

FAST AIR SHOW OPERATIONS

Revision 2, FEB 2021

INTRODUCTION/OVERVIEW

As a Recognized Industry Organization (RIO), FAST provides formation credentials for pilots operating within the air show environment where a Certificate of Waiver (CoW) is in effect. This FAST Air Show Operations document was written to help provide FAST pilots with the knowledge and background information needed to operate safely and legally in CoW airspace. Although it is a comprehensive learning tool, it is not intended to be the only source of information. Much of the material in this document is taken from FAA Order 8900.1, Volume 3, Chapter 6 which is the primary source of information pertaining to all limits, conditions and restrictions. The FAST Foundation and Principles documents contain additional information pertaining to FAST air show operations in particular, and in some cases may be more restrictive. ***Air show pilots must have adequate knowledge of the material contained in FAA Order 8900.1 Vol 3 Ch 6 to safely and legally operate in the air show environment.***

Each FAST pilot operating under a CoW must have been evaluated and have demonstrated both a knowledge of air show procedures, and in-flight formation competency to meet the standards and be issued a formation credential (FAST Card). The complete lists of evaluation metrics and Practical Test Standards for Wingman, Flight Lead and Check Pilot are included in the FAST Foundation and Principles and FAST Practical Test Guides.

When operating under a CoW at an Aviation Event, the 8900.1 document classifies maneuvering in three categories: Aerobatic, Dynamic and Standard. These are further broken down into Solo or Formation maneuvering. ***A FAST Credential allows a pilot to participate only in the Standard maneuvering category.***

In a formation flight, standard maneuvering includes non-abrupt maneuvering, flybys, formation configuration/position changes, and missing-man formations. The flight may not separate inside the flying display area, except to break for landing, or for individual flybys or for a missing man pull-up. Minimum altitude for all flybys is 250' AGL. The pitch and bank limitations in formation are: pitch less than or equal to 45 degrees above or below the horizon and bank angle less than or equal to 60 degrees. A formation of FAST cardholders may separate into separate formations while outside the Flying Display Area, and may alternate passes within the Flying Display Area, but may not execute maneuvers authorized under Dynamic Maneuvering.

SAC – Statement of Aerobatic Competency FAA Form 8710-7				Formation Credential – FAST/FFI			
DMF – Dynamic Maneuvering - Formation DMS – Dynamic Maneuvering - Solo AF – Aerobatics - Formation AS – Aerobatics - Solo				FAST – Formation and Safety Training FFI – Formation Flying Inc.			
Formation Maneuvering				Solo Maneuvering			
	Standard Maneuvering	Dynamic Maneuvering	Aerobatic Maneuvering		Standard Maneuvering	Dynamic Maneuvering	Aerobatic Maneuvering
FAST/FFI	Pitch ≤45° and/or Bank ≤60°			No Credential	Pitch ≤60° and/or Bank ≤75°		
SAC + DMF		Pitch ≤60° and/or Bank ≤75°		SAC + DMS		Pitch ≤60° and/or Bank ≤90°	
SAC + AF			Pitch >60° and/or Bank >75°	SAC + AS			Pitch >60° and/or Bank >75°

While the FAST authorizations are evaluated and administered by FAST, two additional levels of qualification are available to formation airshow pilots. These levels are the Formation Dynamic Maneuvering endorsement, and the Statement of Aerobatic Competency (SAC) card with a Formation endorsement (an aerobatic qualification). The Dynamic Maneuvering card program is administered by the International Council of Air Shows (ICAS) while the Aerobatic SAC card program is administered by both ICAS and EAA Warbirds of America. Credentials for

these levels are issued by the FAA. The Formation Dynamic Maneuvering qualification/endorsement allows for maneuvers that separate aircraft from the formation inside the Flying Display Area, to include solo or formation opposing or crossing passes, "bomb-bursts", or extended trail maneuvering.

QUALIFICATIONS AND AUTHORIZATION

AUTHORIZATION - A FAST card authorizes a pilot to participate in non-aerobatic fly-bys or a series of non-aerobatic fly-bys, performed by one or more aircraft, before an invited assembly of persons at an aviation event while a Certificate of Waiver (CoW) is in effect.

