The RAPTOR
CO2 Ejection Device

"For all practical purposes, acceleration immune, regardless of mounting orientation!"

Features:

Precision Machined Aluminum & Stainless Steel Construction
Works with 1/2" threaded CO2 cartridges from 20 to 85 grams!
Acceleration immune regardless of orientation
Lightweight- about 4 oz without CO2
Works with BP or BP substitute
Works in a complete vacuum & in the deep cold of Space
Lifetime Tech Support & Lifetime Unconditional Warranty

Parts List:

The RAPTOR Kit includes:

Precision Machined Aluminum Mounting Cap (With mounting hardware)
Precision Machined Aluminum Pyro Housing
Single and Dual Charge Cups (With red dot seals)
E-match Potting Putty& O-ring seals
Puncture Piston Assembly & Return Spring
Assembly Lube (Works the best of anything I have found)
Extra O-rings, Disassembly Punch, Cotton Swabs
Powder Measure Vials
Two 23gm & Two 35gm CO2 ctgs
In short, everything you need for an acceleration immune CO2 ejection system!

The **RAPTOR** CO2 Ejection Kit

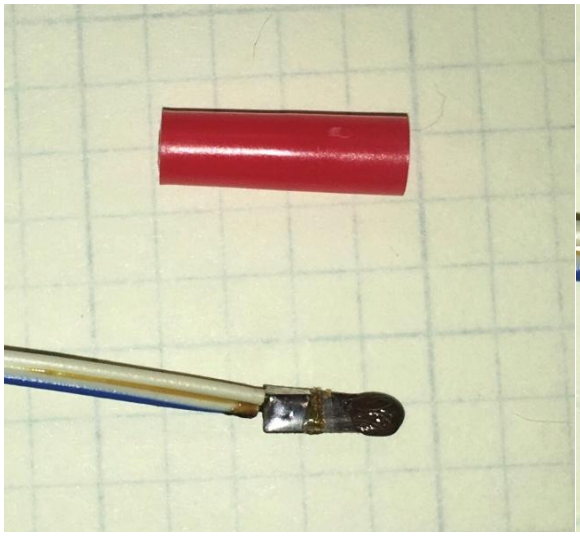
8-10-22 Updated User Instructions

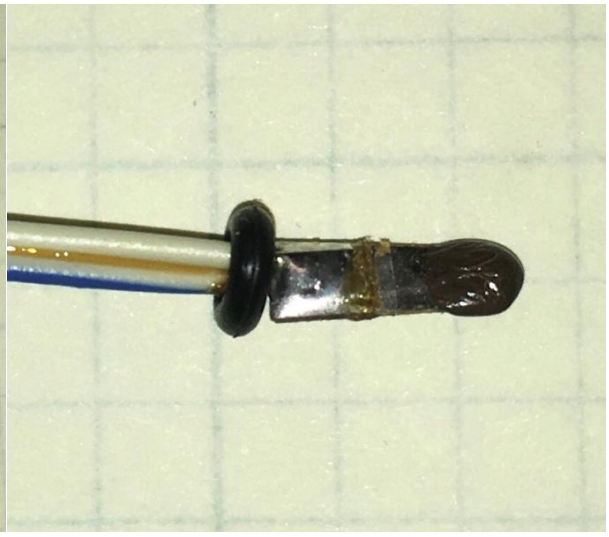
Note: These instructions are written for "rocketry folks" and it is assumed that all directions will be closely followed. If you are not a "rocket" guy or gal or you do not feel that you can follow these directions exactly, **please do not use this device!**

Step 1 - Prepare the E-match& Charge Cup

Using the supplied lube, thoroughly lube the Dual Charge Cup.
(**Hint:** Don't be stingy with the lube and do not substitute other lubes!)

Remove the protective plastic cover from the e-match
Slide one of the small black o-rings over the wire and up to the e-match head





Step 2 - Sealing the E-Match in the Charge Cup

Sealing the gasses in every Tinder Rocketry device is **very important**. Traditionally e-matches have been "potted" or sealed in charge cups using epoxy. More recently, two new and significantly better methods have been developed.

All three sealing methods are outlined below and you are strongly encouraged to read through ALL of the sealing methods AND cleaning instructions before choosing a sealing method!

Traditional Epoxy Sealing Method

The traditional method for sealing e-matches into their housing has been epoxy. While sealing with epoxy does work, it takes time to cure, and can be a challenge to disassemble and clean. In addition, if the goal is to seal 100% of the pyro gasses 100% of the time, the epoxy sealing method is NOT the preferred method. In fact, with the introduction of the other two e-match sealing methods,

I no longer recommend using epoxy to seal e-matches! (Read on and you'll see why)

Even still, I have outlined below how to seal e-matches with epoxy.

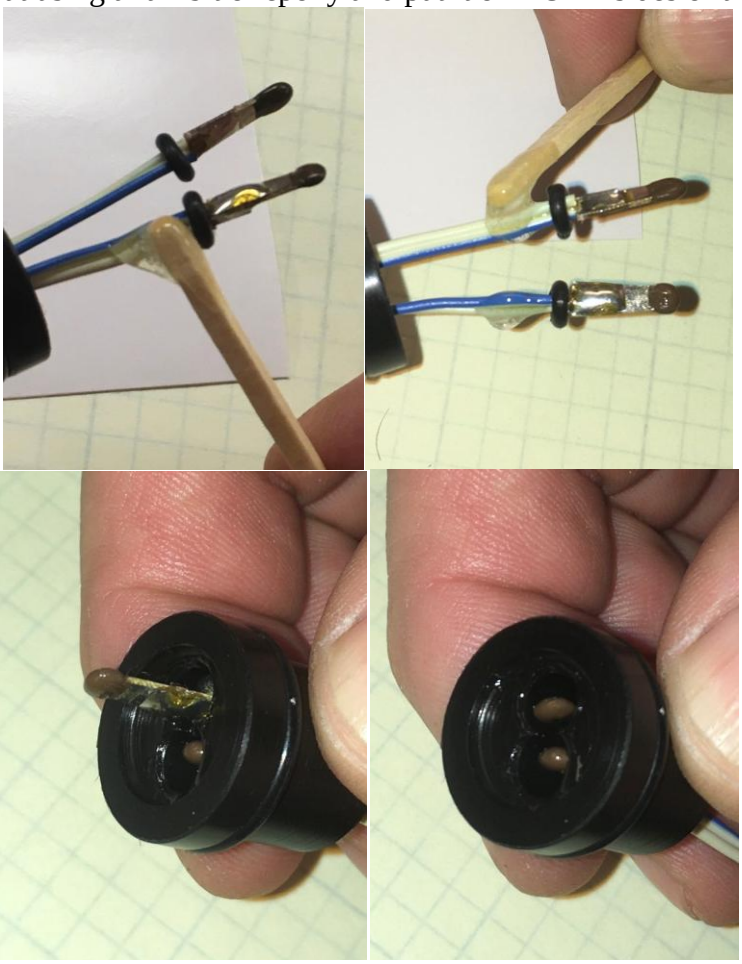
Prepare the e-matches with o-rings and lube the Charge Cup as outlined in **Step 1 on page two**.

