Team America Rocketry Challenge 2009
Team Handbook

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TEAM AMERICA HANDBOOK

Section 1. INTRODUCTION

The Team America Rocketry Challenge (TARC) provides 7th through 12th grade students a realistic experience in designing a flying aerospace vehicle that meets a specified set of mission and performance requirements. Students work together in teams the same way aerospace engineers do. It is not intended to be easy, but it is well within the capabilities of students of these ages with a good background in science and math and some craftsmanship skills.

The purpose of the Challenge is to design and build a safe and stable model rocket flight vehicle and use it to lift a fragile payload (one raw hen's egg) to an altitude of exactly 750 feet and also for a total flight duration score of exactly 45 seconds, then return this payload safely and undamaged.

- Models must weigh no more than 3.3 pounds (1500 grams) at liftoff and must use commercially-made, NAR safety-certified model rocket motors with no more than 62.5 grams propellant weight each and a maximum combined propellant weight of no more than 125 grams.
- Times will be determined by two observers on the ground with electronic stopwatches; time is measured from the moment of liftoff until the moment the egg lands.
- Altitudes will be determined by the official electronic altimeter for the event, the Perfectflite ALT 15K/WD or ALT15K/WD Rev2 , which must be carried in the model rocket
- Winner is the team whose flight vehicle egg payload comes closest to exactly 750 feet altitude and 45 seconds flight duration score in a safe and stable flight, and returns the egg undamaged -- in a single attempt -- at a "fly-off" hosted in Northern Virginia on May 16, 2009.

The Team Handbook provides the Challenge rules plus some guidelines on how to approach the process of rocket design and flight. It also provides additional sources of information on general model rocket design, construction, and flying. It is not a "cookbook"; no design is provided as an example. The challenge and the learning for each team comes from developing and testing your own completely original design.

Teams should begin the Challenge by becoming familiar with the basics of model rocketry. Those who have no experience with how these models are built and flown should begin by reading G. Harry Stine's Handbook of Model Rocketry (available for a reduced price from the National Association of Rocketry's Technical Services at www.nar.org/NARTS), and by purchasing, building, and flying a basic model rocket kit, such as the one offered by Aerospace Specialty Products for TARC.

If you live near one of the 140 "sections" (chartered clubs) or the 350 experienced adult members of the National Association of Rocketry who have volunteered to be mentors, you are encouraged to consult with them. The sections are listed at the NAR web site, www.nar.org. The list of mentors is in the Team America section on the NAR web site. These rocketeers can help teach you the basics of how to build and fly a payload-carrying rocket. Typically they can also help you in locating a test-flying launch sites and work with local officials or the FAA if this is required. Many will allow you to do your practice or "qualification" flight at one of their already-organized launches (launch dates and locations also listed at the NAR web site). **Remember neither these "experts" nor any other adult can help you design, build or fly your actual entry**. All of this work must be done by the student members on your team.

If model rocketry interests you and you want to be connected to the rest of the people in the U.S. who are part of the hobby's "expert team," you should join the National Association of Rocketry. You can do this online at www.nar.org or by filling out the membership application forwarded to each team. Membership brings you insurance coverage, the hobby's best magazine, the bi-monthly Sport Rocketry, and a whole range of other benefits and resources. Good luck! Design carefully, fly safely, and we hope to see you at the fly-off in May 2009!

Section 2. **TARC 2009 EVENT RULES**.

As of July 18, 2008

1. **SAFETY**. All rockets must be built and flown in accordance with the Model Rocket Safety Code of the National Association of Rocketry, any applicable local fire regulations, and Federal Aviation Regulations. Rockets flown at the fly-off must have previously flown successfully. They will be inspected before launch and observed during flight by an event official, whose judgment on their compliance with the Safety Code and with these rules will be final. Teams are encouraged to consult with designated NAR officials who are running this event well before the fly-off to resolve any questions about design or flight safety, about the Safety Code, or about these rules.

2. **TEAMS**. No more than four teams may be entered by any sponsoring organization. The application for a team must come from a single school or a single U.S. incorporated non-profit youth organization (excluding the National Association of Rocketry, Tripoli Rocketry Association, or any other rocket club or organization). Team members must be students who are currently enrolled in grades 7 through 12 in a U.S. school or homeschool. Teams may have members from other schools or other organizations and may obtain financing from any source, not limited to their sponsoring organization. Teams must be supervised by an adult approved by the principal of the sponsoring school, or by an officially-appointed adult leader of their sponsoring youth organization. Minimum team size is three students and maximum is ten students. Each student member must make a significant contribution to the designing, building, and/or launching of the team's entry. No part of any of these may be done by any adult, by a company (except by the sale of standard off-the-shelf components available to the general public, but not kits or designs for the event), or by any person not a student on that team. No student may be on more than one team. The supervising teacher/adult may supervise more than one team. The Team America Rocketry Challenge is open to the first 750 teams that submit a completed application, including payment, postmarked no later than December 1, 2008.

3. **ROCKET REQUIREMENTS**. Rockets may be any size, but must not exceed 1500 grams (3.3 pounds) gross weight at liftoff. They may not be commercially-made kits designed to carry egg payloads. They must be powered only by commercially-made model rocket motors that have 62.5 grams or less of propellant each and are listed on the TARC Certified Engine List posted on the National Association of Rocketry website and provided in the TARC Handbook. They must have only one stage. Any number of motors may be used, but the motors used must not contain a combined total of more than 125 grams (4.4 ounces) of propellant, based on the propellant weights in this List. Loose black powder, separate from the certified rocket motors and their as-designed ejection charges, may not be used in rockets as its use requires a federal license not available to minors.

4. **PAYLOAD**. Rockets must contain and completely enclose one raw large hen's egg of 57 to 63 grams weight and a length of 60 millimeters or less, and must return this from the flight without any cracks or other external damage. This egg must be placed in the rocket "on its back" with its long axis perpendicular to the rocket's intended direction of flight. The external diameter of the rocket at the point where the egg is placed must be no less than 59 millimeters. Egg will be issued to the team by event officials during finals, but teams must provide their own egg for their qualifying flights. Rockets must be allowed to land at the end of flight without human intervention (catching) and will be disqualified if there is such intervention. The egg must be removed from the rocket at the end of the flight in the presence of a designated NAR official observer and presented to that official, who will inspect it for damage. Any external damage to the egg is disqualifying.

5. **DURATION SCORING**. Scores shall be based on total flight duration of the portion of the rocket containing the egg, measured from first motion at liftoff from the launch pad until the moment of landing or until the rocket can no longer be seen due to distance or to an obstacle. Times must be measured independently by two people not on the team, one of whom is the official NAR-member adult observer,

using separate electronic stopwatches accurate to 0.01 seconds. The official duration will be the average of the two times, rounded to the nearest 0.01 second. If one stopwatch malfunctions, the remaining single time will be used. Duration scores will be computed by taking the absolute difference between 45 seconds and the measured average flight duration to the nearest 1/100 second (this difference is always a positive number, or zero), and multiplying this by 2.

6. **ALTITUDE SCORING**. Rockets must contain the commercial electronic altimeter (Perfectflite Model ALT 15K or ALT 15K Rev 2) approved for use in the Team America event, in a compartment that is properly vented to the atmosphere. The altimeter must be inspected by an NAR official both before and after the flight, and may not be modified in any manner. The altimeter must be confirmed by this official to have reset to zero before flight. The altitude of the portion of the rocket containing the egg, as recorded by this altimeter, will be the sole basis for judging the altitude score. This score will be the absolute difference between 750 feet and the altimeter-reported altitude in feet (this difference is always a positive number, or zero).

7. **FLIGHTS**. Team members cannot be changed after the first qualification flight. Only team members on record at AIA with valid parent consent forms are eligible to receive prizes. Only one flight is allowed per team at the final fly-off, except as specifically noted in these rules. In order to be eligible for the fly-off, a team is required to fly a qualifying flight observed in person by an adult (senior) member of the NAR (unrelated to any team members and not a paid employee of their school or member of their youth group) between September 3, 2008 and April 6, 2009. Each team may conduct a maximum of two qualification flights, and will be ranked based on the better of these two scores. A second qualification flight is not required if the team is satisfied with the results of their first flight. A qualification flight attempt must be declared to the NAR observer before the rocket's motor(s) are ignited. Once an attempt is declared, the results of that flight must be recorded and submitted to the AIA, even if the flight is unsuccessful. A rocket that departs the launch pad under rocket power is considered to have made a flight, even if all motors do not ignite. If a rocket experiences a rare "catastrophic" malfunction of a rocket motor (as determined by the NAR official observer), a replacement flight may be made, with a replacement vehicle if necessary. Flights which are otherwise fully safe and qualified but which result in an altimeter reading of greater than zero but less than 50 feet will be counted as “no flight” due to false triggering of the altimeter and may be reflown without penalty. The results from qualification flight attempts must be faxed to and received at the offices of the AIA by Monday, April 6, 2009. As soon as we receive your qualifying score, "Qualification Score Received" will appear under your team information on the "Registered Teams" page at www.rocketcontest.org. The top-scoring 100 teams will be notified no later than April 10, 2009, and invited to participate in the final fly-off to be held on May 16, 2009 (alternate fly-off date in case of inclement weather will be May 17, 2009).

8. **SAFE RECOVERY**. Each part of the rocket must either contain a recovery device or be designed to glide, tumble unstably, or otherwise return to earth at a velocity that presents no hazard. Any entry which has a major part (including but not limited to an expended engine casing) land without a recovery system (lightweight gliding/tumbling tube sections are considered to have a system), or at a velocity that is judged by an event official to be hazardous, due to recovery system absence, insufficiency, or malfunction, will be disqualified.

9. **RETURNS.** Return of the portion of the flight vehicle containing the egg and the altimeter is required by the deadline time established at the beginning of the day's flying. Entries whose egg and altimeter are not returned after flight may not be counted as a qualified flight. If this portion cannot be returned after an otherwise safe and stable flight because it landed in a spot from which recovery would be hazardous (as determined by an NAR official), a replacement vehicle may be substituted for a replacement flight. Return of the other portions of the rocket is required only if there is a question from the NAR official concerning the safe operation of the vehicle (e.g. a question as to whether the vehicle ejected a part that landed in an

unsafe manner). An entry which has any such portion that is not returned when its return is required for this safety inspection shall be disqualified.

