ICAS Multi-Aircraft Operations Best Practices

Rev. 1
Effective 7/20/2024

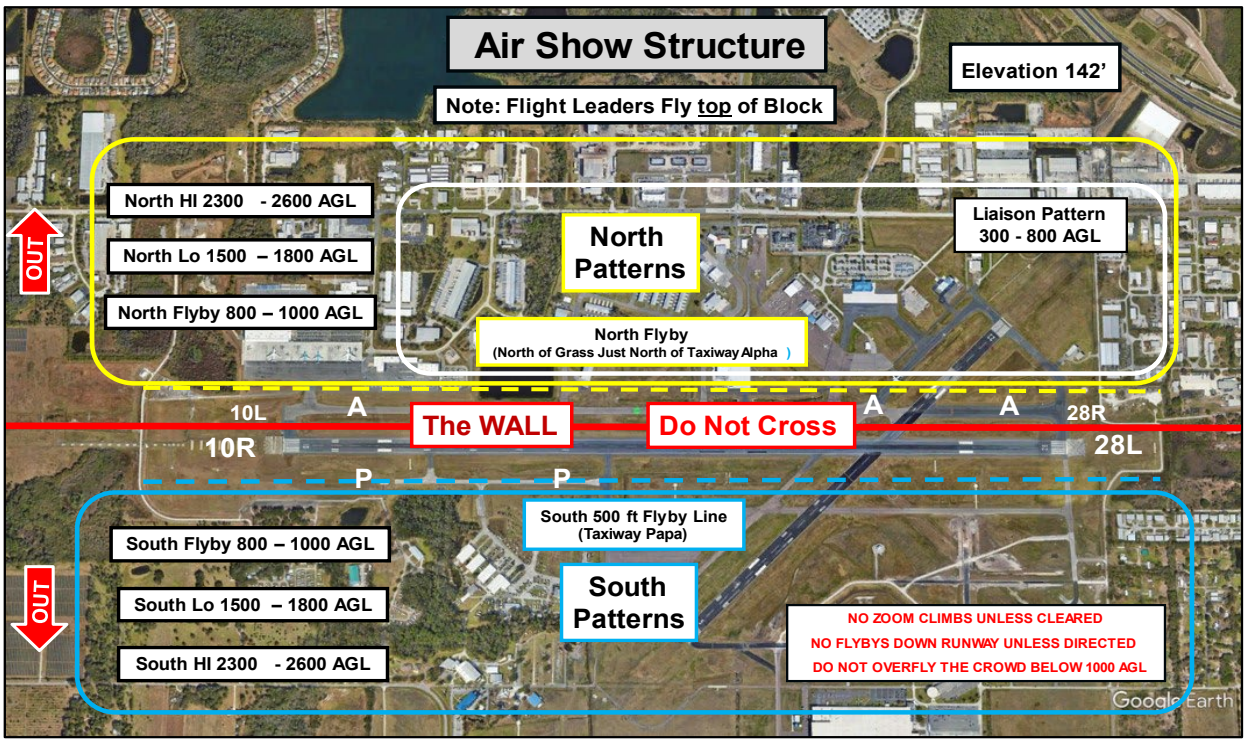
International Council of Air Shows, Inc.
205 Van Buren Street
Hendon, Virginia
20170

ICAS Multi-Aircraft Operations Best Practices

"A standard set of procedures for a safe warbird air show"

To facilitate safe warbird operations at air shows it is essential that a deconflicted structure and execution plan is employed to maximize safety. The challenge at many air shows is that the air boss may not know exactly the number and type of warbirds that want to fly in the air show until they show up at the briefing. This forces the air boss to "invent" the air show "on the fly" during the brief. This results in a discussion that involves trying to figure out where everyone goes and there are frequently many changes that can be confusing and hard to follow. This can result in many questions from the warbird pilots requesting clarification and usually results in additional changes. There is usually nothing in writing and the pilots are forced to rely on memory or the notes that they typically take during the brief. The pilots must exit the briefing with a complete understanding of their role in the show, but they may not have a clear picture on what everyone else is doing. This methodology also results in a warbird air show that requires that the air boss make an extraordinary number of radio calls to keep the execution of the plan safe.