Add a dab of quick set epoxy to the wire on **both sides** of the o-ring

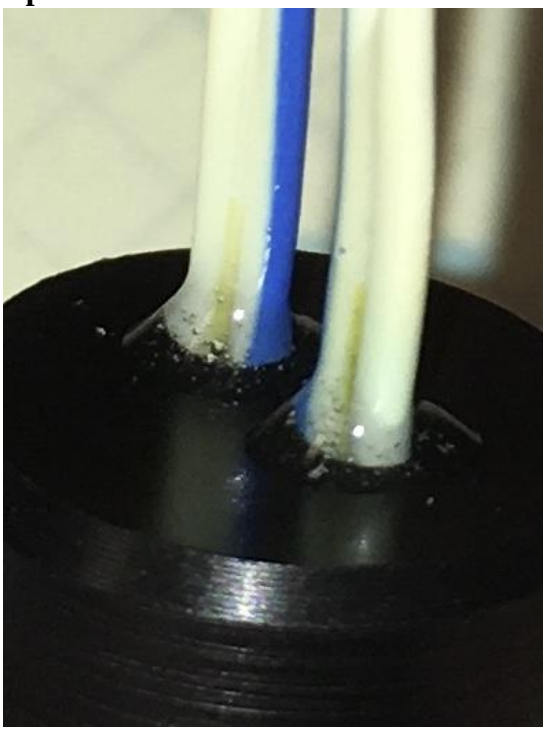
Pull the e-match wire so that the e-match is entirely inside the Charge Cup.

(Note: If you cannot do this you probably have epoxy residue left inside the Charge Cup from previous use. Remove the e-match and see below under cleaning as to how to remove this epoxy residue)

Note: Don't be shy about using a fair bit of epoxy and put it on BOTH sides of the o-ring. (Not shown)



Use Q-tip to wipe any excess epoxy and set aside, **hanging from the wire,** to cure overnight.
IMPORTANT: Make certain that you use enough epoxy so that it oozes out the wire hole when the wire is pulled!

Important: make certain that you allow even this quick set epoxy to fully cure overnight! Failure to allow full cure of the epoxy or failure to use epoxy at all, will result in this device spitting hot burning particles of pyrogen out the back and will reduce the pushing power of the pyrogen, possibly reducing the force to the point of the device failing to achieve the needed Puncture Piston velocity to effectively puncture the CO2 cartridge for proper gas release.

Note: The holes in the Charge Cups are intentionally drilled a little tight to aid in sealing, especially for the epoxy sealing method. It has been noted that there is a slight variation of the thickness of the insulation on some e-matches that can make it more difficult to get these e-match wires started. In some cases, the stripped wire needs to be started buy being pulled by **pliers**. Once started they are easily pulled into the Charge Cup.

Be assured that I am working on another Charge Cup variation for all Tinder Rocketry devices that will make starting e-match wires and cleanup a bit easier, but for now, we have pliers...

While sealing e-matches with epoxy is simple and effective, the down side is that the epoxy must fully cure before use, making the device a once per day proposition...which brings us to a second method of sealing the device...

Hot Glue Sealing Method

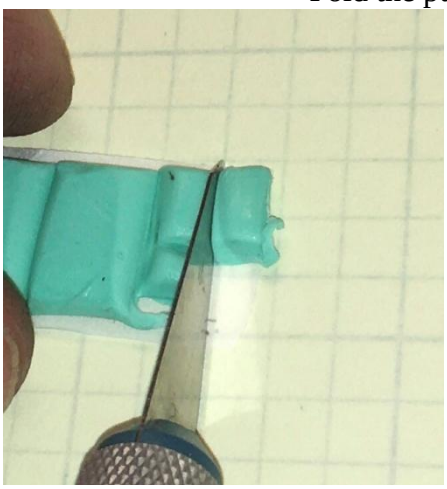
Prepare the e-matches with o-rings and lube the Charge Cup as outlined in **Step 1 on page two**.
Add a dab of hot glue to the wire on **both sides** of the o-rings.
Pull the e-match wires so that the e-matches are entirely inside the Charge Cup.
Note: The glue gun must be up to temp before use. The hot glue must be applied and the e-matches seated in the Charge Cup fairly quickly, as the hot glue will want to cool and set, making pulling the e-matches entirely into the Charge Cup difficult. That said, this method is both simple, quick and does seal very well.

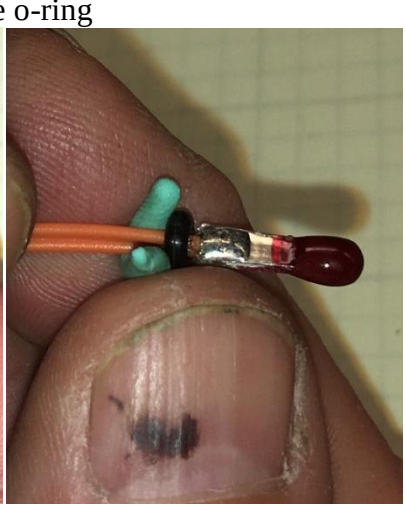


Sealing the e-match in the Charge Cup using hot glue is fast, easy and seals very well. The only known down side is that at a launch, it is often not so simple to find the 120 VAC that most glue guns like to run on. Which leads us to yet another method of sealing the e-match inside the Charge Cup...

