National Association of Rocketry

United States High Power Rocket Sporting Code

Preliminary Edition

Issued April 2009

The NAR High Power Rocketry Sporting Code was designed to provide the NAR HPR flier the means to participate in friendly HPR competition with other fellow members. With the inception of this program, the National Association of Rocketry now provides each of these fliers a means to competitively display his or her skills in design, craftsmanship, safety and flight of high powered sport model rockets. It is ultimately up to the flier to build a safe model for the competition. It is the responsibility of the hosting NAR section to provide a launch site capable of supporting HPR flight as designated in the NAR HPR Safety Code. Also, all rules regarding HPR flight as listed in the NAR HPR Safety Code must be followed during any NAR HPR contest.

Competitors must be NAR members that hold a current membership; as this is a NAR specific program, members of other organizations that are not also NAR members cannot compete at this time, however between-organization competitions with separate classes for members of other organizations are permitted. Also, since this is a high power competition, members are required to provide proof of HPR certification or participation. Members may fly contest models in any impulse class covered by their current HPR level, as long as the impulse class can be supported by the launch site. Members not holding a valid HPR certification or participation level cannot compete in HPR contests.

The NAR Contest and Records Committee has been tasked with the duty of recording record-setting flights for appropriate HPR events, as they have been doing so successfully for many years for model rocketry contests. The events for which records will be maintained are Altitude and Multiple Eggloft. The record program is not yet in place, and its commencement will be announced by the NAR Contest and Records Committee. The HPR contest events listed in this document do not accumulate contest points at this time, so their results will be used by the Contest and Records Committee strictly for identifying and recognizing the leaders in each of the various HPR contest events at a single launch.

From time to time, NAR Contest and Records Committee may add or revise rules by publishing the changes in Sport Rocketry magazine and/or Electronic Rocketeer newsletter or NAR website, listing the changes made to this document, along with the date which they go into effect. There are a number of occurrences that can result in changes to the rules to include actions by the committee, suggestions from the membership and changes in any applicable government regulations.

Since the rules of the Sporting Code cannot cover all possible eventualities of competition, disputes over the rules are inevitable. However, it is our hope that all members attempt to achieve a satisfactory resolution of a problem by exercising common sense, fair play, and sportsmanship. When necessary, interpretation of the rules may be made on the field by the Contest Director and his decision is final.

All NAR members are invited to participate in HPR competition activity. Members who do not belong to a NAR section can obtain the name of a club in their area (or information on starting a new section) by writing to the NAR Section Activities Committee, in care of NAR Headquarters. Also, members wishing to achieve HPR certification or participation should contact their local Section's certification team for assistance. Over time, this program will grow and include additional events, covering many other venues of high power rocketry.

Finally, as with all HPR events, safety is of first concern. By following the rules as defined in the HPR Safety Code, members can safely participate in and enjoy many of the events presented in the NAR High Powered Rocketry competition program.

1 Altitude Data

1.1 Record setting

The NAR HPR record program is currently under development. The Contest and Records Committee will advise the membership when it is complete.

1.2 Altimeters

A commercially available prefabricated barometric altimeter or GPS unit must be used to record any altitude contest. Kits or personally developed altitude measuring devices are prohibited. The device must have a sampling rate of no less than 10 samples per second and a manufacturer-determined accuracy of 3 percent of recorded altitude or better.

1.3 Altitude Sensing

Altimeters with sensors other than barometric or GPS, such as accelerometers or magnetic apogee detection, may be used to deploy the recovery systems. Altitude data other than barometric or GPS altitude will be disregarded.

1.4 Determining Actual Altitude

After the flight, the altitude will be recorded by the RSO from the on-board altimeter or GPS:

- In the case of a reporting-only altimeter, the altimeter will remain powered on until the RSO is able to determine the altitude.
- In the case of a recording altimeter or GPS unit, the RSO must be present for the downloading of the flight data file.
- GPS Mean Sea Level (MSL) altitude must be corrected to Above Ground Level (AGL) altitude by subtracting the field elevation from the GPS readout. The Contest Director will determine the field elevation and post it at the RSO table.
- GPS data must indicate the number of satellites used to determine the altitude. A minimum of three satellites is required for a valid GPS altitude.
- In the event of multiple altitude recording systems, the score will be recorded as the average of all systems rounded to the next-highest 1-foot increment. In the event of one device malfunctioning, the contestant may request that the RSO disregard an obviously invalid readout.