The "Stack Plan" methodology presented here provides a simple, safe structure that any air boss or Warbird pilot can easily follow and execute. This Stack Plan has been employed at both Sun n Fun and Oshkosh with great success for years and the examples given here are from these shows. This simple plan can be easily adapted to any air show show line, has deconfliction built in, can handle small or large volumes of aircraft safely and is essentially based on an airport traffic pattern with reference to the show line or runway. This structure and plan makes it easy for the air boss to make assignments into the patterns and each pilot gets a copy of the "Warbird Air show" (figure 2) so their assignment and the location of other groups is crystal clear.

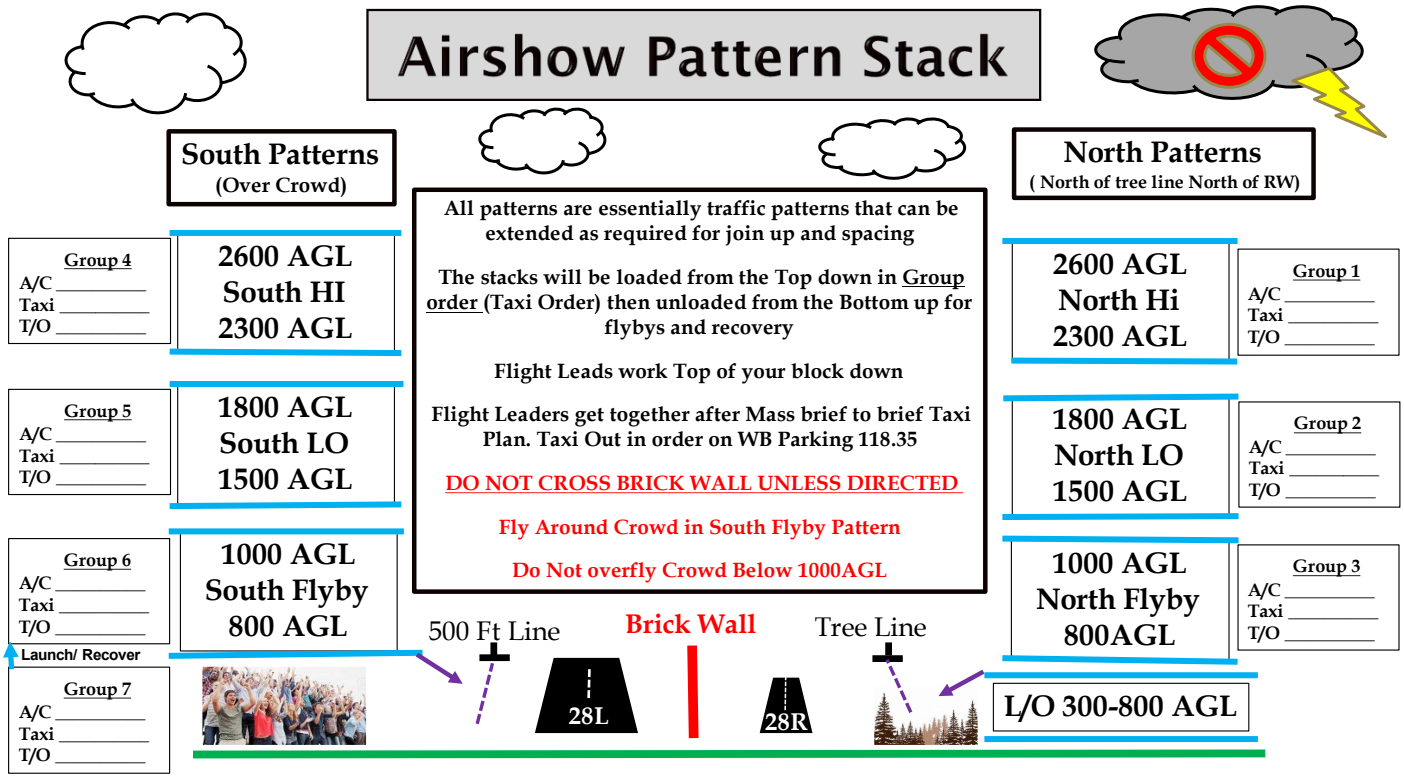


Overhead view of Stack Plan from Sun n' Fun (figure 1)

Basic Structure

The previous diagram (figure 1) shows an overhead view of the Stack Plan structure as executed at Lakeland Airport (KLAL) during Sun n' Fun 2024. The stack consists of three patterns or orbits north of the field and 3 patterns to the south. All altitudes in the stack are specified as AGL altitudes and all pilots must set their altimeters to zero on the ground prior to takeoff. (Very important briefing point!) Each pattern has a specific name such as North Hi, North Lo, North Flyby, South Hi, South Lo and South Flyby, each at a specific block AGL altitude. Two flyby lines are established. One flyby line is north of the runway and one line is south of the runway. In this example, the south flyby line is also the 500 ft show line. A brick wall is setup slightly north of the active air show runway to separate the North and South pattern stacks.

