

## DEPARTMENT – BUILDING EXHIBITS

### SECTION –STEM-ROCKETRY (Must be enrolled in STEM - Rocketry)

#### SECTION - 4-H STEM - ROCKETRY

The Kansas 4-H STEM Rocketry program is designed to allow 4-H members to explore aerospace through rockets of various sizes. Kansas 4-H has adopted the National Association of Rocketry's rules, regulations, and safety guidelines.

#### **Exhibit Information for ALL rocketry categories:**

1. All revisions of all forms previously released for the STEM division either undated or dated prior to 2013 are void for use and new forms must be obtained and used that are dated by the State 4-H Office for the current year. Use of old forms will result in the loss of one ribbon placing for exhibits.
2. Relevant documents may be obtained from the Extension Office or from the state website, [www.STEM4KS.com](http://www.STEM4KS.com)
3. NAR refers to the National Association of Rocketry and its governing board.
4. All NAR documents, with the exception of the "pink book," referenced herein can be found at <http://www.nar.org>.
5. If a fire ban is in effect for any county in Kansas, exhibitors in any Kansas County are not required to launch their rocket(s). All requirements for the launching of rockets for the state fair and the documenting of the launching are suspended for the duration of the ban.
6. Tripoli refers to the Tripoli Rocketry Association and governing board.

#### **Exhibit Definitions for ALL rocketry categories:**

1. As defined by the National Association of Rocketry (NAR), a scale model is "any model rocket that is a true scale model of an existing or historical guided missile, rocket vehicle, or space vehicle." The intent of scale modeling is, according to the NAR, "to produce an accurate, flying replica of a real rocket vehicle that exhibits maximum craftsmanship in construction, finish, and flight performance." (NAR "Pink Book" 50.1 4-1)
2. Adult supervision is defined as being under the direct supervision of someone 18 years of age or older.
3. For the purposes of Kansas 4-H STEM a mid-powered rocket is defined as a rocket that uses an 'E', 'F', 'G', or equivalent engine for launch. In addition, rockets also qualify for mid-power if they meet any of the following criteria:
  - a. Is 2 inches or greater in diameter (not including fins) and taller than 3 feet (36 inches including fins) and do not use an engine(s) exciding 160.01 Newton seconds of total impulse (an 'H' engine equivalent or above).
  - b. The total impulse of all engines used in the rocket is greater than 20.01 Newton-seconds and less than 160.01 Newton-seconds.
4. For the purposes of Kansas 4-H STEM - Rocketry a high powered rocket is defined as a rocket that meets any of the following criteria:
  - a. Weighs more than 3.3125 pounds (53 ounces or 1500 grams) at the time of launch;
  - b. Uses an "H" engine or larger to launch.
  - c. The total impulse of all engines used in the rocket is greater than 160.01 Newton-seconds of thrust.
  - d. Includes any airframe parts of ductile metal, though, the use of ductile metal is strongly discouraged.
  - e. Models powered by rocket motors not classified as model rocket motors per NFPA 1122, e.g.:
    - ii. Average thrust in excess of 80.01 Newtons
    - iii. Contains in excess of 125 grams of propellant and are limited to only H and I motors
    - iv. Uses a hybrid motor or a motor designed to emit sparks

1. High power certification is defined as having successfully completed a certification program for high-powered rocketry through the NAR and Tripoli, maintaining that certification. This applies to all membership levels in the NAR or Tripoli. Specifically, the "Formal Participation Procedure" for the "Junior HPR Level 1 Participation Program" as outlined by the NAR and the "Tripoli Mentoring Program (TMP) as outlined by Tripoli.

2. NAR rules for launching and construction of all rockets are assumed to be used by all 4-H SpaceTech exhibitors and will be considered during judging.

3. For the purposes of Kansas 4-H STEM - Rocketry, NO rocket may be launched using engines totaling more than an "I" impulse engine or 640 Newton-seconds of total thrust.

**Exhibit Rules for ALL rocketry categories:**

Purpose: These rules apply to how rockets are to be displayed at the fair and what those displays should and should not contain. These rules apply to all rockets displayed in the STEM division.

