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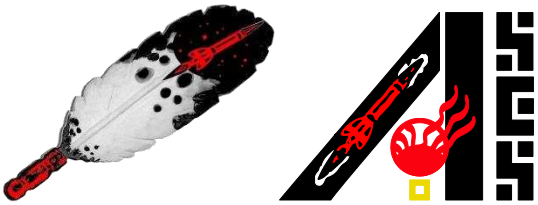

First Nations Launch Rocket Competition Handbook

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FNL Competition Objectives

The First Nations Launch competition offers Tribal Colleges and Universities, in addition to AISES chapter students the opportunity to demonstrate engineering and design skills through direct application in high-powered rocketry. The competition requires teams of undergraduate students to conceive, design, fabricate and compete with high-powered rockets. The restrictions on rocket motors and dimensions are limited so that knowledge, creativity, and imagination of the students are challenged. The end result is a unique aerospace experience for students that provides a great aerospace experience unique to Native American communities.

Tribal Challenge

Rocket Design Objectives

The objective of the WSGC 2016 First Nations Launch **Tribal Challenge** is:

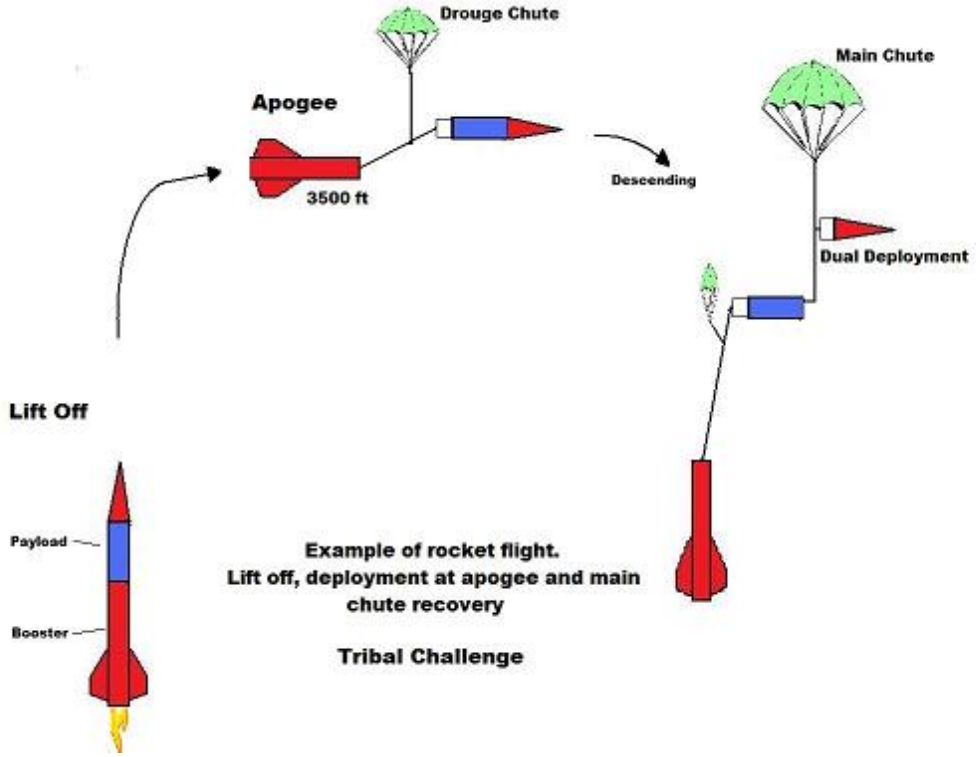
> Student teams will launch a dual deployment high-powered rocket, carrying a **scientific payload** which will collect comparative data from an experiment of your choice throughout the flight from ground to apogee or whole flight duration (predicted vs. actual). All teams are expected to retrieve their rockets in "flyable" condition. The students must conduct all work on the rocket and payload. No outside assistance is permitted. While no professional assistance is permitted, we encourage consultation with local or regional rocket safety professionals on safety matters and rocket design.

Competition Engineering Parameters

Student teams will be required to design and fabricate a high-powered rocket using one reloadable CTI motor, no larger than a K, and capable of withstanding high velocities. The rocket must contain an experiment that is integrated into the rocket or the payload with all components descending under parachute creating a "Safe Flight Mission." A successful "Safe Flight Mission" includes a launch, a successfully deployed recovery system, and all rocket sections recovered in flyable condition.