The following diagram (figure 2) is the Stack Plan air show "Shell" that can be filled out by the air boss in advance if he knows all the aircraft he intends to fly or can be filled out in the beginning of the brief if the composition of the warbird show is unknown. In either case, all pilots should have a copy of this assignment sheet. This air show Pattern side view of the Stack IS the air show. Each Pattern has a data block that is used to enter type aircraft, taxi time and takeoff time. This data is used to manage the patterns by Groups of aircraft. For example, the North Hi pattern as depicted is for Group 1.



Warbird Air show Pattern Assignment sheet (figure 2)

Key Features of the Stack Plan

- Standardizes the air show structure, execution, and terminology.
- Provides built in altitude, lateral separation, and timing to ensure deconfliction.
- Keeps performing warbird aircraft in front of crowd as much as possible.
- Provides a clearly defined and standardized structure.
- Allows dual simultaneous flybys on separate flyby lines if desired.
- Eliminates almost all offsite holding (Takeoff, Perform, then land all in view of crowd)
- Allows numerous separate groups to safely execute their profile at the same time.
- Utilizes a very flexible "Plug and Play" concept where it is easy to insert aircraft as desired.
- All orbits are essentially airport traffic patterns that allow Flight Leaders the ability to takeoff directly to their assigned airspace, rejoin flight, display their briefed formations, perform formation or single ship flybys, and then land in sequence.
- While this plan needs some extra emphasis on timing, profile execution flow and communication for optimum performance, the mechanics of the plan are simple and easy to manage and execute.
- While the view from the spectators may appear to be a beehive of activity it is actually a highly organized and orchestrated plan designed to keep "stuff" in front of the crowd and minimize dead spots in the action.

Concepts of Employment

1) This plan is very flexible and there are many options available. The composition of the stack is dependent upon the number and type of aircraft that are available to fly, the desired theme, or the desired flow for flybys down the runway in front of the air show spectators as designed by the air boss. The air boss can use as little or as many of the patterns as desired employing a mass launch or a launch recover, launch recover sequence. A script of specific narration can be developed and presented by the announcer to showcase specific aircraft or support a desired theme. There is no off airport holding required as the patterns are the holds.

2) During the warbird portion of most air shows there are only a few elements involved. These include formation passes at altitude, formation passes down the runway and single ship passes down the runway. Everyone wants to execute a flyby and this plan provides that opportunity. Once the patterns are stacked by the air boss, It becomes a simple process of clearing aircraft out of their "traffic pattern holds" in sequence for low approaches and a landing on the show runway. Once a lower pattern is vacated or a group lands, the air boss then clears the next group in sequence into a lower block. This is easy for the warbird pilots as they are essentially flying a very familiar airport traffic pattern that is referenced to the show runway.

3) Each group owns their assigned altitude block on their side of the runway and can expand their pattern by moving the downwind leg away from the show runway (to the north or south in this example) to facilitate rejoining larger formations. Once the formation is joined up, the leader can then tighten the pattern and execute belly passes in the north patterns with the apex of the pass at show center. The ideal flow would be to assign the largest formation North Hi where the leader could execute large formation passes at altitude then split up into 4-ship elements in trail when cleared to the lower blocks. This creates a timely and orderly flow for a flat formation pass down the runway followed by the initial for landing or a sequence of elements direct to initial if time is running short.

4) The North Hi group in this example will be the last group airborne in the sequence and if desired they can split off a 4-ship element to hold to the north to execute a Missing Man formation to close the Warbird Show.