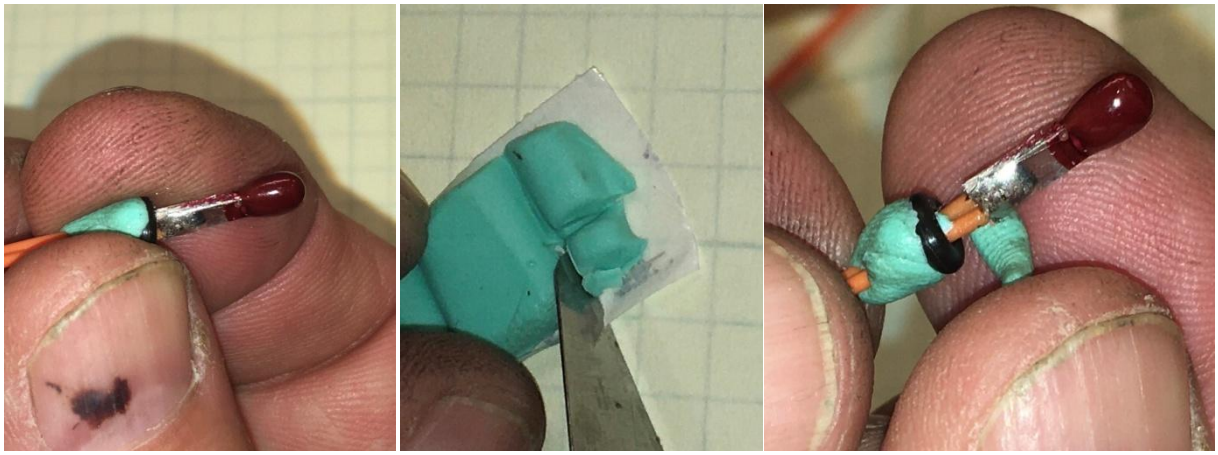
Poster Putty/Mounting Putty
AKA: Putty Sealing Method

Prepare the e-matches with o-rings and lube the Charge Cup as outlined in **Step 1 on page two.**
With a hobby knife cut one of the "squares" into quarter sections
Remove one of those quarter sections and roll it in your fingers
Fold the putty around the wire below the o-ring

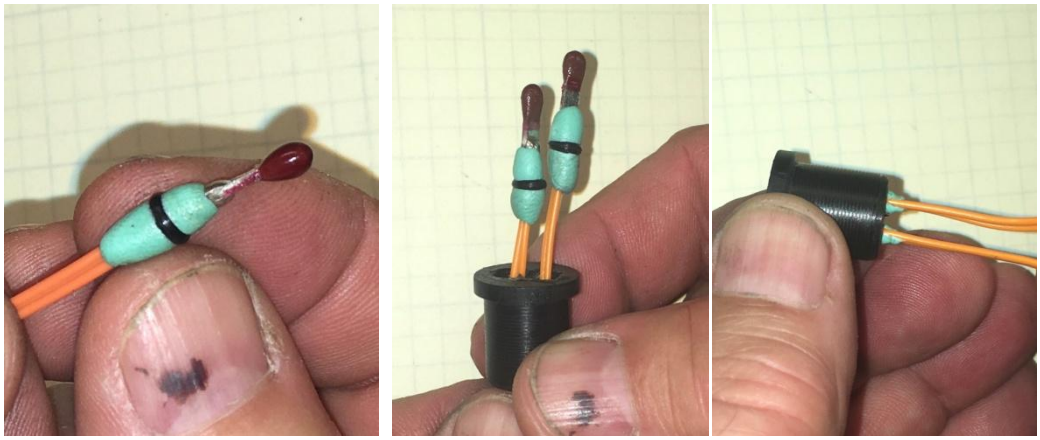




"Roll" the putty covered wire/o-ring in your fingers
Cut one of those quarter sections in half, roll in your fingers and apply it to the top side of the o-ring
Note: To achieve the best seal, first slide the o-ring "down" about 1/8" or so before adding the putty to the "top" side.



Roll the whole thing in your fingers so that you have putty completely encircling the wire on both sides of the o-ring.
Insert the putty prepared e-matches into the Charge Cup
Gently pull the e-match wire until the e-match head is about flush with the mouth of the cap
Note: You may have to tug on and wiggle the wire while tugging to get it seated properly, this is ok.
You may also very likely see the putty ooze through the wire hole along with the wire, this too is ok.

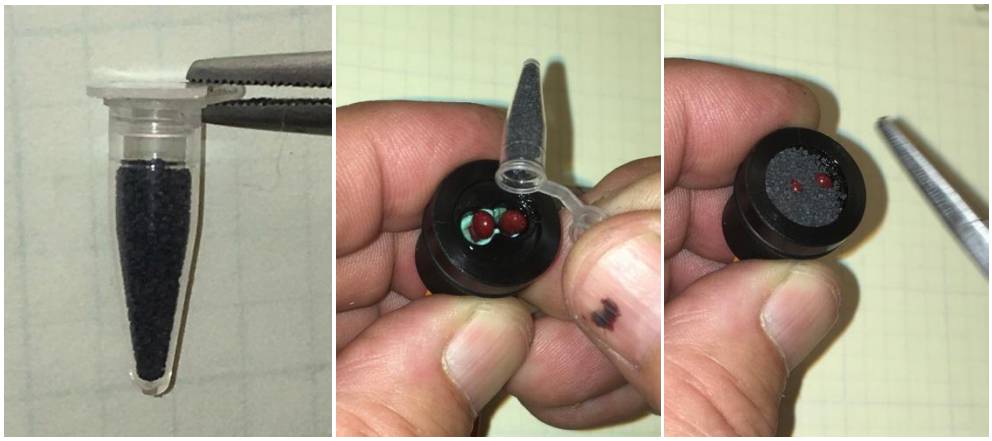


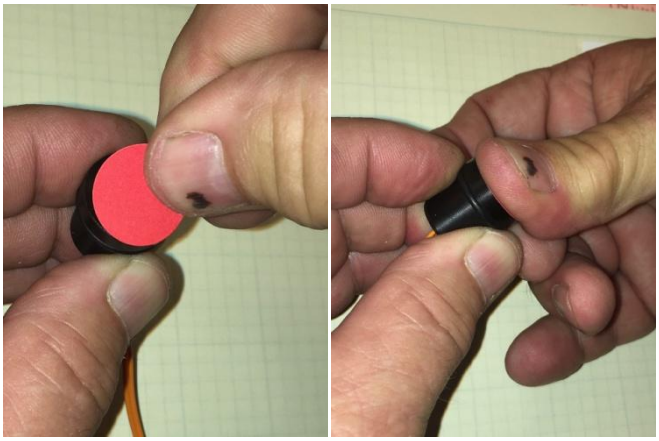
The Putty Method of sealing the e-match has been tested at room temp, at about 0 F and over 140 F and it has been found to seal very well every time in this device!
Because of the excellent sealing, easy setup, fast disassembly and cleaning, this is my preferred method of sealing e-matches in ALL Tinder Rocketry devices!

