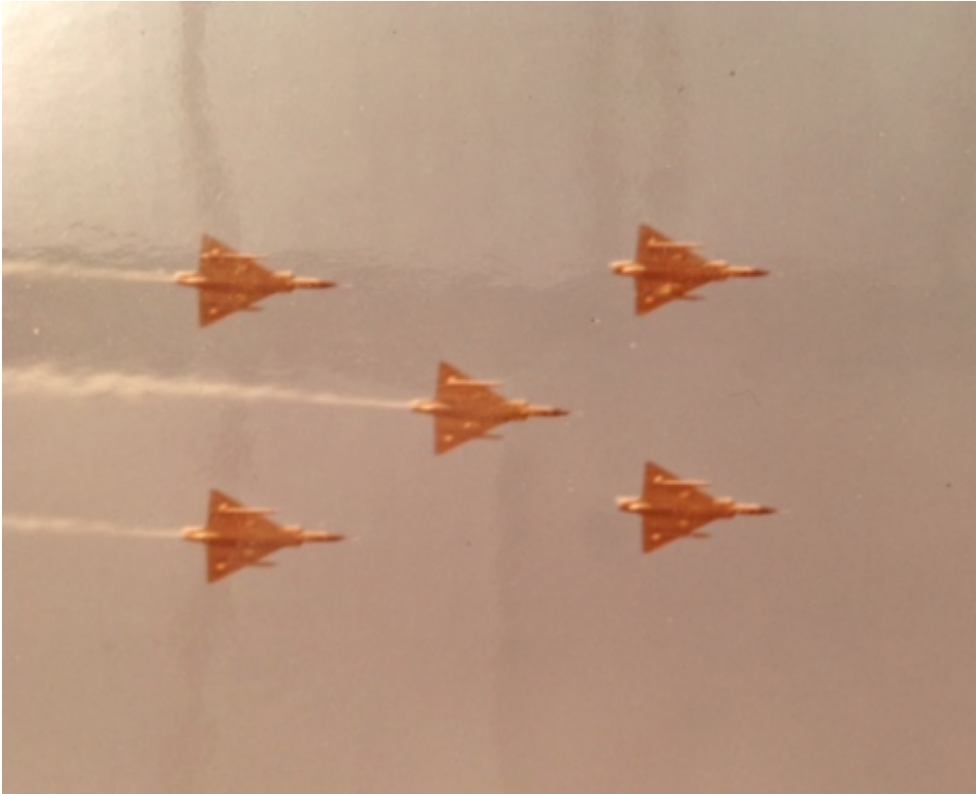
Diagrammatically, viewed from above, the positions were thus:



The standard echelon formation position in the Mirage was stepped backed quite a bit, and this, coupled with a long and skinny airframe resulted in all formation configurations appearing 'long and skinny'. To rectify this to some degree echelon was moved forward a few feet (but not inwards) until the pilot's eye view was in line with the end of the afterburner (A/B) cold flaps; that is, the end of the jet pipe. This is only evident in still photography in plan-form shots.



All compositions were 'building blocks' of echelon and line astern, with the exception of Delta 2 John Archer in Card where the lateral separation abeam Delta 1 was purely by 'calibrated eyeball' and lots of practise. Thus, for example, in Card, Delta 3 Chris Mirow simultaneously flew echelon right off Delta1 and echelon left off Delta 2; while I flew line astern on Delta1 and 'triangulated' distance back by lining up the heads of Deltas 2&3.



Additionally, those of us 'down the back' would, when the need arose approaching crowd centre, 'fudge' our positioning to 'dress' the formation. For example, if I was lagging a little in Card and did not appear to be correcting (for whatever reason) Delta 5 Nick Ford would drop back a little to 'square up' the presentation. While this may appear to be potentially a 'chicken and egg' scenario, it actually worked!

In terms of station-keeping difficulty, after Delta 2 in Card I would suggest Deltas 3&5 in a Goose barrel roll was next, considering that a steep turn was two-dimensional with relatively constant 'g' and airspeed; a loop was two-dimensional but with greatly varying 'g' and airspeed; while a barrel roll was three-dimensional with somewhat varying 'g' and airspeed.

