

# FAST AIRSHOW OPERATIONS

## Revision 0

01 Jan, 2017

### INTRODUCTION

This Air Show Operations Appendix F was written to help provide FAST pilots with the knowledge and background information needed to operate safely within the air show environment where a Certificate of Waiver (CoW) is in effect. 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 other important source of information is the FAST Foundation and Principles, which contains additional information pertaining to FAST air show operations in particular, and in some cases may be more restrictive than FAA Order 8900.1.

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.

A FAST authorization allows 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, and to momentarily project energy toward the spectator areas. With the exception of a pitchout or pitch-up for landing, or in the event of a safety of flight situation, FAST cardholders may not separate from the formation while inside the Flying Display Area. 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.

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.

While the FAST authorizations are evaluated and administered by FAST, there are additional levels of qualification available to formation airshow pilots. These levels are the Statement of Aerobatic Competency (SAC) card with a Formation Dynamic Maneuvering endorsement (a non-aerobatic qualification), and the Statement of Aerobatic Competency (SAC) card with a Formation endorsement (an aerobatic qualification). The Dynamic Maneuvering SAC card program is administered by the International Council of Air Shows (ICAS) and EAA Warbirds of America, while the Aerobatic SAC card program is administered solely by ICAS. SAC cards 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. It is not a prerequisite to hold a FAST or FFI card prior to applying to ICAS to be evaluated for a Dynamic Maneuvering qualification/ endorsement. However, the applicant will be required to demonstrate formation flying skills commensurate with those cards, or with extensive formation experience or background, during the evaluation for a SAC card with a formation endorsement.

## QUALIFICATIONS AND AUTHORIZATION

- A) 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 fly-bys or reversal turns, as long as the formation change is complete, and the formation is stable prior to the energy vector being momentarily projected at the spectator areas.
- 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 strafe runs are acceptable. Pitch-out's or pitch-ups are not to be used as a means of separating the flight to do 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.

- B) 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 500-foot Cat III 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

- C) AIRSHOW CURRENCY** - to operate as a formation within the airspace of a Certificate of Waiver, each pilot within the formation must:

- Have flown in at least 1 formation practice, rehearsal or performance in the same formation performance, within the last 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.

# AIRSHOW ENVIRONMENT TRAINING TOPICS

## AIRCRAFT AIRWORTHINESS

To meet the guidance and directives of the FAA AFS-800 National Aviation Events Specialist (Air Show Coordinator), 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. This section of the FAST Foundation and Principles has been developed to educate the prospective FAST airshow performer in the myriad of details that he will need to be familiar with 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 license
- Medical Certificate
- Authorized Industry Formation credential
- 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 3-38, 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 for inspection by an IIC, so it is recommended that they be available for each aircraft to be flown:

- ELT Batteries / test / inspection FAR 91.207
- Condition inspection
- Transponder check (2 years) FAR 91.413 (as required)
- Altimeter check (2 years) FAR 91.411 (as required)
- Static check (2 years) FAR 91.411 (as required)
- 100-hour inspection (if required) or annual inspection

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.

## **AIRSHOW BRIEFING REQUIREMENTS**

### **AIR BOSS BRIEF**

Airshow briefings are conducted each day of the airshow 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 airshow. Details of the Airshow Demonstration Area, the Flying Display Area, the Aerobatic Box, Airshow 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 runways
- Lead responsibilities
- Wingman responsibilities
- Requirements and restrictions of the Certificate of Waiver (CoW) in effect
- Show line, crowd line, and corner markers
- Boundaries, field layout and markings, holding areas, and taxi routes
- Deconfliction
- Radio communication plan
- Obstacles
- Emergencies
- Structural failure / Midair
- Engine failure
- Fire
- Aborted takeoff
- Broken formation / lost sight
- Communication during an emergency
  - Radio calls during emergencies

