

Launch Site Safety

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Before Setting Up

Perform a pre-event inspection before setting up the launching and landing areas, and update at the beginning of each day of the launch. Identify creeks, ditches, or other bodies of water that may make recovery difficult or messy. Point these out along with other recovery considerations (private property, crops, muddy fields, fences, power lines, etc.) to your flyers at the flyers meeting and perhaps at the lunch break as well.

Look about the fields for any large open holes or other unsafe areas. If anything is found, try to rope it off. Not every club has the benefit of fencing between parking areas, the spectator/vendor area, the LCO area, and the launch pads. However cheap “flag rope” used at carnivals and other events can be used to make separations using plastic ground stakes. Create a well marked viewing area for the spectators.

Safe Distances

When setting up launch pads, make sure that high power pads are at least 1500 feet away from roads, highways, and inhabited buildings that are not part of the launch site. Rockets flying over 6000 feet AGL will require larger setbacks. Setup your LCO station the minimum safe distance or farther than listed in the NAR safety codes. It is always good if possible to make the spectator distance farther back than the LCO station distance, and then parking distance farther back than the spectator distance.

Keep in mind these unexpected situations if wind changes direction to a potential no-landing zone.

- You may need to relocate launchers
- Use proper pad management to aim rockets correctly
- Make sure rockets are not allowed to over fly outside launch area
- Wind speed may reduce your ceiling level if rockets will leave the launch area

You should position people and property crosswind from the launch site. No high power rocket should leave the field during boost or recovery. If one does, it should cause a temporary halt to launch operations and a

discussion of both why the unplanned flight occurred and how to prevent any other flights from leaving the field during the day.

An early flight of the day should be a “weather flight” to check conditions aloft. Its purpose is to validate the judgment of the range team that the planned geometry is safe. If the powered trajectory of this or any other rocket during the day penetrates the airspace over the prep area, spectator area, vendor area (if any) or the parking area, (whether the rocket functions as designed or not) best practice would indicate an immediate review of the flight.

Paperwork

If you are hosting an HPR rocket launch, make sure to check waiver for approval and call it in before the launch as instructed in your waiver documents. During the launch make sure you provide and that flyers fill out RSO approved rocket flight cards. When flyers are applying for the launch, paying launch fees, and at signup time; make sure to verify NAR membership and proper certification levels for the flyers and if you are giving out name badges put the certification level on the name badges.

Communications

Check to see if you can provide the following items:

- Siren or horn to warn of incoming rockets
- Contingencies when a rocket goes over the crowd
- Public address system in place
- Two way radios
- The ability to communicate with officials of the launch.
- Signs identifying which end of the flight line you are on to assist when the LCO warns hazards.

An audio system capable of reaching all areas in which people are in danger is required to communicate a warning. This can be a PA system, FM low power broadcast to remote receivers supplied by the launch team, or a hybrid. Only at the very smallest launches should warnings be solely via un-amplified voice communication. Air horns have been used with good effect by some clubs. At large launches, dedicated personnel with air horns in the spectator, prep, vendor, and parking

areas with radio links to the RSO have been used to warn of incoming rockets. The ability to notify has great potential to reduce danger to people if properly used, and such a warning system should be audible in all spectator, preparation, and parking areas at launches of significant size. NFPA 1127 requires such notification.

Since not everyone who is warned will be able to see an incoming rocket even if they are looking for it, a best practice is to have those who do see the rocket point to it. Another issue is that of desensitization of the launch crowd. If every time a 4 oz model under a parachute floats into the prep or parking area a loud alarm horn goes off, then later in the day the spectators will be ignoring the horn.

Use the correct amount of alarm for the situation. For example on the PA say, “a model under chute is floating into the parking area folks, please look out for it.” Then if an HPR rocket is coming in a flat spin with no drogue, when you sound the super loud safety horn and have folks point at the problem rocket; the crowd will pay better attention without being desensitized to the alarm horn and understand a true danger exists.

All too many “heads up” flights are called for airframes that are poorly constructed or are of questionable stability. Rather than launching such rockets with a “heads up” warning, a better practice would be to correct or mitigate the deficiency of the airframe prior to the flight. The safety code, in fact, requires that models not be launched unless their stability can be verified ahead of time. The use of a “heads up” warning at launch is best reserved for cases such as clustered composite motor flights and multi-stage composite motor powered flights, where there will always be some uncertainty in motor ignition.