A Box-4 barrel roll is a relatively simple manoeuvre, but is made significantly more complicated when turned into a Goose (though my position as third in line astern was not overly demanding). However, Delta 2's modified barrel roll (being 'deep' on Delta 1) resulted in Deltas 3&5 needing to work very hard to keep the box. If you take a critical look at a still photo of a Goose roll you may pick that while 3&5 are in position, quite often fuselages may not be precisely aligned nor bank angles uniform. I have no aerodynamic explanation for this phenomenon and will dismiss it by saying that 'dark forces were at play'.



The definitive five-ship sequence follows. One should remember that the two solos were mostly performing opposition passes while we were repositioning, though on the final Vic steep turn Solo 2 joined up with us 'in the slot' while Solo 1 (the CO) flashed by between us and the crowd.

Vic loop, with 90deg roll right

wingover right

barrel roll left

wingover right

steep turn left

wingover left

Vic into Card loop

Card steep turn left

wingover right into Goose

Goose barrel roll left

wingover right into Vic

Vic steep turn left Solo 2 joins up in the slot to form a true delta

wingover left Solo 2 separates

bomb burst

The station change from Vic into Card going up the loop presented some initial challenges, but with practise we regularly completed the change by the apex. There was added incentive for us 'down the back' to get 'into the slot' by this point as we were sitting 'below' the leader and thus flew loops of greater radius; if we were not slotted by the time the leader's nose came down through the horizon and he started accelerating, we would be 'left for dead'.

Afterburner (A/B)

The display sequence necessitated the use of afterburner during the first half of the 4g loop, which sounds straightforward enough, but the truth of the matter is that afterburner was not sequenced routinely when airborne in close formation.

All Mirage pilots were very familiar with de-selecting A/B in formation after pairs take-offs, (with it having been selected on the ground immediately after brakes release) but NEVER did we select A/B airborne in close formation. The obvious issue being that if light-ups were not in unison, fore/aft displacement would be immediate, and had the potential to get very messy if one or more aircraft was in line astern.

This was but one example of something which at first glance was innocuous, but required practise to the n'th degree until we were as familiar with what was going on in the cockpits around us as we were in our own.

Furthermore, it was standard operating procedure to check that engine turbine temperature (T4) was at least 600deg C prior to lighting the burner, but even a glance into the cockpit was unacceptable to us in close formation, particularly when pulling g. Thus, we adopted the logic that if the leader's T4 was achieved, then ours must be as well.

Another problem we faced when in A/B in close formation was the limited variable thrust range available for station-keeping.

The ATAR engine produced a 'step input' of about 2,000lb thrust when mini-A/B was selected, with a further 2,000lb available in the variable range. Thus, the mid-range A/B setting that Delta 1 chose was critical – if it was too low wingman may have to blip speedbrakes in mini-burner to prevent overshooting, and if it was too high wingmen could be 'left for dead'. Furthermore, momentary excursions out of or into A/B were prohibited in the flight manual: so it was a case of 'one in, all in; one out, all out'.

We soon discovered that despite obviously being within engineering parameters, some aircraft were poor performers, and were quarantined from our pool of aircraft. The A/B section in Nick's aircraft was so far short of its 'rated' power that it's a wonder it had not been noticed in standard squadron operations! We eventually settled on an aircraft 'mix' which alleviated these issues and flew these individually-allocated aircraft where possible; but even so Chris needed a little extra when under 'g' in his unique #3 slot in Card. A sympathetic 'sumpie' unilaterally 'tweaked' the A/B fuel flow setting: Problem solved!

My aircraft was A3-39, which I flew fairly consistently until the Edinburgh dress rehearsal on 16 Apr 71, after which it had no further participation in the Deltas routine. It must have had some major U/S at the time but it did survive until the end of Mirage ops, being retired in November 1987.

