

Assessing Risk For Air Show Explosives Operations



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DISCLAIMER

Although the information in this guide is derived from AF instructions, it is not directive. A list of official directives is included for guidance and research. HQ ACC/SEW will periodically review this guide for accuracy; send comments/questions to acc.sew@us.af.mil.

Table of Contents

1. PURPOSE
2. SAFETY SUMMARY
3. RESPONSIBILITIES
4. EXPLOSIVES
5. EXPLOSIVES OPERATIONS
6. EMERGENCY PROCEDURES
7. COMPREHENSIVE RISK ASSESSMENT

References

Terms

Attachments

Atch 1, List of Explosives

Atch 2, Explosives Shots

Atch 3, Explosives Display Area Map

1. PURPOSE: This guide provides the installation Weapons Safety Manager (WSM) a framework to complete a comprehensive risk assessment (RA) of contractor explosives displays during open houses on ACC installations. An “air show” is the most common open house event a WSM will encounter where explosives demonstrations take place in the presence of the general public; fireworks displays are not addressed here. WSMs analyze risks associated with commercial explosives on the installation, e.g. transportation, storage, and operations. The ACC approach is a form of site planning for intentional detonations and uses the nomograph process to quantify risk as well as determine the appropriate level to accept residual risk. The guide combines the RA with the explosives operations plan as a more practical means to evaluate all the important areas. If an installation uses this format it should address the major paragraphs to facilitate a review.

1.1. The RA identifies specific hazards and risks to AF personnel and resources (the public must not be put at risk), the level of risk, compensatory measures, and includes the commander’s acceptance of risk, if needed. Create a separate RA for each contractor that will conduct explosives operations.

1.2. The explosives operations plan communicates AF Explosives Safety Standards to the explosives contractor and participating AF personnel. It defines the area of operations, operating procedures (including those that implement compensatory measures), and restrictions. It supports the preparation, execution, and any AF support of the contractor’s explosives events, and supports HQ ACC review of the proposed explosives activities.

2. SAFETY SUMMARY:

2.1. State the minimum required safe distance is xx feet, based on either the 1250 foot crowd line (see Terms) or the explosives clear zone (ECZ), whichever is larger. State whether or not the minimum safe distance extends beyond the installation boundary. State if any exposed site (ES) is affected by the storage or use of explosives. If the RA and explosives operational plan are combined, cite the paragraph where the RA is located.

2.2. Briefly state what procedures, if any, will be used to ensure the safety of AF personnel and resources. State what risks to DoD personnel must be accepted, and that affected personnel are aware of those risks.

NOTE: Although the RA evaluates risk to the public there should be no residual risk for the commander to accept.

NOTE: The 1250 foot crowd line is a mandatory (T-1) safe distance for spectators and is not determined by explosives effects. A deviation requires a T-1 waiver request IAW AFI 33-360.

3. RESPONSIBILITIES: The following functional areas are the minimum required to ensure the proper planning and safe execution of air show explosives activities. Ensure personnel who represent or perform these functions understand the safety aspects of providing support, or can assist in the identification and acknowledgment of any risks.

3.1. Installation Commander. Responsible for all aspects of the open house. Approves the open house operations and emergency plans, and is the minimum authority level for acceptance of risk.

3.2. Open House Director. Ensures appropriate risk assessments are accomplished.

3.3. Weapons Safety Office (SEW). Provides safety advice during air show planning and oversight of contractor compliance with the explosives safety requirements of the explosives operations plan during all phases of operations. Consult with EOD, Munitions, Fire Department, Legal, Contracting, and Base Operations personnel to evaluate the safety of proposed explosives events and influence/guide contractor selection. Prepare a comprehensive explosives risk assessment for the installation commander.

NOTE: Recommend review of International Council of Air Show (ICAS) publication “Pyrotechnics and Special Effects for Air Shows”, 4th Ed. (2016), to understand ICAS explosives safety standards. Advise the contractor of AF explosives safety requirements that are more restrictive than ICAS. The ICAS publication is available on the ACC Weapons Safety SharePoint.