Pilots holding a FAST card are authorized to:

- Maneuver in the Flying Display Area to the pitch, angle of bank, and altitude limits of 8900.1
- Momentarily project energy toward the primary or secondary spectator areas
- Perform reversal turns both inside the Flying Display Area and outside of the Flying Display Area
- Perform formation shape changes during flybys or reversal turns in the Flying Display Area.
- Perform pitch-outs or pitch ups to land as long as the intent is to land immediately following the pitch-out/pitch-up at the end of the performance. Missing Man separations and echelon breaks to individual strafe runs are acceptable. Pitch-out's or pitch-ups are not to be used as a means of separating the flight to do any other maneuvers during the performance.

NOTE: A formation of FAST cardholders may separate into separate formations while outside the Flying Display Area, and may alternate passes within the Flying Display Area, but may not execute maneuvers authorized under Dynamic Maneuvering. Dynamic Maneuvering is NOT authorized. Maneuvers that separate aircraft inside the Flying Display Area, or that include solo or formation crossing passes, "bomb-bursts", or extended trail maneuvering are NOT authorized. It is emphasized that Dynamic Maneuvering is NOT authorized with a FAST Credential.

TRAINING - In addition to fundamental formation flying knowledge and skill level development, each pilot seeking a FAST qualification must develop a thorough knowledge of the following areas with respect to operations in the Air Show environment:

- Aircraft and pilot documentation requirements
- Airshow briefing requirements
- Conditions and restrictions as they pertain to non-aerobatic formations described in FAA Order 8900.1.
- Weather requirements and considerations
- Certificate of Waiver specifics to include the flying display area, show center, corner markers, the crowd line, the show line, and the list of waived regulations by section and title
- Air boss communications - normal and emergency
- Energy projection toward the crowd
- Low level maneuvering in formation, to the limits of 8900.1, to include awareness of airshow boundaries and control points, such as, but not limited to: crowd line, show lines, corner markers, as well as terrain and obstacle awareness
- Abnormal and Emergency procedures

AIR SHOW CURRENCY - to operate as a formation within the airspace of a Certificate of Waiver, each pilot within the formation must show evidence of performing or practicing their standard maneuvering formation performance(s) within the previous 45 days.

Note: Initial currency may not be attained during a rehearsal or performance in airspace under a CoW. It must be achieved via practice sessions prior to operating in a CoW. Maintaining continued currency during an airshow season may be accomplished via practices, or via rehearsals and/or performances in a CoW.

AIR SHOW TRAINING TOPICS

The following will provide FAST pilots with the information and knowledge necessary to safely and competently operate in the air show environment, and within airspace where a Certificate of Waiver (CoW) is in effect. It has been developed to educate the prospective FAST air show performer on the information needed to operate safely in the air show environment and within the limits of a Certificate of Waiver.

AIRCRAFT AND PILOT DOCUMENTATION REQUIREMENTS

To be eligible to participate in an aviation event, an aircraft must be in an airworthy condition. Flight Leads are responsible to ensure that all performers / members of the team are in compliance with the following documentation:

Required Pilot Documentation:

- Pilot Certificate
- Medical Certificate
- Authorized Recognized Industry Organization (RIO) Formation credential (FAST Card)
- Evidence of Biennial Flight Review (BFR) or FAA Checkride

Required Aircraft Documentation:

- A Airworthiness certificate
- R Registration
- O Operating Limitations (Aircraft POH, or FAA issued Experimental Operating Limitations document)
- W Weight and Balance

To ensure that the aircraft participating in an aviation event are airworthy, an FAA Inspector in Charge (IIC) or their representative may examine the general condition of the aircraft and required documents to determine if the aircraft meets the specified requirements. To determine compliance with requirements, the IIC, or Aviation Safety Inspector can inspect the aircraft's maintenance records / logbooks, or review a current and valid FAA Aircraft Inspection and Status Form, FAA Order 8900.1, Figure 3-54, supplied by the owner/operator. An appropriately qualified airman who holds a mechanic or repairman certificate or an Inspection Authorization must sign the form. The following inspections documentation may be requested:

- Annual Inspection and/or 100-hour inspection (as required)
- Condition inspection (as required)
- ELT Batteries test/inspection FAR 91.207
- Transponder check (24 months) FAR 91.413 (as required)
- Altimeter/Static check (24 months) FAR 91.411 (as required)

In an effort to increase efficiency, event organizers collect and send electronic copies of the performer and aircraft documentation to the responsible FSDO 30 days or more prior to the event. This allows inspectors time to review the documentation prior to the aviation event. Once recognized by the IIC and event organizer as having no discrepancies, those records and aircraft may not be subject to further inspection during the aviation event. Airmen and aircraft that have not already been inspected by an FAA inspector during the aviation event season (e.g., January–December) may still be subject to inspection at the aviation event. Aircraft egress and safety information should be provided to the airshow coordinator or his representatives, either in person or via the appropriate forms available on the ICAS website.