10. **LAUNCH SYSTEMS**. Teams may use the electrical launch system and the launch pads (with six-foot long, 1/4-inch diameter rods) provided by the event officials at the fly-off, or may provide their own system. Systems provided by teams for their own use must be inspected for safety by an event official before use, and must provide at least 6 feet of rigid guidance, including use of a rod diameter of at least 1/4 inch, if a rod is used. All launches will be controlled by the event Range Safety Officer and must occur from the ground.

11. **FREE FLIGHT.** Rockets may not use an externally-generated signal such as radio or computer control (except GPS navigation satellite signals) for any purpose, including flight termination, after liftoff. They may use autonomous onboard control systems to control any aspect of flight.

12. **PLACES.** Places in the final fly-off of the competition will be determined on the basis of how close the portion of the rocket containing the egg comes to the designated target duration of 45 seconds and the designated target altitude of 750 feet, as determined by the sum of the altitude and duration scores above. At the fly-offs, 20 teams will be invited to make a second flight at the last flight round of the day based on the results of their first flights. Cash prizes, which are awarded to the top ten places, will be awarded only to those teams that make a second fully qualified flight. In this final round, rockets which have issues which would otherwise rate a replacement flight under TARC rules #7 or #9 will not receive a replacement flight. The top ten final places will be ranked on the basis of the sum of the scores from the two qualified flights made at the fly-offs. Places eleven up to one hundred will be awarded to the remaining teams based on the scores from their first flight. Ties will result in pooling and even splitting of the prizes for the affected place(s) -- for example, a two-way tie for 2nd place would result in a merger and even division of the prizes for 2nd and 3rd places. Aerospace Industries Association reserves the right to make all last and final contest determinations.

Section 3. ROCKET DESIGN

Because of the size of the payload (a large hen's egg must weigh between 57 to 63 grams and requires the rocket body to be a diameter of at least 59 millimeters), rockets entered in this Challenge will be fairly large and heavy. The minimum liftoff weight is probably about 6 ounces, but there is no need for the rocket to be the minimum weight; a larger rocket is also fine, but it will require larger rocket motors.

Designing a rocket that will reach an altitude of approximately 750 feet and stay up approximately 45 seconds is not particularly hard to do, although designing one that cushions and protects an egg is a bit harder. The Challenge is finding the exact combination of airframe design, rocket engines, and duration-control technique that will achieve exactly 750 feet and 45 seconds. Doing this will require either lots of trial-and-error (not recommended), or smart use of a rocket-design and flight-simulation computer program to get the design “roughly right” first. Modern aerospace engineers do lots of "flight tests" on a computer before they start building and flying hardware--it's quicker and cheaper!

How do you approach the process of designing a flight vehicle? Engineers start with what is a fixed, given quantity -- such as the size and shape of the egg payload and its cushioning and the altimeter -- and with what the mission performance requirements are. In this case the requirement is to go to 750 feet and stay up for exactly 45 seconds, and then make a safe return to earth at the end. No matter what your design, it must incorporate this payload and achieve the performance requirement.

Remember that this event is about teamwork; engineers design in teams because complex projects that are due in short periods of time demand some kind of division of labor. There are many ways to divide the labor -- perhaps one person could become expert in computer flight-simulation programs, another in the craftsmanship techniques of model rocket building, a third in launch system design, and a fourth in charge of fundraising. All the members need to meet and communicate regularly, because what each one does affects how all the others approach their part of the job. You will need to elect or appoint a Program Manager to make sure everything fits together at the end so that your complex system will work in flight test. And you need to start early!

What, then, are the variables in yours aerospace system's design? Well, the size and shape of the rocket certainly has a wide range of possibilities, subject to the overall limitations that the rocket must be safe and stable, and must not exceed 1500 grams (3.3 pounds) in weight. And the selection of the vehicle's rocket motors is another major variable. Since certified commercially made model rocket motors (those with 62.5 grams and less of propellant each) must be used, you must pick which ones you plan to use from the "Team America Approved Motor List" posted (and updated) at the National Association of Rocketry website at www.nar.org and in Appendix 3. The list of certified motors is quite long, so there is a wide range of possibilities here as well. There are other design variables to be considered including: what recovery system to use; how to predict or control flight duration in various weather conditions; how to cushion and protect the fragile egg; and what kind of electrical launching device to use.

What all of this means is that, like all engineers, you must engage in an "iterative" design process. You start with a very rough design, evaluate its performance against the requirements, and change the design progressively until your analysis shows that you have a design that is likely to meet them. Then you build, test, evaluate the success or failure of the test, and adjust the design as required until your analysis and tests show that the performance requirement is approximately met. Initial tests are best done as "virtual" flights on a computer, with the time-consuming construction and relatively expensive flight testing of an actual rocket saved for the second step.

Here is a path that you may wish to follow to take you through the design process, along with some additional explanation of the design implications of rocketry terminology used in the event rules and in the NAR Safety Code.

1. **Accommodate the Payload.** Determine what size compartment is required to contain the altimeter and (separately) a Grade A large egg (maximum length 60 millimeters, although many are less than this and the specified minimum body diameter for your rocket is 59 millimeters) and cushion it against the shocks of rocket launch, recovery system deployment in flight, and impact with the ground at the end of flight. If you have a flight-termination system that may lead to the egg landing at higher (but still safe) speeds, this requires more egg cushioning.

   Hint: Make sure you cushion the egg from impact with the walls of the payload compartment or metal hardware in every direction including the sides when the rocket's parachute snaps open.

2. **Accommodate the Instrumentation**. The electronic altimeter specified for the event (which you must buy separately from the manufacturer at a special TARC discount price) must be used in your rocket, and will be the sole basis for measuring the rocket's achieved maximum altitude. You may install other additional altimeter-based systems if you wish, to control duration or other features, but only the official altimeter can be used for the official record of achieved altitude. It is very important that the compartment in which the altimeter is placed be properly positioned on the rocket and vented with holes as described in Appendix 4, so that the air pressure inside it is always at equilibrium with the outside air pressure. The instrument measures altitude on the basis of the air pressure changes it senses during flight.

   Hint: Place the altimeter in a compartment that is totally sealed on the bottom against intrusion by high-pressure gases from the rocket motor's ejection charge. These gases will make the altitude reading inaccurate.

   Hint: Place the altimeter compartment well away from the egg compartment. Turbulent flow over the rocket's nose cone-body tube joint at the top of the rocket (where the egg is located) will introduce pressure fluctuations for a few inches down the body tube and this will make the altimeter readings unreliable if it is placed in these first few inches behind the egg compartment

   Hint: Secure the altimeter in place mechanically in its compartment, don't let it "rattle" around or rely on foam padding to hold it in place (such padding might interfere with proper pressure equalization of the compartment, anyway). But make it easy to remove, because you will have to remove the altimeter both before and after flight for inspection by event officials.

3. **Decide on Duration-Control Approach.** There are two fundamental paths you can take to try to achieve a precise flight duration: fly without an onboard autonomous control system or fly with such a system. Remember that the rules prohibit the use of external human-in-loop controls like radio-control signals that you send to the rocket once it is in flight. The basic tradeoff is between the altitude the rocket flies to and the sink rate (in feet per second) after the recovery system deployment at apogee (maximum altitude). This is based on the size and shape of the parachute or other recovery system you select. This tradeoff can be initially simulated on a computer.
   a. Free Flight. If you choose the free-flight route (no control system), then the flight vehicle can be fairly simple but you must develop a more complex strategy for adjusting the rocket’s recovery system size, shape, etc. before flight in response to the weather conditions at that time. And you will have to do a larger number of practice flights to “calibrate” your adjustments.
   b. Control. If you choose the more complex control route, you need to decide what form of time or altitude-based control system you plan to use, and what you plan to have it do. If it is a device that triggers an igniter to burn through some number of parachute shroud lines, for example, then where do you plan to install the device in the rocket, how do you initiate it, and how do you plan to attach the parachute so it does not simply “cut away” completely and leave

the egg capsule in an unsafe free-fall? These factors will significantly determine the shape and arrangement of your rocket.

4. **Learn to use a rocket-design computer program.** Such a program is the best way to work through the remaining steps of flight vehicle design on a basis other than trial-and-error. There are two good rocket-design programs currently available on the market: SpaceCAD and RockSim. There is no single "right" design for this Challenge; there are many different combinations of motor types, rocket length and diameter, rocket weight, and recovery system size and shape that could lead to a flight altitude of 750 feet and flight duration of 45 seconds. A computer program will let you work through the rough possibilities fairly quickly and discard approaches that simply will not work or designs that are not aerodynamically stable. No simulation, however, is exactly accurate. Its estimate of the aerodynamic drag forces on your rocket may be off due to your construction techniques and it may therefore overestimate how high your real rocket will go; the rocket motors you use may perform slightly differently from the notional data for them in the program due to normal manufacturing variations, etc. Just because even the best simulation says your rocket will go a specific altitude and then descend at a specific speed under parachute does not mean that it will, exactly. It may go to a lower altitude (simulations often over-estimate the achieved altitude) and descend more quickly because a parachute shroud line got tangled during its deployment. Or it may crash because of a reliability problem such as how you attached the shock cord! That's why you still need to (and are required to) test-fly at the end of the design process.

5. **Simplicity**. The more complex you make your rocket design, the more things it has that can go wrong and the more it will cost both to develop and test. In the real world of engineering, low cost, rapid delivery, and high reliability are what the customer wants. In this Challenge, since your eligibility for the top ten prizes is based on the results of your flight attempts at the fly-off, whatever you fly has to work perfectly this first time. Add complexity (such as clustered rocket motors; staging is not allowed) only where you need to in order to meet performance requirements. It may turn out that you need to use something complex, but don't assume so from the start.

6. **Basic design safety**. First and foremost, your rocket must be "stable". Read the Handbook of Model Rocketry chapter on stability if you do not know what this means, and use a computer program to calculate stability if in doubt. Because your rocket will be nose-heavy as a result of the egg and altimeter, you should not need extremely large fins -- be conservative and design for a stability margin of at least two "calibers" (Center of Gravity ahead of Center of Pressure by at least two body tube diameters). Second, make sure that the motor(s) you pick provide enough thrust to give your size/weight rocket a speed of 40 ft/sec or so by the time it reaches the end of its launcher, so that it does not "stagger" slowly into the air and tip over and fly non-vertically if there is any wind. Generally, you need a motor or combination of motors whose combined average thrust is at least five times the rocket liftoff weight. As a rule of thumb, make sure that the model's motors' combined average thrust (in units of Newtons, which is how these are marked on the engine casing) is at least 25 times the rocket's liftoff weight in units of pounds.