This poster/mounting putty can be found on Amazon or at your local hardware store.
(A small amount is now included in all Tinder Rocketry kits!)

Step 3 - Adding Pyro Powder to the Charge Cup

Fill one of the supplied Powder Measure Vials "to the line" with 3F or 4F black powder or BP substitute in the 3F or pistol granulation (Such as **Triple Seven or Pyrodex P)**. It is ok to "tap" the powder down a bit to settle the powder to get a good measure. Do not add extra powder. You may find it convenient to fill the vials ahead of time and close the lid for later use.
Carefully add the pyro powder to the prepped charge cup, tap to settle powder if needed.
Use one of the supplied "Red Dots" to seal the pyro in the Charge Cup
Press firmly to make sure the red dot sticks properly.



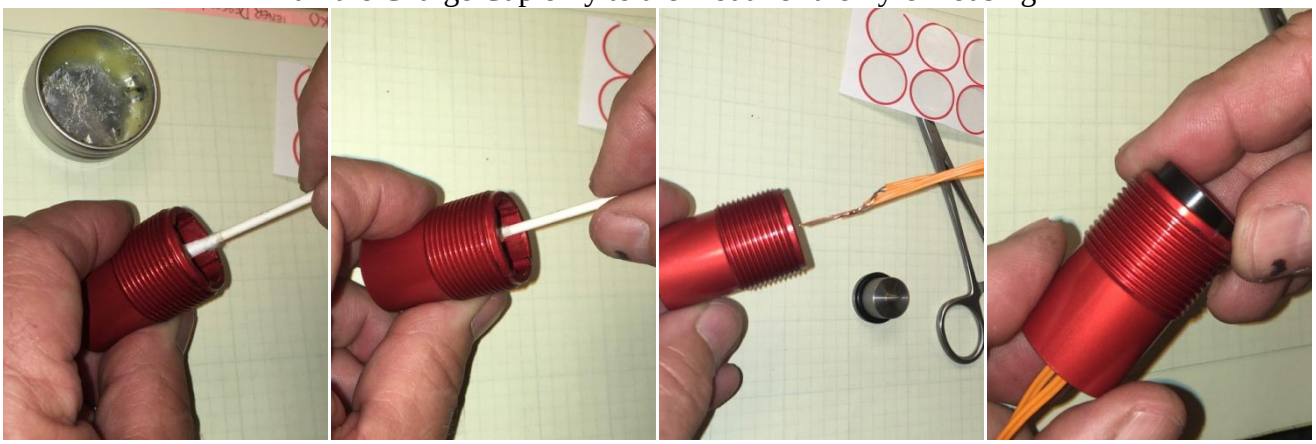


VERY IMPORTANT Note:

Do not ever use smokeless powder in this device! (Or any Tinder Rocketry device for that matter)
Use black powder or black powder substitutes such as Triple Seven or Pyrodex P ONLY!
The powder from a "disassembled bullet" is NOT black powder! The powder from a "disassembled fire cracker" is NOT black powder!
(I tell you this because I have had a few customers that have used these powders with bad results!)

Step 4 - Load the Pyro Housing

Use the supplied lube and a cotton swab to completely lube the inside of the Pyro Housing
Be sure to lube inside "The groves" as well
Twist all 4 wires together (If they are not already) and insert them into the Pyro Housing.
Pull the Charge Cup only to the mouth of the Pyro Housing



Install the spring onto the Puncture Piston
Hold the spring and use it to push the Puncture Piston AND the Charge Cup assembly until the Charge Cup is completely seated
You may need to gently pull on the wires while you push on the spring to get everything fully seated.

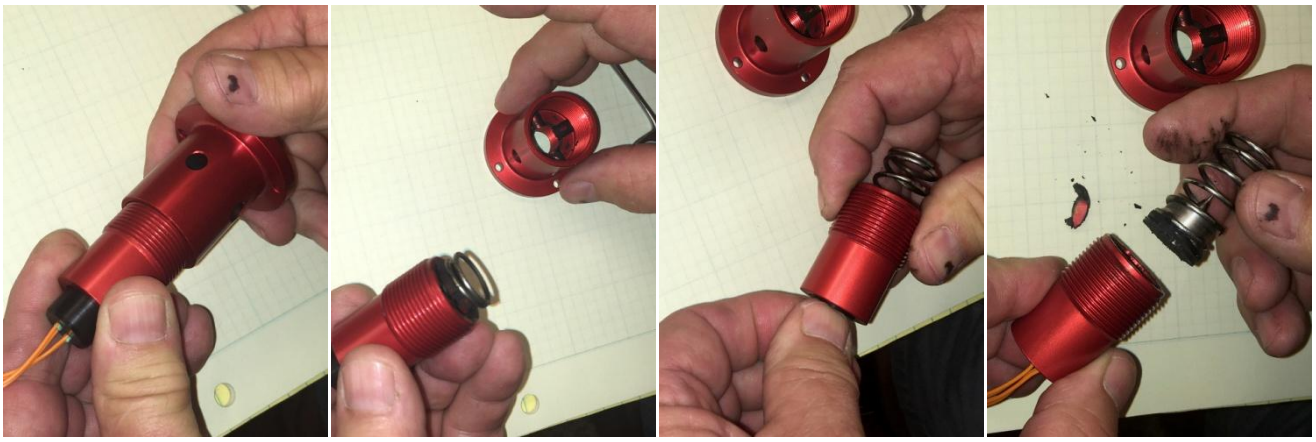
Screw on the Mounting Cap, install the CO2 cartridge and the device is ready to use!