AIR SHOW BRIEFING REQUIREMENTS

AIR BOSS BRIEF

Air show briefings are conducted each day of the air show by the Air Boss and are attended by representatives from each group, team or act. The Air Boss will brief the overall plan with respect to all the acts participating in

the air show. Details of the Air Show Demonstration Area, the Flying Display Area, the Aerobatic Box, Air Show timing, altitudes, launch sequence, recovery, the communications plan, emergency equipment, and other details will be briefed. Specifics within the FAA Certificate of Waiver will be discussed. Only the team leader is required to attend the brief, however, a delegate may represent the team leader, provided the person is a pilot member of the team. It is recommended that all members of a team attend the Air Boss brief, if possible, and allowed by the Air Boss or Airshow Coordinator.

FLIGHT LEAD PREFLIGHT BRIEF

All members of a formation team must attend the briefing given by the team Flight Lead. The following items must be briefed:

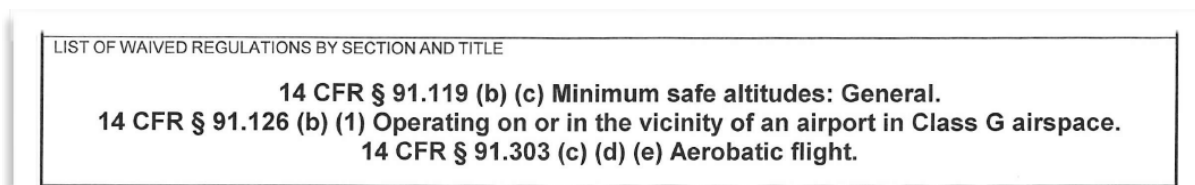
- Mission parameters / Performance Sequence of Events
- Weather considerations - to include crosswind corrections, ceiling, and visibility.
- Field elevation and density altitude
- Altitude limits during fly-bys, reversals and maneuvering
- Alternate fields - heading, distance, frequencies, and runway
- Lead responsibilities
- Wingman responsibilities
- Requirements and restrictions of the Certificate of Waiver (CoW) in effect
- Show line, crowd line, and corner marker
- Boundaries, field layout and markings, holding areas, and taxi route
- Deconfliction
- Radio communication plan
- Obstacles
- Emergencies
- Structural failure / Midair
- Engine failures
- Fires
- Aborted takeoff
- Broken formation / lost sight
- Communication during an emergency
 - Radio calls during emergencies
 - Lost comm
 - Lead responsibilities

CERTIFICATE OF WAIVER

A Certificate of Waiver is an official document issued by the FAA that authorizes certain operations of aircraft to deviate from regulation but under conditions that ensure an equivalent level of safety.

Each performer / formation team should be provided with a copy of the Certificate of Waiver in advance of the airshow, in order to provide access to the operational information pertinent to the event, before arriving at the site. A copy of the CoW, along with diagrams, maps, charts, photos, etc. of the airshow site, should be forwarded to participants.

FAR Section 91.905 lists the sections of part 91 than can be waived. The waived items may be listed on the first page of the Certificate of Waiver as depicted in the following example:



Or the waived items may be on an attached page of the Certificate of Waiver as depicted in this example:

LIST OF WAIVED REGULATIONS BY SECTION AND TITLE

A list of waived regulations is attached.

Launch and recovery of Class 2 rockets will be IAW 14 CFR Part 101.

The following regulations are waived for this airshow:

91.107 – Use of Safety Belts, Shoulder Harnesses, and Child Restraints,

91.117 – Aircraft Speed, § (a), § (b), and § (c)

91.119 – Minimum safe altitudes: General, § (b) and § (c)

91.121 – Altimeter settings, § (a) (1)

91.129 – Operations in Class D airspace

91.155 – Basic VFR weather minimums

91.209 – Aircraft Lights

91.303 – Aerobatic flight, § (c), § (d), and § (e)