5) The taxi order is by group order filling the far side of the show runway first with large formation groups if available and then filling the patterns over the crowd next with additional smaller formation groups or single ships in trail. This result is a nice presentation of formations groups as a backdrop on the far side of the show runway, formation flybys above the crowd and flybys down the air show runway as directed by the air boss. If the particular airport configuration allows the air boss can have the aircraft taxi in front of the crowd and do runups at show center as they move in sequence for takeoff thereby adding an additional element to the Warbird Air show presentation.

6) The patterns are filled from the top down in group order and unloaded for flybys down the show runway from the bottom up. Generally, you unstack the aircraft above the crowd first then start the flow from the far side of the show runway. This maintains groups in front of the crowd in the background doing belly passes while you do flybys and land aircraft in the foreground. Large formations can, time permitting, do a formation flat pass down the runway, then split up into elements in trail for initial. North Patterns always break North and South patterns break always south.

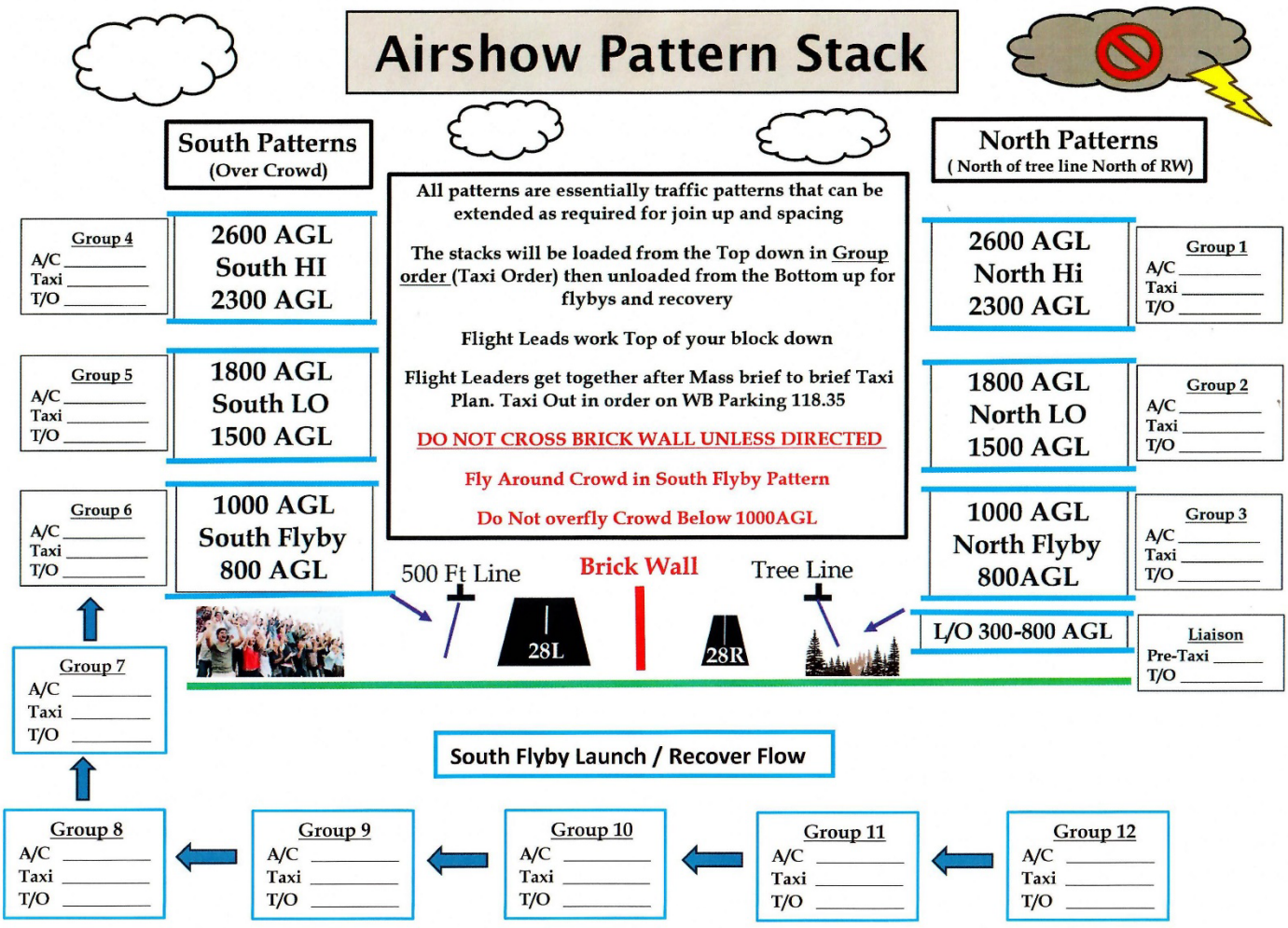
7) There are essentially two types of flybys. One flyby is at altitude in the assigned altitude block on the designated flyby line and the other flyby is down the show runway only when directed by the Air boss.