3.4. Explosives Operator. Identify the contractor conducting explosives demonstrations (e.g. Tora Tora Tora [T3]). The contractor must use a qualified Shooter-in-Charge (SIC [see Terms]) to coordinate and control explosives operations inside the explosives display area. The SIC determines if an unknown or dangerous condition exists and will declare an emergency IAW the air show plan. The SIC is responsible for safety and accountability of their personnel, and will support the on-scene commander (OSC) in the event of a mishap.

NOTE: Only SICs approved by ICAS are authorized to work with ACC aircraft IAW AFI 11-209 ACC Supp and AFI 11-246 ACC Supp.

3.5. Fire Department. Determines actions needed to prepare the explosives display area, e.g. pre-burn, mowing, etc. Determine if a firefighting unit will be assigned to directly support air show explosives operations, positioned outside of the ECZ but close enough to respond immediately.

3.6. EOD. Reviews the contractor’s explosives, setups, and initiation method in preparation for an accident/incident requiring EOD response. Advise SEW as subject matter experts on intentional detonations and explosives characteristics, as needed.

3.7. Airfield Management. Determines activities that require their personnel to enter or transit the ECZ. Advise the contractor on airfield movement restrictions. Ensure a temporary airfield waiver is in place if air show activities violate AF criteria.

3.8. LRS. May provide fuel for explosives displays and will deliver fuel outside the minimum distance from explosives for fire safety.

3.9. Others, e.g. Munitions Flight/CC for storage of commercial explosives in the MSA; Security Forces may control direct access to the explosives display area.

4. EXPLOSIVES: The WSM evaluates the types and maximum quantity of non-DoD explosives within the designated storage location, the display area, and for each intentional detonation. The contractor must provide the following info for all explosives, to include pyrotechnic special effects and shock tube.

4.1. List of explosives. Name, HD, Compatibility Group, fire division/chemical hazard (if known), net explosive weight (NEW) per unit, and the total NEW entering the installation (Atch 1). Provide this information to EOD and the fire department for emergency response preparations. Consult with EOD to determine the effects, hazards, or safety precautions of non-standard explosives.

4.2. Shots. A shot consists of all the explosives in a special effect intended to function at the same time (see Terms). List the NEW of each explosives shot per the air show schedule, e.g. Strafe, Wall of Fire, etc., the total NEW to be used each day, and the total NEW for the entire air show (Atch 2). Only the total NEW per shot is required to be listed, but the WSM must verify the NEW of each shot (EOD can assist with calculation of NEWs). Provide shot information to EOD for emergency response preparations.

4.2.1. Example, the Strafe shot consists of a series of 25 bullet impacts (0.25 lb of Dynagel per impact), 300 feet of det cord, 500 feet of shock tube, a 2.1 lb final effect, and 1 electric and 25 non-electric blasting caps for a total NEW of 11.758 lbs.

NOTE: The shot with the largest NEW is used for QD calculations.

5. EXPLOSIVES OPERATIONS:

5.1. On-base Storage of Explosives. Contractor explosives should be stored off-base if possible, but if on-base storage is authorized by the Base/CC, state where they will be stored. Describe how the explosives will be stored (DoD container, contractor trailer, etc.) and any measures to enhance safety, e.g. grounding, segregation, etc. State what activities are authorized or restricted while contractor explosives are present. Preferred on-base storage locations are (in descending order):

5.1.1. Sited location (state the site plan #) outside of the MSA (hot cargo pad, SVHA, etc.);

5.1.2. Sited location in the MSA not co-located with DoD explosives;

5.1.3. Unsited location outside of the MSA using a deviation (with Base/CC approval);

CAUTION: Contact ACC/SEW before considering storage of commercial pyrotechnics co-located with DoD explosives. This presents significantly more risk to the DoD and should only be considered as a last resort.

5.1.4. In the MSA co-located with DoD explosives (CC must accept potential loss of AF resources).

5.2. Limits

5.2.1. NEW. State the maximum NEW allowed: for the explosives display (i.e. the shot with largest NEW), per day (in display area), and for the air show (max allowed on-base). Refer to Atch 2, Explosives Shots, if applicable.

NOTE: ACC Single-Ship Demonstration Teams are limited to a maximum shot NEW of 20 lbs per AFI 11-246 ACC Supp.