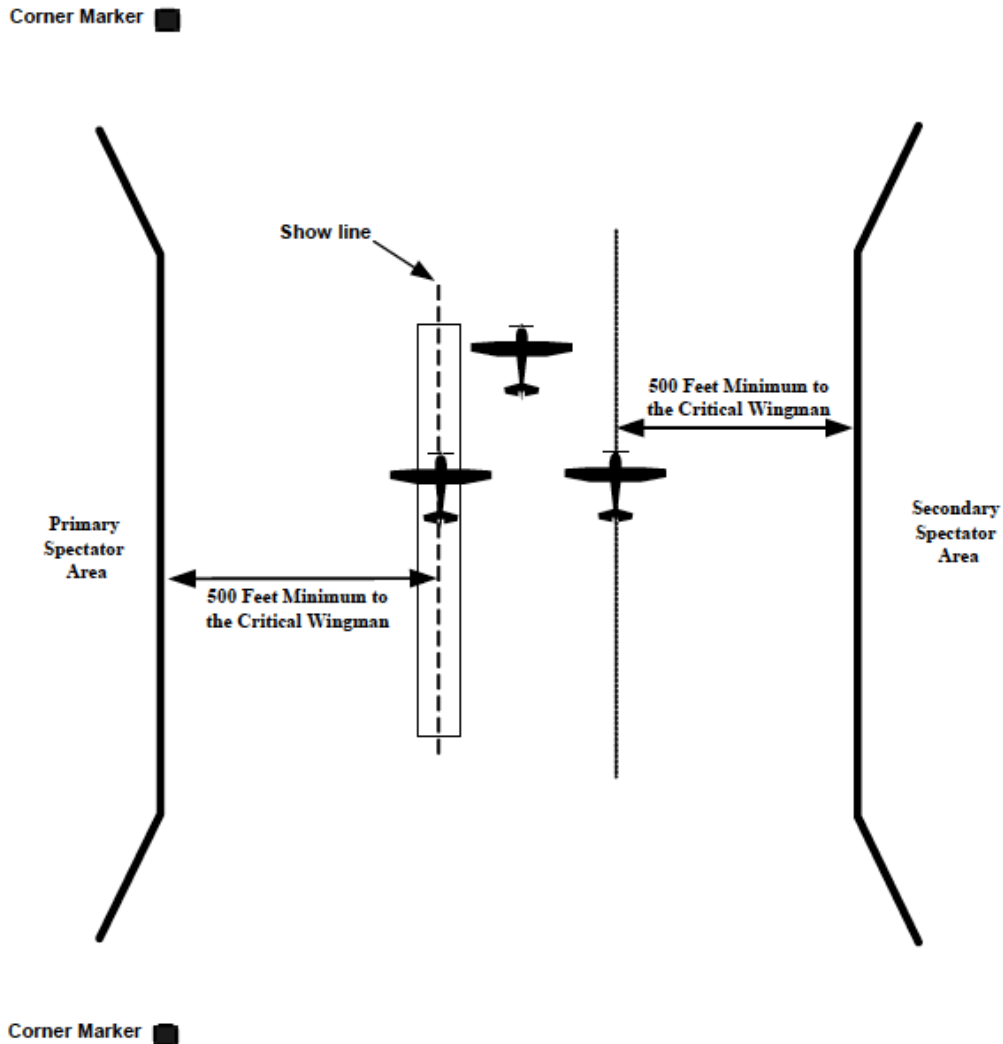
CONDITIONS AND RESTRICTIONS WHEN OPERATING UNDER A CERTIFICATE OF WAIVER

FAA Order 8900.1, Volume 3, Chapter 6 is the guiding document for all performers who operate under a Certificate of Waiver, which is often referred to as waived, or waived, airspace. All pilots, flight leads and wingmen are required to be familiar with the conditions and restrictions contained within 8900.1 as they pertain to non-aerobatic formations, as well as operations within waived airspace. The following are some important subject areas and definitions:

- **Formation Flight.** When two or more aircraft under the command of a flight leader are flown solely with reference to another aircraft and are within 500 feet of the referenced aircraft.
 - **Formation Configuration/Position Change.** Aircraft maintain formation while maneuvering to a new formation configuration (e.g., Fingertip to Diamond) via the movement or repositioning of one or more aircraft within the flight (e.g., aircraft #4 moves from outside right wing to slot). Formation configuration/position change is authorized during formation standard maneuvering.
 - **In-Trail.** A solo aircraft or aircraft in formation that are flown solely with reference to another solo aircraft or formation and are more than 500 feet from the referenced aircraft or formation (e.g., during a parade overflight, a flyby, or a racetrack pattern of flybys).
 - **Standard Maneuvering** Flybys may be conducted by multiple aircraft in trail or multiple formations in trail in the Flying Display Area no lower than 250 feet AGL, using a bank angle of no more than 60 degrees, and a pitch angle of no more than 45 degrees. Standard maneuvering includes non-abrupt maneuvering, flybys, formation configuration/ position changes, and missing-man formations. The flight may not separate inside the flying display area, except to break for landing or for individual flybys, or for a missing man pull-up.
 - **Critical Aircraft** - In a formation, the aircraft closest to the primary spectator area. The formation leader must adjust his or her ground track so that the critical aircraft remains the appropriate minimum distance from the spectator areas.
- **Flying Display Area** – the airspace at an airshow where participating aircraft have authorization to perform. This area includes all the aerobatic boxes, control points and show lines, but does not include ingress/egress routes.

