**AIAA Orange County (California) Section**

**TARC 2013 – Revised December 30, 2012**

Welcome to the Team America Rocketry Challenge 2013. AIAA OC Section is pleased to have you as a team member. The TARC Team Handbook from their web site summarizes the contest very well:

“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.”

**The Challenge**

The Team America Rocketry challenge for 2013 is to design, build, and fly a rocket that meets the following criterion (this is a partial list – see the “Team Handbook” for further details):

* Attains and altitude of exactly 750 ft
* Carries a raw hen’s egg payload weighting 57 to 63 grams and measuring 60mm or less, on its side, and returns it unbroken
* The payload has a total flight time of pad to touch-down of 48 to 50 seconds
* Recovery of the payload portion of the rocket is by a 15” parachute
* The rocket can return all together or be split into two pieces for recovery. The portion of the rocket without the payload can return via any recovery device of any size as long as it does so safely.
* Total weight of the rocket is 650 grams (23 oz) or less total weight at lift-off
* The rocket must be single stage
* The rocket may be a commercially available kit, but cannot be a kit that was designed to carry an egg payload
* The rocket is powered by commercially-made model rocket motors of “F” or lower power class and are listed in the TARC Certified Engine List (in the “Team Handbook” and on the TARC web site). More than one motor may be used, but the total impulse must be 80 Newton-seconds or less as listed in the TARC Certified Engine List
* The rocket cannot contain any pyrotechnic charges (e.g. Pyrodex or gun powder) escept those provided as part of the basic commercially-made rocket motor used for flight, and these must be used in the manner prescribed in the instructions for that motor.
* All rockets must be built and flown in accordance with the Model Rocket Safety Code of the National Association of Rocketry (a copy is in the “Team Handbook”) and any applicable local fire regulations, and Federal Aviation Regulations.
* Rockets flown at the fly-offs must have been previously flown successfully.

**How to do all of this**

The contest is not easy, but it is very do-able. At the beginning of the competition it is important to have a schedule and stick to it (a suggested schedule is in the “Team Handbook”). It is also a good idea to write down a budget – your best guess for the cost of the rocket, the motors, and going out to a launch site. And get an idea of the cost of sending your team to Washington, DC to compete in the finals. This will give you an idea of how much fundraising you will need to do. Start as soon as possible with both your schedule and the fundraising. An approach to the rest of the competition that works is as follows:

* View the slide show on the AIAA OC Rocketry Web site located at: <http://aiaaocrocketry.org/AIAAOCRocketryDocs/TARC2013/TARC_Introduction2012-2013.ppt>
* Download and read the “Team Handbook” located at <http://www.rocketcontest.org/pdf/Handbook_TARC_2013.pdf>
* Choose a program manager to be the team leader
* Decide on what areas of expertise the team needs and find a volunteer that would like to research that area. Suggested areas are:
  + Payload containment and protection
  + Recovery
  + Airframe (the shape of the rocket body0
  + Fins (size, shape, placement)
  + Motors and igniters
  + Weather and how it affects the rocket
  + Sources for all parts
  + Rocksim (CAD - Computer Aided Design and simulation program for model rocketry)
  + Fundraising
  + Collection and analysis of launch data
  + Electronics (e.g. altimeter)
  + Construction and surface finishing
  + Budget and fundraising
* Have each volunteer give a short presentation on their research area. This way the entire team shares the knowledge, but you have one “expert” to go to for answers to the more difficult questions
* Purchase an inexpensive rocket kit and build. We like the Discount Rocketry Centauri at <https://www.discountrocketry.com/level-1-model-rocket-kits/modelrocketsus-centauri-model-rocket-p-2297.html>
* Fly this kit. There will be many launch outings to fly your rocket. The state of California requires that you have the land owner’s permission AND the local fire authorities permission to launch a rocket – so unless you have these you (and possibly purchased a permit) you CANNOT launch in your backyard, school, or park.
* Read a good book on model rocketry, such as G. Harry Stine’s “Handbook of Model Rocketry”
* Become familiar with the Rocksim CAD program (<http://www.apogeerockets.com/Rocksim/Rocksim_information>) or similar such as Space Cad (<http://www.spacecad.com>) or the free Open Rocket (<http://openrocket.sourceforge.net>). Of these Rocksim is probably the most widely used by TARC teams, and the one that AIAA OC Section is the most familiar with.
* Design and simulate your rocket the simulation meets the criterion for TARC
* Locate sources for the parts and motors required and order your parts.
* Test fly your rocket gathering data from each flight so when you return home you can make modifications to the design so that the real-life flights and Rocksim match each other and match the contest criterion. This is an iterative process and can require many launches and many trips to a launch site making modifications between each launch trip.
* When you are ready, declare a flight to be a “qualification flight” and have a NAR senior member inspect the rocket before and after the flight, and observe the flight.
* Turn in your qualification form(s) before the deadline.

**Responsibilities of the Program Manager**

* With your team, make a schedule and budget and submit to the mentors at the beginning of the TARC year
* Create and maintain a team roster and distribute that roster to team members and the mentors
* Manage the team members through the Add and Drop process and report changes to the mentors and to the TARC administration if not done by the mentors
* With your mentors, provide direction for team members for design, construction, build, and launch of the rocket
* Arrange meetings to get the work done
* Make certain the team stays on the schedule created at the beginning of the TARC year
* Arrange for part and motors to be ordered and obtained as needed to prevent delays
* Arrange for the team to attend launches and fly their rocket to test
* Arrange for the team to make their three qualification flights and submit those flights
* Provide direction to team members for fund raising to pay not only for the rocket and test flights but also the trip to Washington DC for the finals (top 100 teams)
* Report progress to mentors every two weeks
* Travel to Washington DC for finals when your team qualifies (top 100 teams)

**Responsibilities of the Team Members**

* Work with the Program Manager to make the schedule and budget and to help fund raise
* Attend work meetings and help design and build the rocket
* Attend launches for test and qualification flights
* Travel to Washington DC for finals when your team qualifies (top 100 teams)

**Launching in Southern California**

California has very strict rules for launching rockets. Launching in your (very large) back yard, at a park, or at a school yard is generally not allowed. To launch rockets in California you need three things after you locate a suitable launch site. Additionally “E” and “F” motors require a site without people, buildings, parked cars that is 1,000 feet on a side:

* The land-owner’s permission
* Permission from the local fire authority (in some cities this is in the form of a permit that can cost as much as $300 per day)
* Insurance (varies by area but is usually at least 1 million dollars)

The maximum lift-off weight of a “model rocket” is 500 grams and motors. Rockets that weigh more than this can be launched in California, but under a different set of restrictions. It is best to launch with an organized club that has already obtained a permit, or in some areas of the desert. Clubs we frequently launch with are:

* ROC (Rocketry Organization of California) at <http://rocstock.org> launches at Lucerne Dry Lake in the Mojave Desert near Victorville
* D.A.R.T. (Diego Area Rocket Team) at <http://www.dartrocketry.org> launches at Fiesta Island near San Diego
* S.C.R.A. (Southern California Rocketry Association) at <http://home.earthlink.net/~mebowitz> launches at the top of the 605 Freeway at the Santa Fe Dam Recreation Area (model rocket permit only with a maximum lift-off weight of 500g)
* M.D.A.R.S. (Mojave Desert Advanced Rocket Society) at <http://www.mdars.info> launches near Edwards Air Force Base.
* Tripoli San Diego at <http://www.tripolisandiego.org> launches at Plaster City near El Centro (quite a drive)

Contest specific documents relating to the 2013 contest are on the TARC web site at <http://www.rocketcontest.org>:

Team Handbook: <http://www.rocketcontest.org/pdf/Handbook_TARC_2013.pdf>

Rules: <http://www.rocketcontest.org/pdf/2013_TARC_Rules.pdf>

Approved motor list: <http://www.rocketcontest.org/pdf/TARC_2013_Approved_Motor_List.pdf>

Qualification form: <http://www.rocketcontest.org/pdf/TARC_2013_Qualification_Flight_Report_Form.pdf>

Application packet (parental consent form is on page 7): <http://www.rocketcontest.org/pdf/TARC_2013_Application_Packet.pdf>

Add drop form: <http://www.rocketcontest.org/pdf/2013_Add-Drop_Form.pdf>

Other useful sites:

AIAA OC Rocketry: <http://aiaaocrocketry.org>

National Association of Rocketry: <http://www.nar.org>

Yahoo News Group for TARC: <http://groups.yahoo.com/group/NARTARC>

Team members – not the parents, mentors, or other adults must do 100% of the work. But AIAA OC Section TARC mentors Bob, Jann, and Sjoen Koepke are here to give help and guidance. This is our sixth year in TARC (placing 8th in the nation in 2010) and we have done the follow-on NASA Student Launch Initiative for two years. Our contact information:

Email: [rkoepke@socal.rr.com](mailto:rkoepke@socal.rr.com)

Skype: rkoepke01

House Phone: (714) 288-0321

Cell Phones – Bob: (949) 331-4160 Jann: (714) 602-0726

Please feel free to contact us with any questions you might have – we’ll do our best to help.

There are several parts in this set of documents meant to help you get started with your design:

Part 1: Is this introductory section

Part 2: Provides an overview of designing a rocket together with some sources for parts

Part 3: Provides more details for designing your rocket

Patt 4: Provides a picture, weight, and source for some of the components you may use in your rocket

Part 5: Are general rules of thumb for model rocket design. These are NOT absolutes – merely starting points (edited list from the Info Central Web Site)

Part 6: Is a list of the tools and components we suggest you have in a toolbox/field box that you will need during the building and launching of your rocket. The AIAA OC Section loans this toolbox to the teams sponsored by AIAA. Other teams might want to use this list as a guideline for what they might need for design and in their field box

Part 7: Is the flight record. You should record the conditions and details of each flight you make during this contest. The design process is iterative – that is, use Rocksim to design and simulate your rocket – fine tuning it until the flight matches the challenge. But simulation and real life often do not match 1 for 1. So test fly your rocket, record the results, then go back to Rocksim and make changes so your simulations and real life more closely align. Then repeat the process until the simulation matches real life, and real life matches the challenge. Then you are ready for a qualification flight. The TARC documentation says that successful teams have 10 or more test flights. Historically, AIAA OC Section teams have had 20 to 30 test flights. Our schedule will provide many opportunities for launch – it is up to you to be ready for them.