(See pages 14-17 for mounting examples as well as CO2 ctg choice & discussion)

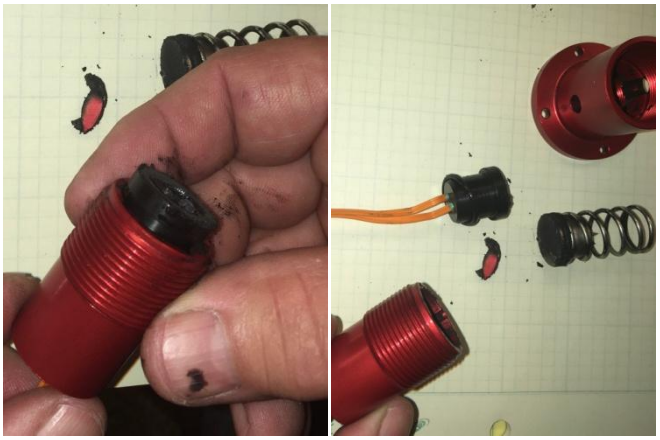
After use Disassembly & Cleaning

Step 1 Disassemble the device

Remove the Pyro Housing from the Mounting Cap
(The Mounting Cap might still be attached to a bulkhead in your rocket!)
Push on the base of the Charge Cup while pulling on the spring.
The Puncture Piston may stay attached to and might come out by pulling on the spring



Push on the Charge Cup and maybe even the wires to help remove the Charge Cup.
Generally the Charge Cup comes out with ease. If the burnt Pyro dries and hardens, you may have to use some small object, such as a pencil, to push on the Charge Cup to get it out of the Pyro Housing.



Step 2 - Cleaning and lubing

Some thoughts on cleaning the device...

In the ideal world, you would be able to find a sink with warm water and you would be able to thoroughly clean all parts with soapy water, allow all parts to **completely dry** before re-lubing and re-loading. In the field, it may be difficult to accomplish ALL of these things.
In my testing, where I may fire the same device again and again and again, I want my turn around time to be a minimum and I want NO CHANCE of any part that may come in contact with pyro powder, to contain ANY moisture. As a result, during the many tests that I might perform one right after another, I never wash any of the dirty parts in water between tests, never!
Instead, I use several cotton swabs dipped in lube to wipe the parts until they are relatively clean. Where cotton swabs are not appropriate, paper towels are used and all parts get reasonably clean then properly lubed.
By "cleaning" the parts with lubed Q-tips, I can do a test every 10 minutes (Using the Putty Method of sealing the e-match)

The moral of this story is that these devices have been thoroughly tested under less than ideal conditions and have been found to work perfectly 100% of the time!

Clean the Pyro Housing by washing or wiping with lubed Q-tip
Thoroughly lube the inside with the supplied lube including the "grooves".
Scrape the burnt pyro from the bottom of the Puncture Piston
Wipe/wash clean and re-lube the Puncture Piston (With a paper towel, wipe the excess lube off the bottom of the Puncture Piston)
Note: If you chose to wash these parts in soapy hot water, an old toothbrush helps to remove the burnt pyro. Do not struggle to remove all of the old lube! This lube is quite tenacious and is difficult and NOT necessary to remove!
If you choose to remove the o-ring on the Push Piston (Not really necessary) for cleaning, be sure you re-lube it prior to re-installing, and while there are extra o-rings, these things really do not wear out if lubed properly!
Wipe the inside of the Mounting Cap with lubed cotton swab

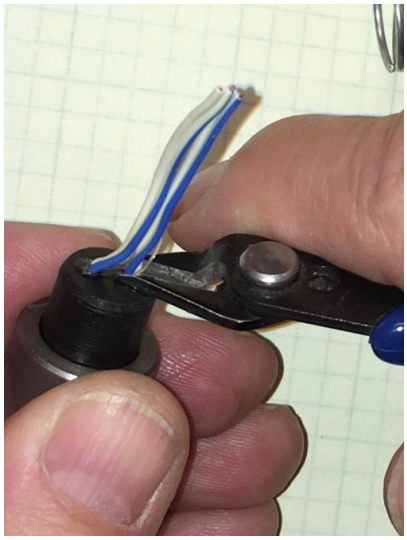
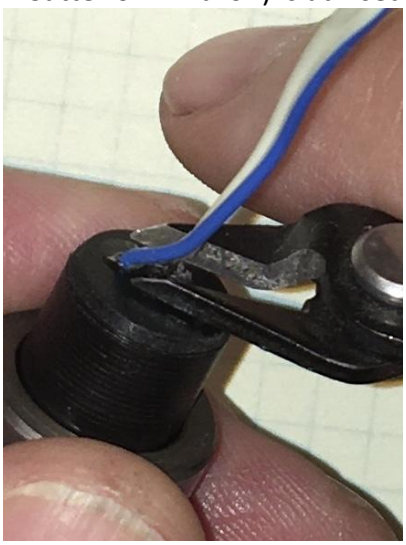
After use Disassembly & Cleaning of the Charge Cup

The method you used for sealing the e-match in the Charge Cup will determine the method and difficulty of removing the spent e-match. Choose from the list below and skip to that section:

Step 1-E if you sealed the Charge Cup in the traditional manner, with **E**poxy
Step 1-HG if you sealed the Charge Cup with **H**ot **G**lue
Step 1-P if you sealed the Charge Cup with **P**utty

Step 1-E & HG Disassemble/Remove Spent E-match

(Use these instructions if you if you sealed the Charge Cup with Epoxy or with Hot Glue.)
Clip the e-match wire as close to the surface of the cap as possible, Using a sharp side cutter (Such as the Xuron 2175 Maxi-Shear Flush Cutter on Amazon) is advised.