The 'Boggies' Revolt'

A formation pair is a relatively straightforward exercise in straight and level flight and in a smooth air mass. Introduce manoeuvring, power changes, station changes and turbulence and the demands increase manyfold. Now add a third player such that he, #3, is flying off #2, who is flying off the leader, and the complexity increases by an order of magnitude.

This is why we needed so much practice.

Further, regardless of how finely we honed our station-keeping skills, all will be to no avail if the team leader was not, in turn, refining his own skills of smoothly positioning his aircraft in pitch and roll such that we wingmen were able to confidently match his inputs, and indeed, with practice, anticipate his inputs.

The original plan was for the CO, WGCDR Bill Simmonds, to lead the 5-ship section. Things got underway as planned, but as time went by there were other, increasing, demands upon his time and very often the B FLT CDR, SQNLDR Bruce Grayson, was called in to lead. At the same time there were increasing demands upon us to 'smarten up our act' on the wing; and on the leader, as we had now progressed in to manoeuvring with respect to a ground reference point and the concomitant considerations of wind effect, etc.

It was becoming increasingly obvious to us 'on the wing' that we were faring far better with the FLTCDR than we were with the CO, and reluctantly we decided the matter had to be addressed. Collectively we approached Bruce Grayson with our concerns and he then had the unenviable task of putting our case to the CO. Bill Simmonds, being acutely aware of the necessity for wingmen to have full confidence in their leader, immediately agreed and called us all into his office to, in turn, put us at ease. (It's not a common occurrence for junior officers to put their CO 'on the spot'!) We all have the utmost respect for him 'taking it on the chin' as he did.

Radio Failure

To this day I suggest that if an aircraft in a large gaggle is to 'get lost on the airwaves' it will most likely happen when changing from one frequency to another. This was partially acknowledged by the air traffic controllers (ATC) at each display location organising the airspace on the day such that all competing aircraft remained on the one frequency (tower) during their individual routines.

However, radios could and did fail randomly, which could usually be rectified by selecting the alternate radio (the 'red set') in the Mirage. Nevertheless, even this simple selection was beyond us as these sets were low down on the forward left console: we were always 'heads out', with left hand on the throttle and right hand on the stick for the continual multiplicity of small inputs necessary for precise station-keeping.

As our proficiency in the sequences improved, we eventually reached the stage where we 'knew the routine backwards'. We were then given the option at the briefing preceding each flight to continue with the show, should we individually experience radio failure. I believe this may have happened on one occasion, but cannot recall whether it was during a prac or a display.

"Bugging out"

The risk of collision is high during formation aerobatics; the slightest distraction or unexpected flight path deviation by your or an adjacent aircraft could have disastrous consequences. In such a circumstance, impact may be avoided at the last possible moment by 'bugging out' of the formation; that is, initiating an abrupt departure from the pack.

When station-keeping, 99.9% of one's attention is on the adjacent aircraft, with the residue on a general awareness of where the ground is, which is of increasing importance the lower one is, if a bug out becomes necessary. Our worse case scenario was arguably when inverted in one of the barrel rolls.

For the record, we never experienced even a slight nudge, or a bug-out.

The 'Flying Circus'

In 1971 by my count the RAAF was operating 17 different types of aircraft, almost all of which participated in the country-wide air displays in March/ April, though there were regional variations. For example, with Pearce being the home of 2FTS, Macchi aircraft featured more prominently here than at other locations.

With the plethora of competing aircraft, support aircraft and myriad support crews, the combined package took on the air of a travelling circus: quickly packing up after a show; possibly some celebratory drinks if not moving on immediately to the next location; the huge gaggle in the air; arrival and ferretting around to cajole and beg, steal or borrow whatever necessary to facilitate setting up for the next dress-rehearsal; poking fun at others' 'misfortunes'; and so on. Truly a unique experience!

In fact, the 'Circus' could be described as being akin to a huge juggernaut, potentially capable of overwhelming the sensibilities and sensitivities of the host Bases. To assist us, should any frisson eventuate, we had, as our 'impresario' AIRCDRE Bay Adams, a larger than life personality who had flown fighters in WW11 and in Korea.