Flyer Safety Issues

Too many times little thought is given to some other issues of flyer safety. Do cell phones work at the launch field? If not have a Wilson trucker booster antenna at the LCO table. These greatly enhance the range of hand held phones and can be found for sale at Pilot and Loves truck stops around the country. Also find out and print where the closest highway stop is to get good reception so in an emergency someone can drive there and call for help. Have a sheet of directions in case 911 needs to be called. Consider printing up and providing a Flyer Safety information packet with surrounding area info.

Besides knowing and having printed directions to the closest hospital, having directions to the nearest restroom or restaurant is also

good; especially if your launch site does not include toilet facilities. If you launch in hot and sunny weather, make sure the launch has a covered area with people can get out of the sun to prevent Heat Stroke. Make sure plenty of water and salty snacks are available.

Fire Safety

The hazards presented by grass fires caused by bad flight trajectories after liftoff can be mitigated by having adequate fire suppression equipment on the range, training range personnel in its use, and having an emergency plan for suppression of fire by the Section which includes a contact plan for professional assistance should that be required.

Check to make sure you have these safety items available at the range.

- The address of the launch site (so that emergency responders can find it) and the appropriate emergency numbers (911 or the local fire department emergency number)
- Extinguishers/Indian Pumps on hand
- Water buckets
- Nomex blankets for sparky motors
- The required cleared area around launcher; example 75 feet diameter for a K motor; 112.5 feet for a sparky K.
- Pressurized water sprayer for the grass around the pads
- Shovels, Rakes, Fire Stomper Stick

Preventing common rocket failure modes

Almost three quarters of all flight failures are due to recovery failures. Initial findings of some best practices applicable to high power rockets are below.

To obtain the maximum strength and reliability, shock cords should be tubular nylon with sewn ends or a water knot. Since water knots can provide more strength than sewn ends do, climbers trust them with their life. You can search online for "water knot" to see how to tie one on the end of a Nylon strap. The knots should be protected from the damaging effects of heat in the airframe; a Nomex or Kevlar sheath, piston, or ejection baffle are possibilities. Parachutes in HPR rockets should also be protected from exhaust gases.

Shock cords should be appropriately sized. A good rule of thumb is to make them 4 to 5 times the length of the rocket booster. A 48" booster section would yield a 16 to 20 foot length of nylon cord. The breaking strength of the shock cord and its attachment hardware should be appropriate for the flight profile.

A rule of thumb here is to have a minimum breaking strength of at least ten times the rate of the rocket. "U" bolts should be used for projects over 5 pounds. Forged eye-bolts should be used for projects over 20 pounds.

The major cause of lawn dart type failures in HPR is no or insufficient electronic event. Make sure your electronics and battery system is up to the task at hand at delivering the proper amount of current into the e-match used for the deployment charge. Cold weather



and an airspeed corresponding to the lowest forward velocity at which the rocket is expected to leave the launcher (4 calibers as predicted by Barrowman analysis) should be used to protect against weather cocking. These two stability margins are essential to safe flight in any conditions except complete calm.

Rockets must be guided by launch rods, rails, or towers until they have attained a forward velocity of at least 4 times the velocity at which the wind is blowing or gusting at the launch site.

Reporting failures

Flight logs of the type analyzed for these recommendations are maintained by several NAR Sections. A standard set of logs procedures should be developed and made available to sections who wish to use them. Analysis of trends on a periodic basis at the national level should include changes in failure modes which may indicate a problem which can be addressed.

The NAR has a Safety review group that conducts reviews of launch incidents. Reporting an incident that you believe could help others avoid should be sent to the NAR safety committee chairman, Andy Eng, at andy_eng@yahoo.com

Best practice is to include a post-flight review of every incident. The use of the Malfunctioning Engine Statistical Survey (MESS) form has declined in recent years, mainly because many fliers are unaware of its existence. Rocket fliers should also make reports of all engine incidents on this form. A web-based version is now operational at <http://www.nar.org/NARmessform.html>.