   And finally, plan on using a launch rod of at least 6 feet in length and 1/4 inch in diameter or a rail for flying these heavy rockets -- they will need the length to achieve safe speed and the rigidity to avoid "rod whip" when the heavy rocket is at the end of the launch rod on its way up.

   Electronic parachute deployment systems, if you choose to use them, must be SAFE. If they are designed to sense acceleration or deceleration of the rocket as the basis for starting an ignition or ejection sequence, then there is a great risk that they can trigger on the ground or in your hands if you drop or jog the rocket while carrying it. Such systems must have a power switch, plug, or other electrical disconnect mechanism that permits you to maintain them in a completely "safe" configuration until placed on the launching pad, and will not be allowed to fly if they do not.

7. **Commercial vs Custom Parts.** The flight vehicle must be made by the student team members. You may use commercially-available "off the shelf" component parts (body tubes, nose cones, egg capsules, etc.) and may adapt some kinds of rocket kits for the event, or you can scratch-build components if you prefer. If a company should release a kit or design specifically for the TARC event (none has, so far) you would not be allowed to use such a kit or design. Having a custom flight vehicle part fabricated by a composite or plastics company or custom wood machining company (even if it is to your design) does not constitute sale of a "standard off the-shelf product" and is not allowed. However, having a mandrel fabricated to your specifications that is used to wrap fiberglass on to make your rocket body would be OK. In this case, the company is making a tool; you are making the part that flies.

8. **Metal Parts.** You may only use non-metal parts for the nose, body, and fins of your rocket, those parts that are the main structure of the vehicle. Fiberglass is OK. You may use miscellaneous metal hardware items such as screws, snap links, engine hooks, electronic circuit boards, and (if you wish) commercial re-loadable metal rocket engine casings.

9. **Recovery**. Your rocket may be recovered in several separate sections if you wish. Each section or piece of the rocket must come down safely. A heavy piece (nose cone, body section, rocket engine casing, etc.) that falls to earth in a stable, non-tumbling/non-gliding mode at high speed without a recovery system of some kind (parachute, streamer, etc.) is not safe, and flights that have this happen will be disqualified for being unsafe. You cannot have a flight-control system that completely cuts away the recovery system from your egg capsule at a predetermined time and causes it to free-fall to the ground with no recovery device from that point; this is not safe. Normally the only part that must be returned to the event officials after the flight is the part with the egg and altimeter.

Section 4. ROCKET CONSTRUCTION

Designing a rocket on a computer is important, but in the end you have to actually build it right for it to fly the way the computer says it will. There are two key resources available to you for learning the craftsmanship techniques for building a model rocket for TARC: One is the instructional DVD on rocket building available on www.rocketcontest.org (teams who participated in prior TARCs should already have this same DVD). The other resource is the Handbook of Model Rocketry by G. Harry and Bill Stine, which can be purchased separately from www.nar.org/NARTS. Watch the DVD and read the applicable chapters of the book before you start trying to put together your rocket. Then build and fly a simple rocket kit (such as the TARC practice kit from Aerospace Specialty Products) before you build your TARC entry.

There are many aspects to constructing a rocket, and this section will not review everything that the DVD tells you. From observing hundreds of teams of new rocketeers over the first four years of TARC, we have learned what common mistakes you need to avoid in this process.

1. Don't over-spend on parts. The basic components of a rocket, such as paper body tubes, balsa fins, and balsa or plastic nose cones are not going to cost you a lot if you design your rocket to use the inexpensive parts that are available from the three "official" component vendors for TARC: Aerospace Specialty Products, Balsa Machining Service, and SEMROC. See their addresses in the "Resources" chapter of this Handbook.

2. Use the right tools. You will need a couple of X-Acto hobby knives with sharp new blades, a steel ruler or straight edge, and various grits of fine sandpaper to build most rocket designs. And you will need a well-lighted work area with a cutting surface. You should not need power tools.

3. Use the right materials in the right places. Body tubes and launch lugs should be commercially-made, smooth, and strong. Don't try using paper towel rolls or other "economy" parts for the main structural member of your rocket, or soda straws for launch lugs. Use balsa wood (or aircraft plywood or basswood) from a hobby store for your fins, probably at least 1/8 inch thickness (for balsa), and make sure that the wood grain lines start on the fin-body glue joint and go outward from it. Put at least a 24-inch long piece of 1/4 inch wide sewing elastic in your recovery system as a "shock cord" between the egg section and the main body of the rocket, to absorb the opening shock of the recovery system.

4. Use the right glues. Body parts should be held together with yellow carpenter's wood glue, not white glue. You can use cyanoacrylate "super" glues for repairs, but do not use them for structural construction. You can reinforce fin-body joints with a "fillet" of hobby epoxy if you're worried about fins breaking off.

5. Use the right recovery system. A standard plastic model rocket parachute with 6-8 shroud lines held on using tape discs at the edges of the canopy will not work with a heavy model carrying an egg; the plastic will split, or the shroud lines will come off due to the forces of the heavy egg. Use thin nylon parachutes, or thicker plastics, to make the parachute (garbage can liner bag plastic works). For plastic chutes, run the shroud lines over the top of the chute canopy – do not just attach them at the edges. Make sure that you fold the chute carefully (see the Handbook of Model Rocketry on this) and use plenty of non-flammable recovery wadding to protect it from melting together due to the hot gases of the rocket motor ejection charge.

Section 5. ROCKET FLYING

Once your flight vehicle (rocket) is designed and built, it's time for flight test. This section provides some suggestions for organizing and conducting these tests, and for preparing for your single flight attempt at the fly-off. First and foremost, of course, is safety: **read and follow the NAR Model Rocket Safety Code** (Appendix 2).

1. Launching system. Consider the launching system to be an integral part of the flight vehicle system design, not an afterthought. Of course, the system has to be electrical and incorporate the standoff distance, safety interlock switch, and other requirements of the Safety Code, and it must be on the ground (no balloons!). But it also has to be able to provide the right amount of electrical current and voltage to fire your rocket motor(s) igniter(s), and it must provide rigid guidance to the rocket until it has accelerated to a speed where its fins can properly stabilize it (generally about 40 ft/sec). At the fly-off, an electrical launch system will be provided that can fire a single igniter of any type, and the launching devices provided will be 6-foot-long, 1/4-inch diameter launch rods. If your design requires something different (such as a rail or tower-type launcher), you must bring your own equipment and power source. In any case, you will need to have (or borrow) a system for pre-fly-off test-flying. You may want to have one team member assigned the job of designing and building the launcher, particularly if you do not use a commercially-made "off the shelf" system. You can also purchase or borrow a launcher.

2. Federal Aviation Administration (FAA). Model rockets that weigh one pound (454 grams) or less and have less than 4 ounces (112 grams) of propellant with no more than 62.5 grams in any one motor are exempt from flight regulation by the FAA; it does not take FAA notification or clearance to fly them anywhere in the U.S. This is explicitly stated in Federal Aviation Regulations (FAR) Chapter 101.1. Of course, you must follow the NAR Safety Code and not fly when aircraft are nearby or might be endangered or frightened by your flight! If your model rocket is heavier than one pound and/or has more than 4 ounces of propellant, but is still within the "model rocket" limits of 3.3 pounds (1500 grams) liftoff weight and 4.4 ounces (125 grams) propellant weight, then you are required to notify the nearest FAA air traffic control facility 24 to 48 hours before flying. Procedures for doing this are provided at Appendix 6. A "waiver", or formal FAA written advance approval to fly, is not required (it is required for rockets above these vehicle and propellant weights, which are called "high power rockets"). **DO NOT TEST-FLY A ROCKET OF OVER ONE POUND LIFTOFF WEIGHT WITHOUT COMPLYING WITH THIS FAA REQUIREMENT!** Notification to the FAA for the Challenge fly-offs will be handled by the NAR.

3. Launch Site. The launch site for the Challenge fly-offs is about 1500 feet by 2500 feet of treeless closely-mowed grassland. If the winds on the date of the fly-off are fairly light, recovery will be easy; in windy conditions (above 15 miles per hour), rockets that achieve a 45-second duration could drift out of the field. The site you use for pre-fly-off flight testing may or may not be large, but note the minimum site dimensions in the NAR Model Rocket Safety Code, which depend on the size of the motor(s) in your rocket. The first and most important thing you must have at a launch site is permission from the owner! If your school or organization has a suitable site and supports this event, your problem is easily solved. Otherwise, you must work with local park authorities, private landowners, etc. for permission to use a suitable site. There are generally two concerns expressed by landowners concerning rocket flying:

- "It's dangerous". Not true -- the NAR handout at Appendix 7 summarizes why this is so, and should be used (along with the NAR Safety Code at Appendix 2) to persuade site owners of this. The accident rate for model rocket flying is nearly zero (exactly zero fatalities caused by the rockets), and it is hundreds of times safer than any of the organized athletic events that use similar open fields!
- "I'm afraid of the liability (lawsuit) consequences if anything happens". If you are a member of the NAR, you have personal coverage of up to $1 million against the consequences of an accident that occurs while you are flying, as long as you are following the NAR Safety Code. See Appendix 6 for

more information on this insurance coverage. If your organization, school, school district, or other landowner of your rocket launch site requires liability insurance, your team can obtain "site owner insurance" coverage for this potential liability by having your supervising teacher/adult and at least three student members of the team members join the NAR and then having the supervising teacher/adult order "site owner insurance" from NAR Headquarters. This insurance is not available to provide personal coverage for school officials or organization officials, only for the legal owner of launch sites. This additional coverage costs $15 per site insured and requires filling out either an online form or a mail-in form, both available at the Team America section of the NAR website.