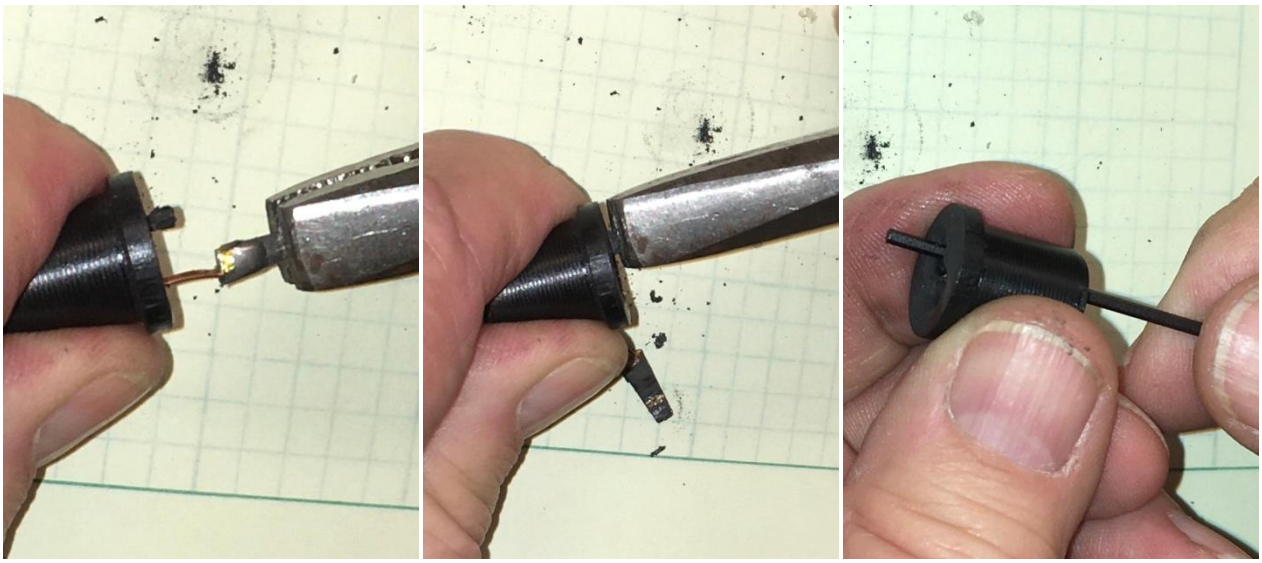



Use the supplied punch to free the spent e-match, o-ring and seal
If you sealed the Charge Cup with Hot Glue, simply hold the Charge cup in one hand and the supplied punch in the other.
Center the punch on the clipped wires and push the wires as far as they will go.


If you sealed the Charge cup with epoxy, you will likely need to first place the Charge Cup on a flat surface, then Center the punch on the clipped wires


Now **Tap <u>gently</u>** with small lightweight hammer to gain movement of the spent e-match.
Once you gain movement of the spent e-match, STOP POUNDING!
(Otherwise you will damage the Charge Cup)
The design of the punch will only allow some movement of the spent e-match and is not intended to completely push the o-ring out.
Use the punch to push until you reach the tapered portion of the punch

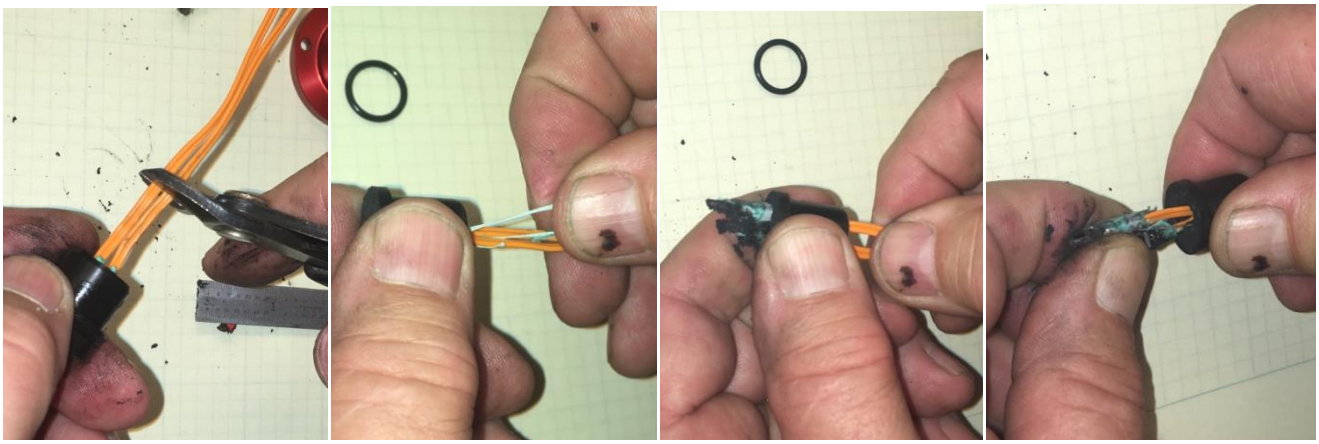

Next, you will need pliers or hemostats to grab the protruding spent e-match
If the Cap was well lubed as instructed prior to loading, the e-match, o-ring and epoxy will all come out together and entirely with relative ease.
Sometimes the e-matches are stubborn and come out in pieces and need to be pushed out.
An Allen wrench or a piece of 12ga solid wire works well for this.



Step 1-P Disassemble/Remove Spent E-match

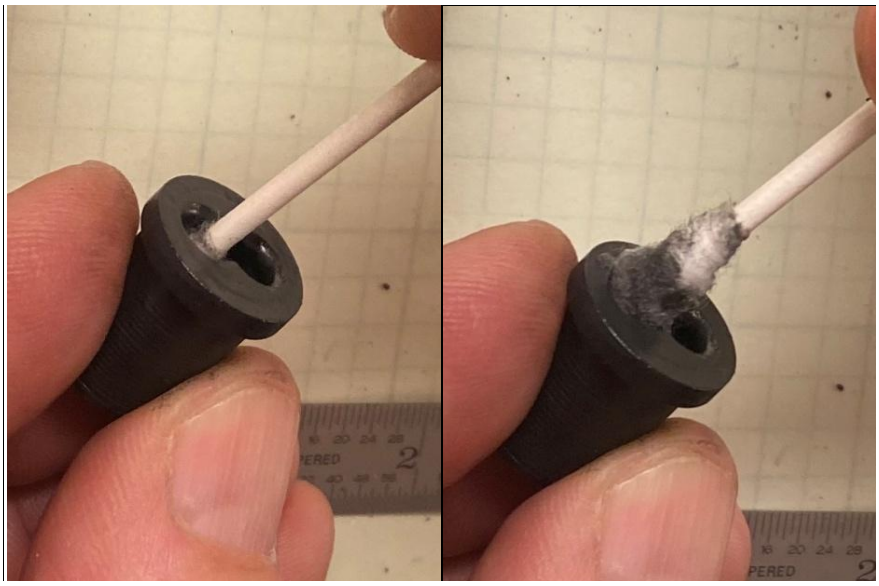
(Use these instructions if you if you sealed the Charge Cup with **Putty**)

Clip the wires to about an inch or so from the Charge Cup
With your fingers, peel back and remove any putty that is on the wires.
Grab the wire with your finger and push it out
Pull the remaining wire out with pliers or your fingers.
Now tell yourself how easy that was!