NOTE: A shot NEW greater than 55 lbs results in an ECZ that exceeds the 1250 foot crowd line.

5.2.2. Personnel. Only contractor explosives personnel are allowed to transport, handle, setup, or function commercial explosives, and are the only personnel allowed in the ECZ; active duty military, civilian employees, or spectators are not allowed inside the ECZ. State whether the following exceptions will be implemented: SEW may enter to provide safety oversight; Airfield Management may transit the ECZ to conduct FOD sweeps of the aircraft operating surfaces. State whether or not the contractor will remain in the display area once shots are setup.

5.3. Display Area. Air show explosives operations will be conducted within a designated area (see Attachment 3, Explosives Display Area Map). State what actions will be taken to prepare the display area for explosives operations, e.g. pre-burn or mowing for fire safety, markings to ensure required separation distances are met, etc. Include the following on the map:

5.3.1. Scaled map with the display area as the potential explosion site (PES) and its associated ECZ. Include the crowd line within the map field of view, and show the actual distance of the ECZ and the crowd line.

5.3.2. Exposed sites within the ECZ such as runway, navigational aids (NAVAID), inhabited buildings, etc. Show or list the distance from the display area to each ES.

5.3.3. Locations of nearby base personnel, e.g. fire department standby, fueling operations, etc.

5.3.4. The contractor's explosive storage location and the explosive movement route to the display area if they fit within the map field of view and PES/ES relationships remain legible. If contractor explosives are stored in the MSA mark the explosive movement route from the point it enters the map field of view. Provide this to the contractor for explosives movements.

5.4. HERO. Advise the contractor of any fixed or mobile RF transmitters that may affect electrically initiated devices, e.g. electric blasting caps, during on-base transportation or within the explosives display area. Inform the contractor of the transmitting power of government-furnished communication devices such as a LMR or cell phone.

5.5. Fuel Delivery. AF fuel, if provided, will be delivered before explosives arrive at the display area. However, if explosives are present, fuel will be dispensed a minimum of 100 feet from the nearest explosives and explosives operations will cease while Fuels personnel are present. Fuel will be dispensed into containers provided by the contractor; the contractor is responsible for fuel placement as well as spill control within the display area.

5.6. On-base Transportation of Explosives. State whether an existing explosives transportation route will be used. The contractor is responsible to transport the quantity of explosives to be used each day; transport should be completed prior to arrival of the public. Explosives will only be transported in their approved storage/transportation configuration, and will move directly from the storage location to the display area. No pre-assembled or partially assembled explosives may be transported on-base. All explosives will be downloaded for setup and will not be stored in vehicles. Describe any security procedures pertaining to the explosives contractor such as area access or escort.

5.7. Explosives Preparation. **WARNING:** the contractor must advise the WSM and EOD if blasting caps used for shot initiation will be connected during the setup; normally they are connected immediately prior to the contractor's show time per the air show schedule. All planned shots for the day should be setup prior to start of the day's events. Describe additional safety requirements such as fire extinguishers, shot layout, etc. Explosives placards and fire symbols are not required to be posted.

5.8. Initiation Schedule. List each air show event involving the detonation of explosives along with the shot names (reference Atch 2). Identify specific performances involving ACC aircraft as these must be closely coordinated with the aerial events POC and reviewed by HQ ACC. State whether commands to initiate explosives will be communicated to the SIC or if the SIC will initiate based on coordinated timing.

5.9. Post-operation. The SIC will conduct a "safety walk" of the display area to ensure no explosives remain following each display event and/or when explosives operations are complete for the day. Airfield Management may conduct FOD checks of taxiways/runways after intentional detonations. Notify SEW of any unusual conditions, to include a request for EOD assistance.

6. EMERGENCY PROCEDURES: Describe how the SIC will communicate any emergency condition or need for response (LMR, cell phone, etc.) and who will be contacted (Air Boss, 911, etc.). Any person detecting an unsafe act/condition inside the display area will report it to the SIC, or any shooter if the SIC is unavailable. Cease all explosives operations immediately until the act/condition is corrected.

6.1. Evacuation. The SIC is responsible for evacuation and accountability of contractor personnel; identify the location of the safe area and/or route. State who the SIC will report accountability to.