8) A block altitude is used for every pattern. Each block assignment is 300 ft thick with a 500 ft buffer between patterns. The leader of each formation group, especially when in elements in trail, should fly at the top of the assigned block to allow for the down stack in the formations.

9) If you have a large number of non-formation qualified single ship aircraft, it is probably better to split them up into smaller groups of 4 and assign them a separate pattern. This will prevent pattern saturation and minimize the risk of someone losing sight of the aircraft they are briefed to follow.

10) The single ship groups should be sorted by speed compatibility. It is desired to put a formation qualified pilot or a highly experienced air show pilot as the lead aircraft in a single ship group. While the single ship group is not flying formation the leader and the Air boss should brief the planned speed, pattern ground track, spacing to be used in the pattern as well as the breakout and loss of sight plan. The red arrow on the slide (figure 1) designates the direction of clean airspace. The lead aircraft in a single ship group should also fly at the top of the assigned block. If someone loses sight, they should make a radio call to the Air boss, descend to the bottom of their block, and maintain the briefed ground track. This move to the bottom of the block will put the other aircraft against the sky instead of the ground making regaining the visual easier.

11) In order to keep radio calls short and concise, It should be briefed, for example, that if you are assigned North Hi, it is understood that in is also an assignment to block 2300-2600 AGL.



Launch Recover, Launch Recover sequence for South Flyby Pattern (figure 3)

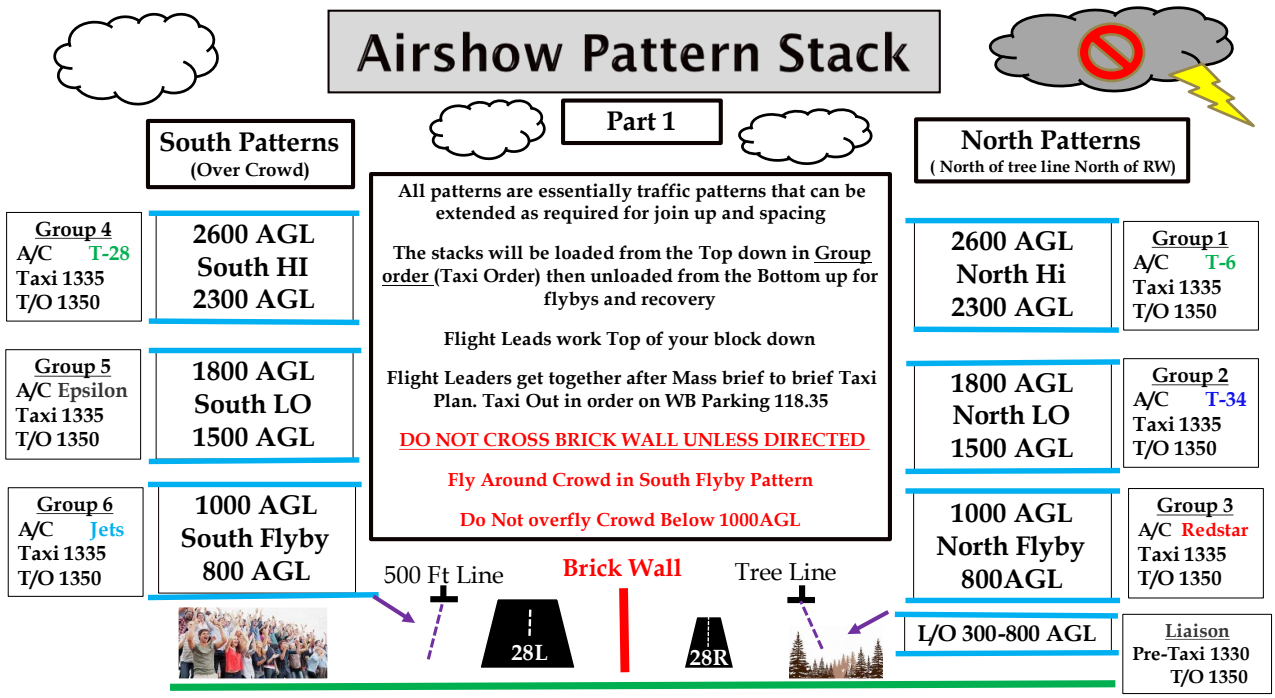
Rules of Execution

The following rules must be clearly briefed and understood by all flying in the show.

