2.10 - Local, State, Federal, and International Laws
Please follow all local, state, federal and international laws.

3.1 General Team Composition Requirements
The team must bring sufficient people to launch and recover their rocket, but there is no limit to how many students can work on the rocket prior to competition. All members must be enrolled in or recently graduated from a college or university that has agreed to allow said team to participate in this competition. Members may be undergraduate or graduate students. Joint teams between colleges are permitted, but those schools must agree to be on the same team realizing that there is only one award. Each team should seek out a mentor to aid in design review and keep them informed on your design progress and issues that may arise. Preferably someone with flight experience or at least ground testing of your chosen propulsion system. **All participants must be over the age of 18.**

3.4 Non-University and Corporate Involvement
Companies may sponsor a team or sponsor the competition. They can enter into a public-private partnership with a university where the students do the research but the students have to design, build, test and integrate their motor into a flight vehicle. Companies can provide valuable mentors and advisors and help direct research like any Principal Investigator at a university, but the work must be done by students. If a certified rocket motor is used, then designing, building, and testing are only referring to the vehicle and not the motor. An untested experimental motor may not be handed off to a student team to fly. The students operating the motor must be intimately knowledgeable about the ins and outs of its design and its operation. A black box understanding leads to very dangerous situations. This is an engineering design competition and it is expected that students do the work and when facilities do not permit they can have components fabricated to their specifications.

5.2.8 - Inflight Detanking
If in effort to dial in altitude the oxidizer and potentially fuel feed may be shut off intentionally. This would leave pressurized fuel, oxidizer and potentially pressurant gasses on board which could create a significant hazard on touch down. Volatile fuels must be dumped prior to landing. Oxidizers must be dumped prior to landing. For self-pressurizing propellants this could be accomplished with a normally open valve that is held closed by limited onboard and ground power prior to launch. If your flight valve is meant to shut keeping pressurized propellants on board a manual valve should be included on the tank that is shut prior to flight.

In the event depressurization fails a rope should be attached to the handle of this manual valve by the recovery team. No other operations should take place in recovery until the tanks are depressurized. Over the recovery radio system alert FAR-OUT that you are preparing to depressurize the tank. Once your recovery team fans out securing the area (preventing other recovery teams coming within 100 ft) the propulsion expert on your recovery team should actuate the valve from a safe distance via the rope. Once all pressurized tanks are depressurized, report over the radio that the tanks are safed and proceed with recovery efforts.

5.4.2 - Filling Rules at FAR
F2F for each Class 2 rocket, under typical desert conditions during the time of the competition, *must* be less than 30 minutes. In order to account for changing conditions and to debug any work problems, an extra 15 minutes *may* be allowed during a launch attempt at the discretion of the pad manager, but

rockets should not be designed to have F2F times past 30 minutes nominally. Teams will be told to abort or launch if F2F exceeds the allowed time.

In such a case, the team should determine prior to competition partial fill altitudes in case of partial fill. In continuously vented motors like UC valve hybrids and pyrovalve hybrids this is a relatively fast process. For motors that have to pressurize on the pad after filling at a lower pressure and temperature, the time to pressurize must fall within the total F2F limit. All Class 2 rocket motors must fill within 30 minutes.. *In other words, the maximum time for pressurized vehicles with Class 2 motors to be unapproachable is capped at 60 minutes during normal operation and worst-case abort procedures.*

Class 3 motors may take up to 1 hour for F2F, but it is preferred to stay in the 30 minutes to not cause issues with launch operations for other teams. Abort times for complete depressurization must take less than 30 minutes.

For non-self-pressurizing-propellants that are filled manually at ambient pressure, pressurization must occur remotely and within the same time constraints. This may require the use of a secondary pressurant gas or pumps. No tank shall become pressurized until the critical flight personnel have all retreated to safety in the shelters and FAR staff have authorized fill and pressurization for your team. Waiting for propellant to boil off is not acceptable.

5.4.5 - Umbilical Fill/Purge Systems

For umbilical fill/purge systems, in the event the umbilical is removed before liftoff the ability to drain the flight must be maintained until the rocket is leaving the ground under thrust with the flight valve open. Otherwise, umbilical systems that separate upon liftoff must allow for the removal of the detanking system from the rocket so long as the umbilical cannot be removed before the rocket is under thrust with positive upwards and increasing velocity.

Specifically for top-filled motors a dip tube for self pressurizing propellants is required such that in an abort the liquid is forced out under its own vapor pressure. This can be accomplished with a normally open valve attached to a plumbing T onboard where the umbilical disconnect is also attached. This is the same dip tube for filling that can be used for the abort after disconnect. In the event of onboard power being lost the valve would be immediately opened.

For top-filled motors without a self pressurizing propellant if the propellant is slowly volatile but not self pressurizing where it could drain itself through a dip tube like liquid oxygen a bottom valve must be included in the design to dump after loss of power.

5.3.5 - Eggs

A point bonus of 10 points per unbroken egg launched and returned to recovery undamaged will be granted, not exceeding the total Payload points of 500 points. FAR staff has to mark each egg so be sure to check in early.

5.3.6 - Drones

For deployable payloads controlled, autonomous or passive make sure the insurance covers it. As long as it's deployed from the rocket after apogee then it went up by rocket. Remote controlled systems must abide by FAA Part 107 and FCC Part 97.

5.4.11 - Launch Rails

Teams are highly encouraged to bring their own launch rails. In the case that a team cannot bring their own launch rail, FAR does have several launch rails of different sizes that may suit your team depending on rocket size. Some of these launch rails require specific rail buttons, so please make sure to contact FAR for more information regarding the special requirements for using a particular rail. Not if you are using a FAR rail if you fail to launch you may have to remove your rocket from the rail and let another team attempt. For that reason, if you are using a FAR rail or tower make sure you have a portable GSe preferably on a cart or dolly that can be rolled out to the tower and rolled away to simply pad operations. Come early on Wednesday to reserve a FAR rail or tower for opening salvo on saturday. We will be conducting a survey or rail usage in your entry form and will coordinate use of each rail type with teams long before competition. For smaller rockets the ability to use either 1010 or 1515 rails will increase your flexibility.

Available launch towers at FAR: https://friendsofamateurrocketry.org/launchers/
Quick reference of available launchers:
x4 10’ 1010 Rail
x2 10’ 1515 Rail
x2 20’ 1515 Rail
x1 Adjustable Tower 48” by 48” by 20’
x1 T Slot 60’ Rail (~20m not a typo)

Team rails must be equipped with a blast deflector or absorber utilizing a trough of water to catch any igniter preventing it from bouncing off the deflector pad and starting a fire outside of your engine. Blast deflectors will deflect exhaust between 10ºNofW and 10ºEofS. Exhaust should not be deflected past these bearings.

Team provided launchers must be able to angle in elevation of 0-5º of Vertical with azimuth +-20 degrees of slots for teams will be 40’ squares laid out With NS and WE demarcation lines.

5.5.1 - GPS Requirements

For GPS, a COTS system must be used to determine the position from the designated touchdown point. More than one system may be used but all frequencies must be identified, and if necessary, a properly licensed individual must be available at the launch site for frequencies requiring an FCC license. A GPS is required for each separately recovered section of the launch vehicle. If a team is unable to bring someone with the proper FCC license they must use a GPS system using the ISM band, preferably the 900 MHz ISM band. Teams must practice pulling telemetry off their rockets at ranges equal or greater than 40% greater than their expected apogee. **Category C flights require GPS altitude recording for scoring as barometric based systems are not accurate enough above 60,000’.**

Acceptable systems include:

Manufacturer	**GPS Tracker**	**Frequency**	**Maximum Functional Altitude for tracking [ft] (Categories Approved for altitude determination)**	**Link**	**Unit Cost**

Multitronix	**Kate 1/3**	**900MHz Variable ISM**	**550,000 LOS A, B, C, HI-EXH**	**https://www.multitronix.com/kate-3-transmitter.html**	**$1440 + $1525 GPS Receiver**
Featherweight	**GPS**	**900MHz Variable ISM**	**262,500 LOS, Relay A, B, C, HI-EXH**	**Featherweight GPS Tracker - Featherweight Altimeters**	**$165 + $190 GPS ground station**
Missileworks	**RTx/GPS**	**900MHz Variable ISM**	**160,042 A,B,C, LO-EXH**	**RTx (missileworks.com)**	**$200 + $200 Base Station $90 Logging no transmission**
	RTx/GPS Logger	**None**	**160,042 A,B,C, LO-EXH Only for Alt Determination not tracking**	**RTx (missileworks.com)**	**$90**
	T3	**Baro**	**160,042 A,B,C, LO-EXH**	**T3 (missileworks.com)**	**$160/$200 + $140 Base Station**
Eggtimer	**Eggfinder TX**	**900 MHz ISM**	**Final Position Only not for Altitude determination**	**Eggfinder GPS Tracking System | Eggtimer Rocketry**	**$70 + $35+ Receiver**
	EggFinder Mini	**900 MHz ISM**	**Final Position Only not for Altitude determination**	**Eggfinder GPS Tracking System | Eggtimer Rocketry**	**$75 + $35+ Receiver**
	Quasar	**900 MHz ISm 869 MHz Or 70 cm HAM**	**Final Position Only not for Altitude determination**	**Altimeters & AV Bay Stuff | Eggtimer Rocketry**	**$100**
Big Red Bee	**2m 5W APRS**	**2m HAM**	**Final Position Only not for Altitude determination**	**Documentation and Programming Utilities – BigRedBee**	**$265 + $119 Receiver**
	70cm 100mW GPS/APRS	**70cm HAM**	**Final Position Only not for Altitude determination**	**Documentation and Programming Utilities – BigRedBee**	**$259 + $119 Receiver**
	BRB Iridium SBD	**Iridium NLOS**	**Final Position Only not for Altitude determination**	**Documentation and Programming Utilities – BigRedBee**	**$409+ Data plan**

Other GPS units can be approved if it is deemed a viable option.

5.5.3 - Flight Computer Requirements

For altitude determination, two systems are required to determine the flight's apogee.. At least one COTS altimeter must be used. **Teams must be able to disarm altimeters from the outside of the rocket while it is still vertical. This may involve a ladder which your team is obligated to bring if the switch cannot be reached by the second tallest member of your team attending the competition. This is in case something happens to the tallest. Altimeters must be armed once the rocket is vertical and before igniter leads are connected.**

Category A and B can use altimeters and/or GPS Report all COTS systems and we will average them for determined altitude.

Examples of acceptable systems include
Category Deployment Altimeter altitude recommendations for allowable altitudes given in MSL (AGL at FAR - MSL -2kft)

Manufacturer	Deployment Altimeter	Measurement Method	Maximum Functional Altitude for deployment [ft] (Categories Approved for deployment and conditions)	Link	Unit Cost
Multitronix	Kate 1/3	GPS / Acc/ Baro	550,000 A, B, C, HI-EXH	https://www.multitronix.com/kate-3-transmitter.html	$1440 + $1525 GPS Receiver
Featherweight	Blue Raven	Baro / Acc	105,000 A,B,C Condition[1]	https://www.featherweightaltimeters.com/store/p25/Blue_Raven_Permalink.html	$175
	Raven 4	Baro / Acc	105,000 A,B,C Conditional[2]	https://www.featherweightaltimeters.com/raven-altimeter.html	Legacy
Perfectflite	SLCF	Baro	100,000 A,B,C Conditional[3]	http://perfectflite.com/SLCF.html	$60
	SL100	Baro	100,000 A,B,C Conditional[4]	http://perfectflite.com/sl100.html	Legacy
MissileWorks	RRC3x	Baro	100,000 A,B,C	RRC3 Altimeter Xtreme - Madcow Rocketry	$88
	RRC3 Sport	Baro	40,000 A,B	RRC3 (missileworks.com)	$80

[1] Must apply a dab of epoxy under capacitor to prevent capacitor from twisting or bending off board in high g flight
[2] See 1
[3] See 1
[4] See 1

	RRC2+	**Baro**	**40,000 A,B**	RRC2+ (missileworks.com)	**$55**
Eggtimer	**Quasar**	**Baro**	**60,000 A,B, Low C Conditional[5]**	Altimeters & AV Bay Stuff | Eggtimer Rocketry	**$100**
	Proton	**Baro**	**60,000 A,B, Low C Conditional[6]**	Altimeters & AV Bay Stuff | Eggtimer Rocketry	**$80**
	Quantum	**Baro**	**60,000 A,B, Low C Conditional[7]**	Altimeters & AV Bay Stuff | Eggtimer Rocketry	**$40**
	Quark	**Baro**	**60,000 A,B, Low C Conditional[8]**	Altimeters & AV Bay Stuff | Eggtimer Rocketry	**$20**
Entacore	**Aim XTRA**	**GPS/Acc/Baro**	**100,000 A,B,C**	AIM XTRA GPS flight computer | Entacore Electronics- Advanced GPS tracking flight computer / rocket altimeter.	**$325 + $125 Base Station**
	AIM USB	**Baro**	**38,000 A,B**	AIM USB Rocket Altimeter | Entacore Electronics- High reliability dual ejection rocket altimeter.	**$115**
Rocketronics	**Altamax G4**	**Baro / Acc**	**102,000 A,B,C**	Altimax G4 Altimeter for model rockets (rocketronics.de)	**$105**
MARSA	**MARSA4, MARSA54, MARSA54L**	**Baro / Acc**	**Limited Documentation A, B**	https://onebadhawk.com/marsa-systems.html	**$199-$219**

Other altimeters can be approved if it is deemed a viable option.

Research altimeters are highly encouraged, but cannot be used as a primary or for altitude determination. Ideally, these should be flight-tested prior to competition on a smaller rocket if possible.

5.6 - Recovery

Two-phase recovery is required. A drogue parachute or other first stage recovery system must be activated to keep the descent velocity between 50 and 150 ft/s **below 30,000'. Due to low pressure at**

[5] Since these are kits assembled by the customer. Teams must conduct a vacuum chamber test or full flight test with another altimeter from the list to compare pressure data curves and ensure deployment relays work.
[6] See 5
[7] See 5
[8] See 5

high altitude an inflated drogue may have a higher descent rate. The activation or deployment of the first system must happen at apogee to prevent the rocket from passing 150 ft/s on descent **under 30,000'**. At some point during descent below ⅓ of the target altitude and above 1000 ft above ground level, the descending velocity must be lowered to below 30 ft/s. Main openings or descent retardation below 50 ft/s occurring above ⅓ of the target altitude will be considered to be premature and teams will lose recovery points due to the likelihood of leaving the field.

5.7.2 - Static Testing

For research motors, at least one full-scale (full-load, full-pressure, with flight hardware that is to be flown at competition) test fire must be completed by the May Progress Update, with more at teams' discretion. If a team shows up with an untested motor to the competition they will not be able to fly or compete.

Thrust data for full burn duration is required for any flight motor. We highly recommend pressure taps for motor diagnostic reasons but they are not necessary. If you take the data please submit it with the thrust data so we can better understand your engine.

Prior to static test teams should test their igniter and preheater outside of the engine to ensure it works. A sample preheater and igniter must be brought to competition for batch testing of what the team intends to use to light their engine. This will insure that the preheater and igniters for your flight will work preventing delays and aborted flights.

5.7.4 - GSE Testing

At a bare minimum the GSE must include ways to remotely fill the motor, remotely dump the motor, ignite the motor, and indicate the fill level of propellants. GSE must successfully demonstrate the required functionality in one of the following ways:

1). A full wet dress rehearsal with the GSE to be used at competition.
2). A static fire of their competition engine using their competition GSE.
3). A flight test of their rocket using their competition GSE.

The entire GSE testing process and tower assembly, mounting of the rocket and erection shall be recorded or live streamed and posted on Youtube so our safety personnel can look for potential issues. If your team cannot launch the rocket should be put into a flight position and secured to a rail or tree with ratchet straps with everything set up. This provides the team with valuable practice for setting up their system and helps identify potential problem areas in pre-launch procedures.

6.4.3 - Emergency Response Plan

We require clear abort and safing procedures that a member of any other team should be able to understand and follow with ease. Prepare a briefing for FAR staff that will be made available to neighboring teams so when something goes wrong they understand what is going on. FAR staff will manage said procedures, but in any case it is best to be prepared for any situation that may arise.

6.6 - Competition Schedule

Removed the competition schedule, as it is still in a tentative state and we want to revise it independently. It will be found on faroutlaunch.org/documents-links

6.8.3 - Ejection Testing

An area near the team setup area will be provided for black powder and CO_2 ejection system testing.

6.8.4 - Leak Testing

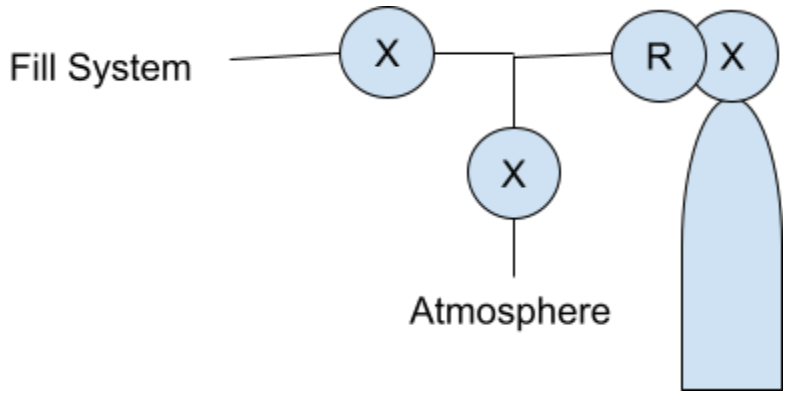
During setup days leak tests can occur at 150 psi by removing people from your team's pad area and restricting personnel on that pad to those who have passed pressure vessel safety training. Every two hours starting at 8am high pressure leak tests can be done when the range is restricted to those who have passed pressure vessel safety training. If teams do not wish to perform leak tests then the range will not be restricted. Teams will be given flags to indicate leak testing status of Red for at High Pressure, Yellow for Low Pressure and Green for Depressurized. Leak tests during active launch days can be done during the salvo times under the same rules. Waivers must be signed by team lead and individual rocketeers attesting to training and understanding the risks.

6.8.4.1 - Pressure Testing Supply System Rules for Air Compressors

150 psi tests with an air compressor must have an inline oil/water filter to prevent contaminating oxidizer lines.

6.8.4.1 - Pressure Testing Supply System Rules for Air Compressors

Regulated pressure from a supply bottle of compatible gas. No fuels in oxidizer lines (only N_2, CO_2, or Noble Gases, O_2). No oxidizers in fuel lines (only N_2, CO_2, Noble Gases). In order to use a regulated gas the team must prepare a plumbing system that allows the setting of the regulator prior to connecting to the fill system. This is accomplished with a manual valve after the regulator and before the fill system. The regulator pressure will be set against the valve to prevent overpressurizing any part of the fill system or allowing the motor to go to full pressure prior to minimal personnel. 150 psi is allowed when restricting personnel to safety certified team members in your team pad area. Full pressure tests cannot occur unless under a red flag. Prior to the red flag the left and bottom valves should be closed and the regulator should be set to the desired pressure for the test. If you wish to pressure your system gradually make sure the set pressure of the regulator is at zero. Be sure to label the direction on your regulator for + or - pressure if it isn't already. In the heat of the moment people miss these things.



6.8.5 - Final Flight Safety Check renumbered

6.11.1 - Team Member Tracking and Check-In/Check-Out Procedure

Team Member Check-In and Check-Out:

- **All recovery teams are required to check in and check out using the radio every 15 minutes.**
- **To ensure convenience and efficient tracking, check-in times will be staggered.**
- **This check-in process must be maintained until all team members have returned safely.**

Personnel Rules:
During recovery operations, the following rules apply to any discovered rockets or rocket parts, regardless of the team they belong to:

1. **Documentation:**
    - **A photograph of the discovered rocket or part must be taken.**
    - **The Latitude-Longitude (Lat Long) location must be accurately recorded.**
2. **Submission to Recovery Check-In:**
    - **All data, including photographs and location information, should be promptly submitted to the recovery check-in team.**
3. **Sportsmanship Points:**
    - **If a team discovers another team's rocket through this process, and it was not previously found, they may earn sportsmanship points.**
        - **Record the precise location.**
        - **Capture a photograph.**
        - **Submit this information to the flight check-in team.**
4. **Data Utilization:**
    - **The collected data will be used for:**
        - **Validating the recovery area.**
        - **Enhancing simulations for anticipated landing zones and ballistic zones in future competitions.**
5. **Self-Discovery:**
    - **When a team locates their own rocket, they must:**
        - **Record the precise location.**
        - **Capture a photograph.**
        - **Safe the rocket**
        - **Pack up the rocket for the journey back**
        - **Submit this information to the flight check-in team along with the rocket**

By following these rules and procedures, we aim to ensure efficient team member tracking and data collection during recovery operations, promoting a fair and competitive environment in our competitions.

7.5.1 - Egg Drop Bonus

- **Bonus 10pt/egg.**

7.6 - Video Bonus

The total amount of video bonus points will not exceed 500 points total. Videos must be submitted the same day as the rocket is recovered. Note, a single video can take multiple of these bonuses. Such as live 360 from the rocket would be 400 points.

Video format must be submitted electronically with a minimum resolution and frame rate of 1080p and 30 frames per second respectively in order to accept your video submissions.

- 250 Live Video from the rocket
- 100 Points for usable onboard video
- 150 Points for usable 360-degree onboard video
- 100 Points for usable launch video (from the ground, from the bunker, from the top of the rail, etc.)
- 50 Points for each extra camera angle we haven't considered or not listed above

7.6.1 - Drones

FAA drone rules apply, they will be allowed in the airspace. Our only additional rule is that the exclusion zone around all launchers, not just yours, comes off as a 45 degree cone from the tip of the launch tower, projected upwards. Drones must not be flown in this cone. This really restricts drones from flying over teams during pads during launch ops and puts them at the perimeter.

Remote controlled systems must abide by FAA Part 107 and FCC Part 97 of the FAA Regulation. Failure to comply with this exclusion zone will result in a strict conversation and if your team continues to do so, your team will be heavily penalized and/or disqualified.