Experiments can include but are not limited to measurements of speed, velocity, temperature, wind speed, material response and behavior, etc. Data can be recorded through the use of electronic devices (i.e. altimeter, accelerometer, etc.). The data collected must show differences between ground level (at the launch pad) to the end of the flight. All data from experiments must be collected after the flight, analyzed on site, documented, and reported to the field coordinator as soon as possible after flight or before the closing of the range on launch day (i.e. measurements of atmospheric or environmental molecules, etc.). All data collected must be downloaded to a portable memory device (flash memory stick). Each team will present their estimated apogee before flight.

Teams must use an electronic device for the primary deployment at apogee followed by a back-up motor ejection charge. The rocket apogee must not exceed 3500 feet above ground level (AGL). Two (2) reloadable motors per team will be provided of your choice I-K impulse.



1. Each team must assemble, fly, and successfully recover a "low—power" rocket provided by WSGC. Pictures of the team at their launch site with the rocket, before and after their launch, must be posted to WSGC's Facebook page prior to submitting the preliminary design report (PDR) and budget.
2. Due to unpredictable cloud cover, apogee must not exceed 3500 AGL.
3. All projects must have a minimum of two (2) scheduled virtual inspections with the designated safety officer during the construction process (see FNL Calendar).
4. All projects must be completely constructed (or *90%) and ready to fly two (2) weeks prior to launch date. *90% = Airframe, motor mount, fins, payload airframe, couplers, bulkheads, should be permanently attached as designed.
5. All projects must be designed to enable the motor deployment charge as a back-up recovery system at apogee.
6. Electronic altimeters are required for primary deployment events (apogee and main).
7. All final competition project designs must have a documented flight/stable simulation profile (i.e. RockSim, OpenRocket, etc.).
8. All projects must have an aero-dynamic design. No odd rockets. **NOTE:** Odd rockets include flying pyramids, saucers, flying spools, etc.
9. The "Center of Pressure" (CP) and the "Center of Gravity" (CG) must be indicated on the rocket.

AISES Challenge

Rocket Design Objectives

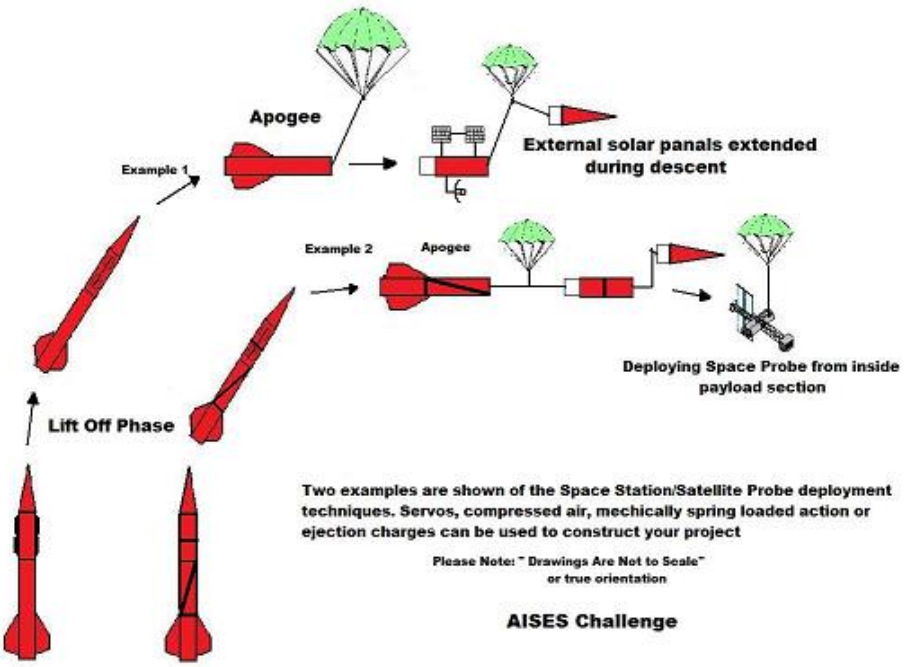
The objective of the WSGC 2016 First Nations Launch **AISES Challenge** is:

> Student teams will design and construct a high-powered rocket that will carry a payload capable of deploying a **self-constructing** "space station" or satellite during its descent. All teams are expected to retrieve their rockets in "flyable" condition. The students must conduct all work on the rocket and payload. No outside assistance is permitted. While no professional assistance is permitted, we encourage consultation with local or regional rocket safety professionals on safety matters and rocket design.