FWIW, this "Putty" method of sealing is the only method I ever use any more. Turnaround time is less that 10min from firing to the next firing and for me, because I am testing these things, this 10 minute turnaround time INCLUDES setting up to take video of the device firing!

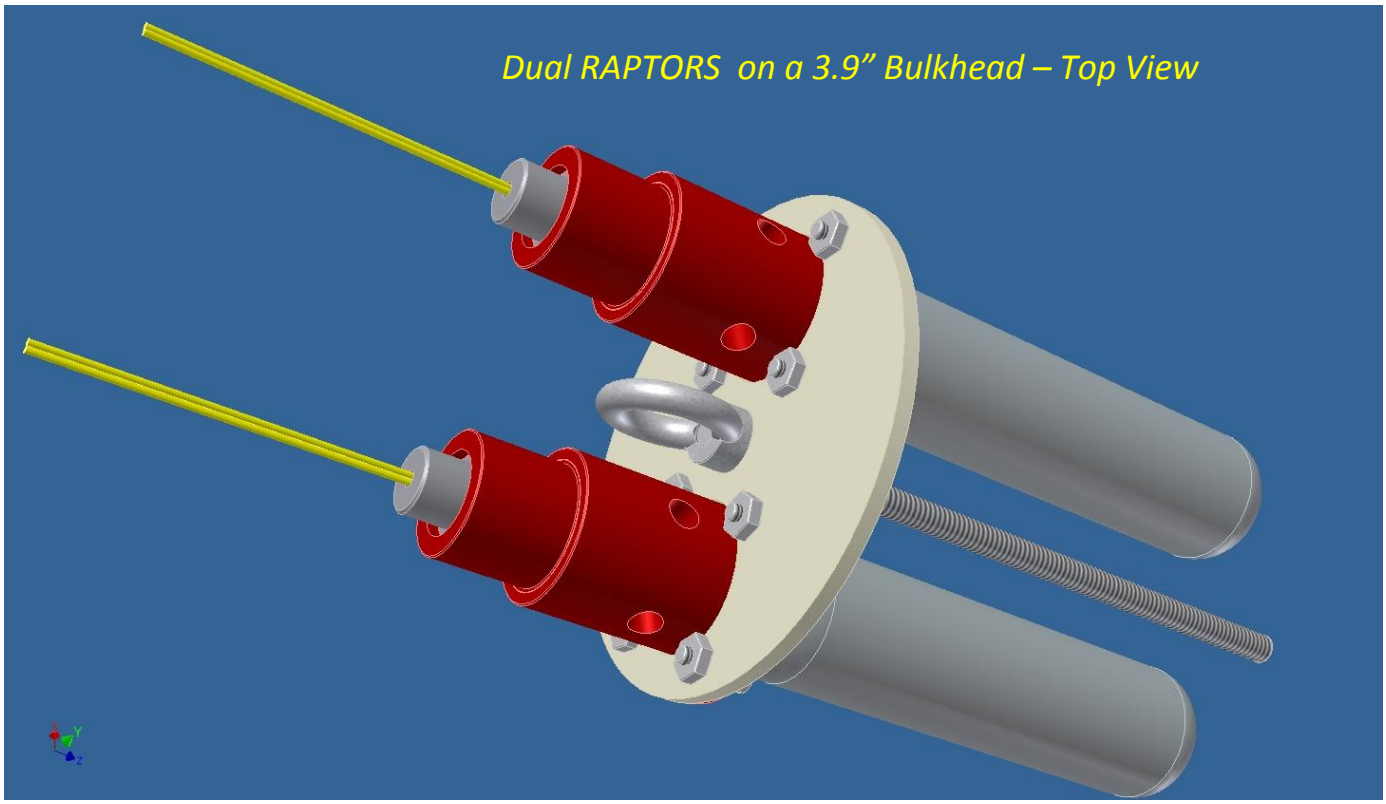
Use lubed Q-tip to twice clean the Charge Cup. The 1st time the Q-tip will be dirty.