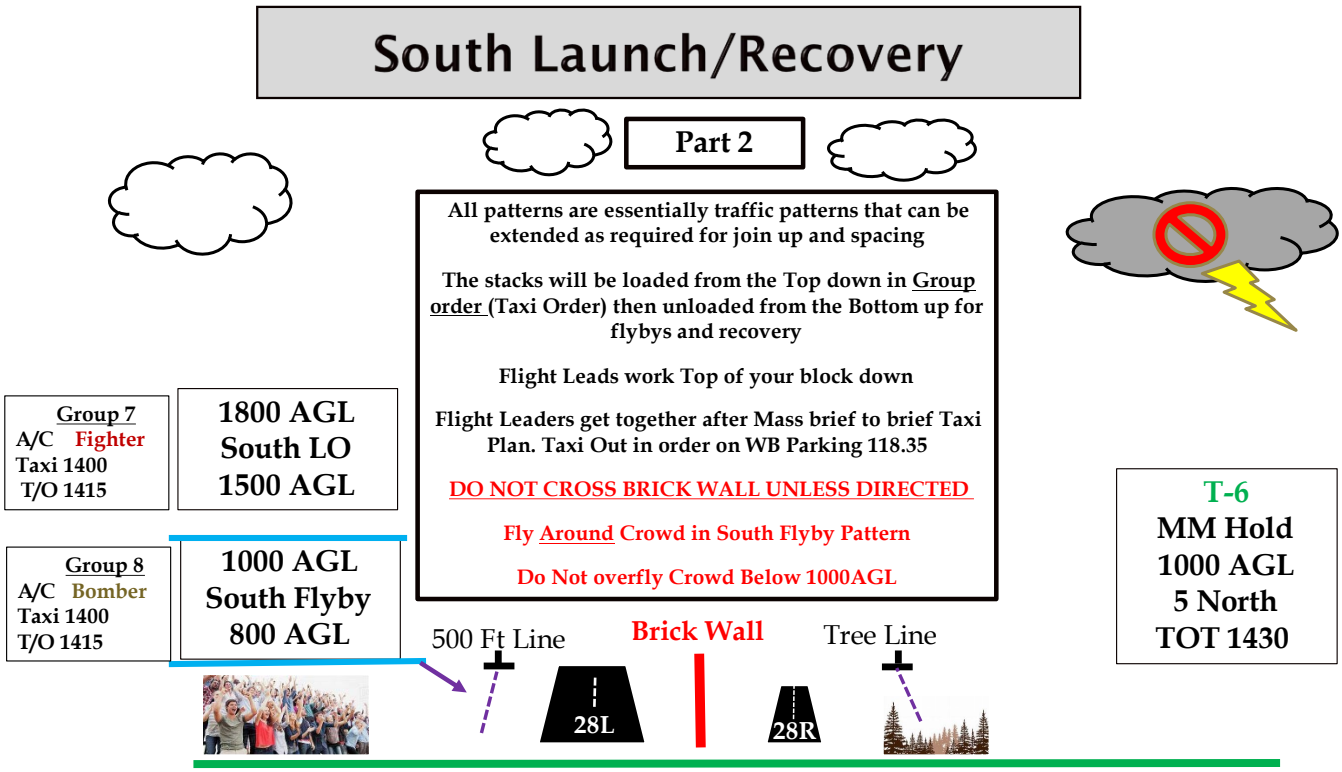
1) Safety is the number one priority.
2) Clear your flight path at all times.
3) Maintain your situational awareness and ask questions if in doubt.
4) Fly your profile as briefed.
5) Follow and acknowledge the Air boss instructions.
6) Do not change your altitude block until cleared.
7) No flybys down the runway until cleared.
8) No Zoom climbs during flybys.
9) Do not overfly the crowd below 1000 AGL.
10) When in the flyby pattern below 1000 AGL fly around the crowd in the flyby pattern.
11) Minimum flyby altitude is 300 AGL for formations passes and 200 AGL single ship.
12) Brief your group carefully and ensure there are no questions on your profile.
13) Don't forget to set your altimeter to zero.
14) Maintain your side of the runway at all times and do not cross the brick wall unless cleared.
15) Pay attention and fly your aircraft at all times.
16) Do not be afraid to go around if required. Call it and fly your aircraft.
17) If you need to abort on takeoff, make the decision early, control your aircraft and make a radio call.
18) Think, Look and Listen. Come prepared to fly and bring your "A-Game" to the table.