Competition Engineering Parameters

Student teams will be required to design and fabricate a high-powered rocket to withstand high velocities. The challenge is to create, articulate, or deploy your payload into the largest space station/satellite as possible after apogee. Utilizing the payload airframe itself or deploying your project from inside the payload section is acceptable. The space station/satellite must construct itself while descending and land safely under parachute. The space probe must reflect the features of a real space station/satellite.

The team rocket must achieve an altitude between 3,000 - 4,000 feet above ground level (AGL) using one reloadable CTI motor no larger than a K impulse. Team participants will be evaluated in part on the accuracy of their projected apogee target. All teams are expected to have a "Safe Flight Mission." A successful "Safe Flight Mission" includes a launch, a successfully deployed recovery system, and all rocket sections recovered in flyable condition.



1. Each team must assemble, fly, and successfully recover a "low—power" rocket provided by WSGC. Pictures of the team at their launch site with the rocket, before and after their launch, must be posted to WSGC's Facebook page prior to submitting the preliminary design report (PDR) and budget.
2. Two (2) reloadable motors per team will be provided of your choice I-K impulse.
3. Due to unpredictable cloud cover apogee must not exceed 4000' AGL.
4. All projects must have a minimum of two (2) scheduled virtual inspections with the designated safety officer (TBA) during the construction process (see FNL Calendar).
5. All projects must be completely constructed (or *90%) and ready to fly two (2) weeks prior to launch date. *90% = Airframe, motor mount, fins, payload airframe, couplers, bulkheads, should be permanently attached as designed.
6. All projects must be designed to enable the motor deployment charge as a back-up recovery system at apogee.
7. Electronic altimeters are required for primary deployment events (apogee and main)
8. All final competition project designs must have a documented flight/stable simulation profile (i.e. RockSim, OpenRocket, etc.).
9. All projects must have an aero-dynamic design. No odd rockets. **NOTE:** Odd rockets include flying pyramids, saucers, flying spools, etc.
10. The "Center of Pressure" (CP) and the "Center of Gravity" (CG) must be indicated on the rocket.
11. Payloads must have an aero-dynamic design consistent with the rest of the rocket with minimal appendages at the launch pad.
12. The Space Station/Satellite Space Probe must be at least double in size (diameter or length) of the payload bay during descent under parachute recovery.
13. The Space Station/Satellite Space Probe construction event can be spring loaded, electronically servo controlled, compressed air, or with a series of ejection charges.
14. The Space Station/Satellite Space Probe must begin its main construction phase while it is descending during the primary parachute recovery.

Standing Competition Parameters for all Teams

All rockets will have motor ejection backup. Ejection must occur at or after apogee. All structural components and materials must be obtained from reputable high-powered rocketry vendors (http://www.tripoli.org/Vendors) or an engineering analysis demonstrating their suitability must be included with the design. The winners of the flight portion of the competition will be the team whose rocket completes a successful performance of instrument-data collection, predicted apogee accuracy, and Safe Flight Mission.

Judging Categories

Teams will be judged on the performance of their design, the demonstration of their knowledge as it pertains to the design, and their ability to communicate effectively. This will be accomplished in four parts: design reports; a presentation to a selected group of judges; the pre-flight readiness and flight of the rockets; and an examination of predicted vs. actual performance for the acceleration of the rockets.

The total score for each student team will be based on the following parameters:

Table 1

Design Reports (Written) Preliminary Design Report (15) Critical Design Report (15)	30
Flight Readiness Presentation (Oral)	15
Readiness Review (Workshop) (10)	10
Flight Performance (Launch Day) Performance of Instrument-Data Collection (10) Predicted Apogee (10) Successful Flight Mission (10)	30
Post-Flight Performance Evaluation Report (Written)	15
Total	100
Arrive at Oral Presentations with Ready-to-Fly Rocket (90-100% Complete) (Bonus points)	10

Additional Comments:

Interested students with questions about the capabilities of the launch motors or seeking help in getting started are highly encouraged to contact **Frank Nobile** (Maxq3@aol.com), FNL Technical Advisor, or **Bob Justus** (bob@mhbofni.com) of Tripoli Rocketry Association (a high-powered rocketry association), a rocket association near them, or a representative at a local Tripoli Prefecture (http://www.tripoli.org/Prefectures). Students interested in gaining information or experience by observing rocket launches are encouraged to contact the local Tripoli Prefecture, or to attend one of the regular rocket launches held within the team's local area.

