

April 12, 2019



Dear Team America Rocketry Challenge Contestant,

Congratulations! You are a finalist for the Team America Rocketry Challenge. Your team's local qualification flights have earned you an invitation to attend the Team America Rocketry Challenge National Finals the weekend of May 17-19, 2019 at Great Meadow in The Plains, VA. 830 teams from 47 states entered this year's competition and your qualifying score was one of the 100 best. You can be proud of your achievements in aerospace design and rocketry.

To accept your spot in the National Finals please fill out and return the registration form that the registered supervisor for your team will be receiving. Do so either online using the TARC Portal (preferred) or by email. All forms must be received by **Friday, April 26, 2019**. If we do not receive all forms from your team by Friday April 26, 2019, we will offer your spot to an alternate team. If you will not be able to attend the fly-offs, please let us know as soon as possible so that we may offer your spot to one of these alternate teams.

The enclosed information should answer your questions about procedures, lodging, and other aspects of the National Finals. It also addresses many of the questions that we have been receiving from teams over the last several months concerning event rules, legal rocket designs, etc; please read the entire document carefully. In case of conflict, the official rules take precedence. Remember that the exact model you fly at the National Finals must have previously been test-flown successfully, and you will not be able to do any test or practice flights at Great Meadow before your Finals flight.

Please contact us at [jeremy.davis@aia-aerospace.org](mailto:jeremy.davis@aia-aerospace.org) if there are things that you need to know about registration that are not covered by this letter. If you have questions about motors, rules, or anything else rocket related please ask them by posting a question on [NARTARC](#), our online Yahoo group forum. We check this every day and would like to answer your questions publicly for everyone to benefit.

We look forward to meeting you at the National Finals!

Sincerely,

A handwritten signature in black ink, appearing to read "Jeremy Davis".

Jeremy Davis  
TARC Manager  
Aerospace Industries Association (AIA)

A handwritten signature in black ink, appearing to read "Trip Barber".

Trip Barber  
TARC Manager  
National Association of Rocketry (NAR)

## TEAM AMERICA ROCKETRY CHALLENGE - TABLE OF CONTENTS

Finals Schedule and Event Logistics .....	3
Tentative Schedule.....	4
Attendance.....	6
Travel .....	6
Food.....	6
Lodging.....	8
Other Competitions .....	9
Media Toolkit .....	16
Rocket Motors, Finals Procedures, and Rocket Design and Construction.....	23



# 2019 Team America Rocketry Challenge Finals

Finals Schedule and Event Logistics

## TEAM AMERICA ROCKETRY CHALLENGE 2019 **TENTATIVE** SCHEDULE

### Friday, May 17

Friday's contestant briefing is at Metz Middle School, 9950 Wellington Road, Manassas, VA 20110

Friday Morning	Breakfast Reception on Capitol Hill
9:00 AM – 4:00 PM	NAR set-up for Saturday contest at Great Meadow (no flights)
5:00 PM – 6:00 PM	Metz Middle School Issue NAR uniform items to NAR range crew
6:00 PM – 9:45 PM	Metz Middle School Contestant registration & rocket pickup
6:00 PM – 7:00 PM	NAR range crew briefing (auditorium)
7:30 PM – 8:45 PM	Contestant team briefing (auditorium)

### Saturday, May 18

All Saturday events will be held at Great Meadow, 5089 Old Tavern Road, The Plains, VA 20198

6:45 AM	Contestant Registration & Egg Issue open
7:00 AM	Pre-Flight Check-In opens (1st 24 teams)
7:30 AM	Great Meadow gates open for spectators
8:15 AM – 8:30 AM	Opening Ceremony/National Anthem
8:30 AM – 9:15 AM	24 team 1st launches (Goddard 1 launch window)
9:15 AM – 10:00 AM	18 team 1st launches (Stine 2 launch window)
10:00 AM – 10:45 AM	24 team 1st launches (Goddard 3 launch window)
10:00 AM – 3:00 PM	Team Rocket-Building Competition (Exhibit area)
10:30 AM – 2:30 PM	Team Presentation Competition (Spring House)
11:00 AM – 2:00 PM	Contestant and staff lunch available
10:45 AM – 11:30 AM	18 team 1st launches (Stine 4 launch window)
11:30 AM – 12:15 PM	17 team 1st launches (Goddard 5 launch window)
12:45 PM	NAR Apollo 11 Commemorative Rocket Demonstration
1:00 PM	Deadline for returning rockets post-flight (1 <sup>st</sup> flights)
1:15 PM	Announcement of top 42 teams from preliminary round
2:00 PM – 4:00 PM	Ice Cream Social for teams
2:30 PM – 3:15 PM	1 <sup>st</sup> -24 <sup>th</sup> team 2nd launches (Goddard 6 fly-off launch window)
3:15 PM – 4:00 PM	25 <sup>th</sup> -42 <sup>nd</sup> team 2nd launches (Stine 7 fly-off launch window) ** WEATHER PERMITTING **
4:15 PM – 4:35 PM	NAR high-power rocket demonstration (Raytheon Range)
4:30 PM	Deadline for returning rockets post-flight (2 <sup>nd</sup> flights)
5:00 PM - 6:00 PM	Award Ceremony (dinner tent)
6:00 PM - 8:00 PM	BBQ Dinner