The actual flight profile will be determined by the RSO. The graph or other flight profile display will be examined for accuracy.

- If it is shown that a sudden peak in altitude is attributable to the apogee separation process or other flight anomaly, that peak will be not be used to determine the recorded altitude.
- The altitude just prior to or just after that sudden peak will be the official recorded altitude.

The RSO's decision is final. If possible, the same RSO should examine all altitude readouts.

1.5 Recovery System Deployment

Motor delay recovery system deployment is allowed.

1.6 Theodolites

Because of the altitudes achieved in high power rocketry, theodolites are not be practical for HPR altitude competition and will not be used.

2 General Information

2.1 Event limitations

The Contest Director must reasonably assess the capabilities of the launch area when determining what motor class to advertise. The CD will sanction the contest with the respective NAR Regional Contest Board.

2.2 Contestant responsibilities

The contestants must be able to provide, at a launch official's request, a valid flight simulation that shows their entry's maximum altitude at 90% of the launch waiver ceiling or less. Contestants must fill out a contest entry form. Contestants cannot officiate, judge, or vote on their own entries.

2.3 Motors

Contestants must only use motors on the current NAR "Combined Certification List" which reflects all certifications granted by the NAR based on its own testing or on reciprocal recognition of TRA and CAR testing. It is the Contest Director's responsibility to provide a current list for RSO use, however; it would behoove contestants to bring evidence of the motor's certification with them.

2.4 Flight limitations

Each entry must make a safe, stable flight. If the entry does not make a safe, stable flight, it will be disqualified. All entries will be returned to the RSO table. In the event of damage that would not allow the entry to make an immediate additional flight, the entry will be disqualified. The RSO's decision is final.

2.5 Contest Officials

The Contest Director will designate a launch official or officials to record flight performance. As the size of any given contest may vary widely from another, where these duties are designated under an "RSO" as it applies to recording flight performance, they may be performed by another launch official so designated. Safety-of-flight determinations remain solely with the RSO.

2.6 Contest Rules

As these events are not events that accrue points towards meet or national championships, some effort has been made to reduce the normal amount of regulation and to provide the Contest Director with broader discretion as opposed to sanctioned contest points events. The CD also has the discretion to add rules or make the existing ones more restrictive as he/she sees fit to better support a specific launch or event. Changes or additional restrictions will be indicated in the meet announcement and reviewed at a pre-launch fliers' meeting.

20 Altitude Competition

20.1 Scope

Altitude Competition comprises eight events open to any rocket. The purpose of this competition is to achieve the highest altitude. The Contest Director, as his/her discretion, may stipulate a minimum body diameter due to launch field restrictions.

This competition is divided into classes based on the permissible total impulse of the motor(s). The following classes of Altitude Competition are established:

Motor Class	Total Impulse (Newton-seconds)
H	160.01 -- 320.00
I	320.01 -- 640.00
J	640.01 -- 1,280.00
K	1,280.01 -- 2,560.00
L	2,560.01 -- 5,120.00
M	5,120.01 -- 10,240.00
N	10,240.01 -- 20,480.00
O	20,480.01 -- 40,960.00

20.2 Flight Information

Flight altitude will be recorded per Section 1.4

20.3 Altimeter limits

Many commercial altimeters use the Motorola MPX-4100-series pressure sensors, which are guaranteed by Motorola spec sheet to operate to 20 bar (approximately 35,000 feet Mean Sea Level, or MSL). If a flight's altitude exceeds 35,000 feet MSL (launch field altitude plus flight's Above Ground Altitude, or AGL), the flight must either include a recording GPS unit or the contestant must provide the manufacturer's certification that the altimeter is capable of accurately recording altitudes in excess of 35,000 feet MSL.

20.4 Scoring

The highest recorded AGL altitude is the winner. The RSO's decision on the validity of altitude reporting is final. The same RSO should examine all data files, if possible.

21 Precision Altitude Competition

21.1 Scope

Precision Altitude Competition comprises one event (with two classes) open to any rocket. The purpose of this competition is to accurately predict the altitude that a model will attain. The Contest Director, as his/her discretion, may stipulate a minimum body diameter due to launch field restrictions.