Safety and Construction

Setting the Tone

It is understood that this experience may be the first time many of the competitors have designed, built, and flown a high-powered rocket. Safety will be paramount. All teams will adhere to the Code for High-powered Rocketry as laid out in NFPA 1127 and further specified by the Tripoli Rocketry Association and the National Association of Rocketry.

Design and Safety Review

All teams are required to participate in the virtual Design and Safety Review and a Final Virtual Inspection (see FNL Calendar). The teams must be prepared to discuss the design of their rocket and its systems. In addition the teams must display:

- The team's rocket with the airframe, fins, and motor mount intact.
- A diagram of the rocket indicating the configuration of its main components.
- Flight simulation showing max altitude and launch guide velocity (speed at 10 ft.).
- Deployment altimeter user manual
- Preflight Checklist
- Launch Pad and Flight Arming checklist
    - Must include the altimeter's ready/standby tones
- Recovery/Post flight Checklist
    - Must include procedure to "safe" deployment charges and payload

Table 2 **FAA Model Rocket Classification**

Limitation	**Class 1**	**Class 2**
Rocket weight	1500 grams (3.3lbs)	No limit
Motor limit	4.4 oz. of fuel (mid-size H motors)	40960 N-sec total thrust
Altitude limit	None - may be set by local agreement.	FAA limited
Other	Clear of clouds (all classes)	5 miles visibility, Clouds less than 5/10ths coverage (Clear of clouds) FAA Waiver required and Notice to Airmen (NOTAM) filed Between Sunrise and Sunset

Table 2 **NAR/Tripoli Certification Requirements and Limitations**

	Rocket / Motor Limitations			
Certification required	None	Level 1 HPR	Level 2 HPR	Level 3 HPR
Total Combined Impulse	320 N-sec (2 G Motors)	640 N-sec (H,I)	5120 N-sec (J,K,L)	40960 N-sec (M,N,O)
Combined propellant mass	125 grams (4.4 oz.)	No Limit		
Single Motor Impulse	160 N-sec (G motor)	No Limit		
Single Motor propellant mass	62.5 grams (2.2 oz.)	No Limit		
Single Motor Average Thrust	80 N	No Limit		
Sparky Motors	Not allowed	Allowed		
Total Rocket Mass	1500 grams (3.3 lbs.)	No Limit		
Field distance requirements	Per Model rocket safety code	Per HPR safety code		

The purpose of NFPA 1127, the Tripoli Safety Code, and the NAR Safety Code are to:

- Provide safe and reliable motors, establish flight operations guidelines and prevent injury.
- Promote experimentation with rocket designs and payload systems.
- Prevent beginning high-powered hobbyists from making mistakes.

NFPA 1127 Code for High-powered Rocketry
National Fire Protection Association
http://www.nfpa.org/1127

Tripoli Code for High-powered Rocketry
Tripoli Rocketry Association
http://www.tripoli.org/LinkClick.aspx?fileticket=vF%2f34Qq57zg%3d&tabid=185

NAR High-powered Rocket Safety Code
National Association of Rocketry
http://www.nar.org/NARhpsc.html

These policies and procedures are generally accepted nationally. Please consult your local Tripoli or NAR prefecture before test launching your rocket in your home state.

I. All Launches:
   A. Must comply with United States Code 1348, "Airspace Control and Facilities," Federal Aviation Act of 1958 and other applicable federal, state, and local laws, rules, regulations, statutes, and ordinances.
   B. A person shall fly a rocket only if it has been inspected and approved for flight by the Rocket Safety Officer (RSO). The flier shall provide documentation of the location of the center of pressure and the center of gravity of the high-powered rocket to the RSO if the RSO requests same.
   C. The member shall provide proof of membership and certification status by presenting their membership card to the LD or RSO upon request.
   D. A rocket with a predicted altitude in excess of 50,000 feet AGL requires review and approval by the TRA Class 3 Committee.
   E. Recovery.
      1. Fly a rocket only if it contains a recovery system that will return all parts of it safely to the ground so that it may be flown again.
      2. Install only flame resistant recovery wadding if wadding is required by the design of the rocket.
      3. Do not attempt to catch a high-powered rocket as it approaches the ground.
      4. Do not attempt to retrieve a rocket from a power line or other place that would be hazardous to people attempting to recover it.
   F. Payloads
      1. Do not install or incorporate a payload in a high-powered rocket that is intended to be flammable, explosive, or cause harm.
      2. Do not fly a vertebrate animal in a high-powered rocket.
   G. Weight Limits

1. The maximum lift-off weight of a rocket shall not exceed one-third (1/3) of the average thrust on the motor(s) intended to be ignited at launch.