### Friday Daytime:

Team America Rocketry Challenge staff will be out at the launch site at Great Meadow from 9:00 AM until 4:00 PM on Friday, May 17th setting up equipment for the fly-off. Teams may come out to look during this time, but NO TEST FLIGHTS can be supported and there are no other flying sites available.

### Rockets on the Hill:

The Aerospace Industries Association will be hosting a breakfast reception for TARC participants on Capitol Hill on Friday. All teams are invited to bring their rockets. If you are interested in attending, please indicate this on your RSVP form. **Space at this reception is limited and will be allocated on a first-reply basis.** To allow the maximum number of student participants, only one adult chaperone per team may attend.

### National Air and Space Museum Udvar-Hazy Tour:

Special 90-minute guided tours of the National Air and Space Museum's Udvar-Hazy Center (near Dulles Airport) will be offered at Friday afternoon. **Full information and RSVP information (first-reply basis, capacity is 100 people) will be sent in a separate email.**

### Aurora Flight Sciences Tour and Dinner:

Aurora Flight Sciences will be hosting an optional BBQ Dinner and Facility Tour on Friday afternoon. **Full information and RSVP information (first-reply basis) will be sent in a separate email**

### Friday Contestant Briefing:

The contestant registration and briefing is at 7:30PM on Friday night at Metz Middle School, 9950 Wellington Road, Manassas, VA 20110. Metz Middle School is located 6 miles from the hotels. The roads will be busy, so plan your trip accordingly. You should plan to arrive no earlier than 6:15 PM and no later than 7:00 PM in order to pick up your registration materials before the briefing. Rocket motor orders that were made in advance to Performance Hobbies and rockets and/or motors shipped ahead to Aurora Flight Sciences will be available for pickup during this event, beginning at 6:00 PM and will also be available on-site on Saturday morning.

We will announce the decision at the Friday contestant briefing if the weather forecast for Saturday is so unfavorable (heavy rain or wind above 20 miles per hour) that the fly-off must be postponed to Sunday. This has not happened in the previous sixteen years, so keep your fingers crossed! We will also do a coin toss to determine if the flight challenge target for second-round flights on Saturday will be 25 feet higher or 25 feet lower than 856 feet.

### Saturday Flying Schedule:

All events on Saturday, May 18<sup>th</sup>, will take place at Great Meadow, 5089 Old Tavern Road, The Plains, VA 20198. To get there, take I-66 exit 31 (which is 16 miles west of the Manassas hotels, toward Front Royal), turn left on Highway 245, away from the town of The Plains and toward the village of Old Tavern, and follow the signs 2 miles to Great Meadow, which will be on your left. Parking is free.

Teams assigned the first launch window time slot (7:00 AM check-in opening, 8:30-9:15 AM liftoffs) should plan to be at the flying field at 6:45 AM on May 18. Other teams may choose to arrive later than this, but each team should arrive at least two hours before its assigned rocket flight window

time. All teams should plan to remain at the flying site until the conclusion of the award ceremony at 6:00 PM on Finals day. The barbecue after the award ceremony will end before 8:00 PM Saturday. Teams should be flexible enough in their plans to be able to stay for a May 19 (Sunday) fly-off if bad weather on Saturday forces postponement.

## **Attendance:**

Teams that are selected to attend the Finals must confirm their participation with the form that was sent to all supervisors no later than **Friday, April 26, 2019**. Alternate teams will be notified by Wednesday, May 1, 2019 if a primary team has declined their invitation.

We ask that any team that attends do so with an adult chaperone, preferably the supervising teacher, and at least one of the students; it is not mandatory that every student team member attend, but the more the better.