6.2. Fire. State if the SIC will attempt to fight small grass fires. State whether shots may be initiated outside the scheduled time to prevent explosives from catching fire. Installation firefighting units will not enter the display area without coordination with the SIC on the presence and location of explosives. EOD may advise, if needed.

6.3. Severe Weather. Describe severe weather conditions (lightning, etc.), procedures, and evacuation distances/locations. State who will provide weather notifications to the SIC and any additional means of communicating weather updates (via LMR, runner, etc.). Include criteria to determine when explosives operations can resume.

6.4. Explosives Misfire/Mishap. State who the SIC will notify in the event of a misfire; misfires are normally declared after the explosives demonstration is complete. The SIC will determine the cause of the misfire and how to correct it. Only the SIC shall disassemble misfires. In the event of a mishap where contractor personnel are unable to account for remaining explosives or place them in a safe condition, the OSC should request EOD assistance.

7. COMPREHENSIVE RISK ASSESSMENT: The ACC approach has 2 steps. First, determine if anything is affected by the minimum safe distance, including the installation boundary. If nothing is at risk no further analysis is required; however, if anything is within the ECZ proceed to the next step.

Second, evaluate all exposed sites to determine the level of risk, develop procedures to mitigate risk, quantify any residual risk, and determine the appropriate authority for risk acceptance.

7.1. Specific risks and compensatory measures.

7.1.1. On-base transportation of non-DoD explosives. State whether the on-base transportation of commercial explosives deviates from approved routes, describe any resulting risks, and describe any procedures to mitigate risk.

7.1.2. On-base storage of non-DoD explosives. State what risks, if any, result from on-base storage and how the risk will be mitigated. Describe how personnel will be protected, either with existing mitigation measures identified in the ESP or air show-specific measures. If commercial explosives are co-located with DoD explosives the potential loss of DoD assets must be listed on the risk acceptance for the CC to acknowledge and accept.

CAUTION: Contact ACC/SEW before considering storage of commercial pyrotechnics co-located with DoD explosives. This presents significantly more risk to the DoD and should only be considered as a last resort.

7.1.3. Runway lateral clear zone. If the explosives display area is within the runway 1000 foot lateral clear zone state whether this clear zone is temporarily waived for the duration of the air show IAW AFI 10-1004. State if this presents any risks to personnel in the display area and how the risk will be mitigated. Check with the Airfield Manager.

7.1.4. QD. State the ECZ distance for the shot with the largest NEW using K328 for intentional detonations (K328 equates to an overpressure of 0.0655 psi which will not injure people in the open). List all ES's within this ECZ (runways, NAVAIDs, etc.) in the sample Table 1 below, to include the installation boundary or any personnel.

7.1.4.1. Calculate K-factor based on the actual distance and NEW ($D / NEW^{1/3}$). Lookup the corresponding mishap severity in AFMAN 91-201 Table 1.3 to the closest K-factor, e.g. a building at K27 = Negligible...greater than full PTR (K24) but less than IBD (K40).

7.1.4.2. Describe the risk to each ES using the nomograph process in AFMAN 91-201; describe mishap severity using Table 1.3 or para. 2.5 (Expected Consequences). Consider the ES's function as well as its criticality to the mission. Using a combination of AFMAN 91-201, AFI 90-802, and AFPAM 90-803, the hazard risk level for each ES can be summarized in Table 1 below. For example, aircraft in flight (landing or taking off) may lose control and crash at K30 (Critical mishap severity), so aircraft operating on RWY Right are at the Medium risk level.

7.1.4.3. Describe any exception to mandatory QD requirements, any compensatory measures to eliminate or reduce risk, and any residual risk that cannot be eliminated. Include a nomograph to determine the level of risk and the approval level of authority for accepting the risk(s). For example, the Medium risk for aircraft in flight is eliminated by closing RWY Right for the duration of the air show; Taxiway B will be closed while intentional detonations are conducted, eliminating the Low risk.

NOTE: Only submit a nomograph for exceptions to QD with residual risk(s).