There is a degree of levity in the 'circus' description, but nothing could be further from the truth. The potential for something to go horribly wrong was ever-present, and here I speak for all participants, not just the Deltas. Very fortunately, the only Incident I recall was the Canberra that burst a tyre during a short landing demonstration at Richmond (short = coming to a stop as soon as possible after landing).

Now for some entertaining snapshots of events while the Circus did its rounds

Richmond Dress Rehearsal

The airshows were 2+ hours duration, with The Deltas being the finale. There was thus the opportunity for us to do our own thing for the first half hour or so, until our sortie briefing. At Richmond the show opener was a box-16 (that is; four box-4s) of Mirages from 76 Sqn, and I found a vantage point above the hangar offices to take in events. I was also able to secure a similar vantage point later, at Canberra.

At Richmond, 76 Sqn duly appeared on time, low, heading south to north. Very impressive. They then gently banked right to head north-east for the transit back to Willy. However, while there was a clear air-mass over Richmond I noted there was menacingly dark low level cloud to the NE. My last tail-end view of the 16 Mirages was of them disappearing into the murk, hugging the terrain. "That could be interesting" I said to myself as I looked the other way for the next event.

While (non-aerobatic) formation flying is second nature to all fighter pilots, there are basically only two close formation positions – echelon and line astern – with the former being the only one employed on occasions where cloud needed to be penetrated; as here the formatting pilot had his best three dimensional view of the lead, and he had some assistance from formation and navigation lights in low visibility and/or at night. Additionally, cloud penetration was strictly limited to two-ship-only events.

Should the formatting aircraft lose sight of his lead in thick cloud, he would immediately announce it on the radio, then turn away using 20 degrees of bank through 20 degrees of compass heading, and hold this for 20 seconds, then reverting to the original heading. This would place him clear of his leader but in a 'stable' position from which he could quickly regain close formation when visibility improved.

Another reason for echelon being the 'one and only' was that speedbrakes were forbidden in line astern for a very good reason: if this aircraft missed a call to select speedbrakes out, he would immediately be faced with a very high closure rate on his lead. Thus, formations involving more than two aircraft were made up of various combinations of echelon and line astern, and were strictly fair-weather-only affairs.

Now, getting back to our disappearing box-16 Mirages

The weather was closing in rapidly, with a very low cloud base and reducing visibility in showers. The large formation was far too unwieldy to make a U-turn, so the only way was up! In short order the formation entered a very dense cloud and simultaneously 14 aircraft lost contact with each other!

Clearly, the '20/20/20 rule' was not going to work on this occasion. All our intrepid aviators could do was to gently spread out and fervently hope they would not hear or

feel metal against metal. Miraculously, all aircraft cleared each other without incident and popped up into clear air at about 15000feet, at which stage the gaggle resembled confetti in an updraft!

The aircraft were now well and truly in controlled airspace without an airways clearance – a 'mortal sin' - but all the Sydney Controller wished for was that they would get off his frequency, and pleaded with them to call Willy Approach!

Only one aircraft in the 16 retained visual contact with his reference aircraft, and that was 'our' boggie Steve Low, who was in echelon right on the overall leader.

Canberra Planning Conference

In the months and weeks leading up to the Displays each host Base held at least one major planning event which would have spawned a host of subsequent lesser meetings. In addition to the display aircraft and their crews there were numerous support aircraft and personnel, and the consideration that tens or hundreds of thousands of spectators would be on base or in close proximity to them 'on the day'. I imagine our representation would have been the team manager Hugh Collits, senior engineering officer SQNLDR Pete Watson, and the equipment officer FLGOFF Garth Buick.

When the discussion came around to airspace management the ATC rep advised that Canberra only controlled the airspace up to 8,000feet and any aircraft needing to go higher would have to call Sydney Control for clearance. This directly impacted our operation as the Mirage takes up to 10,000feet to execute a 'gentle' 4g loop, and with Canberra's elevation of 2,000feet it meant we would require up to 12,000feet above sea level.