You may not add team members after your initial qualification flight attempt, except in the special case described in the TARC rules where a school has more than two teams whose scores are better than the Finals cutoff and has to limit Finals participation to just two teams in accordance with the rules. Please submit an add/drop form if you choose to drop team members. All team members who are registered as of the date of the fly-off (regardless of whether they attend the fly-off) will share equally in any prizes awarded to a winning team. All team members on the final team should have contributed to the designing, building, and/or launching of the team's entry.

## **TRAVEL**

There are no additional event fees for those teams selected for the Finals, however travel expenses to attend are the responsibility of each team. The entire team is not required to attend the Finals, but for a team to compete, at least one member plus a supervising adult must be present.

The nearest major airports to the launch site are:

- Washington Dulles (IAD): 17 miles away
- Reagan National (DCA): 35 miles away
- Baltimore-Washington International (BWI): 70 miles away

Teams must provide their own transportation to get from the hotel to the launch site, and to/from any airport. In planning your travel, please keep in mind DC rush hour: I-66 westbound from the DC area to Manassas and beyond is very heavily congested and very slow-moving by 2:00 PM on Fridays.

## **FOOD:**

Student contestants and team supervisors with credential badges will receive free lunch, ice cream, and BBQ dinner.

There will be a food and beverage vendor on the field for lunch and anyone else that wishes to purchase food. Free water will be available throughout the day.

We will end the day on Saturday with a BBQ dinner after the award ceremony. Parents and other spectators can purchase tickets for this event for \$20; please send payment for these tickets with your attendance confirmation form.

**SITE RULES:**

Great Meadow is an incredible venue that we wish to preserve for future years. Please be sure to observe the following site rules.

- Please do not bring cooking devices to the field. Coolers are OK.
- Glass bottles are not permitted.
- Drone flying is not permitted.
- Dogs are not permitted (service animals exempted).



### LODGING FOR TARC 2019:

Teams are responsible for making their own lodging arrangements. We have reserved blocks of rooms--mostly with two beds--at the **first three hotels** listed below. These are reserved under the group names listed below for the nights of Thursday, May 16 through Saturday, May 18. Hotels with our group reservations are all on I-66 in Manassas, VA. Take Highway 234 (Sudley Road) south (exit 47A). All of the hotels are within the first two blocks after the exit.

Please call the hotel and use an individual credit card and the specific group code specified below to make a reservation. Tax on rooms adds 13% to the rates. **These rooms will be released on April 19 if not reserved by then.** All the hotels are within a few blocks of each other and are surrounded by restaurants and shopping. If you wish to make hotel reservations at places other than the three TARC hotels, you should pick among the other hotels listed below that are also at I-66 exit 47 in Manassas.

TARC Hotel	Exit	Address	Phone Number	TARC Rate
Quality Inn Manassas	I-66 Exit 47A	10653 Balls Ford Road, Manassas, VA 02109 tell them you are with "Team America Rocketry Challenge" and ask for " <b>Manager's #4 rate</b> "	(703) 368-2800	\$72.00 + tax
Days Inn	I-66 Exit 47A	7249 New Market Ct., Manassas Use code: <b>Team America</b>	(703) 659-9023 Option 1	\$55.00 + tax
Red Roof Inn Manassas	I-66 Exit 47A	10610 Automotive Drive, Manassas Use code: <b>B192USA515</b>	(800) 733-7663	\$79.99 + tax
<b>Other Hotels in Same Area</b>				
Comfort Suites	I-66 Exit 47A	7350 Williamson Blvd., Manassas	(703) 686-1100	
Courtyard by Marriott	I-66 Exit 47B	10701 Battlevue Pkwy., Manassas	(703) 335-1300	
Hampton Inn	I-66 Exit 47A	7295 Williamson Blvd., Manassas	(703) 369-1100	
Best Western Battlefield Inn	I-66 Exit 47A	10820 Balls Ford Road, Manassas	(703) 361-8000	
LaQuinta Inn & Suites	I-66 Exit 47B	6950 Nova Way, Manassas	(703) 393-9966	
Holiday Inn Manassas Battlefield	I-66 Exit 47A	10424 Balls Ford Road, Manassas	(571) 292-5400	
Wyndham Garden	I-66 Exit 47B	10800 Vandor Lane, Manassas	(703) 335-0000	
Holiday Inn Express	I-66 Exit 47B	10810 Battlevue Pkwy, Manassas	(703) 393-9797	