This competition is divided into classes based on the permissible total impulse of the motor(s). The following classes of Precision Altitude Competition are established:

Motor Class	Total Impulse (Newton-seconds)
H	160.01 -- 320.00
I	320.01 -- 640.00
J	640.01 -- 1,280.00
K	1,280.01 -- 2,560.00

21.2 Classes

The two classes of Precision Altitude shall be:

21.2.1 Predicted Altitude

The contestant must predict the altitude in meters to which the model will be flown. This Predicted Altitude shall be recorded on the flight card and given to the Contest Director or his/her deputy prior to any official flight by the contestant at the meet. The minimum altitude prediction allowable is 1000 feet.

21.2.2 Set Altitude

The Contest Director shall set the target altitude in the contest announcement. This value shall appear in the sanction form and all appropriate contest information. The target altitude shall be a multiple of 100 feet between 500 and 15,000 feet. All contestants shall attempt to achieve this same Set Altitude.

21.5 Control

The entry shall not be radio controlled or contain any device whose purpose is to limit the altitude of the model (e.g., a wire or string). Altimeters for the first deployment event must be set to apogee detect.

21.6 Scoring

In the event of multiple altimeters, the RSO will average the reports and round to the next-highest 1-foot increment to get the reported altitude. This reported altitude of the model will be rounded up as follows to the next highest 10-foot increment (for example, 673 feet would be recorded as 680 feet; 5426 feet would be rounded to 5300 feet). Then divide the recorded altitude of the model by the target altitude and multiply the result by 100. Then round this figure to the nearest 0.1. If the result is greater than or equal to 100, subtract 100 from it; otherwise, subtract it from 100. The contestant whose score comes closest to zero shall be declared the winner.

Flight 1: The model's target altitude is 5200 feet and the reported altitude is 5426 feet.

- Round 5426 to the next highest 10-ft increment – recorded altitude of 5430 feet.
- 5430/5200 = 1.04423
- 1.04423 * 100 = 104.423 rounded to the nearest 0.1 = 104.4
- 104.4 – 100 = 4.4

Flight 2: The model's target altitude is 1500 feet and the reported altitude is 1367 feet.

- Round 1367 to the next highest 10-ft increment – recorded altitude of 1370 feet
- 1370/1500 = 0.9133
- 0.9133 * 100 = 91.33 rounded to the nearest 0.1 = 91.3
- 100 - 91.3 = 8.7

The entry with the lowest score and a qualified flight is the winner. In this example, Flight 1 would be the winner.

30 Timed Recovery

30.1 Scope

Timed Recovery comprises a single event open to any model rocket. The purpose of this competition is to maximize the altitude and minimize the return time to the launch area. The Contest Director, as his/her discretion, may stipulate a minimum body diameter due to launch field restrictions.

This competition is divided into classes based on the permissible total impulse of the motor(s). The following classes of Timed Recovery Competition are established:

Motor Class	Total Impulse (Newton-seconds)
H	160.01 -- 320.00
I	320.01 -- 640.00
J	640.01 -- 1,280.00
K	1,280.01 -- 2,560.00

30.2 Flight

A single-deployment entry must use parachute recovery. A dual-deployment entry does not require a parachute at apogee, but it must use a parachute for the main deployment, with a minimum deployment altitude of 500’ AGL.

30.3 Flight Information

The CD will designate a specific return location in the launch area at the start of the contest. The LCO or RSO will annotate the contestant's flight card with the launch time (local hour and minute preferably using a GPS unit or cell phone). The flight cards will be kept at the return location and the return time will be annotated when the contestant returns the model.

30.4 Degree of Difficulty

The basic contest is weighted towards high-performance models. The Contest Director may modify the scoring formula for return time in minutes (time multiplied by a factor of 2, 3, 5 or 10, or time squared) to weight the event more towards rapid recovery. If used, the CD will announce this weight factor in the contest announcement and again before the start of the contest.

30.5 Scoring

The time in minutes will be subtracted from the altitude (AGL) in feet. The highest score with a qualified flight is the winner. Flights must be returned by the contestant, or the contestant’s designated recovery team, entirely on foot. Using a wheeled or motorized vehicle for any part of the recovery is prohibited.

50 Multiple Eggloft

50.1 Scope

Multiple eggloft comprises a single event open to any model rocket that carries anywhere from two to six large Grade A hens' eggs. The Contest Director will determine the motor class, and contestants will pick the number of eggs in their entry.