1. 4-H members must be currently enrolled in the 4-H STEM-Rocketry program to exhibit in this division.
2. Entries selected for entry at the State Fair should receive a top blue or purple ribbon and meet Kansas State Fair guidelines.
3. Each exhibitor may enter up to two rocket exhibits that have been constructed during the current year. If two rockets are entered, one rocket must be a "model rocket kit" and the second may be entered into any other applicable class. An exhibitor may not enter two rockets in the same class.
4. The report that accompanies the rocket must be limited to the 4-H STEM Rocket Exhibit Information Form which is affixed to a 10" x 13" envelope. This envelope should NOT be attached to the rocket stand or rocket. The information form should be signed by the exhibitor. This may be downloaded from [www.STEM4KS.com](http://www.STEM4KS.com) Any rocket exhibit not including this completed envelope will receive an automatic participation ribbon.
5. Plans (or a photocopy) must be placed inside the envelope.
  - a. This includes original design rockets.
  - b. If a rocket kit has been modified structurally, (which must provide all necessary details to construct an original design rocket) notations need to be given indicating the changes made, either by notations on the Rocket Exhibit Information Form or by placing notes in the plans. Such modifications require the rocket to be swing tested and documented to show a stable flight.
6. One or more photographs of the rocket during construction and at the launch site are required.
  - a. Photographs showing the rocket at the moment of ignition are preferred.
  - b. Photographs must be mounted on one side of 8 1/2" x 11" *page(s)*.
  - c. There must be at least 1 page of photos and no more than 5 pages' photos.
  - d. Include at least one photo showing rocket construction, preferably with the exhibit included.
  - e. Do not include photos of members catching their rockets as they return to earth. This is an unsafe practice, and we do not recommend or condone this practice.
  - f. Pictures at the launch site are not required in the event of a burn ban.
7. To exhibit in this division:
  - a. The rocket must have been flown, unless a burn ban is in effect.
  - b. Support rods must not extend past the tip of the highest nosecone on the model.
  - c. Support rods must remain in the upright position, 90 degrees to the display base, do not angle. If support rods are not perpendicular to the base, the judge should deduct two ribbon placings.
  - d. No model may be submitted on a launch pad.
8. Launches should not be conducted in winds above 20 mph, and will constitute a disqualification of rocket exhibit.

9. All rockets must have a safe method of recovery, e.g. parachute, streamer or tumble recovery. Any rocket without a recovery system will be disqualified.
10. The altitude achieved by the rocket is to be determined using a method other than estimation. Examples of accepted methods include altimeter, computer software, range finders, etc. If additional space is needed to show calculations of how the altitude was achieved one additional page may be added to the rocketry information pack.
11. Flight damage is to be documented by the participant on either the construction plans an additional sheet of paper titled "flight damage" or the 4-H STEM - Rocketry Exhibit Information Form.
12. The judging of flight damage is to be secondary to all other aspects of the model and only then may it even be considered. However, under no circumstance may flight damage be grounds for disqualification.
13. Engines and igniters, under any circumstance: ARE NOT permitted with the exhibit and constitute an immediate disqualification.
14. If an engine becomes stuck, jammed, wedged, or in any other way permanently affixed in or to a rocket and can not be removed from the rocket, the rocket will be subject to immediate disqualification. This is because it is not possible to make a full and immediate assessment of the safety of the rocket when it is being judged and safety is paramount.
15. Engines may not be used as display stands hollowed out or otherwise. Engines used as a display stand will be subject to immediate disqualification. This is a significant change from previous year's rules.
16. Rocket engines should not be used to join multi-stage rockets together.
  - a. Multi-stage rockets can be displayed without having the stages connected together. In that case, the final stage (the one with the nose cone) should be placed on the display stand, and other stages should be placed with a loop of string to the display strand.
  - b. The different stages must be included to complete the rocketry exhibit, incomplete exhibits will be deducted at least one ribbon placing.
  - c. Use of any engines to join the stages together will be subject to immediate disqualification.
17. Multi-stage rockets can be flown using just the final stage and be considered fully flown.
18. If a safety violation is noted by the judges, superintendent, or other staff, the exhibitor's rocket, at the judges' discretion, will receive a participation ribbon. All information necessary will be given to NAR and/or TRIPOLI for investigation and possible revocation of membership.

### **Construction Rule for all Rockets**

Purpose: These rules apply to the construction of all rockets displayed in the STEM division.

1. Rockets are to be properly assembled according to the assembly instructions.
2. Beginner kits with prefabricated fin assemblies and pre-finished rockets requiring no painting are not acceptable and will be disqualified in the State fair. (Exception is LVCO 7-8-year-old classes. See very end of rocket section.)
3. Plastic snap together fins and prefabricated fin assemblies that do not require fin alignment are not acceptable and will be disqualified.
  - a. This rule does not apply to plastic fins that must be manually aligned and do not utilize a fin alignment mechanism, including but not limited to fin alignment rings or spacing blocks.
  - b. This rule does not apply to fiberglass, Kevlar, extruded foam, composite or wood fins; especially when used for "through the wall" fin attachment techniques that are common in larger rockets.
  - c. In addition, plastic parts for decorative and mechanical purposes (i.e. decorative nozzles and moving landing struts) are not considered fins and can consist of plastic. Decorative nozzles, etc. need to be securely fastened and not pose a safety hazard.
  - d. Fin assemblies that are printed using a 3D printer are excluded from this rule. Through

detailed instructions on the creation of the fin assemblies must be provided and an additional page of photos may be included to show the creation/printing of fin assemblies.

4. Angles of fins must fall within a plus or minus 2 degree variation using an approved fin alignment guide (such as KSSTAC10). An official fin guide is available from [www.STEM4KS.com](http://www.STEM4KS.com).
5. Fins should be rounded or streamlined according to instructions. If the other edges are rounded to reduce drag on all exposed sides, there should be no ribbon deduction, unless instructions indicate to leave flat.
6. Fins and body tubes are to be sealed with sanding sealer and/or primer to eliminate the appearance of body grooves and wood grain.
7. Fins and launch lugs are to be filleted to reduce drag and properly secure them to the model.
8. Engine mounts are to be securely attached to the body tube.
9. Any seams on plastic parts are to be sanded smooth.
10. Body tubes/airframes/engine mounts can be made from suitable materials, including, but not limited to: reinforced paper, cardboard, phenolic resin, specialized polymer resins, fiberglass, Kevlar or other suitable structural materials. However, foam may not be used for external body or other external rocket parts.
11. The nose cone is to fit snugly but still allow for easy removal.
12. Exhibits must be uniformly painted and smoothly finished or finished as per rocket instructions, and have decals applied smoothly.
13. Nonstandard surfacing (such as textured paint) may be used if directed by the instructions, this includes scratch built rockets.
14. Models may not be judged based on their paint scheme (colors and placement on the rocket), with the exception of rockets that fit the definition of a "scale model." All other rockets do not have to follow the suggested paint scheme, allowing the 4-Her to display maximum creativity in the finishing of their rocket. Under no circumstances is the weight given to the paint scheme to be sufficient enough, by itself, to move the model from one ribbon placing to another.
15. "Scale models" may be judged based on their paint scheme. The judge may deduct up to one ribbon placing for not following the paint scheme.
16. Scale Model Rockets are to be finished and completed with a majority (greater than 70%) of decals.
17. If a modification is made to the rocket, for example, adding a fin, a swing test must be conducted on the rocket, and the documentation provided. Failure to test and document flight stability following modifications will result in two ribbon placing deductions.

### **Model Rocketry Specific Guidelines (ages 9 and up):**

Purpose: Model rockets are generally small-to-medium sized rockets that can be purchased at hobby stores that an individual(s) builds from parts similar to those found in model rocket kits.

1. Rockets classified as high or mid-powered may not be entered in this category.
2. Each rocket must be able to stand freely by itself or be supported by a solid base, not to exceed 4-1/4" (four and one quarter inch) thick and 8" square. The exhibitor's name, county or district, and age must be labeled on the top of the base. Rod materials should be sturdy and not made of flimsy materials, such as coat hangers.
3. If the model rocket is greater than 4 feet tall it can be displayed without a base, or displayed parallel to the ground with up to 3 notched blocks not to exceed 4" in height width and depth. The exhibitor's name, county or district, and age must be labeled on the base(s).
4. All exhibitors must comply with the NAR Model Rocket Safety Code that is in effect as of October 1st of the current 4-H year. However, in the event that there is a modification in this code, the SpaceTech Action Team may review and implement the modified code.

### **Original Design Specific Rocket Guidelines (ages 11 and up):**

Purpose: To allow for youth to develop their own rockets (model, mid, and high powered) in a safe manner that displays maximum craftsmanship.

1. Original design rockets cannot be a modification of a pre-existing kit and must be of original design.

2. Original design rockets must be designed by the exhibitor(s).
3. Original design rockets must include detailed instructions, so that someone could construct the original designed rocket just like a kit purchased at a store. Instructions can be as many pages as needed to convey full and complete construction techniques.
4. Original design rocket instructions should not include copies of instructions in part or in whole from existing kits.
5. For a rocket entered in the original design classes, describe in the summary how the rocket was tested for stability prior to flying. Swing testing of the rocket is required. Other tests and calculations are encouraged. Exhibitors must include documentation of the swing test. Failure to swing test a rocket will result in a deduction of TWO ribbon placings.
6. A minimum of one additional page must be added to the rocketry information pack detailing the test(s) performed to insure stability. 4-Hers are strongly encouraged to provide as much detail as possible. Failure to provide adequate written documentation will result in a disqualification.

### **CLASSES – 5520: Rocket made from kit, 9-13 years old**

Include plans.

**5521: Rocket designed by exhibitor, 11-13 years old** (9-10 year olds may NOT enter in this class) Not merely a modification of an existing kit. Include original plans.

#### **5525: Rocket made from kit ,14 years and older**

Include plans.

#### **5526: Rocket designed by exhibitor, 14 years and older**

Not merely a modification of an existing kit. Include original plans.

#### **5527: Rocket designed by exhibitor - Alternative Skins, 14 years and older**

That uses alternative skins; not merely a modification of an existing kit. Include original plans.

#### **5530: Rocket designed by 2 or more exhibitors, 11 years and older**

Not merely a modification of an existing kit. Include original plans. This class is designed to encourage teamwork among individuals and clubs to work on a rocket from the initial design to the finished product.

### **Mid-power Rocketry (2x'D' to 'G' Engines) Guidelines:**

Purpose: To allow for improved safety and judging of rockets that meet the requirements of 4-H mid-power rockets.

1. Exhibitors must be at least 14 years of age by January 1 of the current year.
2. The rules for ALL categories apply.
3. In addition to the information packet completed for all rockets, a high/mid power information form is to be completed and placed inside of the information packet. This may be downloaded from <http://www.kansas4-H.org/>. Click on KSF Packet link.
4. Exhibitors in this division must hold memberships in either NAR or Tripoli organizations.
5. The NAR Model Rocket Safety code applies to the construction and launching of all rockets displayed in this division. As such all exhibitors must comply with the NAR Model Rocket Safety Code that is in effect as of October 1<sup>st</sup> of the current year. However in the event that there is a modification in this code the STEM Action Team may review and implement the modified code.
6. All rockets in this division are to be launched under adult supervision by the 4-H member who constructed the rocket.
7. High power rockets as defined above ('H' or 'I' engines) may not be launched in this division.
8. If according to Federal Aviation Regulations Part 101, a waiver is required to fly the rocket, a copy of that waiver is to be attached to the High Power Information Form. In the case where the launch

was a public event a substitute to a copy of the waiver is the Range Safety Officers (RSO's) contact information.

9. Mid- Power rockets may be displayed without a supporting stand. If a supporting stand is used, it is not to exceed 4-1/4" (four and one-quarter inch) thick and 8" square. The exhibitor's name, county or district, and age must be labeled on the base.

#### **5536: Mid-Power Rocket Made from Kit, or original design. Exhibitors 14 years and older**

#### **High Power Rocketry ('H' or 'I' Engines) Guidelines:**

Purpose: To allow for improved safety and judging of rockets that meet the requirements of 4-H high power rockets.

1. Exhibitors must be at least 14 years of age by January 1 of the current year.
2. The rules for ALL categories apply.
3. In addition to the information packet completed for all rockets, a high power information form is to be completed and placed inside of the information packet. This may be downloaded from [www.STEM4KS.com](http://www.STEM4KS.com).
4. Exhibitors in this division must hold memberships in either NAR or Tripoli organizations.
5. The NAR High Power Rocket Safety Code applies to the construction and launching of all rockets displayed in this division. As such all exhibitors must comply with the NAR High Power Rocket Safety Code that is in effect as of October 1st of the current 4-H year. However, in the event that there is a modification in this code the STEM Action Team may review and implement the modified code.
6. All rockets in this division are to be launched under adult supervision by the 4-H member who constructed the rocket.
7. For rockets launched using an engine(s) that have 160.1 ('H' engine or equivalent amount of smaller engines) Newton's-seconds or larger, adult supervision must be provided by an individual having at least a level I high power certification.
  - a. The 4-H member should also hold or be attempting to attain their level 1 high power certification, and should include supporting documentation of such (a copy of Level 1 card is sufficient).
7. If according to Federal Aviation Regulations Part 101, a waiver is required to fly the rocket, a Copy of that waiver is to be attached to the High Power Information Form. In the case where the launch was a public event a substitute to a copy of the waiver is the Range Safety Officers (RSO's) contact information.
8. High Power Rockets may be displayed without a supporting stand, if a supporting stand is used, it is not to exceed 4-1/4" (four and one-quarter inch) thick and 8" square. The exhibitor's name, county and age must be labeled on the base.

#### **5535: High power rocket made from kit or original design, 14 years and older**

##### **Rocket made from kit (7-8 years old)**

##### **(Not a State Fair Class)**

Prefabricated fins and pre-finished rockets requiring no painting are acceptable in this class only. Include plans.

#### **4-H STEM EDUCATIONAL EXHIBITS – POSTERS, NOTEBOOKS AND DISPLAY BOARDS**

Purpose: To allow 4-Hers to explore STEM outside the bounds of traditional projects for rockets, robotics, astronomy, computers and unmanned aerial systems. All posters, notebooks and display boards are listed in this section and have been removed from the individual sections to save space.

1. For notebooks, display boards, and posters, no additional exhibit information is required; no manila envelope is needed for these exhibits.
2. Exhibits in posters, notebooks and display boards must contain substantial supporting educational materials.
4. Educational display boards, posters and notebooks should be creative and showcase details about the knowledge learned in the project during the current 4-H year. Value is placed on youth who can demonstrate how their skills have increased while completing the project. Each exhibit will be judged on uniqueness, creativity, neatness, accuracy of material, knowledge gained, and content. An exhibit judging score sheet will be available at [www.STEM4KS.com](http://www.STEM4KS.com). For example, a rocket that may have crashed may be made into an educational display or poster that tells a great story with many lessons learned.
5. Follow copyright laws, citing all sources of information in a standard notation. Sources of information must be cited on the front of your exhibit, including all posters and educational display boards.
6. Educational displays are not to exceed a standard commercial 3'x 4' tri-fold display board. Card tables for display are not required but can be used at the county only level. Care should be taken to use durable materials that will withstand Fair conditions.
7. "Construction Kits" that are part of Educational displays must be contained in cases (tackle boxes, sealable containers, etc.) that may not be larger than 1' X 2' X 2' and must have a latch which securely keeps all components contained in the "Construction Kits". Other components are to adhere to appropriate dimensions as stated elsewhere.
8. Educational Project notebooks must be organized in a 3-ring binder.
9. Any three dimensional display exhibits may not be thicker than 1".
10. Engines and igniters in rockets ARE NOT permitted with the exhibit and constitute an immediate disqualification. This is for safety reasons and includes both spent and live engines.
11. Exhibitor's name, county or district, age, and year(s) in project must be tagged or labeled in a prominent location on the notebook and/or "Construction Kit." For educational displays and/or posters, the exhibitor's name, county, age, and year(s) in project must be tagged or labels on the back of the exhibit. Failure to label an exhibit may result in one ribbon placing deduction.
12. Exhibits should possess the following qualities (in no particular order):
  - A Central theme
  - What you want others to learn
  - Be designed and constructed in a manner befitting the exhibit
  - Be something you are interested in
  - Be related to Astronomy, Computer Systems, Robotics, Rocketry, or Unmanned Aerial Systems and those characteristics described above
13. If a safety violation is noted by the judge, superintendent, or other staff, the exhibit will receive a participation ribbon (exhibit at the judge's discretion).

### **Rocketry - Novice – Ages 7-8**

- 5735 Rocketry Educational Display
- 5739 Rocketry Educational Notebook
- 5740 Rocketry Educational Poster

### **Rocketry Division F – Exhibitors 9 through 13 years old**

- 5741 Rocketry Educational Display
- 5742 Rocketry Notebook
- 5743 Rocketry Poster Board

**Rocketry Division G – Exhibitors 14 years and older**

5746 Rocketry Educational Display

5747 Rocketry Notebook

5748 Rocketry Poster Board