H. Launching Devices
   1. Launch from a stable device that provides rigid guidance until the rocket has reached a speed adequate to ensure a safe flight path.
   2. Incorporate a jet/blast deflector device if necessary to prevent the rocket motor exhaust from impinging directly on flammable materials.

I. Ignition Systems
   1. Use an ignition system that is remotely controlled, electrically operated, and contains a launching switch that will return to "off" when released.
   2. The ignition system shall contain a removable safety interlock device in series with the launch switch.
   3. The launch system and igniter combination shall be designed, installed, and operated so the liftoff of the rocket shall occur as quickly as possible after actuation of the launch system. If the rocket is propelled by a cluster of rocket motors designed to be ignited simultaneously, install an ignition scheme that has either been previously tested or has a demonstrated capability of igniting all rocket motors intended for launch ignition within one second following ignition system activation.
   4. A rocket motor shall not be ignited by a mercury switch or roller switch.

J. Install an ignition device in a high-powered rocket motor only at the launch pad.

K. Launch Operations
   1. Do not launch with surface winds greater than 20 mph (32 km/h) or launch a rocket at an angle more than 20 degrees from vertical.
   2. Do not ignite and launch a high-powered rocket horizontally, at a target, in a manner that is hazardous to aircraft, or so the rocket's flight path goes into clouds or beyond the boundaries of the flying field (launch site).
   3. A rocket shall be pointed away from the spectator area and other groups of people during and after installation of the ignition device(s).
   4. Firing circuits and onboard energetics shall be inhibited until the rocket is in the launching position.
   5. Firing circuits and onboard energetics shall be inhibited prior to removing the rocket from the launching position.
   6. When firing circuits for pyrotechnic components are armed, no person shall be allowed at the pad area except those required for safely arming/disarming.
   7. Do not approach a high-powered rocket that has misfired until the RSO/LCO has given permission.
   8. Conduct a five second countdown prior to launch that is audible throughout the launching, spectator, and parking areas.
   9. All launches shall be within the Flyer's certification level, except those for certification attempts.
   10. The RSO/LCO may refuse to allow the launch or static testing of any rocket motor or rocket that he/she deems to be unsafe.

II. Commercial Launches

A. Use only certified rocket motors.

B. Do not dismantle, reload, or alter a disposable or expendable rocket motor, nor alter the components of a reloadable rocket motor or use the contents of a reloadable rocket motor reloading kit for a purpose other than that specified by the manufacture in the rocket motor or reloading kit instructions.
C. Do not install a rocket motor or combination of rocket motors that will produce more than 40,960 N-s of total impulse.
D. Rockets with more than 2560 N-s of total impulse must use electronically actuated recovery mechanisms.
E. When more than 10 model rockets are being launched simultaneously, the minimum spectator distance shall be set to 1.5 times the highest altitude expected to be reached by any of the rockets according to Tripoli Rocketry Association Safe Launch Practices.
F. When three or more rockets (at least one high-powered) are launched simultaneously, the minimum distance for all involved rockets shall be the lesser of:
    1. Twice the complex distance for the total installed impulse. (refer to V. Distance Tables)
    2. 2000 ft. (610 m)
    3. 1.5 times the highest altitude expected to be achieved by any of the rockets.
G. When more than one high-powered rocket is being launched simultaneously, a minimum of 10 ft. (3m) shall exist between each rocket involved.

Table 3

MINIMUM DISTANCE TABLE				
Installed Total Impulse (Newton-Seconds)	**Equivalent High-powered Motor Type**	**Minimum Diameter of Cleared Area (ft.)**	**Minimum Personnel Distance (ft.)**	**Minimum Personnel Distance (Complex Rocket) (ft.)**
0 -- 320.00	H or smaller	50	100	200
320.01 -- 640.00	I	50	100	200
640.01 -- 1,280.00	J	50	100	200
1,280.01 -- 2,560.00	K	75	200	300
2,560.01 -- 5,120.00	L	100	300	500
5,120.01 -- 10,240.00	M	125	500	1000
10,240.01 -- 20,480.00	N	125	1000	1500
20,480.01 -- 40,960.00	O	125	1500	2000

Note: A Complex rocket is one that is multi-staged or that is propelled by two or more rocket motors

Design, Safety and Readiness Review (RR) (Day before Launch)

Endeavoring to have all teams perform their flights in a safe and controlled manor, each team must have the design and construction of their rocket reviewed in advance of the competition flight by a person holding at least a High-powered Rocket Level 2 Certification. The reviewer must not be associated with the team whose design is being reviewed.