- **Primary Spectator Area.** The main area designated by and under the control of the event organizer for spectator use. The crowd line creates its boundary and has well defined lateral limits (ends). This is the area, which begins at the surface, from which the public is directed to view the aviation event and should be aligned (parallel) with the show lines. There may be more than one primary spectator area.
 - Flight over the primary spectator area is permitted when at or above 1,000 feet above the airport elevation.
- **Secondary Spectator Area(s).** Any area, not designated as a primary spectator area, where people have a natural tendency to gather to observe the aviation event. This includes, but is not limited to, private property or property not under control of the event organizer, public roads, and private access roads.
 - Flight over a secondary spectator area is permitted when at or above 500 feet above the airport elevation and the flight will be non-maneuvering and wings level in a normal climb.
- **Show Line** - a line on the surface of the ground (often the centerline of the runway, or runway edge), intended to provide the performer with a clear visual reference to the minimum safety distance. The Show line is annotated on the field diagram in the waiver.
- **Show Center** – a visible reference point that denotes the center of the flying display area. Show Center is annotated on the field diagram in the waiver.
- **Show Line categories** - Show Line categories and required distances from the Show Line for aircraft are determined by the speed of the aircraft. Minimum show line distances are measured from the crowd line.
 - Category I - more than 245 knots. The minimum show line distance from the spectator area for Category I aircraft is 1500 feet.
 - Category II - more than 156 knots but 245 knots or less. The minimum show line distance from the spectator area for Category II aircraft is 1000 feet.
 - Category III - 156 knots or less, or 2250 pounds or less gross takeoff weight. The minimum show line distance from the spectator area for Category III aircraft is 500 feet.
 - NOTE: The following criteria are the basis for the minimum distances for airplanes:
 - a) For reciprocating-engine-powered airplanes, KIAS in straight and level flight at 75% power at standard temperature and pressure (15 °C/sea level) and maximum certified gross weight.
 - b) For turbine engine-powered airplanes (does not include the BD-5J (or equivalent) Microjet), 85% of the maximum continuous powered straight and level flight KIAS at standard temperature, pressure (15 °C/sea level), and maximum certified gross weight.
 - c) For Category III, either the speed or weight characteristic must be met.
- **Corner markers** - An easily identifiable marker or landmark from the air, 500 feet or more right and left of the primary spectator area along the crowd line to provide performers with a 500-foot reference point for proper separation from the spectators. The corner markers must be highly visible with a distinct contrast to the background. Corner markers are annotated on the field diagram in the waiver.
- **Compensation at Air Shows** - To receive any type of compensation (fuel, oil, lodging, rental cars, etc.), for flight activities at an air show, an airman must have a commercial pilot certificate and at least a valid second-class medical certificate.

Minimum Width of a Flying Display Area for Category III Aircraft In Formation Flight



WEATHER REQUIREMENTS AND CONSIDERATIONS

- Flight demonstrations will not be conducted unless the ceiling is at least 1500 feet, and the visibility is at least 3 statute miles at the time of the demonstration. The FAA monitor may adjust the minimum ceiling and visibility requirements at his or her discretion to no less than 1,000 feet and 3 miles if certain conditions exist.
- Wind direction and wind velocity must be considered as it affects the flight path of the formation. The Flight Lead must ensure the critical wingman in the formation never drifts inside of the show line, or within the minimum distance of the spectator areas, as dictated by the aircraft category (I, II, or III).
- Temperature and the effect of density altitude upon true airspeed in relation to indicated airspeed is an important consideration. High density altitudes also have a serious effect on the performance of aircraft and engines, and on the ability to gain and / or maintain energy.