4. Launch Safety. Your rocket (and your launch system, if any) will be inspected for flight safety by an event official before they may be used in the fly-off. Any discrepancies noted there must be corrected before flight is allowed. **AT THE FINALS, YOUR ROCKET MUST HAVE PREVIOUSLY BEEN SUCCESSFULLY TEST-FLOWN.** You must also be prepared to show and explain any complex rocket features affecting flight such as electronic timer systems, etc. The pre-flight safety check will also look for the following types of things:

- Do the motors (or motor) have sufficient thrust (average thrust to liftoff weight ratio 5 or greater) to give the rocket a safe liftoff velocity from its launcher?
- Is the rocket stable (CG at least one caliber ahead of CP) with motor(s) and egg installed?
- Are the motor(s) used listed on the TARC Approved Engine List, and are they clearly not modified in any manner by the user?
- Are the fins and launch lugs attached securely and straight?
- Is the recovery system (shock cords and anchors, parachute, etc.) sturdy enough to withstand the shock of opening with that rocket, and is it large enough to produce a safe landing speed?
- Does any separable part of the rocket have a recovery system or a design (e.g. gliding, tumbling) that will ensure it lands at safe, slow speed?
- Does the design prevent any expended motor casings or other massive objects from being separated in flight without a recovery system?
- If there is an electronic in-flight recovery control system, does it have a safety/arming technique (switch or safety plug) that positively ensures it is not capable of causing a pyrotechnic event until the rocket has been installed on the launch pad? Hint: If your rocket is complicated, develop a pre-flight checklist and use it before every launch of you rocket. That’s what real engineers do!
- Does the launch system (if the team provides its own) comply with Safety Code requirements for interlocks and standoff distance; can it deliver enough current to ignite multiple motors at once (if cluster ignition is planned); and does the launcher have sufficient length (6 feet is expected) and stiffness (if a launch rod is used, it must be 1/4-inch) to guide the rocket securely until it reaches safe speed?

Important note: It is against the law to travel by airliner with rocket motors in your luggage. We will have a motor vendor (Hangar11 Hobbies) available on site at the finals for teams who fly in, and will provide information on how to advance-order fly-off motors from the vendor for onsite delivery.

Section 6. QUALIFYING AND PRACTICE FLIGHTS.

Practice-fly early and often. The teams that qualified to attend the previous fly-offs had an average of 15 practice flights with several crashes and/or lost rockets before they did the flight that got them to the fly-offs. None of them waited until the last week before the deadline to do their first test flight; teams that waited this long were universally unsuccessful. Only by test-flying can you master the skills of recovery system deployment, egg cushioning, and overall flight reliability and repeatability needed for success.

Each team that enters this competition must conduct an NAR-observed "qualification" flight and FAX (703-358-1133) the results of that flight to the AIA (using a copy of the form provided in this Handbook) no later than Monday, April 6, 2009. Plan ahead for weather (rain or wind that "scrubs" a launch day, problems with the rocket's flight, etc.) and do not wait until the last minute to try and fly this flight. Teams must provide their own egg and timing stopwatches for all qualifying and practice flights; pre-measured egg and timers with watches will be provided by the NAR at the fly-offs.

The top 100 qualifying teams, based on their reported scores, will be invited to attend the competitive "fly-off" event that will be held on May 16, 2009 (alternate fly-off date will be May 17, 2009, in case of bad weather) at the Great Meadow Outdoor Center, The Plains, Virginia. All teams who submit a qualification flight form will be notified of their status by April 10, 2009, by a representative of the AIA, and the list of those accepted will be posted at www.rocketcontest.org. Notification will be sent to you using the email addresses provided on your application.

Selection of the top 100 teams will be made on the basis of the lowest (best) 100 scores reported on the qualification flight forms. Score is the total difference (in seconds and hundredths) by which the average timer-measured flight duration differed from 45.00 seconds (always a positive number) MULTIPLIED BY TWO, plus the total difference (in feet) between the altimeter-reported altitude and 750 feet (always a positive number). Note that cracking of either egg carried by the rocket is disqualifying.

The official qualifying flight must be observed by a Senior (adult) member of the National Association of Rocketry, who must be “impartial”, i.e. not related to any member of the team, and not a paid employee of the school or member of the non-profit organization sponsoring the team. This NAR observer is one of your two required flight timers. In addition, a second “impartial” person not on the team (who does not have to be a member of the NAR, or an adult) must be the second flight timer. There are three ways to obtain an NAR observer, if you do not already know of a qualified local NAR Senior member who is ready to do this for you:

- Attend an organized launch run by an NAR section, and fly your rocket at that launch. You can also use these launches as a place to practice-fly before you do your official qualification flight. These launches are listed in the "Launch Windows" Calendar on the NAR web site, www.nar.org. Always call a launch's point of contact before attending to confirm the time and place of the launch and the availability of FAA clearance for rockets up to 3.3 pounds.
- Contact the nearest "section" (or chartered club) of the NAR to see if they have launches not listed on the web site. Check the NAR site for a list of these sections and contact information.
- Contact someone on the list of volunteer "mentors" posted on the NAR web site (some of these folks live in places remote from an NAR section).

Obtaining an observer and providing stopwatches **is the responsibility of each team. PLAN AHEAD**, to find an observer for your qualification flight(s). **DO NOT WAIT** until late March to try to find someone on a day's notice to observe your flight, and do not expect them to drive a long distance to do so. Upon request, we will send you a roster of every senior NAR member in your state to help you find a nearby qualification observer. Contact us at rocketcontest@aia-aerospace.org if you need this assistance. Not every NAR member is aware of the Team America event, so you may have to explain it a bit first when you call one who is not already signed up as a mentor!

If there is no NAR member available within reasonable distance (and this will be true in a number of areas of the US), it is OK to have an impartial adult, i.e. someone who is not related to any member of the team and not a paid employee of the team's sponsoring school or the team's sponsoring non-profit organization, become a NAR member in order to be an observer. NAR membership can be ordered online and is effective the day it is ordered. Observers who joined too recently to yet have a membership card and number may record their membership number as "PENDING" on the qualification flight form, and we will check with NAR Headquarters to get the membership number. Experienced rocketeers are certainly preferred to do the observer duties because they can usually understand the rules better and offer advice and tips at the same time -- but experience is not absolutely required. We do not pre-approve observers, but we will check the form they sign to verify that the observer who signs is a current NAR senior (adult) member.

Finding a launch site is the responsibility of each team, but you do not have to fly at an NAR launch site. You simply need to locate an open field of suitable size (at least 1500 feet on a side), get permission from the landowner, and comply with any local laws regarding model rocketry. If your rocket is over one pound liftoff weight, you must notify the local FAA. (The procedures for doing so are explained here in the Appendix 6.) Model rocketry is recognized and regulated by the National Fire Protection Association's Code 1122, which local fire officials should be familiar with. There is a safety handout in Appendix 7 of this Handbook that you should read and can share with concerned landowners and public safety officials.

Teams may practice as much as they wish, but may only make TWO (2) official qualification flight attempts. The form provided in this Handbook, or a copy, must be used to report the results of these flights. Be sure to get the signatures of the supervising teacher/adult of the team and the Senior NAR member who is the official observer. It is the responsibility of the team to fax your completed form for successful qualification flights to (703) 358-1133, no later than April 6, 2009. NAR observers who observe a qualification flight attempt that is not successful (i.e. crash or broken egg) are asked to fax the form on that flight directly to the AIA.

TEAM AMERICA ROCKETRY CHALLENGE 2009
QUALIFYING/SELECTION FLIGHT DEMONSTRATION

TEAM'S SCHOOL/ORGANIZATION: ____

AIA TEAM NUMBER: ____________ ADULT ADVISOR: ______________________________

DATE OF THIS FLIGHT: ____________ LOCATION: ______________________________

MINIMUM FLIGHT REQUIREMENTS (ALL MUST BE MET) PUT "YES" OR "NO"

Did this rocket weigh less than 1500 grams at takeoff, with egg and motors? ________

If the rocket weighed more than 453 grams, was FAA notification done? ________

Did this rocket use only motors from the TARC list of NAR approved/certified motors? ________

Did the rocket contain one Grade A large, raw hen's egg oriented on its side? ________

Did this rocket make a safe flight and recovery under the TARC rules & NAR Safety Code? ________

Did the part of the rocket containing the egg land without any human intervention (catching)? ________

Did the egg carried by the rocket remain uncracked after the flight? ________

SCORING

TIMER # 1 (NAR OBSERVER): _____ . _________ (SEC, HUNDREDTHS)

TIMER # 2 (OTHER ADULT): _____ . _________ (SEC, HUNDREDTHS)

AVERAGE TIME: _____ . ______ (SEC, HUNDREDTHS) → DIFFERENCE FROM 45.00 SEC: ___ . ____ (NO NEGATIVES)

↓ MULTIPLY DIFFERENCE BY 2: _____ . ____

\+

ALTIMETER ALTITUDE: ___________ FEET → DIFFERENCE FROM 750 FEET: ________ (NO NEGATIVES)

FINAL SCORE (SUM) ____ . ____
Put <u>only</u> "DQ" if any answers above are "no"

SUPERVISING TEACHER/ADULT CERTIFICATION

I certify that the student members of this team designed, built, and flew this rocket without my assistance and, to the best of my knowledge, without the assistance of any other adult or any person not on the team. I also certify that no more than two official qualification flight attempts were made by this team, and that the team information on file at AIA is current. I understand that team membership can no longer be changed and only team members on file at AIA with valid parent consent forms are eligible to receive prizes.

SIGNATURE: ______________________________ PRINT NAME: ______________________________

ADULT N.A.R. MEMBER OBSERVER CERTIFICATION

I certify that I am a Senior NAR member who personally observed this flight, and the above initials and scores are mine, based on my observations. I certify that I am not related to any team members or affiliated with their school or non-profit organization, and that this flight was conducted in compliance with the rules of the Team America competition.

SIGNATURE: ______________________________ PRINT NAME: ______________________________

NAR NUMBER: __________ STREET ADDRESS: ______________________________________

CITY, STATE: ____________________ PHONE: ____________ EMAIL: ____________________

******FAX TO 703-358-1133 NO LATER THAN APRIL 6, 2009******
Team sends in form if flight successful, NAR observer sends in form for unsuccessful flights.