Teams that arrive to the launch weekend with rockets deemed "Ready to Fly" will earn an additional 10 bonus points that will be added to the team's total score.

The teams must be prepared to discuss the design of their rocket and its systems. In addition, the teams must display:

- The team's rocket in its current state of assembly
- A diagram of the rocket indicating the configuration of its main components
- Flight simulation showing max altitude and launch guide velocity (speed at 6 ft.)
- Deployment altimeter user manual
- Preflight Checklist
- Launch Pad and Flight Arming Checklist
    - Must include the altimeter's ready/standby tones
- Recovery/Post-flight Checklist
    - Must include procedure to "safe" unexploded deployment charges (if any) and turn off payload (if needed for safety reasons)

Preflight Safety Inspection (Day of Launch)

On flight competition day, all teams must have their rockets inspected before they will be allowed to proceed to the launch pad. The teams must be prepared to discuss their rocket's design and its deployment systems. In addition the teams must display:

- Team's rocket readied for launch
    - Center of Gravity (CG) and Center of Pressure (CP) must be clearly marked on the rocket's exterior
- Preflight Checklist (showing that all steps have been completed up to the launch)
- Launch Pad and Flight Arming checklist
    - Must include the altimeter's ready/standby tones
- Recovery/Post-flight Checklist
    - Must include procedure to "safe" deployment charges and payload

Post-flight Check-in (Immediately After Launch)

Following the team's competition flight the team must follow their Recovery/Post-flight Checklist to insure a safe recovery. The team then proceeds to the recovery check-in with:

- The team's rocket
- Recovery/Post-flight Checklist showing team completed recovery step procedures

Flight Readiness Presentation (Oral)

Presentation Format

One or more team members will deliver the presentation to the judges. All team members who will deliver any part of the presentation, or who will respond to the judges' questions, must be in the podium area when the presentation starts and must be introduced to the judges. Team members who are part of this "presentation group" may answer the judge's questions even if they did not speak during the presentation itself.

Presentations should include a PowerPoint presentation with a maximum of eight (8) slides. The oral presentation is limited to a maximum of six (6) minutes. The judges will stop any presentation exceeding ten minutes. The presentation itself will not be interrupted by questions. Immediately following the presentation there will be a question and answer session of up to two (2) minutes. Only judges may ask questions. Only team members who are part of the "presentation group" may answer the judges' questions. If time allows there may be opportunity to take additional questions from the audience. If questions are taken from the audience, a designated presentation official will determine if the question is appropriate; and if so, the team will be allowed to answer the question.

Evaluation Criteria

Presentations will be evaluated on content, organization, visual aids, delivery and the team's response to the judges' questions. The scoring criteria are detailed in Appendix A-1 "Presentation Judging". The criteria are applied only to the team's presentation itself. The team that makes the best presentation, regardless of the quality of their rocket, will score highest for the presentations.

Scoring Formula

The scoring of the Presentation is based on the average of the Presentation Judging forms. There is a maximum of 100 points on the Presentation Judging Form that will be scaled to meet the 15% of the competition total score.

It is intended that the scores will range from near zero (0) to fifteen (15). In the event of multiple judging teams, the Presentation Event Captain may at his/her discretion normalize the scores of different judging teams.

PRESENTATION SCORE = 15 x P_{team}/P_{max}.

Where:

- "Pmax" is the highest score awarded to any team
- "Pteam" is the score awarded to your team

Design Report (Written)

Design Report Objective

The concept of the design report is to evaluate the engineering effort that went into designing and achieving rocket altitude "accuracy" and how the engineering meets the intent of the competition i.e. "Clustering" or "Climate Change" payload. The rocket that illustrates the best use of engineering to meet the design goals and the best understanding of the design by the team members will score the highest.