AIR BOSS COMMUNICATIONS

Communications with the Air Boss should be simple and straightforward. Aircraft operating in the Flying Display Area will be using the briefed "Air Boss" frequency. With multiple aircraft using the same frequency, radio discipline is critical, and communication may become difficult. For formation teams, it is common for the team to operate on a discrete frequency or "tactical" frequency, that is only used by that team while they are performing. The discrete frequency will be monitored by the Air Boss, or the Lead should monitor the Air Boss primary frequency on a second radio.

NORMAL OPERATIONS

After engine start, the flight lead will typically check all pilots in on the briefed discrete frequency. The Flight Lead will advise the formation of the weather / ATIS, and communicate any changes. The Flight Lead will then typically direct the flight to the Air boss frequency for taxi and takeoff. Once airborne, and with the permission of the Air boss, the Flight Lead will direct the flight to the discrete frequency, if desired. Communications must be available with the Air Boss on the assigned discrete frequency, or the Lead should monitor the Air Boss primary frequency on a second radio.

EMERGENCY OPERATIONS

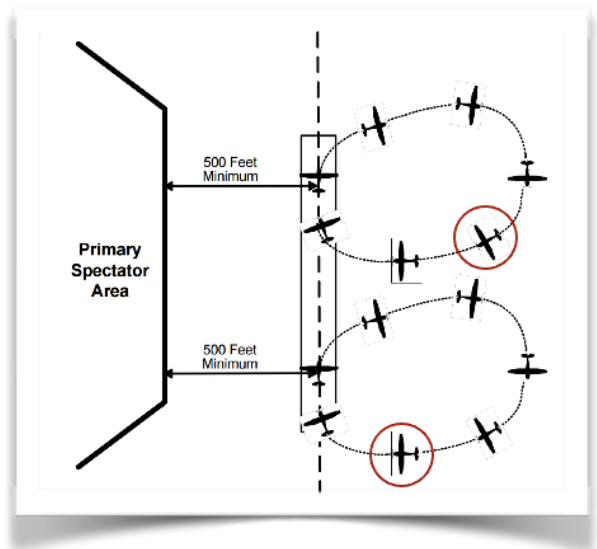
In an emergency situation, the affected pilot, if at all possible, must communicate the situation immediately on the briefed frequency. The Air boss must be informed, so that all efforts can be made toward the safe recovery of the emergency aircraft. If the distressed aircraft is unable, or has not made the radio call, the Flight Lead, or the chase pilot, will coordinate with the Air Boss.

KNOCK IT OFF (KIO) CALL

During a performance, the Air Boss or any member of the formation flight may feel it is necessary to make a Knock-it-off call. It may be because an intruder aircraft that has wandered into the area creating a conflict, or an emergency situation somewhere in the formation or on the airfield. Once a Knock-it-off call has been initiated by the Air Boss or by any member of the flight, all members of the formation shall cease maneuvering. The Flight Lead or the Air Boss, or both in coordination, as appropriate, will decide the appropriate course of action.

ENERGY PROJECTION TOWARD THE SPECTATOR AREAS

Flight Leads should always align their flight path so as not to direct energy toward the primary spectator area for any extended period of time. FAST formations are authorized to momentarily pass their energy vector through the spectator area, provided the formation remains beyond the appropriate CAT I, II, or III show line, and the formation is stable during the entire period that the energy vector is passing through the spectator area. Formation changes are not authorized while the energy vector is projected toward the primary spectator area.