## 2019 Team America Rocketry Challenge Finals

Additional Competitions: Rocket-Building Competition, Plane-Building Competition, Presentation Competition

Additional Awards: Team Outreach, Engineering Notebook, Outstanding Team Advisor, Outstanding Mentor, and Special Awards

## ROCKET-BUILDING COMPETITION: SPONSORED BY LOCKHEED MARTIN AND ESTES INDUSTRIES

Student teams who qualified for the TARC Finals have developed good model rocket-building skills, and our rocket-building competition puts them to the test! Teams will have a 75-minute time slot between 10:00 AM and 3:00 PM on Saturday to build a flight-worthy rocket out of a bag of rocket parts provided by TARC staff. We will provide basic tools (yellow carpenter's glue, X-acto knives, sandpaper), but teams are free to bring their own tools and building supplies, but not additional rocket parts.

Teams can sign up for this competition starting at 6:15 PM on Friday night, prior to the contestant briefing. Teams will only be permitted to sign up for a time slot after their team's assigned launch window time. Alternates will take the place of any team that ends up making the fly-off round and is therefore unable to participate in the building competition during the time slot they signed up for.

The purpose of the competition is to build a creative, well-assembled rocket that has the required components to fly, such as a motor mount and recovery system, and that in the judgment of the event judges could most likely fly stably. However, these rockets will not be flown during the TARC Finals. Teams may pick them at the end of the day after judging and go fly them elsewhere.

Cash prizes (\$500) and a plaque will be awarded to the team with the best rocket in each of two categories:

1. Best craftsmanship
2. Most creative design

## TEAM PRESENTATION COMPETITION

On top of strong design, construction and flight-testing skills, aerospace engineers must also be able to communicate to others what they have done and how they did it.

Participating teams will give a six-minute presentation on their TARC rocketry project experience to a panel of judges and an audience of aerospace industry sponsors. Following the presentation, there will be a 2-minute question and answer session with the judges. Teams that volunteer for the presentation must have three or more members attending the Finals, and at least three different student members of the team must have a speaking role in the presentation. Prizes will be awarded for 1<sup>st</sup> place (\$500), 2<sup>nd</sup> place (\$300) and 3<sup>rd</sup> place (\$200), with a plaque also going to 1<sup>st</sup> place.

This competition will be limited to twelve finalist teams that will be selected from among those that submit a draft presentation by May 3 as described below. Finalists plus three alternates will be announced no later than Monday, May 13. Presentations will be held between 10:30 AM and 2:30 PM Saturday during the Finals; any teams that are presenting but that also are likely to make the second (fly-off) round of the Finals will go early.

Presentations must have an electronic component (which will be the only component used for preliminary evaluation). PowerPoint is preferred; these may be converted to Adobe Acrobat PDF files to reduce digital size for transmission. The presentations must include the following topics which will be judged for selection:

- Design and construction process – How was the rocket designed? How were the dimensions, materials, and motors selected? How was the rocket built?
- Teamwork – How did each member of the team contribute to the rocket design, construction, flight testing, or other elements of the team’s operation, and to the presentation?
- Flight testing process – How did the team use flight testing to refine the design and make adjustments that resulted in a great score?
- Lessons learned – What lessons did the team learn from their TARC experience about how to do an engineering design and construction project, and how would they change their approach for a future TARC entry?

The International Rocket Challenge competition, which features the 1<sup>st</sup> place teams from TARC (USA) and the equivalent events in England, France, and Japan, has a presentation competition element that counts for 40 percent of the final score (flight performance being the remaining 60 percent). If you’re set on winning the Team America Rocketry Challenge and competing in Paris, this presentation competition is critical!

#### **Judging criteria:**

The final presentations will be judged on the following criteria:

- Delivery – Do the speakers have a smooth and clear delivery? Do their voices, poise, and eye contact make a favorable impression? Notes may be used, but should not be just read aloud.
- Organization – Does the presentation have a logical organization? Do the speakers make clear what was done and how it was done?
- Visual Aids – Do the speakers use visual aids appropriately? Were the slides helpful or distracting? Did the speakers use any other aids such as models, sub-assemblies, etc.?
- Familiarity with subject – Do the presenters demonstrate adequate knowledge of the subject? Did they answer questions fully and clearly?
- Time – Speakers may use 6 minutes for the presentation (plus 2 minutes for questions). Did they adhere to the 6 minute limit and finish their presentation within it?