Stack Plan Example

The following slides from Sun n' Fun 2024 is presented as an example of a large group plan complete with group aircraft assignments and a flow sheet that depict the sequence of events. (figures 4-8)



Sun n' Fun 2024 (figure 4)



Sun n' Fun 2024 (figure 5)

AIRSHOW EVENTS

Wednesday ShowTime Slot 1350 - 1435 (45 Min)

Group	Flow	Area	Taxi Order	Taxi	TO	Events / Altitudes MSL	Notes
Pre Taxi	1st	North	Liaison	1330	1350	Liaison 300 -800 AGL	Split into two blocks if desired
1		North	T-6	1335	1350	North High 2300 - 2600 AGL North Low 1500 - 1800 AGL North Flyby 800 - 1000 AGL Missing Man 1000 AGL	200 AGL Min on SS Flyby 300 AGL Formation on North Flyby Line Hold North / South to North MM to land
2		North	T-34	1335	1350	North Low 1500 - 1800 AGL North Flyby 800 - 1000 AGL	200 AGL Min on SS Flyby 300 AGL Formation on North Flyby Line
3		North	RedStar	1335	1350	North Hold 800 - 1000 AGL North Flyby 800 - 1000 AGL	200 AGL Min on SS Flyby 300 AGL Formation on North Flyby Line
4	2nd	South	T-28	1340	1355	South High 2300 - 2600 AGL South Low 1500 - 1800 AGL South Flyby 800 - 1000 AGL	200 AGL Min on SS Flyby 300 AGL Formation South Flyby Line (500 FT Line)
5		South	Epsilon	1340	1355	South Lo 1500 - 1800 AGL South Flyby 800 - 1000 AGL	200 AGL Min on SS Flyby 300 AGL Formation South Flyby Line (500 FT Line)
6		South	Jets	1340	1355	South Flyby 800 - 1000 AGL	200 AGL Min on SS Flyby 300 AGL Formation South Flyby Line (500 FT Line)
7	3rd	South	Fighter	1400	1415	South Lo 1500 - 1800 AGL South Flyby 800 - 1000 AGL	200 AGL Min on SS Flyby 300 AGL Formation South Flyby Line (500 FT Line)
8		South	Bomber	1400	1415	South Flyby 800 - 1000 AGL	200 AGL Min on SS Flyby 300 AGL Formation South Flyby Line (500 FT Line)

Group Block Assignments Sun n' Fun 2024 (figure 6)

Taxi	Time	Area	A/C	Event	RW	Pattern	Altitude	Notes
1330	1350	North	Liaison	Takeoff	10L/28R	Liaison	300-800 AGL	2 Orbits if desired 300 & 800 AGL
1335	1350	North	T-6	Takeoff	10R/28L	North Hi	2300-2600 AGL	North Flyby Line
1335	1350	North	T-34	Takeoff	10R/28L	North Low	1500-1800 AGL	North Flyby Line
1335	1350	North	Redstar	Takeoff	10R/28L	North Hold	1000 AGL	Hold till L/O Land
	On Call	North	Liaison	Land SS from Liaison	10L/28R			After North formations airborne
	On Call	North	Redstar	Change	10R/28L	North Flyby	800 - 1000 AGL	North Flyby Line After L/O Land
1340	1355	South	T28	Takeoff	10R/28L	South HI	2300-2600 AGL	
1340	1355	South	Epsilon	Takeoff	10R/28L	South Low	1500-1800 AGL	South Flyby Line
1340	1355	Jets	F-86, Mig17, L-39	Takeoff	10R/28L	South Flyby	800-1000 AGL	South Flyby line
	On Call	South	Jets	Land SS from Flyby Pattern	10R/28L			After 2-3 passes
	On Call	South	Epsilon	Change	10R/28L	South Flyby	800 – 1000 AGL	After Jets Land
	On Call	South	Epsilon	Land SS from Flyby Pattern	10R/28L			After 2-3 passes
	On Call	South	T-28	Change	10R/28L	South Low	1500-1800 AGL	After Epsilon in South Flyby
	On Call	South	T-28	Change	10R/28L	South Flyby	800-1000 AGL	After Epsilon Land
	On Call	South	T-28	Land SS from Flyby Pattern	10R/28L			After 2-3 Passes