Section 7. RESOURCES

This Team Handbook is the most important resource you need to participate in this Challenge. In addition, many answers to questions on contest specifics may be found in the Frequently Asked Questions section at www.rocketcontest.org. There are many resources that may be useful in learning the basic model rocketry skills needed to succeed in this Challenge or in getting the supplies necessary to participate. These include:

www.nar.org	The web site of the National Association of Rocketry, the nation's oldest and largest non-profit model rocket consumer and safety organization. From this you can link to one of the NAR's 140 or more "sections", or local clubs, for advice and general assistance. You can join NAR online as well, to get insurance plus NAR's glossy magazine "Sport Rocketry". NAR Technical Services (NARTS) at www.nar.org/NARTS has many technical resources on the hobby for sale, including the official reference handbook for TARC, the Handbook of Model Rocketry by G. Harry Stine (available at a special price of $20 postpaid for registered TARC teams).
www.rocketryplanet.com	This is a popular commercial web site useful to get to other online resources.
www.SpaceCAD.com	SpaceCAD is an approved simulation software for TARC, and information regarding its successful use and other useful rocket design information can be found here.
www.apogeerockets.com/rocksim.asp	RockSIM is an approved simulation software for TARC, and information regarding its successful use and other useful rocket design information can be found here.

The following are vendor-supporters of the NAR and TARC who have the types of rocket supplies and components needed for most TARC designs, at reasonable prices with good customer service. BMS, ASP, and SEMROC have agreed to offer a discount to teams that are registered for TARC:

www.balsamachining.com	Balsa Machining Service (BMS), 11995 Hillcrest Drive, Lemont, IL 60439. A manufacturer/vendor of body tubes, balsa nose cones, model rocket motors, and other components for model rockets.
www.asp-rocketry.com	Aerospace Specialty Products (ASP), PO Box 1408, Gibsonton, FL 33534. A manufacturer/vendor of body tubes, plastic nose cones, recovery devices, plastic egg-carrying capsules for rockets, and a special TARC learner's kit.
www.semroc.com	SEMROC Astronautics, Box 1271, Knightdale, NC 27545. A manufacturer and vendor of body tubes, nose cones, and other component parts.
www.hangar11.com	Hangar11 Hobbies, Inc., 29 Capital Drive, Washingtonville, NY 10992. (845) 304-1303. The official on-site vendor for the TARC finals.

The NAR has developed a nationwide list of experienced rocketeer "mentors" who are willing to be a resource to teams. A "mentor" is an adult rocketry expert advisor who helps a team learn basic rocketry skills and shows them where to get rocket supplies and launch sites. They can do this in person, by phone or e-mail. Teams are not required to have mentors, and mentors are not required to be NAR-approved (i.e. you can get local help from non-NAR rocket experts.) There is a list of NAR-approved mentors on the NAR website for your convenience. You may contact any mentor on the list, regardless of the state you or they live in, or you may seek online advice through the very active NAR TARC Yahoo online group at http://groups.yahoo.com/group/NARTARC.

APPENDIX 1.

RECOMMENDED SCHEDULE OF ACTIVITIES FOR TARC 2009 TEAMS

Week 1-11 below refers to the elapsed time since team entry forms and payment were received and accepted by AIA.

WEEK 1

- Ensure all team data (names, e-mail, etc.) on file with AIA is correct
- Join TARC electronic forum (Yahoo group http://groups.yahoo.com/group/NARTARC/)

WEEK 2

- Assign team responsibilities (such as project manager, airframe, propulsion & ignition, launch system, fundraising etc.)
- Get a mentor (see the list of available NAR mentors at www.nar.org)
- Watch the instructional DVD "How to Build and Fly a Model Rocket" that is provided to new teams.
- Download the Team Handbook & Rules and the Frequently Asked Questions from www.rocketcontest.org, and have all team members read both
- Begin research on rocket parts supply sources (starting with the three "official parts suppliers" listed in the TARC Handbook)
- Order one of the two available flight-simulation and rocket-design computer programs, SpaceCAD or RockSIM, at the TARC Team discount price directly from the vendor.

WEEK 3

- Purchase an inexpensive one-stage rocket kit to familiarize team with rocket building & flying, and build it. A good basic kit specifically for TARC teams is available from Aerospace Specialty Products.
- Locate a place to fly rockets (or a nearby NAR launch to attend and fly at, see the "Launch Windows" calendar at www.nar.org or contact the nearest NAR club or "section" listed at this same website)
- Develop a plan to raise required funds for purchase of rocket supplies (and hopefully for later travel to the flyoffs), covering at least 2-3 rockets and motors for at least 10 test and qualification flights

WEEK 4

- Obtain a comprehensive book on model rocketry, such as G. Harry Stine's "Handbook of Model Rocketry" (available at a TARC Team discount from NAR Technical Services www.nar.org/NARTS), and have all team members read it.
- Load the rocket design and flight simulation computer program that you purchased, and have team members learn to use it
- If you require "site owner" insurance for the place where you will be flying, have the teacher and at least three team members join the NAR, and order NAR site owner insurance

WEEK 5

- Fly a basic one-stage model rocket
- Order your ALT 15K/WD Rev2 official altimeter from Perfectflite at the special TARC price.

WEEK 6

- Using the computer program and the knowledge gained from reading and from building basic rockets, develop a first design for TARC entry

WEEK 7

- Using the computer program, conduct flight simulations of your design with various rocket motors on the TARC approved motor list, to determine the best motor(s) to use
- Locate sources for the materials needed to build the TARC design (starting with the official vendors in the TARC Handbook) and purchase required parts and rocket motors

WEEK 8

- Design and build (or purchase) the electrical launch system and the launch pad (rod or rail) to be used with your TARC entry, if you do not have a local rocket club's system available for your use

WEEK 9

- Begin construction of your initial design for your TARC entry
- Locate a NAR Senior (adult) member who can serve as your official observer for your qualification flight(s), if you do not already have an NAR Mentor who will do this.

WEEK 10

- Develop a pre-flight checklist for your TARC flight and assign responsibility for each of the duties to a member of the flight team
- Test your launch system by test-firing igniters without installing them in rocket motors

WEEK 11

- Weigh your completed TARC rocket and re-run computer flight simulations with actual rocket weights
- If your rocket weighs over 1 pound, locate the appropriate FAA flight control office to notify of your planned launch (see Appendix 5), unless you are flying with an NAR club that already does this for their launches

By February 1 you should (but are not required to):

- Test-fly your initial TARC design (without altimeter), making sure that you leave time to redesign, rebuild, and re-fly by April 6 if this initial flight/design is not successful!
- If your first flight is fully successful, test-fly again with stopwatch timing and the altimeter installed. Repeat test flights until you hit the design targets.
- If your first flight is not successful, do post-flight failure analysis and re-design.

By March 15 you should (but are not required to):

- Make your first official qualification flight attempt in front of an NAR Senior member observer

NO LATER THAN April 6 you must:

- Make your final official qualification flight attempt in front of an NAR Senior member observer
- Submit (fax) your qualification flight report to AIA

April 10

- If notified of selection to attend the flyoffs, make reservations at one of the TARC motels identified by the organizers and conduct fund-raising to cover travel and lodging
- Continue test-flying to "tune" rocket design to target altitude
- If you plan to travel to the flyoff by airline, order rocket motors for flyoff to be shipped to TARC receiving point or delivered on-site by flyoff vendor (Hangar11 Hobbies)

NO LATER THAN May 1

- Complete and test-fly the actual rocket to be used in the flyoff. This flyoff rocket must have been test-flown before arrival at the flyoff, as there is no opportunity for test-flying at the flyoff site.

APPENDIX 2

NATIONAL ASSOCIATION OF ROCKETRY
MODEL ROCKET SAFETY CODE

Revision of February 2001

1. **Materials.** I will use only lightweight, non-metal parts for the nose, body, and fins of my rocket.
2. **Motors.** I will use only certified, commercially-made model rocket motors, and will not tamper with these motors or use them for any purposes except those recommended by the manufacturer.
3. **Ignition System.** I will launch my rockets with an electrical launch system and electrical motor igniters. My launch system will have a safety interlock in series with the launch switch, and will use a launch switch that returns to the "off" position when released.
4. **Misfires.** If my rocket does not launch when I press the button of my electrical launch system, I will remove the launcher's safety interlock or disconnect its battery, and will wait 60 seconds after the last launch attempt before allowing anyone to approach the rocket.
5. **Launch Safety.** I will use a countdown before launch, and will ensure that everyone is paying attention and is a safe distance of at least 15 feet away when I launch rockets with D motors or smaller, and 30 feet when I launch larger rockets. If I am uncertain about the safety or stability of an untested rocket, I will check the stability before flight and will fly it only after warning spectators and clearing them away to a safe distance.
6. **Launcher.** I will launch my rocket from a launch rod, tower, or rail that is pointed to within 30 degrees of the vertical to ensure that the rocket flies nearly straight up, and I will use a blast deflector to prevent the motor's exhaust from hitting the ground. To prevent accidental eye injury, I will place launchers so that the end of the launch rod is above eye level or will cap the end of the rod when it is not in use.
7. **Size.** My model rocket will not weigh more than 1,500 grams (53 ounces) at liftoff and will not contain more than 125 grams (4.4 ounces) of propellant or 320 N-sec (71.9 pound-seconds) of total impulse. If my model rocket weighs more than one pound (453 grams) at liftoff or has more than four ounces (113 grams) of propellant, I will check and comply with Federal Aviation Administration regulations before flying.
8. **Flight Safety.** I will not launch my rocket at targets, into clouds, or near airplanes, and will not put any flammable or explosive payload in my rocket.
9. **Launch Site.** I will launch my rocket outdoors, in an open area at least as large as shown in the attached table and in safe weather conditions with wind speeds no greater than 20 miles per hour. I will ensure that there is no dry grass close to the launch pad, and that the launch site does not present risk of grass fires.
10. **Recovery System.** I will use a recovery system such as a streamer or parachute in my rocket so that it returns safely and undamaged and can be flown again, and I will use only flame-resistant or fireproof recovery system wadding in my rocket.
11. **Recovery Safety.** I will not attempt to recover my rocket from power lines, tall trees, or other dangerous places.

LAUNCH SITE DIMENSIONS

Installed Total Impulse (N-sec)	Equivalent Motor Type	Minimum Site Dimensions (ft.)
0.00--1.25	1/4A, 1/2A	50
1.26--2.50	A	100
2.51--5.00	B	200
5.01--10.00	C	400
10.01--20.00	D	500
20.01--40.00	E	1,000
40.01--80.00	F	1,000
80.01--160.00	G	1,000
160.01--320.00	Two Gs	1,500

APPENDIX 3.