#### **Submitting:**

**Teams wishing to participate should submit their initial presentations electronically (only!) to [TARC\\_Presentations@yahoo.com](mailto:TARC_Presentations@yahoo.com) by 5:00 PM (Eastern Time) Friday May 3, 2019.** The size of this submission must not exceed 5 megabytes if sent by e-mail attachment; larger presentations may be sent as downloadable files from Google drive. Please do NOT include videos. From these submissions, 12 finalists and 3 alternates will be notified by Monday, May 13, 2019. Teams may (and are encouraged to) revise their report up until the turn-in deadline of Friday evening May, 17<sup>th</sup> (no later than 8:00 PM) at the finals. Turn-in will be via USB thumb drive.

#### **TEAM OUTREACH AWARD**

TARC 19 features a special 101<sup>st</sup> spot at the Finals for a team judged to have had the best outreach program, but would not have already made the cut-off to attend the finals. To be eligible, the team had to submit an outreach program application and fly at least two valid qualifying flights. A special award for the team with the best overall outreach program among all teams will be awarded at the

National Finals. We will recognize the winner of the overall outreach competition at the Finals. The winning team will receive a plaque and a cash prize of \$500.

### ENGINEERING NOTEBOOK AWARD

A prize will be awarded at the National Finals to a team that skillfully crafts an engineering notebook that documents their design cycle for the Team America Rocketry Challenge (TARC). Teams from across the country have already submitted entries to be judged by a panel of engineers from TARC sponsor companies. The winner will be announced at the National Finals (and may or may not be a finalist team). The team will receive a plaque and a cash prize of \$500.

### OUTSTANDING TEAM ADVISOR AND OUTSTANDING MENTOR AWARDS

TARC grows bigger and better each year thanks to the teachers and mentors who inspire and encourage students to excel in our program. We want to gather stories and share the excellent work of TARC's unsung heroes.

Each year, we recognize one outstanding team advisor/teacher and one outstanding TARC mentor. To nominate a team advisor or mentor (or both) for these awards, write a short summary (two pages max; photos – no more than two -- are optional but encouraged and do not count towards the page limit) of how your teacher and/or mentor went above and beyond to support your team and make TARC a great experience for the students. Team advisors/teachers may only be nominated by students. Mentors may be nominated by team advisors and/or students. Nominations are open to all teams, not just national finalists, but the awards will be announced at the National Finals.

Nominations should be submitted to [jeremy.davis@aia-aerospace.org](mailto:jeremy.davis@aia-aerospace.org) by April 17<sup>th</sup> at 5:00 pm ET.

### SPECIAL AWARDS

In addition to the prizes and places based on rocket flight performance, five teams will be selected by judges on the field at the Finals for the following awards:

- TARC competition rocket most resembling the Apollo 11 Saturn 5 in profile and/or paint pattern
- Best TARC Rocket Craftsmanship sponsored by Lockheed Martin
- Best-Dressed Team (uniform/costume) **\*\*See flyer for more information\*\***
- Spirit of TARC (combination of teamwork, sportsmanship, team spirit) sponsored by Boeing
- Most Innovative Approach to Mission sponsored by Raytheon

Plaques and \$500 cash prizes for out at the awards ceremony.



each of these categories will be given

# TEAM AMERICA ROCKETRY CHALLENGE

## Best Dressed Team Competition!

Think your team has what it takes to be named “Best Dressed” at the 2019 TARC National Finals? Be sure to show up to Great Meadow decked out in team uniforms/costumes to be considered for this year’s award!

**What:** Best Dressed Team Competition

**Where:** Photo Booth – Exhibit Area

**When:** 12:00 pm – 2:00 pm

Winning team will be announced at the awards ceremony at the end of the day.

Be sure to take your own photos and share them on TARC’s Facebook, Instagram and Twitter pages @RocketContest! #TARC2019



# 2019 Team America Rocketry Challenge Finals

Rocket Motors, Finals Procedures, and Rocket Design and Construction

## APPROVED ROCKET MOTORS

Your rocket must be powered only by commercially-made model rocket motors that are safety-certified by the NAR and listed on the **final** NAR Engine Certification List at [www.rocketcontest.org](http://www.rocketcontest.org).