The ATC rep was adamant. However, once apprised that (a) there were potentially serious pitfalls in changing frequency with such a large formation (b) pilots did not possess a third hand to manipulate the radio control panel and that (c) they would be climbing at 30,000feet/minute on the upside of the loop and that nothing was going to stop them, the rep then acquiesced that some arrangement would be made with Sydney Control. For the dress rehearsal and on the day the appropriate block of airspace was temporarily transferred to Canberra's control.

If there is a moral to this event, it could be that airspace is managed for the benefit of the end user, NOT vice versa!

Canberra Show Opener

The opening event here was a Vic-5 of our Deltas aircraft (but not the Deltas pilots) led by our 'Spare' pilot FLTLT Jack Smith. Jack's principal task during the Circus was to ferry the spare aircraft around the traps – a spare being wise in case one of our team

aircraft went U/S. The Vic-5 took off well before the official start of proceedings and 'held' at an appropriate 'initial point' (IP) in the general vicinity of Lake George until the time Jack had pre-determined was necessary to leave, to arrive overhead bang on time.

In the heat of the moment Jack was a little late leaving the IP. Consequentially, to arrive at the airfield on time the aircraft were considerably in excess of the planned 450 knots (900kph) resulting in a considerable increase in the element of surprise!

The day was perfect: clear skies, no wind, and a comfortable temperature; ideal flying conditions with the air 'as smooth as silk'. I was perched in my lookout above the hangar offices, waiting for events to unfold.

The commentator was telling the crowd that the first event would be the Mirage Vic-5 followed by a swarm of 5 Sqn Iroquois choppers. The Mirages were heading in from the north-east, but all eyes were on the choppers heading in from the south. As the Mirages screamed overhead it appeared to me that the crowd in unison involuntarily jumped about 6 feet into the air, in surprise. Great stuff!

Edinburgh Dress Rehearsal

All this flying and support effort is thirsty work. It was routine that after all de-briefing was completed most of us (around 100) would repair to the Officers' Mess bar to 'critique' the day's events. On this occasion the bar's shutters were well and truly down and locked as the 'Base Hierarchy' had decided to 'save us from ourselves'!

Initial shock turned to indignation, then rebellion, with cries of 'let's go down to the Sergeants' Mess and see if they will invite us in!' Fortunately our 'top cover' Bay Adams was just as thirsty as the rest of us, and the O's Mess bar soon reverted to normal operations.

Amberley

An aircraft will create a sonic boom if it attains the speed of sound (Mach 1) in 1 g flight. It may also create a boom at a slightly lower speed if under significant g, - due to air accelerating around one or more protuberances in the airframe and subsequently 'cracking the barrier' at this spot on the fuselage or wings.

In 1971 the RAAF was operating loan Phantom F-4E aircraft while awaiting delivery of the delayed F-111. The Phantom was an extremely capable aircraft, but could never be accused of having the sleek and graceful lines of the Mirage. In fact, it was often rather disparagingly referred to as 'being a triumph of thrust over aerodynamics'.

On one practice the Phantom solo came screaming in at 'only' Mach 0.9 and entered a high-g level turn. This produced a very pronounced WHUMP that was heard and felt

by all, being only a 'gnats whisker' below a fully developed sonic boom and the likelihood of broken windows, etc, etc. He was a little less enthusiastic on subsequent occasions!

"Bomb burst GO"



In close multi-formations all configuration changes are called by the leader on the radio. First the forthcoming action is nominated, then a slight pause of about one second, then the imperative "GO" to ensure everyone actions the change simultaneously.

The final manoeuvre by the 5-ship was a bomb burst from Vic while heading towards the crowd. Delta 1 pulled straight up into a loop, Deltas 2&3 rolled away to 40 degrees of bank then pulled into big wingovers, while I and Delta 5 rolled away to 85 degrees of bank and then pulled into a level 4.5g turn.