NATIONAL ASSOCIATION OF ROCKETRY CERTIFIED MODEL ROCKET MOTORS APPROVED FOR USE IN TEAM AMERICA 2009

The commercially-made model rocket motors listed below have been subjected to rigorous safety and reliability testing conducted by the NAR Standards & Testing (S&T) Committee and are the only ones approved for sale in the U.S. or for use in this Challenge. All motors listed here are in current production. Every motor listed here will continue to be approved for use in the Team America 2009 event regardless of any subsequent announced changes to the NAR's overall official engine certification list. This list may be expanded if new motors are certified during the period of the Challenge; this expansion and any revised list will be communicated to all those teams enrolled in the Challenge.

Download "Motor Data Sheets" from the NAR web site if you desire additional information. Each data sheet contains a thrust curve together with values from a test firing, including measured average thrust and total impulse, plus 32 data points for use in altitude simulation computer programs.

Abbreviation	**Full Manufacturer Name**
Aerotech	Aerotech
Apogee	Apogee
Cesaroni	Cesaroni Technology Incorporated
Estes	Estes Industries
Quest	Quest Aerospace Education
Rdrunner	Roadrunner Rocketry

Note: (R) following the listed casing dimensions denotes that the motor is a reloadable motor system certified only with the manufacturer-supplied casing, closures, nozzle, and propellant. Reloadable motors (and "G" power class motors of any kind) are not available for sale to persons under age 18, per U.S. Consumer Products Safety Commission regulations. Also, the metal casings that reloadable motors use are quite expensive. But if the performance of these types of model rocket motor happens to be exactly what you need for your design, your supervising teacher/adult advisor can purchase them and supervise your use of them.

NATIONAL ASSOCIATION OF ROCKETRY
CERTIFIED MODEL ROCKET MOTORS
APPROVED FOR USE IN TEAM AMERICA 2009

As of September 1, 2008

Designation		Mfgr.	Casing Size (mm)	Propellant Mass (grams)	Total Impulse (N-sec.)
1/4A3-3T		Estes	13 x 45	0.8	0.62
1/2A3-2T,4T		Estes	13 x 45	2.0	1.25
1/2A6-2		Estes	18 x 70	2.6	1.25
A3-4T		Estes	13 x 45	3.3	2.50
A6-4		Quest	18 x 70	3.0	2.30
A8-3,5		Estes	18 x 70	3.3	2.50
A10-3T,PT		Estes	13 x 45	3.8	2.50
B4-2,4		Estes	18 x 70	6.0	5.00
B6-0		Estes	18 x 70	5.6	4.90
B6-2,4,6		Estes	18 x 70	5.6	5.00
B6-0,2,4		Quest	18 x 70	6.5	5.00
C6-0,3,5,7		Estes	18 x 70	10.8	9.0
C6-0		Quest	18 x 70	11.0	8.8
C6-3,5		Quest	18 x 70	12.0	8.76
C11-3,5		Estes	24 x 70	12.0	9.0
D5-P		Quest	20 x 88	25.0	19.6
D9W-4,7	R	Aerotech	24 x 70	10.5	20.0
D10-3,5,7		Apogee	18 x 70	9.8	18.3
D11-P		Estes	24 x 70	24.5	18.0
D12-0,3,5,7		Estes	24 x 70	21.1	17.0
D13W-4,7,10	R	Aerotech	18 x 70	9.8	20.0
D15T-4,6/7	R	Aerotech	24 x 70	8.9	20.0
D21T-4,7		Aerotech	18 x 70	9.6	20.0
D24T-4,7	R	Aerotech	18 x 70	8.8	18.5
E6-4,6,8,P		Apogee	24 x 70	22.0	37.8
E9-4,6,8,P		Estes	24 x 90	35.8	28.5
E10-6,10		Ellis	24 x 102	28.3	35.8
E11J-3	R	Aerotech	24 x 70	25.0	31.7
E12-6,10		Ellis	24 x 102	28.3	35.8
E15W-4,7,P		Aerotech	24 x 70	20.1	40.0
E16W-4,7	R	Aerotech	29 x 124	19.0	40.0
E18W-4,8	R	Aerotech	24 x 70	20.7	39.0
E23T-5,8	R	Aerotech	29 x 124	17.4	37.0
E28T-4/5,7/8	R	Aerotech	24 x 70	18.4	40.0
E30T-4,7		Aerotech	29 x 70	19.3	40.0
F10-4,6,8		Apogee	29 x 93	40.0	74.3
F12J-2/3,5	R	Aerotech	24 x 70	30.0	45.0
F20W-4,7		Aerotech	29 x 73	30.0	64.0
F20-6,10		Ellis	24 x 140	31.2	67.9
F22J-4/5,7	R	Aerotech	29 x 124	46.3	65.0
F23FJ-4,7	R	Aerotech	29 x 73	32.0	56.0
F23FJ-4,8		Aerotech	29 x 83	30.0	41.2
F23-6,10		Ellis	24 x 140	31.2	67.9
F24W-4,7	R	Aerotech	24 x 70	19.0	50.0
F25W-4,6,9		Aerotech	29 x 98	35.6	80.0
F26FJ-6,9		Aerotech	29 x 98	43.1	62.2
F27R-4,8		Aerotech	29 x 83	28.4	49.6

F35-6,10		Rdrunner	29 x 112	40.1	76.5
F37W-S,M,L	R	Aerotech	29 x 99	28.2	50.0
F39T-3,6	R	Aerotech	24 x 70	22.7	50.0
F40W-4,7,10	R	Aerotech	29 x 124	40.0	80.0
F42T-4,8		Aerotech	29 x 83	27.0	52.9
F45R-5,8,P		Rdrunner	29 x 112	30.0	62.3
F50T-4,6,9		Aerotech	29 x 98	37.9	80.0
F52T-5/6,8,11	R	Aerotech	29 x 124	36.6	78.0
F60R-4,7,10		Rdrunner	29 x 112	38.1	75.9
F62T-S,M,L	R	Aerotech	29 x 89	30.5	51.0
G20-3		Ellis	29 x 149	62.0	124.2
G35-6,10		Ellis	29 x 165	62.0	124.2
G37-6,10,P		Ellis	24 x 181	62.0	110.5
G38FJ-4,7		Aerotech	29 x 98	55.0	94.0
G40W-4,7,10		Aerotech	29 x 124	55.1	97.1
G53FJ-5,7,10	R	Aerotech	29 x 124	60.0	90.9
G54W-S,M,L	R	Aerotech	29 x 124	46.0	85.0
G61W-S,M,L	R	Aerotech	38 x 106	61.5	110.5
G64W-4,7/8,10	R	Aerotech	29 x 124	62.5	120.0
G67R-S,M	R	Aerotech	38 x 106	60.0	110.0
G69-12A	R	Cesaroni	38 x 127	62.5	128.8
G71R-4,7,10	R	Aerotech	29 x 124	56.9	107.0
G76G-4,7,10	R	Aerotech	29 x 124	60.0	115.0
G77R-S,M	R	Aerotech	29 x 150	58.0	105.0
G77R-4,7,10		Aerotech	29 x 146	58.1	102.9
G79W-S,M,L	R	Aerotech	29 x 150	62.0	108.6
G79W-4,7,10		Aerotech	29 x 146	60.1	108.0
G80-4,7,10		Aerotech	29 x 124	56.9	120.0
G80T-7,10,13		Aerotech	29 x 128	62.5	136.7
G80R-4,7,10		Rdrunner	29 x 140	54.7	105.7

Additional notes:

- The manufacturer-reported total impulse and propellant mass of motors often differs from the values reported above, which are based on testing by the NAR Standards & Testing Committee. The values above are the ones that will be used in TARC.
- Where two delays are listed with a slash for a motor, both delay times are approved for use

APPENDIX 4.

PERFECTFLITE MAXIMUM ALTITUDE ALTIMETER

Perfectflite Electronics
www.perfectflite.com
P.O Box 328
Mirror Lake, NH 03853
(603) 569-1344

DESCRIPTION

The altimeters approved for use in TARC 2009 (the Perfectflite ALT15K/WD or ALT15K/WD Rev 2 Modela) are "maximum altitude altimeters" that precisely measures the air pressure at the altitude where your rocket is located every 0.1 second and convert this to an above-ground altitude value. The altimeter is energized by inserting the battery. It senses the liftoff of the rocket from the sudden air pressure drop that results from its altitude change, then senses the maximum altitude that the rocket subsequently reaches, and "freezes" and beeps out this maximum altitude thereafter using a piezoelectric buzzer, until the battery is removed to turn it off. It will not work on flights that achieve less than 160 feet altitude or greater than 15,000 feet altitude (far outside the 750-foot TARC 2009 target range) above ground level. It is accurate to better than 1 percent of the measured altitude, which is far better accuracy than any other altitude-measurement technique readily available to hobby rocketeers.

APPROVED ALTIMETERS

Only two altimeters are approved for use in TARC 2009 official altitude scoring: the Perfectflite ALT15K/WD or Rev 2. These are about 2.5 inches long, fit in an 18mm-diameter body tube like Estes BT-20, weigh 13-14 grams with battery, and use a 12 volt "N" size lighter battery. Only these TARC-approved altimeters may be used as the basis for official event scores in either local qualification flights or in the final fly-offs.

USING THE ALTIMETER

Read and follow the detailed manufacturer usage instructions provided with the altimeter. Always handle them by the edges when testing or installing to avoid touching any of the circuitry. Never store the device bare in a clear plastic bag; use a small cardboard box, or wrap the altimeter in a paper towel inside a plastic bag. Do not use tape on the altimeter, and use care to keep it clean and dry. Protect it from the fumes and residue created by rocket motors and their ejection charges by installing it in a compartment of your rocket that is totally sealed from motors and charges. Make sure that it cannot "rattle around" in this compartment and get damaged in flight. Always mount the altimeter with the spring end of the battery holder facing upward toward the nose end of the rocket. This will avoid compression of the spring and battery disconnection during a very high acceleration liftoff.

The altitude achieved by the rocket (and the altitude read by the altimeter) depends on launch site altitude and air temperature. If you live at an altitude much different from the Team America launch site (600 feet above sea level), or fly when the temperature much different from the temperature on "fly-off" day in May, your rocket will go to a different altitude (and the altimeter will read a different altitude) than it will at the fly-off. You need to compensate for this in your planning.

An altimeter must be mounted in a "sealed" chamber which must have a vent hole or holes to the outside. A sealed bulkhead below the altimeter chamber is necessary to avoid the vacuum caused by the aft end of a rocket during flight. A sealed bulkhead above the altimeter chamber is necessary to avoid any pressure fluctuations that may be created at the nose end of the rocket. If the front of the payload section slip fits to another section such as a nosecone, then the fit must be as free as possible from turbulence. A breathing hole or vent (also known as a static port) to the outside of the rocket must be in an area where there are no obstacles above it that can cause turbulent air flow over the vent hole. Do not allow screws, ornamental objects, or anything that protrudes out from the rocket body to be in line with and forward of a vent hole. Vents must be neat and burr free and on an outside surface that is smooth and vertical where airflow is smooth without turbulence.

Some rocketeers use multiple static ports (vent holes) instead of just one. Very strong wind blowing directly on a single static port could affect the altimeter. Multiple ports evenly spaced around the rocket tube may help cancel the effects of strong wind on the ground, the effects of transitioning through wind shears during flight, the pressure effects of a non-stable liftoff, or the pressure effects that occur due to flipping and spinning after deployment. If you wish to use multiple ports, then use three or four. Never use two. Ports must be the same size and evenly spaced in line around the tube. The best configuration would be four 1/32" holes (1/4 the area of the single 1/16" hole) spaced at 90 degree intervals around the circumference of the body tube. This will reduce the likelihood of false triggering and insure the cleanest, most consistent data.

If the altimeter is reporting an altitude of some very small value (a number less than 160, the launch detect trigger altitude) post-flight, this is a result of it getting a brief (approximately 0.1 second) vacuum spike due to a wind gust over the vent hole or other causes. The altimeter would see the altitude going from 0 to over 80 to 160 in 0.1 second (more than 800 feet per second, obviously not a valid reading around apogee) so the spike itself would be excluded from the beeped out apogee reading. Any small number that the altimeter does beep out (4, 8, 12...) would just be the result of background or wind-induced noise.

There are ways to minimize this effect. The size of the sampling hole depends on the altimeter compartment dimensions, but generally should be quite SMALL. For most TARC sized rockets a 1/16" or smaller hole is proper. Many people seem to be drilling a nice large 1/4" hole in the side of their rocket, which not only isn't necessary, but will increase wind noise on the data. It will also increase the likelihood and magnitude of spikes in the data when the rocket separates, which can affect the apogee reading. Since the goal of the contest is consistency, clean data is essential. In order to get the cleanest data, the sampling holes should NOT be oversized, and ejection should be slightly after apogee so any turbulence-induced noise on the data will not spike up over the true apogee height.

After power is applied to the altimeter you have approximately 25 seconds to install it and close the rocket before it begins looking for a pressure change to signify launch. If you are handling the altimeter after the 25 second period has elapsed, you could trigger it prematurely. When the altimeter is sounding the periodic “launch ready” chirp it is very sensitive to handling, wind gusts, and light in the sensor hole. The altimeter should be safely inside the rocket with the altimeter compartment closed before this occurs.

Direct exposure to sunlight will trigger the altimeter pressure sensor and cause it to incorrectly "sense" maximum altitude and beep out a false value before liftoff. Be sure to shade the altimeter from the time you zero it before flight until it is safely inside the altimeter compartment in your rocket. If direct sunlight shines in the sensor hole, you will get such a spike, though you can exclude this possibility if the altimeter is already shielded inside the rocket and emitting the periodic "ready" chirp.

It is possible (though extremely unlikely) that RF energy from a nearby cellphone, FRS/GMRS radio, etc could cause such a spike. The altimeter does have RF bypassing to reduce such effects, but a full power GMRS radio held about an inch away from the altimeter could trigger it.

If the altimeter remains silent post-flight, there are a number of possibilities. First is a weak battery. Battery voltage must be at least 11 volts. Second is dirty battery contacts or battery holder contacts. If the altimeter starts beeping again when the battery is rotated a turn or two in the battery holder it would indicate that the contacts were dirty. Clean with an eraser and blow out debris. Third is that the battery lost contact briefly during flight (shock at motor ignition or ejection are the most likely times, especially if the altimeter is free-floating in a compartment and can slam around, which is a bad practice). The altimeter should be padded to protect it from shock, the battery holder should be inspected for cracks from previous crashes which could loosen the battery retention force, and the altimeter should be installed with the spring end of the battery holder facing "up" so the spring is not compressed during acceleration. While it shouldn't be necessary, a wrap of tape around the battery holder can prevent deformation, especially if the holder is cracked.

If the altimeter is still beeping the launch ready chirp on landing, this is almost without question a case of the altimeter losing power during flight. It detected launch, started recording the flight, then lost power momentarily during flight (again, shock from boost, ejection, etc breaking battery contact). It would then start over from scratch, waiting thirty seconds and beep awaiting launch. But since the rocket would be on its way down by then, another launch detect would never get triggered, so it would still be beeping readiness on the ground.

APPENDIX 5.

FEDERAL AVIATION ADMINISTRATION NOTIFICATION PROCEDURES

If your rockets are under 1 pound, no notice to or coordination with the FAA is required and you may launch anywhere (including within 5 miles of an airport) as long as you follow the Safety Code on not endangering aircraft. If, however, you plan to launch model rockets that are above 1 pound in liftoff weight, you must notify the nearest FAA Air Traffic Control (ATC) facility 24 to 48 hours in advance (and any airport within 5 miles of the launch site) with the information as described below.

The FAA does not issue a "waiver" or permit for these "large model rocket" launches the way they have to do for the very large high-power rockets (those exceeding 3.3 pounds weight), so technically all you have to do is notify them and then proceed to fly unless they object (which they should not, but do in some regions or around some local airports out of ignorance).

The following Federal regulations apply to model rockets of liftoff mass greater than 1 pound but less than 3.3 pounds (1500 grams):

Federal Aviation Regulations Section. 101.22 <u>Special provisions for large model rockets</u>. Persons operating model rockets that use not more than 125 grams of propellant; that are made of paper, wood, or breakable plastic; that contain no substantial metal parts, and that weigh not more than 1,500 grams, including the propellant, need not comply with Sec. 101.23 (b), (c), (g), and (h), [Note: these are the FAA regulations requiring an advance-approval "waiver" for launch] provided: (a) That person complies with all provisions of Sec. 101.25; and (b) The operation is not conducted within 5 miles of an airport runway or other landing area unless the information required in Sec. 101.25 is also provided to the manager of that airport.

Section. 101.25 <u>Notice requirements</u>. No person may operate an unmanned rocket [Note: over 1 pound in weight] unless that person gives the following information to the FAA Air Traffic Control facility nearest to the place of intended operation no less than 24 hours prior to and no more than 48 hours prior to beginning the operation: (a) The names and addresses of the operators; except when there are multiple participants at a single event, the name and address of the person so designated as the event launch coordinator, whose duties include coordination of the required launch data estimates and coordinating the launch event; (b) The estimated number of rockets to be operated; (c) The estimated size and the estimated weight of each rocket; and (d) The estimated highest altitude or flight level to which each rocket will be operated. (e) The location of the operation. (f) The date, time, and duration of the operation. (g) Any other pertinent information requested by the ATC facility.

<u>Filing the Notification</u>. The notification that you are required to do is <u>not</u> an official "request for a waiver", it is a notification of intent to fly large model rockets. Waivers are required only for <u>high power</u> rockets, which are those above 1500 grams liftoff mass or 125 grams propellant mass. Such rockets are not allowed in this Challenge competition. If for some reason the FAA contact you reach wants you to apply for a "waiver", then you can get a downloadable, printable copy of Form 7711-2, Application for Certificate of Waiver at: www.faa.gov/avr/afs/7711.pdf. In order to find the appropriate FAA air traffic control office with which you should file (fax) your "notification of intent to fly large model rockets", contact the Flight Standards District Office at any airport with air traffic control. (Phone the airport tower and ask for Flight Standards.) Tell them you're interested in filing this notification under FAR 101.25 and ask for the address of the Regional FAA office with jurisdiction over the airspace at the site where you plan to launch.

When you fax the notification to the FAA office, we suggest that you use a format such as the following, which provides all of the elements of information required by FAR 101.25, and accompany the fax with a copy of the NAR Model Rocket Safety Code (Appendix 1):

- -

Notification of intent to launch large model rocket(s) under provisions of FAR 101.25.

Name, address and telephone number of launch coordinator (including cell phone for use on day of flying):

Location of launch site: (specify latitude and longitude to the nearest tenth of a minute or better).

Date and time period of launch operations: (give a several-hour block of time during which the flight(s) will occur, and specify the time zone used for this time)

Rockets requiring notification: 1 (or 2 or 3) rocket flight(s) of a large model rocket not to exceed 1500 grams liftoff mass or 125 grams propellant mass, flying to an estimated maximum altitude of 2000 feet above ground level.

As per the requirements of FAR 101.23, the launch will be canceled if the horizontal visibility is less than five miles, if the sky is more than five-tenths obscured at the maximum estimated altitude, or if surface winds exceed a steady 20 miles per hour. No flight will exceed 2000 feet AGL, and all operations will be conducted in accordance with the Safety Code of the National Association of Rocketry (attached) and shall be under the control of an experienced Range Safety / Launch Control Officer. A spotter will watch for aircraft entering the operations area, and will temporarily suspend operations in this contingency. [If applicable] This notice is also being provided to (name of airport), which is within five miles of the launch site.

APPENDIX 6.

QUESTIONS AND ANSWERS ABOUT INSURANCE NATIONAL ASSOCIATION OF ROCKETRY

1. What activities does NAR individual insurance cover?

NAR insurance is general liability coverage included as part of NAR membership benefits. Individual insurance covers the insured NAR member for accident losses solely arising out of NAR sport rocketry activities, including both model and high power rockets. It protects the owner of the model in the event his rocket causes damage or injury to the person or property of another.

2. What are the coverage limits of the insurance?

The NAR policy limit is $1,000,000 per occurrence and $2,000,000 aggregate per annum.

3. When do NAR insurance benefits kick in on a claim? After my personal insurance has been exhausted?

NAR individual insurance is primary coverage, meaning it applies before other applicable coverage you might have (such as a homeowners' policy).

4. If my rocket hurts someone at a club launch (with or without my own stupidity contributing to the accident) does the NAR insurance cover it completely?

NAR insurance will cover individual members up to the existing limits in the policy (up to $1 million annually). However, "stupidity" in disregarding any part of the NAR Safety Codes is never covered. Your insurance is void if you violate the NAR Safety Codes.

5. If a family member or I get hurt at an NAR sponsored activity, does the NAR insurance cover medical expenses?

Yes. The NAR policy has a medical payments provision for accidents during NAR operations. The applicable limit for this coverage is $5,000. This would also apply if a fellow club member were to be injured. Other medical insurance coverage you possess (for example, from your employer) must be exhausted first.

6. My Section/Team has non-members attending our launch. Are they covered by NAR insurance when they fly with us?

No. Non-members are not covered by NAR insurance. To obtain coverage, they must join and become members of the NAR. However, your Section or Team's coverage and your individual NAR members' coverage remains, and they are covered by the policy.

7. Does this cover rocket-related injuries only? What if I trip over a hole on the launch field and break a leg?

Coverage applies to losses arising out of NAR sport rocketry activities. "Activity" would include meetings, field trips, launches, etc. An injury on the premises of such an activity would be part of the activity.

8. **Does the NAR insurance cover property damage? If my rocket damages a car (including mine) is this covered? Are we covered if a rocket hits a house and causes damage?**

   Property damage to "third parties" is covered. Coverage for property damage to the member's owned property is also covered. Any existing member insurance (in this case, auto insurance) would be primary. Fire damage coverage is limited to $100,000 per occurrence.

9. **Are we covered if a rocket hits someone who is not part of the launch?**

   Yes. The individual NAR member has coverage over and above any existing personal liability coverage (e.g., homeowner's policy). The NAR, and the applicable NAR Section, are also covered. Non-NAR members are not covered.

10. **Can NAR offer a rider to allow the individual rocketeer to purchase extra coverage above the policy limits?**

    Currently the NAR's insurance provider has no provisions for additional coverage.

11. **Does my insurance expiration date match my membership expiration date?**

    All NAR members are additional insureds on the NAR policy as long as they have paid their membership dues and are entered on the NAR membership list.

12. **Does my insurance (as a Senior member) cover my minor children too?**

    Only if they are also members of the NAR. If your children are not members, then your NAR member insurance does not cover them when they fly rockets. They must also be NAR members.

13. **Will the NAR insurance cover claims related to use of non-certified motors?**

    No. NAR insurance is null and void if the accident involves a Safety Code violation. Use of uncertified motors is prohibited by the NAR Safety Codes.

14. **Who is protected under NAR Section/Team insurance?**

    This insurance protects the group, corporately, against liability claims during activities sponsored by the group. If the group is sued as a result of a rocket accident, insurance would pay for the expenses resulting from the lawsuit, plus damages awarded. Individual members may still be held liable for their own actions. Some additional protection may be achieved if the club is a registered nonprofit corporation -- contact an attorney in your state for guidance.

15. **Any difference between individual and Section/Team insurance as far as what stuff it can cover?**

    No. Policy limits and coverage are the same for individuals, Sections, and site owners.

16. **OK, what about the site owner insurance we get after we've covered our Section/Team? What does it cover?**

    The optional additional coverage (available for $15 from NAR HQ) for the site owner is to defend him from third-party liability claims brought against him as the owner of the property, due to covered activities of the Section or NAR TARC team. This coverage can only be obtained by chartered NAR sections, and by registered TARC teams that have the adult supervisor and at least three of the student team members signed up as members of the NAR.

17. How do I convince the landowner that this is real insurance backed by a reputable provider, so that he'll let me launch on his land? What benefits can I show him?

The NAR Section can deliver an insurance certificate listing the landowner as an additional insured regarding NAR activities on their site. This certificate will provide the site owner with policy facts such as limits, effective dates, and the insurance company providing the coverage. We strongly recommend keeping one copy on file with your Section records, and providing another copy to your landowner. Your landowner can then contact our insurance agency directly with any additional questions.

18. A rocket launched is responsible for seriously injuring a human being. The loss of income and medical damages comes to several millions. The NAR covers up to $1 million. The landowner's personal policy does not fully cover the difference. What happens to the owner?

The landowner is the least likely party to be found negligent and legally liable for injuries from a rocket. If, however, a court found the owner legally liable for the loss, and his NAR insurance and all other insurance he has becomes exhausted, he would be personally liable for the balance.

19. When an insured Section or Team is flying, do club officers of that Section or the team's supervising teacher/adult need to be present?

There is no requirement for officers or adult to be present at a launch. However, we strongly encourage a responsible adult to attend all flying events. In all cases, we strongly recommend that a Range Safety Officer be appointed and on duty at all times.

20. Is there anything that clubs can do to minimize the risk of paying a judgment?

Yes! Follow the Safety Codes. Use only certified motors at your launches. Make sure there is a designated and safety-conscious Range Safety Officer (RSO) supervising your launches at all times. If in doubt, err on the side of safety.

21. If a claim must be filed, how do I file it?

Contact NAR HQ immediately after any accident for which you believe you might have to file a claim. They'll have complete information available for you to file a claim.

22. Can I contact someone if I have questions about insurance?

NAR members may call or email <bob.blomster@japrice.com> at the J. A. Price Agency: (952) 944-8790, Ext. 127. Please understand that Bob is there to address and help with your insurance issues only. Questions about Safety Codes, By-Laws, Section activities, other NAR services and other sport rocketry issues should be directed to the NAR at:

National Association of Rocketry
P.O. Box 407, Marion, IA 52302
(800) 262-4872 nar-hq@nar.org

National Association of Rocketry

SPORT ROCKETRY: AMERICA'S SAFE, EDUCATIONAL AEROSPACE HOBBY

WHAT IS SPORT ROCKETRY?

Sport rocketry is aerospace engineering in miniature. This popular hobby and educational tool was founded in 1957 to provide a safe and inexpensive way for young people to learn the principles of rocket flight. It has grown since then to a worldwide hobby with over 12 million flights per year, used in 25,000 schools around the U.S.. Its safety record is extraordinarily good, especially compared to most other outdoor activities. It is recognized and permitted under Federal and all 50 states' laws and regulations, and its safe and inexpensive products are available in toy and hobby stores nationwide. Sport rocketry has inspired two generations of America's young people to pursue careers in technology.

WHAT IS A SPORT ROCKET?

A sport rocket is a reusable, lightweight, non-metallic flight vehicle that is propelled vertically by an electrically-ignited, commercially-made, nationally-certified, and non-explosive solid fuel rocket motor. For safety reasons no rocket hobbyist is ever required or allowed to mix or load chemicals or raw propellant; all sport rocket motors are bought pre-made. Sport rockets are always designed and built to be returned safely and gently to the ground with a recovery system such as a parachute. They are always designed to be recovered and flown many times, with the motor being replaced between flights. Sport rockets come in two size classes: MODEL rockets, which are under one pound in weight (3.3 pounds under some conditions), have less than 4.4 ounces of propellant, and are generally available to consumers of all ages; and HIGH-POWER rockets, which are larger, use motors larger than "G" power, and are available only to adults.

ARE THESE ROCKETS LEGAL?

Model rockets are legal under the laws and regulations of all 50 states and the Federal government, although some local jurisdictions may have ordinances restricting their use. Model rockets are regulated by the National Fire Protection Association (NFPA) Code 1122, which is adopted as law in most states. They are specifically exempted from Federal Aviation Administration (FAA) air traffic control by Part 101.1 of Federal Aviation Regulations (14 CFR 101.1) and may be flown anywhere without FAA clearance. They are permitted for sale to children by the Consumer Product Safety Commission under their regulations (16 CFR 1500.85 (a) (8)). They are permitted for shipping (with appropriate packaging and labeling) by the Department of Transportation and U.S. Postal Service. They are not subject to regulation or user licensing by the Bureau of Alcohol, Tobacco, Firearms & Explosives (BATFE). They are endorsed and used by the Boy Scouts, 4-H Clubs, the Civil Air Patrol, and NASA.

High power rockets are regulated under NFPA Code 1127. Because of their size and power they are not available to people younger than age 18. Their flights are subject to FAA air traffic regulations, and purchase of the larger motors for these rockets generally requires user certification by a national rocketry organization, plus BATFE licensing in some cases. Despite these greater legal restrictions, high power rockets are also very popular. They also have an outstanding safety record.

IS THIS HOBBY SAFE?

In well over 500 million flights since the founding of the hobby, there has never been a death caused by the flight of a sport rocket. Injuries are rare and generally minor. They are almost always the result of failure to follow the basic safety precautions and instructions provided by the manufacturers. Sport rocketry's record shows that it is safer than almost any sport or other outdoor physical activity. The hobby operates under the simple and easy-to-follow Model Rocket and High-Power Rocket Safety Codes of the National Association of Rocketry, which have been fine-tuned by professional engineers and public safety officials over the past 50 years to maximize user and spectator safety. The foundations of these Safety Codes are that sport rockets must be electrically ignited from a safe distance with advance warning to all those nearby, must have recovery systems, must be flown vertically in a suitably-sized field with no aircraft in the vicinity, and must never be aimed at a target or used to carry a pyrotechnic payload. All sport rocket motors are subjected to extensive safety and reliability certification testing to strict NFPA standards by the National Association of Rocketry or other national organizations before they are allowed to be sold in the U.S..

AREN'T THESE ROCKETS FIREWORKS?

All Federal and state legal codes recognize sport rockets as different from fireworks. Fireworks are single-use recreational products designed solely to produce noise, smoke, or visual effect. They have few of the designed-in safety features or pre-consumer national safety testing of a reusable sport rocket, and none of the sport rocket's educational value. Fireworks are fuse-lit, an inherently dangerous ignition method that is specifically forbidden in the hobby of sport rocketry. Sport rockets are prohibited from carrying any form of pyrotechnic payload; their purpose is to demonstrate flight principles or carry educational payloads, not blow up, make noise, or emit a shower of sparks.

WHO ARE THE EXPERTS?

The oldest and largest organization of sport rocketeers in the U.S. is the National Association of Rocketry (NAR). This non-profit organization represents the hobby to public safety officials and federal agencies, and plays a key role in maintaining the safety of the hobby through rocket engine certification testing and safety code development. The NAR also publishes Sport Rocketry magazine, runs national sport rocketry events and competitions, and offers liability insurance coverage for sport rocketeers and launch site owners. You may reach the NAR at:

National Association of Rocketry
Post Office Box 407
Marion, IA 52302
http://www.nar.org

You may purchase copies of the NFPA Codes 1122 or 1127 regulating sport rocketry from:

National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02269-9101
http://www.nfpa.org