

# Guide to High Power Certification

presented by  
Tripoli Oklahoma

## Introduction

The purpose of this document is to help the individual interested in achieving High Power certification through the Tripoli Rocketry Association. Certification is not a single event, but rather the end result of a process. You might be a student wanting to participate in a competition, or just an individual looking to advance their skills and ability. We want you to succeed. We'll do as much as we can, with advice and help, to get you to this goal.

The first part of the process is Tripoli membership. You must be a current member of Tripoli to certify. It can take several days for your membership to go through, do this ahead of time. Once your payment has gone through and your membership is active, you can go to the Tripoli web site and download a picture of your membership card. You will need to present your card, or a picture of it to the prefect. While you're at the Tripoli web site, download, print, and fill out the Universal Certification Form. Level 2 attempts must pass a written test prior to certification flight. Study guides and practice questions are available on the Tripoli web site.

Attend several launches and see what the experience is like. Safety is the most important thing at a launch. We have distances we stay away from the pad while launching (including parking). We have procedures we go through during the launch to insure safety. Come, hang out, have fun, listen to the tall tales (some are even true!). We'll even let you push the button and send a rocket up!

## Rocket

According to Tripoli regulations, you must build the rocket you are certifying with. We have to trust you, we're not going to stand over you as you build it. We'll offer all the help you want, but building it is your responsibility.

There are two basic "types" of rockets, kits and self-designed. If you're not already an experienced builder, it's highly recommended that you build a kit for your cert rocket. All the parts you need should be in the kit. It's a proven design. There are a number of manufacturers that sell kits appropriate for L1 or L2 certification.

Regardless of which way you decide to go, it's highly recommended that you create a simulation of the rocket. When you present the rocket to the prefect or LSO (Launch Safety Officer), it needs to have the CG (Center of Gravity) and CP (Center of Pressure) clearly marked. The simulation will also be able to give you the performance of the

rocket using a specific motor. This is important because you may need to adjust the delay element so that ejection occurs as close to apogee as possible. The two popular simulation software packages are Rocksim and Open Rocket. Rocksim is a commercial product sold by Apogee Components ([www.rocksim.com](http://www.rocksim.com)). Open Rocket is a free community-developed product that can be downloaded from [www.openrocket.info](http://www.openrocket.info). The two packages are similar in results, but each has unique features.

## Motor

To certify Level 1, the applicant must use a motor in the H impulse range; for Level 2 it is a J motor. There are two main engine manufacturers in the market today, Aerotech and Cesaroni. Aerotech is an American company out of Utah, Cesaroni is a Canadian company.

There are two “types” of high power motors, single-use and reload. With a single-use motor, the delay is adjusted (if needed), and the ejection charge is added. No assembly is required. It is highly recommended that a single-use motor be used for certification flights, especially for Level 1.

Reloadable motors require assembly before use. There is a big difference in the design philosophy between the reload systems the two companies make. The Cesaroni reload is essentially one piece, requiring only to have the delay time adjusted, and the reload to be screwed into the motor case. Aerotech motors come as a set of propellant grains, liners, washers, o-rings, and a delay grain. The motor has to be assembled with care, making sure the correct components are in the proper position in the motor case. End closures are screwed into each end of the motor case. It's not terribly hard, but close attention needs to be paid.

As of the writing of this document, Cesaroni has shifted its efforts to making military products, and away from consumer rocketry. This has created a lack of availability of Cesaroni hardware and motors. They are very difficult to find right now. Aerotech products are more available. They too produce military products, but have seasonal production of most consumer motors. Another difference between the two manufacturers is cost. With the Cesaroni motors, the case is a simple aluminum tube, fairly inexpensive, but the reloads themselves are expensive (most of the manufacturing effort goes into the reload). Aerotech cases are more expensive. The cases are aluminum tubes, internally threaded on each end, with precision machined end closures. The reloads are much less expensive than the Cesaroni because they only contain material that is consumed during the rocket's flight.

Following Tripoli rules, the individual seeking certification must assemble the motor. If you assemble the motor at the launch site, we will be glad to help you. If you want to sit at home on the couch and think things through as you assemble the motor, that's

acceptable too, as long as you state that you assembled the motor. You are responsible for the performance of the motor during the cert flight, wherever you assemble it. You are responsible for providing the motor/case/reload. We can't provide one to you. The package the motor or reload came in must be presented to the prefect prior to flight. Students seeking to certify may obtain a motor from their faculty advisor or preceptor. Since an individual cannot possess a motor in an impulse range they are not certified for, the individual must contact the prefect at least two weeks prior to the cert launch to arrange for a motor (you still have to pay for it!).

## Recovery

Tripoli rules state that for a cert flight to be successful, the rocket must be recovered in a condition that it can be quickly flown again. We fly at the Sayre Municipal Airport. It's surrounded by wide open fields and pastures. It's amazing how many rockets land on the hard, hard runway or tarmac. If a rocket is observed to be recovering normally, but is damaged by landing on the runway, or lands normally on the runway and is damaged by being dragged by the parachute, the flight may be considered successful for certification. It's probably obvious, but the rocket has to be recovered to have a successful cert flight. To this end, Featherweight trackers are available for loan. The tracker holder is about 3/4" in diameter and 6" long. If you want to use one, there must be room inside the airframe.

In summary, try to keep the flight as simple as possible. Choose a rocket design that is simple and easy to build. Use a single use motor if one is available. Run simulations to get an idea of rocket performance, and how to adjust the ejection delay. Good Luck, we're cheering for you!

## Glossary

Some commonly used terms and abbreviations:

Prefect – the administrative authority of the club. He/she is responsible for the legal requirements for the launch; contacting the land owner for permission, obtaining FAA permission and issuing NOTAMs, doing certifications of flights.

NOTAM – Notice To Airmen, a bulletin that is published by the FAA notifying that there is an ongoing activity at a location that pilots should be aware of.

Motor/Engine – the propulsive component of the rocket, the terms are interchangeable

CG – Center of Gravity, the physical balance point of the rocket.

CP – Center of Pressure, the aerodynamic “balance point” of the rocket. The Center of

Gravity must be closer to the nose of the rocket than the Center of Pressure for the rocket to be stable. The CG should be at least two rocket diameters ahead of the CP. Typically, the CP is just ahead of the fins

RSO – Range Safety Officer, the individual responsible for overall safe conditions on the ground and in the air for the launch to proceed

LCO – Launch Control Officer, the individual who operates the launch control system, and has immediate responsibility for launch safety

The duties of the RSO and LSO may be combined

LSO – Launch Safety Officer, the individual responsible for insuring that rockets are in flight-worthy condition prior to being placed on the pad

Thanks to Bob Brown, current president of Tripoli for suggestions made in the introduction