Table 1, Hazards and Risk Levels

Exposed Site	Distance Required	Distance Actual	K-Factor Actual¹	Mishap Likelihood	Mishap Exposure²	Mishap Severity	Risk Level
RWY Right	1009	95	31	Unlikely	Unusual	Marginal	Medium
Taxiway B	1009	626	204	Unlikely	Unusual	Negligible	Low
NAVAID	1009	82	27	Unlikely	Unusual	Negligible	Low

NOTES:

1. Calculated from actual distance and NEW $[D / NEW^{1/3}]$; contact SEW for a calculator.
2. Based on infrequent, short duration of typical air show explosives operations.

7.2. Overall Risk Level Determination. State the overall risk level determination for the air show (LOW, MEDIUM, etc.). This is typically the highest individual risk but a higher level may be assigned based on a combination of risks.

7.3. Describe any deviations to non-QD requirements where the WG/CC is the approval authority per AFMAN 91-201_ACCSup paragraph 1.4. For example, a decision to not mow or pre-burn the display area requires a documented deviation that describes any risks.

7.4. Risk Acceptance. Commander’s statement acknowledging and accepting the risks and potential loss (if any) of personnel and resources listed in Table 1. State whether the acceptance and approval of deviations to non-QD requirements is within the Base/CC authority. Include both acceptance options for the CC to select upon signing. For example, “IAW the RM principles of “accept no unnecessary risk” and “make risk decisions at the appropriate level”, I do / do not accept the risk for damage or loss of USAF resources identified in Table 1 associated with the contractor-operated explosives operations during the XXX AFB Open House (event name).”

References

AFI 11-209 ACCSup, *Aerial Event Policy and Procedures*
 AFI 11-246 ACCSup, *AF Aircraft Demonstrations*
 AFI 90-802, *Risk Management*
 AFMAN 10-1004, *Conducting AF Open Houses*
 AFMAN 91-201, *Explosives Safety Standards*
 AFPAM 90-803, *Risk Management (RM) Guidelines and Tools*

Terms

Crowd Line – a physical barrier or line marked on the surface of the ground or water that serves as a restraining line for designated spectator areas and provides the appropriate safety distances for an aviation event. The crowd line for air shows must be a minimum of 1250 feet from intentional detonations; however, this distance is not based on NEWQD and is not the same as the explosives clear zone. The crowd line distance applies in all directions from the intentional detonation site.

Explosive Train – two or more components (with or without explosives) connected together and designed to initiate or continue a sequence of events that culminates in the detonation of explosives. Components that contain explosives typically have different characteristics and hazards based on the type and quantity of explosives used, but hazards are evaluated for the entire explosive train. (see Shot)

Shooter in Charge (SIC) – a federally licensed user of explosives, experienced in using special effects explosives at air shows. The SIC coordinates/controls air show explosives operations, ensures only qualified workers handle explosives, and ensures operations meet all federal, state, and local safety regulations. Only SICs approved by ICAS are authorized to work with performing ACC aircraft IAW AFI 11-209 ACC Supp and AFI 11-246 ACC Supp.

Shot – (as used in this guide) all explosives connected together and intended to function at the same time to provide an explosive special effect. (see Explosive Train)

Attachment 1
List of Explosives

Name	Hazard Div / CG	Qty	NEW per Unit (lb)	NEW Total (lb)
Cap, Electric Super Instant	1.1B	50	0.003	0.1500
Cap, NONEL MS	1.1B	200	0.003	0.6000
Detonating Cord, 50 GPF	1.1D	6000	0.011	66.0000
Dynagel 1¼ x 8	1.1D	300	0.25	75.0000
Shock Tube	1.4S	2500	0.00000004	0.0001
SFX (Sim White Phosphorus)	1.4G	6	2.205	13.230
TOTAL NEW				154.9801

Attachment 2
Explosives Shots

Shot	NEW/Shot (lb)	Qty/Day¹	NEW/Day¹	NEW/Show
Strafe	11.7580	2	23.516	47.032
Single Bomb	0.7136	28	19.981	39.962
Sim WP Marker	6.6150	1	6.6150	13.230
Wall of Fire	29.100	1	29.100	58.200
		Totals	77.490	154.980

NOTES:

1. May include multiple performances per day