Performance Hobbies will support advance (pre-paid) orders for delivery at the Finals. They have motors of all types, plus other supplies such as parachutes. **IF YOU CANNOT TRAVEL BY AUTO TO THE FINALS WITH YOUR MOTORS (see below) YOU SHOULD ORDER THEM IN ADVANCE, FOR DELIVERY ON-SITE AT THE FINALS.** Do not count on Performance Hobbies happening to have the motor that you need at the Finals, order whatever you need in advance and it will be delivered to you Friday evening at TARC Registration. Performance Hobbies is operated by Ken Allen and can be reached at:

Performance Hobbies  
[www.performancehobbies.com](http://www.performancehobbies.com)  
[kensrockets@rocketmail.com](mailto:kensrockets@rocketmail.com)  
(202) 723-8257

If Performance Hobbies does not have what you need in stock when you call, then do not backorder; go to one of the TARC online vendors (Wildman Rocketry at [www.wildmanrocketry.com](http://www.wildmanrocketry.com); Balsa Machining Service at [www.balsamachining.com](http://www.balsamachining.com); Apogee Rockets at [www.apogeerockets.com](http://www.apogeerockets.com); or Chris' Rocketry [https://csrocketry.com](http://csrocketry.com)) and order motors for delivery to your team, shipping them to Aurora Flight Sciences as described below (there will be a HAZMAT shipping fee).

### Shipping Rockets and Launch Equipment:

It is ILLEGAL to put model rocket motors, igniters, or other pyrotechnic materials in your baggage on an airplane, **DO NOT TRY THIS**. It is also illegal to ship a rocket motor by UPS or USPS without disclosing to the shipper what you are shipping, and these shippers will not accept motors for shipment by private individuals. Order these things from Performance Hobbies or another vendor who has the necessary shipping permits, and have them delivered to you care of the address below.

You may ship your model rockets and launching equipment to us and they will be given to you at the contestant briefing on May 17. A vendor with the proper license may also ship motors that you have ordered to this location. **Make sure you use a shipper that utilizes a tracking system to confirm delivery of your rocket, do not call Aurora Flight Sciences.**

Trip Barber/Team America  
c/o Aurora Flight Sciences Corporation  
9950 Wakeman Dr.  
Manassas VA 20110  
Hold for Team America Team #\_\_\_\_\_, \_\_\_\_\_ High School



## FINALS PROCEDURES

### Students Only:

All elements of rocket design, preparation, and flight are to be done by student members of teams. Only student team members -- no teachers, mentors, parents, or non-team members -- may go into the team check in area, onto the flying field, pad, or approach the pad which includes assisting with rocket preparations before flight. Anyone can help on recovery if the rocket drifts outside the main flying field area.

### Time Management:

Each team will be assigned a 45 minute "launch window," preceded by a 45-minute "prep window". **These time assignments will be posted on our website [www.rocketcontest.org](http://www.rocketcontest.org) no later than May 13, 2019, and are not negotiable. You must fly during your assigned window.** Between 18 and 24 teams will be assigned to each launch window period, and each may fly at any time during that period. You will not be allowed to set up your rocket or launch system on the flying range until your prep window time slot begins, which is the beginning of the launch window period before your own launch window. You should plan to be done setting up by the time your launch window opens. You should plan to be issued your eggs and to present your rocket to us for pre-flight safety and rules-compliance inspection prior to this prep window. This means that you should plan to be on the flying field at minimum of **two hours prior to your launch window** -- earlier if you still need to do registration on the field because you were not at the Friday evening contestants' meeting. The first launch window will open at 8:30 AM on the Finals flight day (with a 7:30 AM prep window), so teams who get assigned this window should be prepared to be on the field at 6:45 AM on Saturday, May 18.

You must fly your rocket during the launch window, and will be disqualified and must clear the pad if you fail to achieve liftoff during this window. Misfires are not an excuse for missing an assigned launch window -- so do not wait until the last moments of your window to fly.

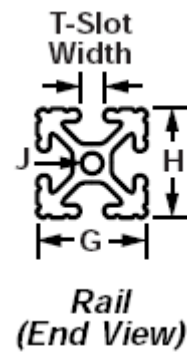
The top 24 to 42 teams based on scores from first flights (all of which must be completed by 12:15 PM) will be asked to make a second flight during one or two final "fly-off" rounds to be held between 2:30 PM and 4:00 PM. The flight objective for this second round will be either 25 feet and one second higher or lower than the first round, based on the results of a coin toss at the Friday evening team briefing. The teams making second flights will include the 5 teams who each had the best score in their respective initial flight round, plus the 19-37 next best teams overall. If thunderstorms develop which require closing the range early or opening it late for safety reasons (one or the other has happened five times in the last sixteen years) then this flyoff will be limited to the 24 teams promised in the TARC 2019 Rules, flying in one round. Otherwise we will fly two rounds, a total of 42 teams. The flyoff teams will be notified as soon as possible after 12:15 PM but no later than 1:15 PM. The top 40 places in TARC 2019 (20 places if there are only 24 second flights) will be awarded to these teams, ranked on the basis of the SUM of the scores from their two flights. Any team that cannot make a second flight or that is disqualified on the second flight will be ranked behind all teams that do make a second flight.