Nick and I, being all too aware that Deltas 2&3 respectively would be rapidly rolling towards us, developed the habit of initiating our individual rolls away on the 'ST' in 'Bomb burst'; the logic being that it would take us about a second to achieve our desired bank angle, at which stage Delta 1 would issue the imperative "GO"

This worked a treat except for the time when Bruce Grayson, instead of calling "GO", said 'Standby', as he wished to delay the action momentarily. Thus, there were Deltas 1, 2&3 with wings level and Nick and I with 85 degrees bank, in suspended animation defying the laws of aerodynamics until we got the go-ahead to start pulling into the turn.

Five weeks, with a 'preview'

The Deltas were created for the seven country-wide Golden Jubilee air displays 28 Mar 71 to 25 Apr 71, but we had a 'curtain raiser' of the definitive sequence at the RAAF Academy Graduation ceremony at Point Cook on 9 Dec 70.

Dave Robson has mentioned the 40 knots crosswind when we took off at Avalon (Pt. Cook runway being way too short for the Mirage), but he failed to mention the 45 knots when we returned for landing – the Flight Manual limits being 22 and 25 knots respectively!

For our take-off in such conditions we dispensed with the usual configurations and rolled individually with five second spacing, which afforded us more leeway with our control inputs in unfamiliar conditions.

The Mirage had a landing speed of 175 knots (350kph!) so was fitted with a brake parachute to reduce brake wear and reduce the landing distance. There was an immediate 20 knots reduction when the 'chute was first deployed, followed by a more gradual retardation. Standard practice was to edge towards the exit side of the runway where the chute was released, upon which it dropped limply onto the runway and was collected by a Chute Recovery Team after all aircraft in the package had landed.

The 45 knots crosswind was a real consideration as the aircraft tended to 'weathercock into wind' when the chute was deployed, as the aircraft's nose wheel was still in the air at this stage. We were thus briefed to release the 'chute immediately after the first jolt of retardation, even though we would, individually, still be on the runway centreline. However, there was absolutely no chance of the 'chute then falling limply onto the centreline where it may foul the next aircraft in the landing sequence!

The howling westerly wind at Point Cook generated lots of mechanical air turbulence which made for a very difficult air display, but I don't recall any complaints once we had 'put the aircraft to bed' at Avalon and joined the celebrations at Point Cook.

This Display was the 'crowning glory' of my time as a PLTOFF. I was promoted to the heady rank of FLGOFF four days later, December 13, being the second anniversary of the graduation of No. 67 Pilots' Course at Pearce.

Epilogue

All in all, counting all the practices, transits and displays, I have 126 logbook entries directly attributable to The Deltas. Multiply this by seven, and a 1.1 hour average sortie length, and that's just short of 1000 hours – and we were but one element of the Golden Jubilee 'Circus". I believe I can unequivocally state that never before had the RAAF devoted so much effort to a single series of airshows, and never again will it!



Alf Allen
Perth
October 2018

Addendum

Turbulence

At high altitudes aircraft often go for long periods without experiencing any turbulence, because they are flying in a stable airmass. Down close to the ground the air is often still and smooth in early morning, but by 'airshow time' mid-afternoon mechanical and/or heat turbulence is usually evident. Surprisingly, even though only a few feet separate aircraft in close formation, they will invariably respond differently to an encounter with the same 'lump' of turbulence.

Thus, each and every member of a formation team is continuously making small control inputs to counter the effects of turbulence – as an 'overlay' to basic station-keeping requirements.

Station –keeping technique

Aircraft flying directly off the leader have, relatively speaking, a simpler task to perform than those further out. Thus, in our 'simplest' formation, the Vic-5, Deltas 2&3 have it easier than Deltas 4&5. Right! Wrong! Deltas 2&3 need to exercise super-refined judgment to maintain their positions using tempered control inputs, cognisant that Deltas 4&5 are positioning on them. The latter, on the other hand, can be relatively care-free with their control inputs as they do not have these responsibilities.

A 'daisy-chain' formation, such as our Echelon-5, requires an additional consideration. If an error develops and is continued 'down the line' there is the possibility for a 'whip' or a 'surge' to develop. 'Looking through' your reference aircraft to the next in the line can contain this. That is, #3 would 'look through' #2 to #1, #4 'looks through' #3 to #2, and so on.