Flow of events Sun n' Fun 2024 Part One (Figure 7)

Taxi	Time	Area	A/C	Event	RW	Pattern	Altitude	Notes
	On Call	North	Redstar	Land (Initial)	10R/28L			After T28's Land
	On Call	North	T-34	Change	10R/28L	North Flyby	800-1000 AGL	Parade Pass After Redstar Lands
	On Call	North	T-6	Change	10R/28L	North Lo	1500-1800 AGL	After T-34 in Flyby pattern
	On Call	North	T-34	Land (Initial)	10R/28L			After Parade Pass
	On Call	North	T-6	Change	10R/28L	North Flyby	800-1000 AGL	After T-34 Land
1400	1415	South	Fighter	Takeoff	10R/28L	South Lo	1500-1800 AGL	South Flyby Line
1400	1415	South	Bomber	Takeoff	10R/28L	South Flyby	800-1000 AGL	South Flyby Line
	On Call	South	Bomber	Land SS from Flyby Pattern	10R/28L			After 2-3 passes
	On Call	South	Fighter	Change	10R/28L	South Flyby	800-1000 AGL	After Bombers Land
	On Call	South	Fighter	Land SS from Flyby Pattern	10R/28L			After 2-3 Passes
	On Call	North	Non MM T-6	Land (Initial)	10R/28L			After Fighters land
	On Call	North	T-6	MM Hold		North 5 miles	1000 AGL	Hold for TOT
	On Call	North	T-6	Missing Man		N to S	1000 AGL	1430 TOT
	On Call	North	T-6	Land	10R/28L	Initial +1	1000 AGL	Break to land full stop

Flow of events Sun n' Fun 2024 Part Two (Figure 8)

Summary

This document contains a lot of information as presented but after the information is reviewed and digested this methodology is really quite simple. The Warbirds of America conducts very large air shows at both Sun n' Fun and Oshkosh. Because we fly very large formations, we start the coordination and planning process months in advance and we know what aircraft we intend to fly each day. The example presented here is from Sun n' Fun 2024. The level of detail shown in these documents (figures 4-8) is not realistically possible unless you know the type and quantity of warbirds you intend to fly well in advance of your air show. Every Air boss at every air show nationwide can however create his own custom "Plug and Play" de-conflicted air show shell based on the one presented here. (see figure 2) This shell, when all groups are assigned, yields a very effective representation of the air show plan that is simple to manage and easy to safely execute. This plan, which is distributed to all pilots, clearly specifies each group's role and also presents the big global picture of where every other group is located in the air show airspace.

Key Takeaways

1. Build your own deconflicted air show shell in advance based on the air show runway.
2. Do NOT invent the air show in the brief.
3. The Air boss must avoid trying to "fly" the warbird pilot's aircraft or direct formation changes with a constant stream of radio calls. Monitor the safe execution of the plan and step in only if required.
4. Conduct a concise and complete brief of the group assignments and flow for the show.
5. Carefully brief the rules of execution for the plan and spend time talking about contingencies, emergencies, loss of sight, breakout procedures and location of clear airspace for each group.
6. Place strong emphasis on the importance of staying in your assigned pattern, ground track, breaking in the proper direction on initial, not changing patterns until cleared, and the location of the flyby lines. Everyone must clearly understand the critical importance of staying in their stack on their side of the show runway, honoring the flyby lines and not crossing the brick wall unless cleared.
7. Foot stomp the use of AGL altitude and setting the altimeter to zero.
8. Focus on safety
9. Ensure in the briefing that everyone in each group understands the plan and has no questions.
10. Distribute a copy of the plan to all pilots flying in the show.
11. Conduct a debrief of the execution of the show and focus on lessons learned and how the next days execution can be improved.