**Primary and Backup Models:**

We recommend that you bring two models to the Finals, if possible. If your primary model lands in a tree, power line, or other dangerous place where it is visible to the judges but cannot be recovered safely, or if you experience a rocket motor catastrophic failure as judged by the Range Safety Officer (burst motor or complete failure of the ejection system, with the cap still retained in place on the ejection charge), or if you have an altimeter failure (an altitude reading of greater than zero but less than 50 feet after a normal qualified flight) the judges may allow you to have a second flight. Otherwise only one initial flight attempt is allowed. If a rocket clears the pad and becomes airborne, this is considered a "flight attempt". If there are any "backup" flights allowed, there will be a few time slots reserved for this purpose in the last first-flight launch window of the day (11:30 AM-12:15 PM). For your second-round flight, if your first flight is good enough to earn you this opportunity, you may use a different model if desired to achieve the different flight performance targets.

**Equipment:**

The launch system provided for contestant use will have individually-assigned, well-spaced sturdy three-legged pads with the a single, 6-foot-long "1010" (1 inch on a side, ¼ inch center slot) T-slot launch rail on an adjustable base (see photo below) and one pair of high-current 12-volt electrical igniter leads with a single pair of micro-clips at the end. These will provide 18 amperes from our launch system from a car battery through 60 feet of 16-gauge wire, which will light any igniter or cluster of up to 4 igniters. Launch rods will not be provided and may not be used; rockets will need "rail buttons" in order to fly from the launchers provided at the Finals. Teams are not required to use the launch system and rail that we provide. They may bring their own launch pads, towers, rails, or other hardware, "clip whips" to light clusters of motors from our single pair of micro-clips on the ignition wires, and even their own electrical launch systems if they need anything different from what we provide. Such individual launch systems must comply with the NAR Safety Code requirements and will be subject to our safety check and approval. Launch rods may not be used and a minimum rail/launcher length of 6 feet is required.



**Returns:**

All teams that have a safe and otherwise qualified flight must return the portion of their model containing the eggs and altimeter to the "Returns Table" for post-flight inspection of the eggs and recording of altimeter reading. This must be done no later than 1:00 PM for first flights, which is 45 minutes after the final "launch window" for the first-flight rounds closes; and it must be done by 4:30 PM for flights from the final fly-off round(s). We will have several ingenious devices available to assist teams in plucking rockets from trees if this unfortunate circumstance occurs.

**NAR MEMBERSHIP AND INSURANCE**

You are not required to be a member of the National Association of Rocketry to participate in this contest as a teacher or team member. But we certainly encourage membership, and you may need to become a member if you need insurance coverage for rocket flying in addition to whatever coverage may be provided by your personal insurance.

Your NAR membership includes personal liability insurance to cover YOU against liability claims from rocket activities conducted in strict accordance with the NAR Safety Code. This individual insurance does not cover others (such as your school or the owner of your launch site.)

**ROCKET DESIGN AND CONSTRUCTION**

First and foremost, read the Model Rocket Safety Code of the NAR, and the Team America rules, very carefully. These answer many questions about what is allowable and what is not. We have been asked many questions of interpretation, and have provided answers both individually and via the FAQ on the website. If you are in doubt about your design's compliance with our rules, it is better to ask us early than to find out at the Finals that what you did is not allowable. Remember that your rocket cannot weigh more than 650 grams at liftoff (with eggs and rocket motor or motors) or have more than 80 Newton-seconds of total impulse in all of its rocket motors put together.

There is no minimum or maximum required length or diameter for individual sections of the rockets this year, but the assembled rocket must have an overall height when standing on a table of at least 650 millimeters from the bottom of the fins or other lowest part of the structure to the tip of the nose. And the payload section must be big enough in diameter to contain the 45mm diameter eggs.

Motors must be retained in the rocket during flight and at ejection by a positive mechanical means (clip, hook, screw-on cap, etc.) and not retained simply by friction fit inside the motor mounting tube. If this mounting tube end sticks out at the base of the rocket, it is permissible to retain the rocket motor by exterior wraps of non-heat-sensitive tape (not cellophane or masking tape) that adhere to both the end of the exposed motor mounting tube and the exposed end of the motor casing.