This competition is divided into classes based on the permissible total impulse of the motor(s). The following classes of Multiple Eggloft Altitude Competition are established:

Motor Class	Total Impulse (Newton-seconds)
H	160.01 -- 320.00
I	320.01 -- 640.00
J	640.01 -- 1,280.00
K	1,280.01 -- 2,560.00

50.2 Post-flight inspection

After the flight, the RSO will examine all eggs for damage and record the altitude. Any egg cracked or broken during the flight will disqualify the entry. Egg damage decisions by the RSO are final.

50.3 Eggs

The Contest Director will provide sufficient Grade A Large Hen's Eggs for the contest. Those wishing to compete must notify the CD in advance, to include number of eggs and number of flights planned.

50.4 Flight

Entries must be recovered via parachute.

50.5 Scoring

The RSO will determine the flight's recorded altitude via Section 1.4. The flight's recorded altitude will be multiplied by a factor according to the following table:

Number of Eggs	Altitude Factor
2	1.05
3	1.1
4	1.15
5	1.2
6	1.3

The entry with highest score that returns all eggs unbroken with a qualified flight is the winner.

55 Upscale Competition

55.1 Scope

Upscale Competition comprises a single event open to any high power rocket that is visibly recognizable as an upscale of a manufacturer's kit. Determining the validity of the entry, as far as it being based on a manufacturer's kit, is at the discretion of the CD.

55.2 Classes

The two classes of Upscale will be:

55.2.1 H through K class motors (160.01 to 2560.01 Newton-seconds)

55.2.2 L through O class motors (2560.01 to 40,960.00 Newton-seconds)

55.3 Kits

Commercially-available upscale kits are permitted. Upscale models that are patterned after scale kits of military, space or sounding rockets must model the round represented by the original kit.

55.4 Data

The contestant must supply a color picture of the model being upscaled. Permissible sources include catalogs, advertisements or pictures from a manufacturer's website.

55.5 Stages

If the prototype is a multi-staged vehicle, the upscale model may be designed so that some or all of the upper stages are inoperable dummies.

55.6 Judging

Each entrant shall be judged by a "People's Choice" process. All models must be judged together in a group, either before or after flights. All launch participants are eligible to vote, but voters must be registered launch participants with a valid NAR card. The vote sheets must contain the voter's name and NAR number, and they must be checked against the launch registration. The Contest Director will provide a sheet for voting, with five of the following considerations for the voters to use:

- Paint scheme
- Decals and markings (if applicable)
- General outline
- Maintaining unique entry features (staging, recovery)
- Fin shape(s)
- Nose cone shape(s)
- Original kit's popularity
- Magnitude of the upscale

55.7 Flight Characteristics

In the event of recovery means other than a parachute, the RSO has the final decision on what constitutes a safe recovery.

55.8 Scoring

The entry with the highest number of votes and a qualified flight will be the winner.

60 Speed Competition

60.1 Scope

The speed competition comprises a single event open to any high power rocket that is safely capable of flying in the chosen motor class. The goal is to achieve the fastest recorded velocity.

Only one flight attempt per event will be allowed, with the exception of a motor CATO. In that event, the contestant may attempt another flight.

Motor Class	Total Impulse (Newton-seconds)
H	160.01 -- 320.00
I	320.01 -- 640.00
J	640.01 -- 1,280.00
K	1,280.01 -- 2,560.00
L	2,560.01 -- 5,120.00
M	5,120.01 -- 10,240.00
N	10,240.01 -- 20,480.00
O	20,480.01 -- 40,960.00

60.2 Data

Each entry must carry a prefabricated commercially-available flight computer that uses an accelerometer to record velocity. The velocity should be in common form such as feet per second, meters per second, or miles per hour. The flight computer may use a barometric sensor for deployment(s), but velocity must be measured by the accelerometer.

The contestant must download the data onto a computer or other electronic device and present it plotted in graphical form to the RSO. A simple numerical readout is not sufficient. The CD is not responsible for supplying computers to contestants to download their data. The RSO must be present for the downloading of the flight data file.

The RSO will examine the graph or other flight profile display for accuracy.

- If the RSO determines that a sudden peak in velocity is attributable a flight anomaly, that peak will be not be used to determine the recorded velocity.
- Maximum velocity should occur at or near motor burn out.

The RSO's decision on the validity of velocity reporting is final. If possible, the same RSO should examine all velocity readouts.

60.3 Stages

If the entry is a multi-staged vehicle, all stages must have ignitable engines.

60.4 Scoring

The entry with the highest velocity and a qualified flight will be the winner.