- Lost comm
- Lead responsibilities

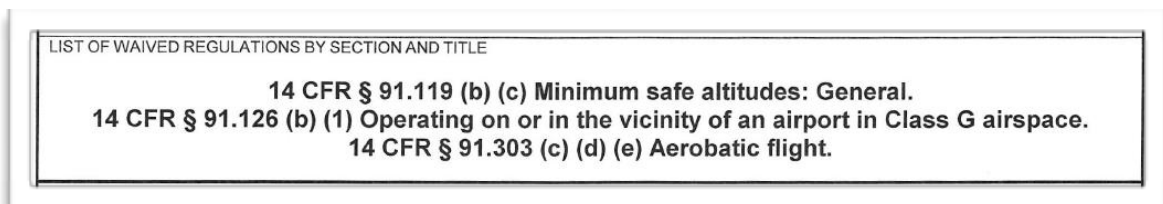
## CERTIFICATE OF WAIVER

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.

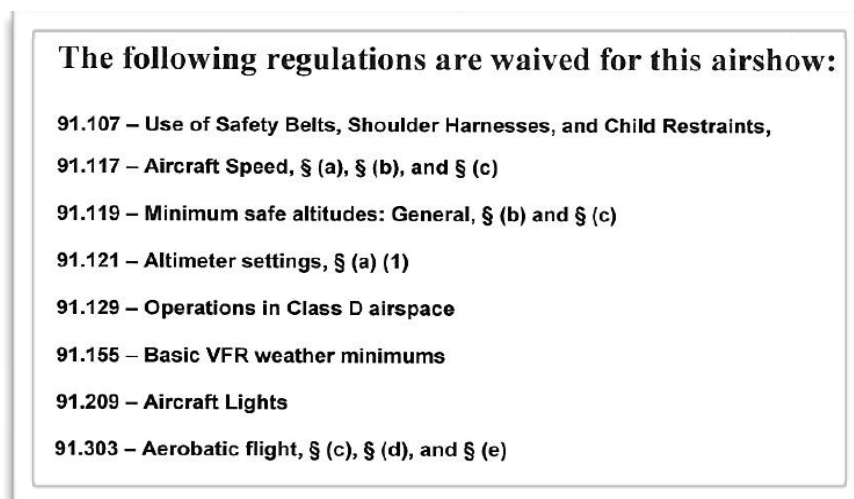
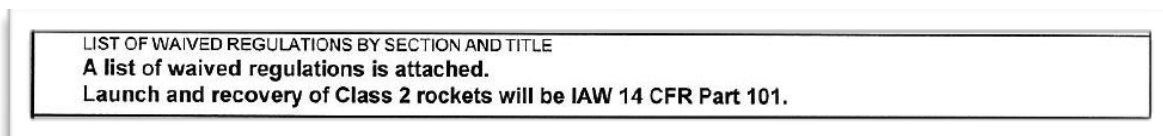
Each performer / formation team should be provided with a copy of the Certificate of Waiver in advance of the airshow, in order to provide access to the operational information pertinent to the event, before arriving at the site. A copy of the CoW, along with diagrams, maps, charts, photos, etc. of the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