Report Format

The Flight Performance Report should follow these guidelines:

- Maximum twenty five (25) single-sided pages in length
- Times New Roman
- 12 pt. font
- 1" margins
- Pages numbered in the upper right high corner (except for cover page)
- Each section of the report clearly delineated with a heading
- Section headings must appear in a table of contents.
  Reports submitted electronically in .pdf format

Material that must be included, as a minimum:

- Cover Page
- Table of Contents
- Executive Summary
- Design Features of Rocket
- Design Features of Payload System
  - additional features
- Diagram of Rocket Identifying the dimensioned locations for the:
  - CP (center of pressure)
  - CG_1 (center of mass with the fully loaded rocket motor(s))
  - CG_2 (center of mass after motor(s)-burnout)
- Analysis of the Anticipated Performance – including how each were estimated
  - Estimated Rocket Altitude
  - Estimated Peak Acceleration for the Rocket
  - Plot of Estimated Acceleration vs. Time for the Rocket
- Construction of Rocket (include photos)
- Photographs of Completed Rocket
- Conclusion
- Budget

Evaluation Criteria

Reports and design will be evaluated on content, organization, clarity, completeness and professionalism of the material. The criteria are detailed in Appendix A-2 "Design Judging".

Scoring Formula

The scoring of the event is based on the average of the report judging forms. There is a maximum of 100 points from the Design Judging Form that will be scaled to meet the 30% of the competition total score.

Competition Flight

Launch and Flight Format

The launch will take place at a site determined by Tripoli Wisconsin Association. Each rocket must pass a safety inspection before launch and any additional equipment must be cleared by the Range Safety Officer (RSO) before entering the launch area. The RSO will have discretion over the number of team members that attend the rocket once it is in the launch area. Each team must assemble a recovery team that will follow the directions of the RSO or designee.

To be considered a successful Safe Flight Mission, the rocket must:

- Launch
- Recovery system must successfully deploy
- All rocket sections must be recovered in flyable condition

Flyable condition shall be considered condition that if the flyer were handed another motor(s), the rocket would pass RSO inspection and could be put on the pad and fly again safely.

The entire rocket (all component parts) must be returned to a designated location for post-flight inspection by the RSO or designee.

A flight performance report sheet will be filled out by a designated flight operations recorder. The flight operations recorder will record the data on the sheet during and following the flight. Upon completion, a team member must sign their initials of acceptance before a copy will be released to the team.

Evaluation Criteria

Finishing order for of the competition flight will based on:

- Successful flight and recovery
- Maximum altitude

Post-Flight Performance Report

Performance Comparison

The comparison of the fight performance to the predicted performance will help to demonstrate the team's knowledge and understanding of the physics involved. It will be presented in the form of a brief report that will include a “Flight Performance Comparison Sheet” and discussion of the results, especially any differences between the actual and the predicted values.

Performance Comparison Format

The performance comparison document should follow the same guidelines as the Design Report, be no more than eight (8) pages in length and must be submitted electronically in *.pdf* format.

Material that must be included, as a minimum:

- Cover Page
- Flight Performance Comparison Sheet
  - Table of performance characteristics (Table 4)
  - Plot: "Acceleration Performance Comparison of Predicted and Actual" (Figure 2)
- Discussion of Results
  - Compare predicted and actual apogees, describe and defend possible reasons for differences
  - Compare predicted and actual accelerations, describe and defend possible reasons for differences
  - Discussion of rotation sensor system data and performance.

Evaluation Criteria

Reports will be evaluated on how closely the predicted results compare to the actual results, how well the team explains any differences, clarity, completeness and professionalism of the material. The criteria are detailed in Appendix A-3 "Flight Performance Judging".

Scoring Formula

The scoring of the Flight Performance is based on the average of the Post-Flight Performance Report Judging forms. There is a maximum of 100 points from the Post-Flight Performance Report Judging Form that will be scaled to meet the 15% of the competition total score.

APPENDIX A-1

SCHOOL _____ **Team** _____

ORAL PRESENTATION JUDGING

Score the following categories on the basis of 0-25points each according to the following scale (any number or fraction along this scale may be used).

0.0 = inadequate or no attempt
¼ Val = attempted but below expectation
½ Val = average or expected
¾ Val = above average but still lacking
Max Val = excellent, perfectly meets intent

_____ **ENGINEERING AND DESIGN CONTENT: (25 pts)**

- Discussion of Engineering Methodology (5 pts)
- Use of Design Tools (5 pts)
- Addressed Competition Objectives/Requirements (5 pts)
- Use of Analytical Data (5 pts)
- Description of Construction Techniques (5 pts)

_____ **ORGANIZATION: (25 pts)**

- Logical Organization & Structure (10 pts)
- Presentation Clarity (5 pts)
- Use of Visual Aids as Support Material (5 pts)
- Balance & Transitions Among Presenters (5 pts)