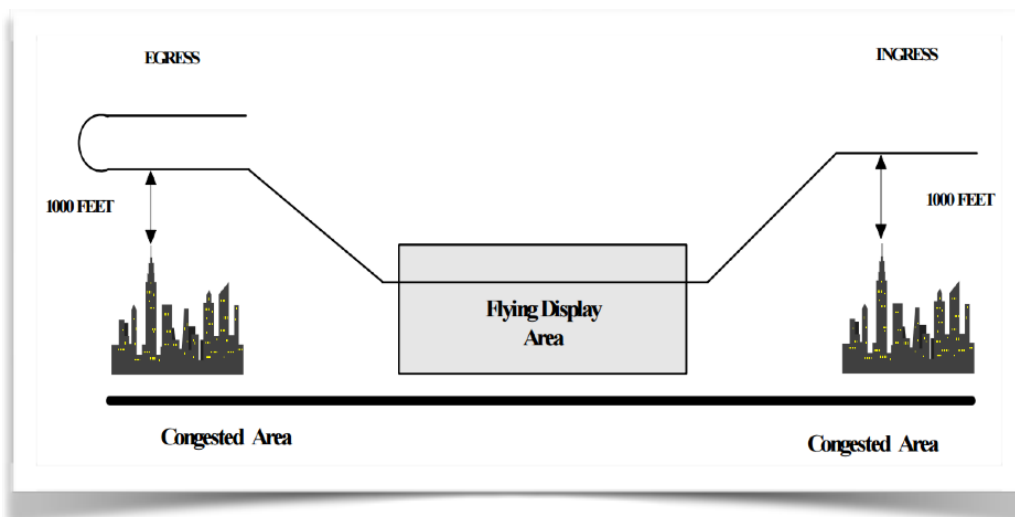


LOW ALTITUDE MANEUVERING

For FAST formation flights, fly-bys may be conducted as low as 250 feet AGL, using a bank angle of no more than 60 degrees, a pitch angle of no more than 45 degrees.

Special consideration must be made when flying near ground terrain and obstacles. Low level decision making by all members of the formation is critical. Pilots may experience a ground rush illusion where the surface features rapidly spread out to fill the entire field of view and the ground appears to rapidly rise. It is imperative that all members of the formation remain situationally aware, maintain their direct reference to the other aircraft in the flight, and not allow themselves to become distracted.

Special consideration must be made when densely populated or congested areas exist adjacent to the Flying Display Area. When this is the case, ingress and egress routes will likely be defined in the Certificate of Waiver. Typically, the Air Boss or IIC will brief a requirement that aircraft must be climbing to 1000' or above when egressing over these areas.



ABNORMAL AND EMERGENCY PROCEDURES

When operating within a Certificate of Waiver, during an abnormal situation or airborne emergency, every possible consideration must be made for the safety and well-being of the spectators on the ground. Typically, airshows are held over airports, and a suitable runway is within gliding distance.

The priorities are: Aviate, Navigate, and Communicate. Fly the airplane first. If it is an immediate-action type of emergency, pull the airplane up and out of the formation and turn in the shortest direction to the most suitable place to land. Call a May-Day or Knock-It-Off, and announce your intentions over the radio to the extent possible, within workload constraints. If the distressed aircraft is unable, or has not made the radio call, the Flight Lead, or the chase pilot will coordinate with the Air Boss.

TYPICAL STANDARD MANEUVERING AIRSHOW MANEUVERS

The following Airshow Competency Elements are typical maneuvers that each pilot should be familiar with:

- **Reversal Turns** - After each pass down the show line, the formation will do an appropriate reversal turn to reposition the formation for the next pass. This reversal turn may be a 90°/270° (dog bone) turn in either direction, or some type of 180° reversal turn to reposition the formation with reference to the reciprocal show line for the next pass.

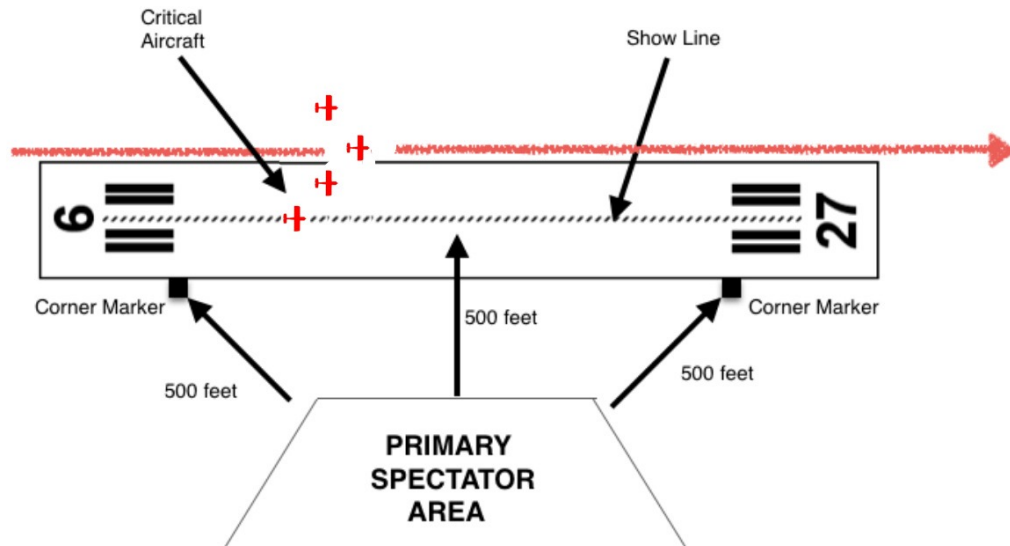
- **A Formation Transition** reconfigures aircraft in the formation. The following are some typical basic formation configurations:

Fingertip left
Fingertip right

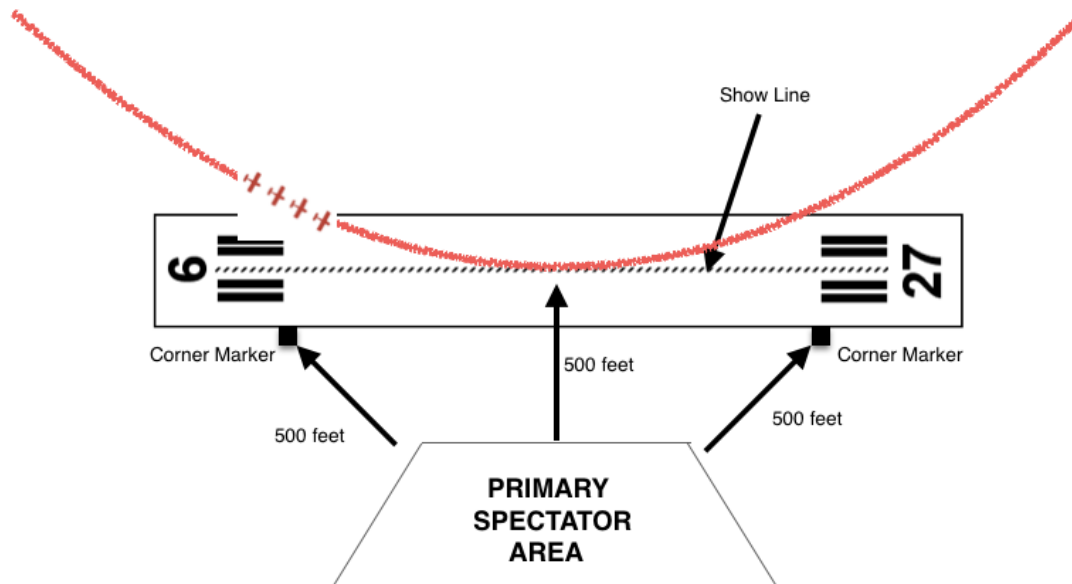
Diamond
Close trail

Echelon left
Echelon right

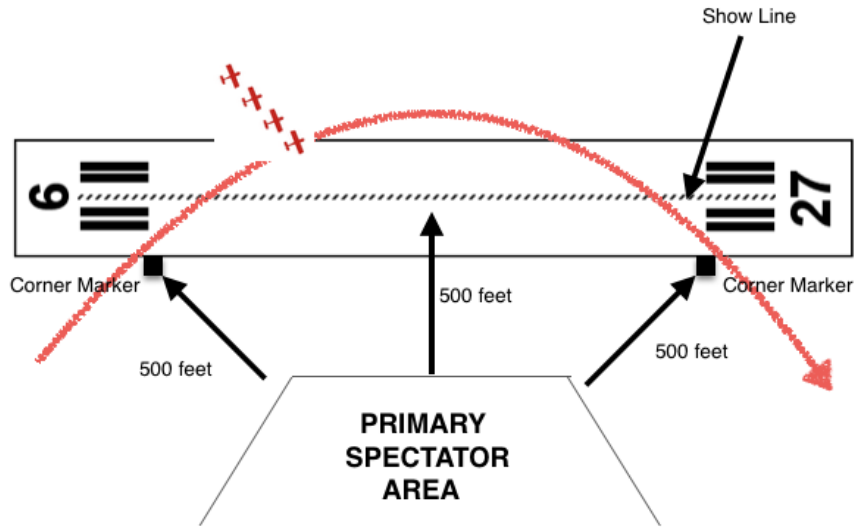
- **Flat Pass** - A straight and level flight path that parallels the show line (minimum altitude 250'AGL.)



- **Reverse Banana Pass** - An arcing flight path that begins away from the show line and primary spectator area, approaches the show line at show center, and then arcs away again, while maintaining a near constant radius turn.



- **Corner to Corner (Photo or Banana) Pass** - An arcing flight path that begins at one corner marker, arcs away from show center, and ends at the opposite corner marker, while maintaining a near constant radius turn.



- **Inclined 360° Turn** - A 360° circle that starts at show center, on or beyond the show line. The formation begins a 360° turn with a climbing arc going away from the show line. The turn apexes in altitude at the point farthest from the crowd, at show center. The formation then descends while continuing the 360° turn back toward show center, completing the maneuver on or beyond the show line at the original starting altitude.