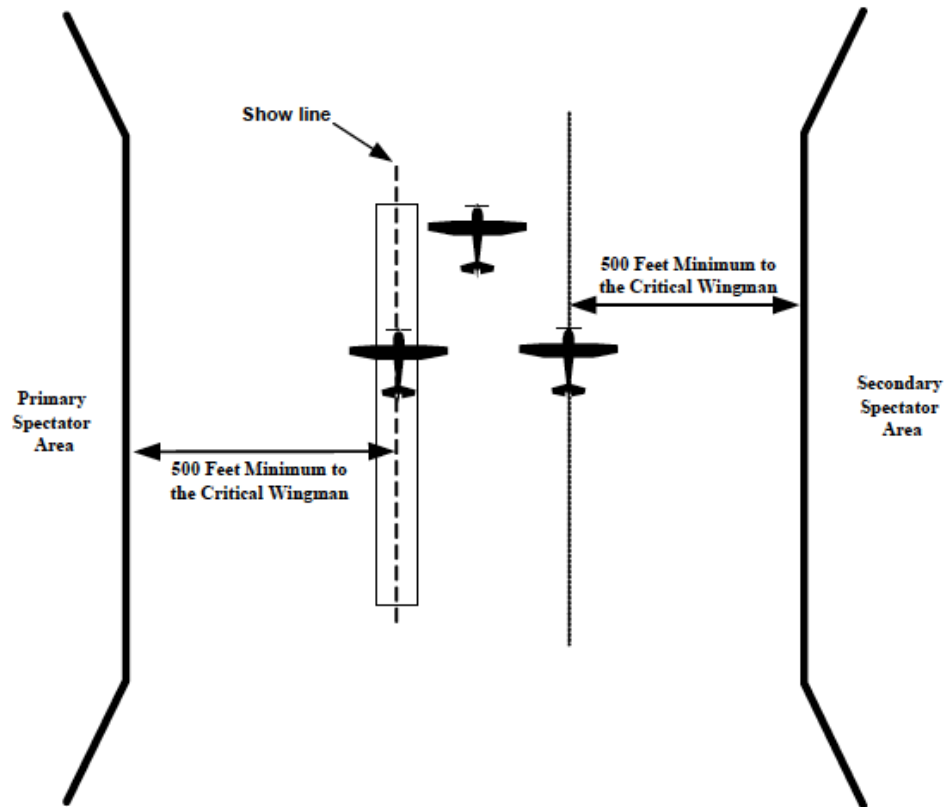
## **CONDITIONS AND RESTRICTIONS WHEN OPERATING UNDER A CERTIFICATE OF WAIVER**

FAA Order 8900.1, Chapter 6, Section 1 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 particularly important areas.

- 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 - FAST falls into Category III, 156 knots or less, and 2250 pounds or less gross takeoff weight. The minimum show line distance from the spectator area for Category III aircraft is 500 feet. All FAST formation flights shall fly the Category III show line regardless of aircraft type.
- 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.
- Crowd Line - a physical barrier or line marked on the ground that serves as a restraining line for the designated spectator areas.
- 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.
- 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.
- 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.
- 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 distance from the spectator areas.
- Standard Maneuvering, Non-Aerobatic Formation Flight - flight during which the bank angle does not exceed 60 degrees or 45 degrees of pitch in the Flying Display Area.
- Flight over the primary spectator area is permitted when at or above 1,000 feet above the airport elevation.
- 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.
- For formation flights, Standard Maneuvering Flybys may be conducted by multiple aircraft in trail or multiple formations in trail in the Flying Display Area no lower than 200 feet AGL, using a bank angle of no more than 60 degrees, and a pitch angle of no more than 45 degrees
- 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 second-class medical certificate.

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

Corner Marker ■



Corner Marker ■

## **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, but 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. This is the primary 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.

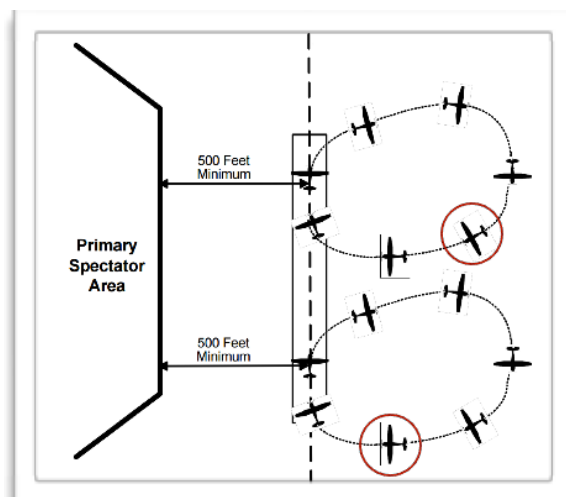
### **KNOCK IT OFF (KIO) CALL**

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 due to 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.

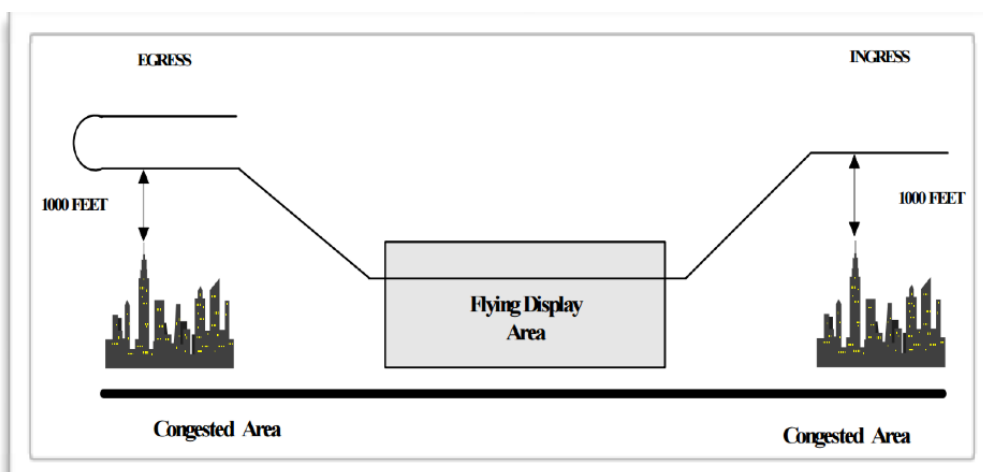


## LOW ALTITUDE MANEUVERING

For FAST formation flights, fly-bys may be conducted as low as 200 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.

## MISCELLANEOUS DEFINITIONS

- Practice Session - Flying a dedicated event with a planned series of maneuvers. Up to, but no more than three (3) practice sessions may be accomplished in one flight. The series of maneuvers may be or may include part of a performer's actual sequence. The appropriate number of practice sessions are required to attain currency prior to conducting Airshow rehearsal and performance operations in a CoW. Actual rehearsals and performances may be utilized to meet the minimum number of practices to maintain currency purposes during an Airshow season, once initial currency has been achieved. Only practices outside of a CoW may be used to attain, or re-attain, initial currency.
- Formation flying - When an aircraft is flown solely with reference to another aircraft and within 500 feet of the referenced aircraft.

## TYPICAL STANDARD MANEUVERING AIRSHOW MANEUVERS

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

Flat Pass

Corner to Corner (Photo or Banana) Pass

Reverse Banana Pass

Inclined 360° Turn

**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** moves from one formation configuration to another. The following are some typical basic formation configurations:

Fingertip left  
Fingertip right

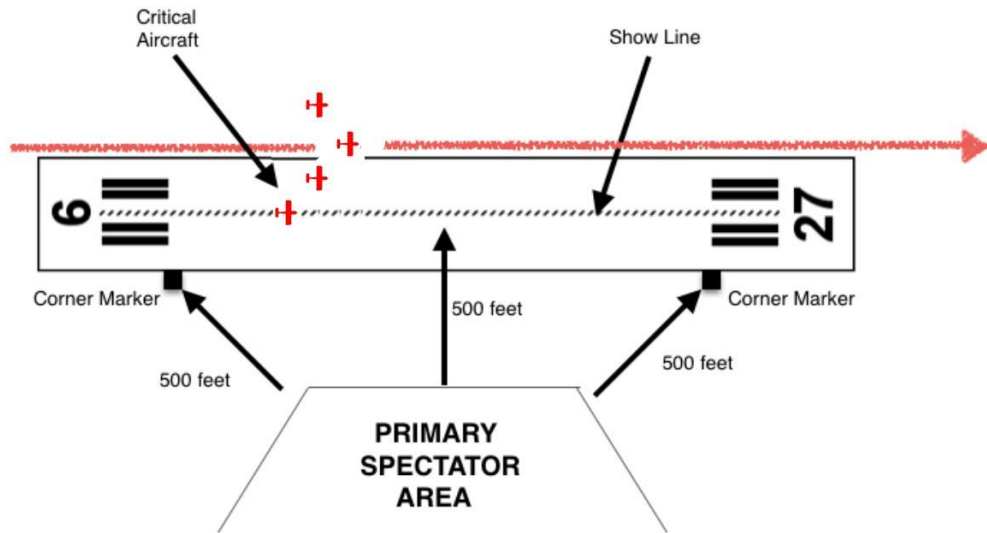
Diamond  
Close trail

Echelon left  
Echelon right

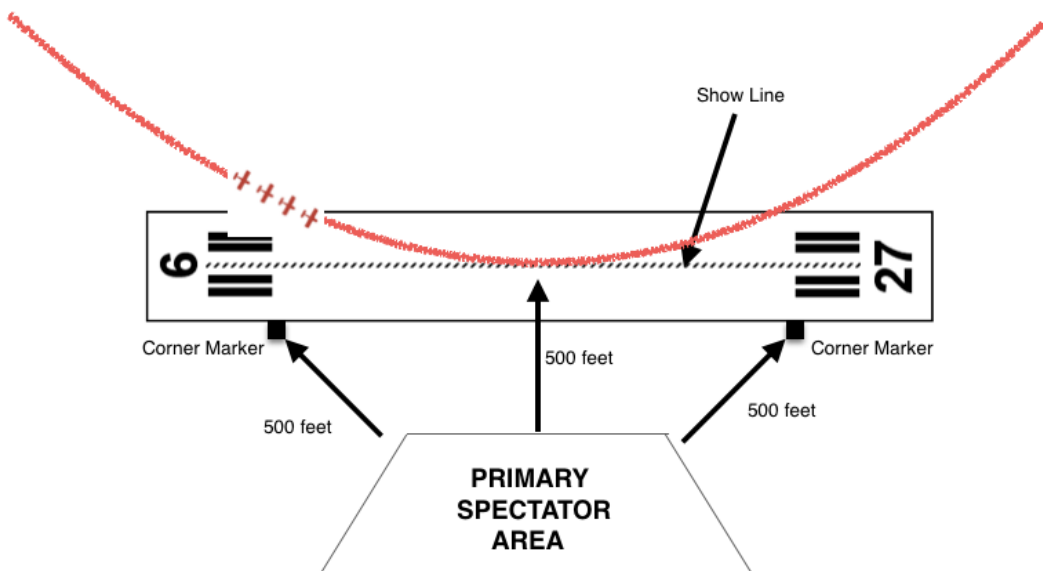
- The formation changes must be complete and the formation must be stable prior to the energy vector passing through the spectator area.

**TYPICAL AIRSHOW MANEUVERS DEFINED:**

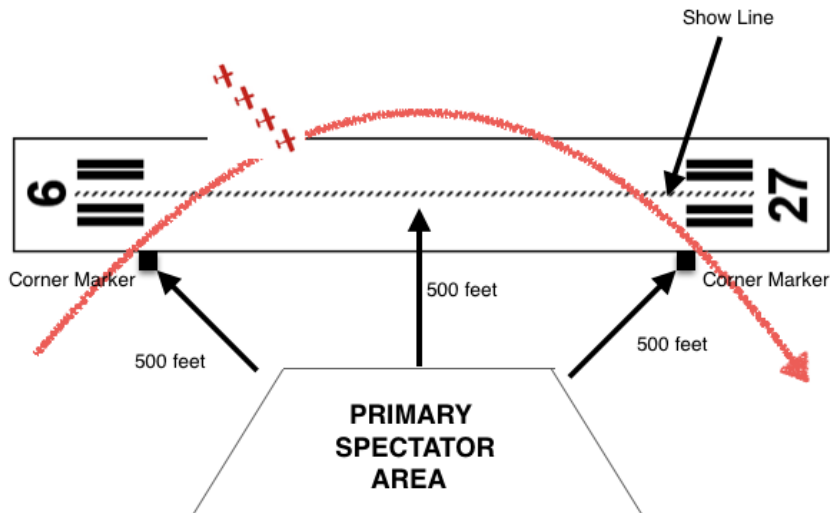
- **Flat Pass** - A straight and level flight path that parallels the show line.



- **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.