_____ **VISUAL AIDS: (10 pts)**

- Appropriate Use of Text (2 pts)
- Informational Charts & Illustrations (2 pts)
- Appropriate Design and Use of Graphics (2 pts)
- Use of Supporting Physical Materials (2 pts)
- Appropriate Use and Formatting of Slides (2 pts)

_____ **ROCKET APPERANCE: (5pts)**

- Visual Appearance (2 pts)
- Quality of Construction (3 pts)

_____ **COMMUNICATION SKILLS: (25 pts)**

- Articulation (5 pts)
- Eye Contact (5 pts)
- Verbal Projection (5 pts)
- Body Language (3 pts)
- Poise/Presence (3 pts)

- Adherence to Time Constraints (4 pts)

_____ **QUESTION & ANSWER: (10 pts)**

- Active Listening Skills (4 pts)
- Answer Relevance (3 pts)
- Response Confidence/Persuasiveness (3 pts)

TOTAL = PRESENTATION POINTS (100 points maximum)

COMMENTS:

APPENDIX A-2

SCHOOL _____ **Team** _____

DESIGN REPORT JUDGING

0.0	=	inadequate or no attempt
¼ Val	=	attempted but below expectation
½ Val	=	average or expected
¾ Val	=	above average but still lacking
Max Val	=	excellent, perfectly meets intent

_____ **AESTHETICS (0-5)**

- "High performance" appearance (3 pts)
- Payload features and required functions incorporated in a way that enhances appearance (2 pts)

_____ **ROCKET MECHANICAL & ELECTRICAL DESIGN (0-25)**

- Dimensional Specifications (1 pts)
- Recovery System Design Specifications (5 pts)
- Propulsion System Specifications (1 pts)
- Avionics System Design Specifications (5 pts)
- Planned Construction Solutions & Techniques (5 pts)
- Structural Analysis of Scratch-Built Parts (5 pts)
- Risk Mitigation Analysis (3 pts)

_____ **FLIGHT PERFORMANCE MEASUREMENT PLAN (0-30)**

- Flight Analysis (5 pts)
- Modeling of Flight Profile (10 pts)
- Recovery Analysis (5 pts)
- Stability Analysis (5 pts)
- Environmental Conditions Analysis (5 pts)

_____ **INNOVATIVENESS (0-15)**

- Uniqueness of Components/Systems (10 pts)
- Functional Relevance of Components (5 pts)
- Relevance to Competition Objectives (5 pts)

_____ **SAFETY (0-10)**

- Designed for Safe Flight & Recovery (5 pts)
- Documented Material Handling Procedures (5 pts)
- Planned Assembly Procedures (5 pts)
- Planned Pre & Post Launch Procedures (5 pts)

_____ **MISCELLANEOUS (0-10)**

- Followed Specifications (2 pts)
- Consistent Formatting (2 pts)
- Correct Spelling and Grammar (2 pts)
- Documented Figures and Graphs (2 pts)
- References and Labeling (2 pts)

_____ TOTAL = DESIGN REPORT POINTS (100 points maximum)

APPENDIX A-3

SCHOOL _____ **Team** _____

POST-FLIGHT PERFORMANCE REPORT JUDGING

0.0 = inadequate or no attempt
¼ Val = attempted but below expectation
½ Val = average or expected
¾ Val = above average but still lacking
Max Val = excellent, perfectly meets intent

_____ **ASSESSMENT OF ROCKET OPERATION (30)**

- Flight Anomalies Analysis (10 or 0 pts)
  {If no anomaly then points are distributed to remaining subsections}
- Propulsion System Assessment (4 or 6 pts)
- Flight Path Assessment (4 or 6 pts)
- Recovery System Analysis (4 or 6 pts)
- Rocket Location & Recovery Analysis (4 or 6 pts)
- Pre & Post Launch Procedure Assessment (4 or 6 pts)

_____ **ACTUAL VS PREDICTED PERFORMANCE (30)**

- Altitude Comparison (10 pts)
- Acceleration Comparison (10 pts)
- Velocity Comparison (10 pts)

_____ **DATA COLLECTION (20)**

- Sensor Data Report (5 pts)
- Data Interpretation (15 pts)

_____ **REPORT AESTHETICS (20)**

- Followed Specifications (3 pts)
- Professionally Written (10 pts)
- Accurate Representation of Events (7 pts)

_____ **TOTAL = POST-FLIGHT PERFORMANCE REPORT POINTS (100 points maximum)**

COMMENTS: