MASA Meeting – Thursday, February 2, 2012
Level 1 & 2 High Power Certification

Packet

- An Introduction to Large Model Rockets
- High Power Level 1 Certification
- NAR High Power Certification Application (2 pages)
- Recorded Level 1 Certification Flights at MASA Launches
- Range of Suitable Kits for L1 Cert Flights
- High Power Rocket Safety Code (2 pages)

Miscellaneous Notes

- KISS.
- Pick an appropriate kit. Build it well, but don't go overboard.
- Elastic shock cord belongs in your underwear, not in your rocket. Tubular nylon makes a good high-strength shock cord.
- Don't trust that molded plastic attachment point on the nose cone. Add an eye bolt or U-bolt.
- Good motor retention is a must. Friction fit and masking tape won't cut it.
- Nomex heat shields work nicely to protect your parachute.
- The rocket will always end up heavier than you expect. Plan accordingly.
- Pick a motor that will give you a safe flight, good liftoff acceleration, and at least 1,000 ft of altitude. Simulate it to check these parameters and help you pick a delay length. Bring a printout of this simulation to the launch.
- Consider installing rail guides/buttons instead of launch lugs for a more secure liftoff.
- If flying in "corn season", remember your paranoia buzzer.
- Mark the CP location on the finished rocket. Mark one caliber in front of it so that the rocket's stability margin can be easily checked at the field.
- Figure out how & where to acquire your motor well in advance.
- In the week before attempting a cert flight at a MASA launch, let those in charge know your intentions and needs. If you show up and just assume that there will magically be an appropriate pad, launch rod, etc, you may end up frustrated & disappointed! Line up your NAR cert team in advance of the day. Be prepared. Remember your NAR paperwork.

Costs?

- Kit – anywhere from $60 to $200
- Motor casing - $60 to $100 (Aerotech)
- Motor reload - $17 to $50
- Plus paint, glue, motor retention, etc…

An Introduction to Large Model Rockets

What is an LMR?

LMRs (Large Model Rockets) are generally defined as weighing up to about 3 pounds and using E, F, or G size motors. LMRs are constructed using heavier-duty materials and stronger glues than smaller model rockets. LMRs are not necessarily harder to build than model rockets. In fact, most LMRs contain the same number of parts as a small rocket. If you have a reasonable amount of experience with model rockets, you can handle the bigger stuff. Depending on who you talk to, LMRs may also be called "medium power" or "mid power" rockets.

How are LMRs different than model rockets?

Size & Weight. The model rocket range is generally defined as weights up to a pound and motor sizes up through "D". LMRs may weigh up to 3.3 pounds (1500 grams), be four inches (or more) in diameter, up to 5 feet (or more) in height, and use engines up through G. There is some overlap – the two categories aren't rigidly defined.

Materials. LMRs use heavier materials than model rockets. LMR body tubing may be a thick-wall cardboard, phenolic (a paper that is impregnated with resin to make it harder and stronger), or a "plastic" polymer material. LMR nosecones are sturdier and heavier. LMR fins will usually be made of aircraft plywood or G10 (a fiberglass sheet). LMRs use nylon parachutes instead of plastic. Also, the centering rings for the motor mount will often be made of aircraft plywood or composites instead of cardboard.

Construction Methods. The basic methods are similar to model rockets. While LMRs may still be built with yellow glue, 2-part epoxies are most commonly used. Epoxies are available with different working times. Generally, the longer the working time, the stronger the bond will be. (I recommend 15-minute as being most all-around useful.) You might also use cyanoacrylate (CA) glues. CA glues are essentially hobby-grade "super" glues. They "grab" extremely fast and are very light. While they make a strong bond, it doesn't have any "give" to it; when a CA glue joint fails, it can do so in a very sudden and brittle manner.

Engines. Generally, a LMR may use an E, F, or G size engine (or even a cluster of several engines) that contain a "composite" propellant. The main reason for the stronger, heavier materials in LMRs is because these engines have a lot more "grunt" than the smaller, black powder engines used in model rockets. For example, a G80 has over 7 times the total power and over 6 times the thrust of a D12! These engines can rip apart ("shred") rockets that aren't properly constructed. Motors in LMRs may not have more than 80 Newtons of average thrust, contain more than 62.5 grams of propellant, or have more than 160 N-s of total impulse.

Launching. LMRs require a sturdier launch pad and larger launch rods than model rockets. Also, the engines need a 12 volt launch system for ignition. You can buy suitable pads and launch controllers or build your own.

How Should I Get Started?

Sets. Aerotech sells a LMR "starter set" that contains an "Initiator" rocket, "Mantis" launch pad, and "Interlock" controller. Of course, you can buy rocket kits, pads, and controllers separately. Pads and controllers can also be built from plans available on the Internet or from rocket clubs.

Recommended Kits. Aerotech makes nice kits for those new to LMR. They are straightforward to construct, have decent instructions, look good, and fly well. Recommended Aerotech kits for the beginner include the Initiator or Arreaux. Public Missiles Ltd (PML) makes a lot of nice LMR kits. Recommended LMR kits from PML include the IO, Phobos, Explorer, X-Calibur, AMRAAM 2, Small Endeavour, Tiny Pterodactyl, Bull Puppy 2.1, and Callisto. PML kits will be a little more complicated, and their instructions assume some previous LMR building experience. LOC/Precision also makes a variety of kits. Some recommendations would include the Graduator, Onyx, lil' Nuke, Weasel, or Forte. LOC instructions are not very detailed; they assume that you have some previous rocket building experience.

Engine Choices. Computer simulation of your rocket flights will allow you to choose appropriate motor types and delay lengths. Your first LMR launch is quite an experience. Most people are startled by the smoke, visible flame, noise, and by just how astonishingly fast and high the rocket just flew!

Rocket "*Wisdom*" from www.mn-rocketry.net

High Power Level 1 Certification

KISS (Keep It Simple, Stupid)

Keep it simple, keep it safe. The true purpose of a level 1 certification is to demonstrate to the NAR and / or TRA that you know what you're doing. A successful certification flight depends on proper knowledge, proper preparation, and a little bit of luck. Proper knowledge depends upon you reading everything that you can find; you can learn a lot from reading rocket magazines and books as well as taking advantage of the info on the Web. Rocket people are almost invariably helpful; ask questions of those who have tread this path before you. Proper preparation depends on you successfully applying your hard-won knowledge and using your rocketry common sense. The bit of luck is beyond your control, but if you're well prepared, you don't need *much* luck.

Rocket Selection

Buy a kit. You may be tempted to scratchbuild something, but resist that temptation. You probably don't know enough yet about large rockets to attempt a Cert flight with a scratchbuilt rocket. Plus, RSO's tend to be nervous about Cert flights on scratchbuilts. There are many good kits available from companies such as LOC/Precision, Public Missiles, Aerotech, Mad Cow, Wildman, and many more.

Bigger rockets are better. I strongly urge that you use a 3 or 4 inch diameter rocket. Resist the urge to use a very small rocket or a very large rocket. Keep weight in mind; I like cert flights that go up about 1,000 to 1,500 feet. Any flight below 1,000 feet will be slightly dicey; anything much over 2,000 runs an increasing risk of losing the rocket. Look for a rocket with good stability characteristics. My advice is to avoid the short, stubby class of rockets (like the LOC Minie Magg) due to their small stability margins. (They can fly fine - just wait until later to try them.)

Kit Examples (NOT a comprehensive list).

Smaller:	LOC - Forte, Caliber ISP, Hi-Tech H45; PML - Black Brant VB, Quasar, Small Endeavour, Explorer
Perfect:	LOC - EZI-65, Expediter, IV, Cyclotron, Fantom; PML - Ariel, D Region Tomahawk, 1/4 Scale Patriot, AMRAAM 3, Tethys, Miranda, Hydra, Intruder, Matrix; Aerotech Sumo
Bigger:	LOC I-roc, PML - Endeavour; AMRAAM 4

Modifications. You may wish to modify your rocket kit - "improve it". This is fine, so long as you do it carefully; each modification should have good reasoning behind it. Some people get paranoid and really reinforce their rockets. Some reinforcement is fine, but don't go nuts. Remember, it all adds weight. Again, Keep It Simple. Leave the fancy stuff (like onboard electronics) for later projects.

Motor Selection

Diameter. Most people will choose a 29mm or 38mm reloadable motor. You choice of 29 versus 38 may be forced by the size of your motor mount. (Some PML kits have "Kwik-Switch" mounts to cope with 54, 38, or 29mm motors. Otherwise, you're best off with a rocket that has a 38 or 54mm mount. "You can always adapt down. You can't adapt up.") Plus, a 38mm mount allows for a larger selection of motors.

Power. Stick with an "H" motor for your Cert flight - leave the I motors for later fun. (Exception - if you have a very large / heavy rocket, a safe flight may require an I motor.) In 29mm, consider motors like the Aerotech H128 or the H180. In 38mm, perhaps the H123 or the H242. A computer simulation can help you choose an appropriate motor and delay time. If you are flying a heavier rocket, you will need a higher thrust motor to provide a safe thrust-to-weight ratio.

Retention. You've just paid quite a bit for that reloadable motor casing. Make sure you build some type of secure motor retention into your rocket; masking tape is no longer appropriate. Ejecting the casing instead of the parachute is a *bad* thing.

One last thing, remember to mark the center of pressure (Cp) location and one caliber's distance forward from the Cp directly on your rocket. That way, the stability can be checked before launch by a simple balance test to locate the center of gravity.

For more information on certification requirements and procedures, please visit www.nar.org or www.tripoli.org

NAR HIGH POWER CERTIFICATION APPLICATION

APPLICANT INFORMATION (Completed by applicant)

Name: _____ Birth Date _____/_____/_____
First Last

Address: _____ NAR No.: _____
Street Apt.

_____ Expiration Date: _____
City State Zip Is membership current?

Evening phone no.: (_____)_____ Cell phone no.: (_____)_____ (Optional)

I, _____, certify that I am a member in good standing of the National Association of Rocketry. I am 18 years of age or older. I understand that I must comply with all applicable federal, state, and local laws or regulations during and after this certification attempt.

Signed:_____, Date:_____, Location:_____

HPR LEVEL 1 CERTIFICATION CHECKLIST (Certification Team - Use this section Only for HPR Level 1 Certification Attempts)

Preflight: Motor(s) used: _____ (At least one motor must be an H or I Impulse Motor)
☐ Motor is certified ☐ FAA Waiver available (if required) ☐ Safety checklist complete (see back)

Flight: ☐ Model is stable ☐ Recovery system deployed ☐ Safe recovery

Post Flight: ☐ Verify that no major damage is Present Minor impact damage or "zipper" is acceptable
☐ Verify motor(s) is (are) present **Successful flight?** ☐ Yes ☐ No

HPR LEVEL 2 CERTIFICATION CHECKLIST (Certification Team - Use this section Only for HPR Level 2 Certification Attempts)

Preflight: Motor(s) used: _____ (At least one motor must be an J, K or L Impulse Motor)
☐ Motor is certified ☐ FAA Waiver available (if required) ☐ Safety checklist complete (see back)
☐ Applicant is Level 1 certified ☐ Level 2 Written Exam passed within one year on ____/____/____
Month Day Year

Flight: ☐ Model is stable ☐ Recovery system deployed ☐ Safety recovery

Post Flight: ☐ Verify that no major damage is Present Minor impact damage or "zipper" is acceptable
☐ Verify motor(s) is (are) present **Successful flight?** ☐ Yes ☐ No

CERTIFICATION AFFIDAVIT (Successful attempts only, completed by certification team)

We, the undersigned, being members of the National Association of Rocketry distinct from the applicant, have witnessed a demonstration by (Name) _____ (NAR#)_____, of skills relative to the building and safe operation of High Power Rockets. We attest that the applicant is 18 years of age or older and a member in good standing of the NAR. We believe this member is qualified to build and operate High Power rockets with a total installed impulse up to: ☐ 640 N-sec. (Level 1) ☐ 5120 N-sec. (Level 2)

Name (Printed): _____ Signature: _____ NAR No: _____

Birth Date: _____/_____/_____ Membership Expiration Date: _____/_____/_____ Certification Level: _____

Name (Printed): _____ Signature: _____ NAR No: _____

Birth Date: _____/_____/_____ Membership Expiration Date: _____/_____/_____ Certification Level: _____

NAR HIGH POWER CERTIFICATION

Name (Printed): _____

NAR No.: _____ Cert Level: "1" "2"

Certification Date: _____/_____/_____

Witnessed By: _____

Witnessed By: _____

This card is void 60 days after Certification Date

Cut Along Dotted Line

1) Request individual Level 2 Written Exams from
NAR HQ
PO Box 407
Marion, IA 52302
Certification Teams or Section Leaders wishing to obtain multiple copies of the of the Level 2 Written Exams can send an email to the current NAR Chairman of Sport Services listed on the NAR Website for a soft copy of the files
2) Send completed forms (with exams, if applicable) to the NAR HQ address listed above

Revision 2-Oct-2010, File - hpappl

NAR HIGH POWER ROCKETRY CERTIFICATION CHECKLIST

Has the rocket model that is being used for the certification attempt been built by the applicant requesting certification?	
Is the nosecone or payload shoulder sufficiently light to prevent drag separation? The nosecone or payload should not wobble side to side or separate from its own weight. Is a vent hole needed to relieve pressure for high altitude flight? Do stage couplers fit snuggly to prevent bending or separation during flight? Is the body tube thickness adequate to withstand high power flight (typically .050 inch walls or thicker)? Is there pre-existing damage which may weaken the model structure (e.g. tube crimps)? Are screws and fasteners tight, if used?	
Are the launch lugs securely fastened to the model? Verify no cracking of adhesive joints. Is the launch lug(s) appropriately sized for the model, typically 1/4 inch or larger diameter? Will the launch lugs bind on the launch rod? Taped on launch lugs are not permitted.	
On cluster models are the spaces between the motor tubes filled to prevent ejection pressure leakage? If mixing black powder and composite motors does the modeler assure composite motor ignition before black powder motor ignition (composite motors ignite more slowly than black powder motors)? If the cluster model is not using all of its motors are the unused motor tubes plugged to prevent ejection blow-by?	
If a Level 1 Certification is being attempted, does the rocket model contain at least one single H or I impulse motor? If a Level 2 Certification is being attempted, does the rocket model contain at least one single J, K or L impulse motor?	
Is (are) the motor(s) sufficient to safely fly the model? Use motor manufacturer's recommendations or recommended motor lists for similarly sized models as a starting point (Also consider, model weight, configuration, and finish when evaluating motor capabilities). Is (are) the either NAR, Tripoli or CAR certified? Motors must be currently certified to be used. Low current igniter? ☐ Yes ☐ No	
Is (are) the rocket motor(s) firmly restrained in the model? Check for engine mount integrity to prevent a "fly through" (Is a thrust ring used?). Check for a motor hook or similar motor restraint. Carefully check taped or friction fit motors for tightness. Ask the modeler what adhesives were used during assembly. Are clusters wired in parallel?	
If electronics are used, is the battery secured against "g" loads? Will electrical connections fail or loosen from acceleration forces? Will igniters stay fully inserted in rocket motors during boost? Is the user protected against inadvertent operation, e.g. is the circuit remotely armed, are safety switches present, is an armed status indicator used (visual or audible)? Does the modeler have a checklist or reminder to arm or operate the system prior to flight?	
If radio control is used, is for flight functions (e.g. recovery) the operating frequency in the 27, 50, 53, or 72 megahertz bands? Use of 75 megahertz for flight functions is not permitted. Is the antenna protected from breakage (not flopping freely)? Did the operator range check his equipment?	
Are the fins fully secured to the model? Check for looseness or cracking at the fin to body tube junction. "Thru the wall" construction is recommended for high power models. Is the fin material compatible with the motor thrust range (1/8 inch minimum plywood is recommended for high power models)? Ask the modeler how his fins are mounted, what adhesives were used (epoxy is preferred), and what fin material was used. Are the fins mounted parallel to the roll axis of the model? Are any warps present which may cause erratic flight?	
Is the model stable? If stability is in doubt require proof of the CG and CP locations (remember CG should be forward of the CP by approximately 1.0 body tube diameters). Ask the modeler to show the CG and CP locations and how they were determined. Verify that the modeler shows the CG with the motor(s) intended for flight and not a smaller motor or fewer motors (clusters). Ask the modeler to show CG and CP for the complete model and less each stage for a staged model. Require evidence of CP calculations if further doubt exists.	
Will the model "bust" the FAA waiver? Verify compliance by comparing model weight and power with charts/tables (if available) or by calculation. Ask the modeler what the expected performance is and how he made his determination (e.g. computer simulation, similar models).	
Does the recovery system being used follow the requirements of an Active Recovery deployment system required for certifying? Inspect the recovery system. Verify that the shock cord is not cut or frayed and free of burns. Are the shock cord mounts securely mounted to the model? Are sharp edges present which may cut shock cords, parachute risers, and suspension lines? Is hardware, e.g. swivels, screw eyes, sufficiently strong to withstand recovery loads. If required, perform a pull test on the recovery system. Is parachute protection (e.g. wadding) adequate? Check for parachute damage, e.g. tears, burns, which may spread during recovery.	

Recorded Level 1 certification flights at MASA launches (1998 - 2011)

(in roughly chronological order) *ae; Jan 30, 2012*

Rocket	Motor	Outcome
LOC IV	H128	success
LOC Forte (stretched)	H128-M	success
NCR Patriot	H128-S	success
LOC EZI-65	H123	failure, motor blow-by; incorrect delay assembly?
Aerobee 150	H128	success
Aerotech Nostromo	H128-S	success
NCR Archer	H128-S	success
BSD Horizon	H123-M	success
PML X-Calibur	H123-M	success
Aerotech Sumo	H220	success
PML Phobos	H238-M	success
Aerotech Sumo	H128	success
LOC Forte	H128	failure, lost rocket; no return
Public Enemy V2	I212	success
Thoy WASP	H165-M	success
Aerotech Sumo	H128	success
Black Brant VB	H128-M	success
PML Tethys	H180-M	success
LOC IV	H180-M	success
Executioner Clone	H165	success
LOC Minie Magg	H180-M	success
PML 1/4 Scale Patriot	H123-M	success
LOC Expediter	H123-S	success
PML Tethys	H242-M	success
LOC Fantom	H123	success
Genisis	H128	unsuccessful, no chute
Super DX3	H123	success
Patriot	H242-M	success
Genisis	H128	success
PML Tiny Pterodactyl	H128	success
PML X-Caliber	H123-M	success
LOC Bruiser	J350-S	success
LOC Fantom	H128	success
LOC IV	H128	success
Patriot	H225	success
PML Callisto	H128	success
		Not a success!

Recorded Level 2 certification flights at MASA launches (1998 - 2011)

(in roughly chronological order) *ae; Jan 30, 2012*

Rocket	Motor	Outcome
LOC Mini Magg	J350	disallowed - flew into overcast
LOC Magnum	J350-M	unsuccessful, CATO
PML Tethys	J350-M	success
PML AMRAAM 4	J350-M	success
"Thor"	J350	success
"Green Lantern"	J275	success

Range of suitable kits for L1 cert flights (PML & LOC) *ae; Jan 30, 2012*

Mfg	Rocket Name	dia (in.)	length (in.)	weight (oz.)	mmt size	motor range
Small						
Loc	Nuke Pro Maxx	2.2	40	16	38mm	F, G, H, I
Loc	Vulcanite	2.2	53	23	38mm	F, G, H, I
PML	AMRAAM 2	2.1	42	24	29mm	F, G, H
PML	Callisto	2.1	46	25	29 or 38mm	F, G, H
PML	IO	2.1	33	23	29 or 38mm	
PML	Mini-BBX	2.1	61	39	29mm	G, H
PML	Phobos	2.1	57	32	29 or 38mm	G, H
PML	Quicksilver	2.1	55	34	38mm	G, H
PML	X-Calibur	2.1	46	32	38	F, G, H
Acceptable						
Loc	Hi-Tech	2.6	50	20	38mm	F, G, H, I
PML	Black Brant VB	2.5	51	32	29 or 38mm	G, H, I
PML	Explorer	2.5	48	32	29 or 38mm	G, H
PML	Quasar	2.5	56	39	KS	H, I
PML	Small Endeavour	2.5	47	35	38mm	G, H
PML	AGM-256 Pit Bull	2.5	35	29	38mm	G, H, I
Better						
Aro	Sumo	4	39	32	29mm	G, H
Loc	Athena3	3	59	44	29	F, G, H, I
Loc	Caliber-ISP	3.1	59	29	54mm	F, G, H, I, J
Loc	Cyclotron	3.1	57	35	38mm	F, G, H, I
Loc	Forte	3.1	45	20	38mm	F, G, H
Loc	HyperLoc 300	3.1	50	52	54mm	H, I, J
Loc	Isis	3.1	55	30	38mm	G, H, I
Loc	Lil' Diter	3.1	47	21	38mm	F, G, H
Loc	Norad	3.1	36	20	29mm	F, G, H
Loc	Norad Pro Maxx	3.1	46	24	38mm	F, G, H, I, J
Loc	Shadowhawk	3.1	62	31	38mm	G, H, I
Loc	Tweed-B	3.1	81	38	38mm	G, H, I
PML	AMRAAM 3	3	61	51	KS	G, H, I, J
PML	Ariel	3	58	51	KS	H, I
PML	Bull Puppy	3	39	32	38mm	G, H
PML	D-region Tomahawk	3	71	55	38mm	H, I
PML	Matrix	3	54	55	38mm	H, I
PML	Miranda	3	62	52	KS	H, I
PML	Mystic	3	37	38	38mm	G, H, I
PML	Spitfire	3	50	41	38mm	H, I
Preferred						
Loc	3.9" V2	4	34	41	38mm	F, G, H, I
Loc	Bullet	4	40	28	38mm	F, G, H
Loc	Expediter	4	62	40	54mm	H, I, J
Loc	EZI-65	4	58	35	54mm	G, H, I, J
Loc	Fantom 438	4	47	30	38mm	F, G, H, I
Loc	HyperLoc 835	4	74	60	54mm	H, I, J
Loc	LOC-IV	4	48	29	38mm	F, G, H
Loc	R2/ARO	4	39	42	38mm	F, G, H, I
PML	1/4 Patriot	3.9	56	50	38mm	H, I
PML	AMRAAM 4	3.9	78	78	KS	H, I, J
PML	Black Brant X	3.9	102	107	KS	I, J
PML	Endeavour	3.9	71	71	KS	H, I, J
PML	Tethys	3.9	53	53	KS	H, I, J
Larger						
Loc	I-Roc	5.5	54	56	38mm	H, I, J
Loc	Minie-Magg	5.5	37	40	38mm	G, H, I

Notes: listed weights (especially for LOC kits) tend to be low
classifications are my opinions only - AE
many other kits and manufacturers out there - not an exhaustive list

High Power Rocket Safety Code

1. **Certification.** I will only fly high power rockets or possess high power rocket motors that are within the scope of my user certification and required licensing.
2. **Materials.** I will use only lightweight materials such as paper, wood, rubber, plastic, fiberglass, or when necessary ductile metal, for the construction of my rocket.
3. **Motors.** I will use only certified, commercially made rocket motors, and will not tamper with these motors or use them for any purposes except those recommended by the manufacturer. I will not allow smoking, open flames, nor heat sources within 25 feet of these motors.
4. **Ignition System.** I will launch my rockets with an electrical launch system, and with electrical motor igniters that are installed in the motor only after my rocket is at the launch pad or in a designated prepping area. My launch system will have a safety interlock that is in series with the launch switch that is not installed until my rocket is ready for launch, and will use a launch switch that returns to the "off" position when released. If my rocket has onboard ignition systems for motors or recovery devices, these will have safety interlocks that interrupt the current path until the rocket is at the launch pad.
5. **Misfires.** If my rocket does not launch when I press the button of my electrical launch system, I will remove the launcher's safety interlock or disconnect its battery, and will wait 60 seconds after the last launch attempt before allowing anyone to approach the rocket.
6. **Launch Safety.** I will use a 5-second countdown before launch. I will ensure that no person is closer to the launch pad than allowed by the accompanying Minimum Distance Table, and that a means is available to warn participants and spectators in the event of a problem. I will check the stability of my rocket before flight and will not fly it if it cannot be determined to be stable.
7. **Launcher.** I will launch my rocket from a stable device that provides rigid guidance until the rocket has attained a speed that ensures a stable flight, and that is pointed to within 20 degrees of vertical. If the wind speed exceeds 5 miles per hour I will use a launcher length that permits the rocket to attain a safe velocity before separation from the launcher. I will use a blast deflector to prevent the motor's exhaust from hitting the ground. I will ensure that dry grass is cleared around each launch pad in accordance with the accompanying Minimum Distance table, and will increase this distance by a factor of 1.5 if the rocket motor being launched uses titanium sponge in the propellant.
8. **Size.** My rocket will not contain any combination of motors that total more than 40,960 N-sec (9208 pound-seconds) of total impulse. My rocket will not weigh more at liftoff than one-third of the certified average thrust of the high power rocket motor(s) intended to be ignited at launch.
9. **Flight Safety.** I will not launch my rocket at targets, into clouds, near airplanes, nor on trajectories that take it directly over the heads of spectators or beyond the boundaries of the launch site, and will not put any flammable or explosive payload in my rocket. I will not launch my rockets if wind speeds exceed 20 miles per hour. I will comply with Federal Aviation Administration airspace regulations when flying, and will ensure that my rocket will not exceed any applicable altitude limit in effect at that launch site.

10. **Launch Site.** I will launch my rocket outdoors, in an open area where trees, power lines, buildings, and persons not involved in the launch do not present a hazard, and that is at least as large on its smallest dimension as one-half of the maximum altitude to which rockets are allowed to be flown at that site or 1500 feet, whichever is greater.
11. **Launcher Location.** My launcher will be 1500 feet from any inhabited building or from any public highway on which traffic flow exceeds 10 vehicles per hour, not including traffic flow related to the launch. It will also be no closer than the appropriate Minimum Personnel Distance from the accompanying table from any boundary of the launch site.
12. **Recovery System.** I will use a recovery system such as a parachute in my rocket so that all parts of my rocket return safely and undamaged and can be flown again, and I will use only flame-resistant or fireproof recovery system wadding in my rocket.
13. **Recovery Safety.** I will not attempt to recover my rocket from power lines, tall trees, or other dangerous places, fly it under conditions where it is likely to recover in spectator areas or outside the launch site, nor attempt to catch it as it approaches the ground.

MINIMUM DISTANCE TABLE

Installed Total Impulse (Newton-Seconds)	Equivalent High Power 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

Revision of July 2008