### **Painting and Decorating:**

**This year there is a new requirement that rockets flown at the Finals must have a decorative finish (paint and/or adhesive patterns) on any exterior surface of the rocket that is made of paper, wood, or fiber.** Fiberglass, carbon, and plastic parts are not required to have this covering. A 5-point penalty will be assessed against any rocket not meeting this requirement.

Because this is the 50<sup>th</sup> anniversary year of the Apollo 11 lunar mission, we are having a special judged competition (with \$500 cash prize) for the rocket that most resembles the Apollo 11 Saturn 5 in exterior paint and decoration pattern and/or rocket body shape. Entry is optional and results will not affect flight competition scores. The model judged will be the one flown in the first competition round. There will be a separate judging station in the check-in area for teams that want to participate to stop by before going to check-in.

Some of the common topics of questions we have been asked about rocket designs have been:

### **Design Changes:**

You are free to change your team's design in any manner that you wish up until the moment you check in at the Finals. You are not required to use the same design that you flew for your "qualification" flight. If you make the second (fly-off) round you can use a different model than the one you flew in the first round. All rockets flown at the Finals must have been test-flown previously. Please put your TARC team number on the rocket that you fly at the Finals.

### **Motor Selection:**

Make sure that you have or can get the rocket motors you plan to use with your design at the Finals, or change your design to suit the motors that you can get. Some teams have problems with very slow liftoffs that make their rocket vulnerable to tipping over in flight ("weathercocking") in windy conditions. This is the result of an inadequate thrust-to-weight ratio for the rocket. If the average thrust of your motor(s) in Newtons (the unit of measurement of thrust that is labeled on the motor) is not greater than 20 times the liftoff weight of the rocket in pounds, then your rocket is underpowered and may weathercock.

### **Staging:**

Use of more than one stage is not permitted.

### **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 rocket kits for the event -- or you can scratch-build components if you prefer. If some company should release a kit specifically for this event or for the NAR "Eggloft" contest event you would not be allowed to use such a kit. 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. Having a mandrel fabricated to your specifications that you wrap fiberglass on to make your rocket body (for example) would be OK. In this case the company is making a tool that you are using, but you are making the part that flies. 3D printed parts are fine as long as the team did the design and printing.

#### **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 reloadable metal rocket motor casings.

#### **Eggs:**

Your rocket must contain three eggs (oriented in any manner) throughout flight. (Note: Apollo 11 carried three astronauts!) We will provide a tray full of eggs for issue to the contestants, all of them measured to be no more than 45 millimeters in diameter or 60 millimeters in length and between 55 and 61 grams in weight, and all of them marked with their weight to the nearest 0.1 gram.

#### **Recovery:**

Your rocket must separate into two or more portions during the recovery phase of its flight, and one of these portions must include both the eggs and altimeter. This portion must be recovered using two or more parachutes of equal size (diameters of canopies within two inches of each other). These parachutes can have different size center spill holes and different shroud line lengths, if desired. The other portion(s) of the rocket must recover safely using your choice of recovery device. If structural pieces (not counting disposable recovery wadding) or the rocket motor casing separate prior to landing, the flight will be disqualified. Breakage of fins or other parts on landing is not disqualifying.

Time will be recorded from the moment of liftoff to the moment that the part of the rocket containing the eggs and altimeter touches the ground, ceases its descent (e.g. lands in a tree), or disappears from the timers' sight.

Rockets may not be controlled by human intervention; radio control is prohibited. Flight control systems carried onboard the rocket such as electronic or other forms of timers, altimeters, etc. that control duration in some safe manner are permitted. They may not use pyrotechnic charges (black powder, pyrodex, or small rocket motors) to deploy recovery systems. They may use burn-through wires or igniters. If they are designed to sense acceleration or deceleration of the rocket as the basis for starting an ignition or ejection sequence through an igniter or other trigger, 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 disconnect mechanism that permits you to maintain them in a completely "safe" configuration until they are placed on the launching pad, and will not be allowed to fly if they do not.

The field for the Finals is not huge (see the site map posted on the [www.rocketcontest.org](http://www.rocketcontest.org) website), but with winds of 20 miles per hour or less (the NAR Safety Code limit) a rocket that stays up no more than 50 seconds will remain on the field. We will have some devices to help pluck rockets out of the lower portions of trees, if you are unlucky on recovery. We have never had a payload portion of a rocket lost to a tree at the TARC Finals.