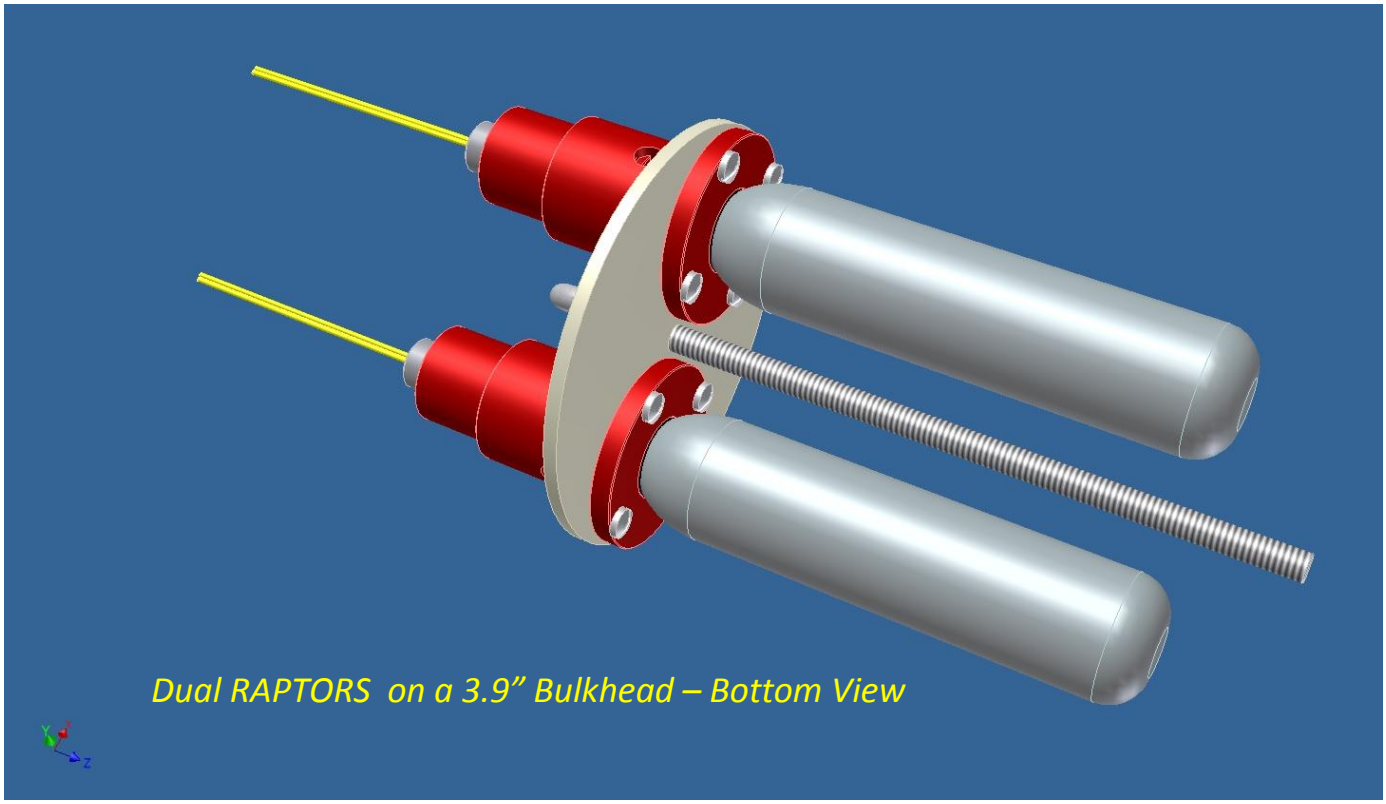


Lube and re-install the o-ring on the Charge Cup
Remember that while replacement o-rings are provided in case of loss, they do not wear out and should be re-used!

Your **RAPTOR** can either be put back into the kit box or re-loaded now for the next time!

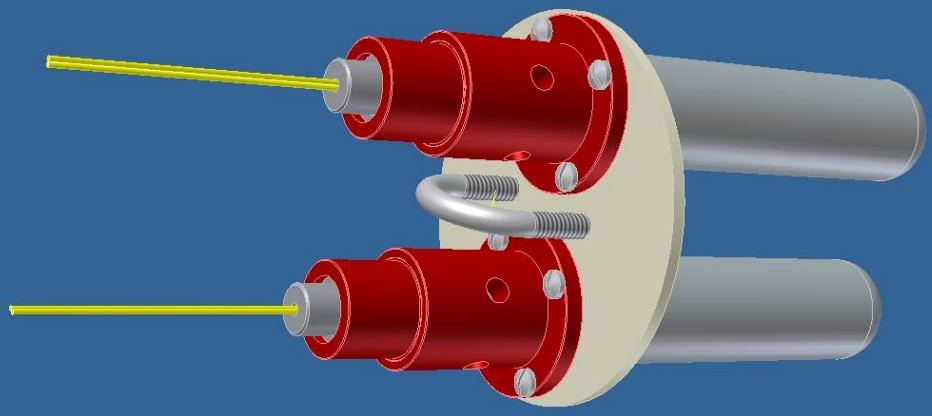
Dual RAPTOR Mounting Example - 1

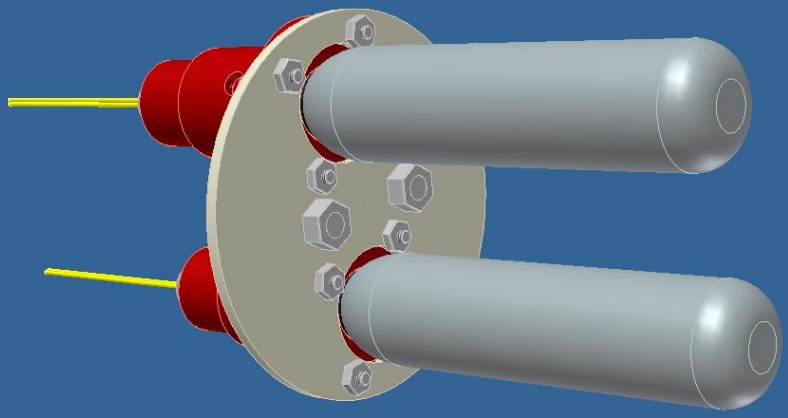




Dual RAPTORS Mounting Example - 2

Dual RAPTORS on a 3.9” Bulkhead – Top View





Dual RAPTORS on a 3.9” Bulkhead – Bottom View

Choosing the Right CO2 Cartridge for your Rocket

"Make everything as simple as possible, but not simpler."
This is a quote from a really smart guy with bad hair, Albert Einstein.

Simple is good and simple is what we are going to try and do here...

Choosing the right CO2 cartridge for your rocket:

Method 1:

You may choose this method if you have flown your rocket (or you have ground tested it) and a known qty of BP has been determined for deployment. **The factor is 5. Whatever the qty of BP that you have used in your rocket, measured in GRAMS, multiply that by 5 to get the equivalent grams of CO2 needed for the same deployment pressure.**

For example: A rocket that has been flown (or ground tested) with **4 grams** of BP, would need about 20 grams (**4 gms** x 5) of CO2 to achieve the same ejection pressure. In this example you would choose either a 20 or 23 gram CO2 ctg and that would very likely work just fine, but you will still ground test!
Example #2: A rocket that has been flow (or ground tested) with **6 grams** of BP, would need about 30 grams (**6 gms** x 5) of CO2 to achieve the same ejection pressure. In this case, round up and choose the 35 gram CO2 ctg and then ground test!

Method 2:

You may choose this method if you have never flown nor tested you rocket and have no idea as to how much BP you might need for adequate deployment. I recommend that you first follow this link to the Rocketry Calculator website (https://rocketrycalculator.com/rocketry-calculator/bp-estimator/) where they have a very useful BP calculator and thoughts about how to determine how many grams of BP your rocket might need for BP deployment in your rocket.
Warning: Do not let your head explode with all this discussion!
Simply use this discussion to determine a STARTING POINT for your ground testing!
Once you have determined how many grams of BP that you would need to use in your rocket, use this number and go to Method 1. Then you must GROUND TEST!

There you go! The focus here is to get you to a starting point where you will then ground test this CO2 deployment system in your rocket before flight!

(Have I mentioned that you should ground test?)

A word on CO2 cartridges:
For rocketry flights using CO2 for deployment, more is OK! Unlike BP, it is really difficult to use too much CO2! Always use enough gas and **error on the high side when choosing a CO2 ejection cartridge**!

Another word on CO2 cartridges:
The CO2 cartridges that are used in The RAPTOR are somewhat difficult to find locally (READ: Nearly impossible). In addition, there are 3 different thread sizes and only the 1/2-20 thread size works with the RAPTOR. Because of this you may choose to order replacement CO2 cartridges directly from Tinder Rocketry to be sure that you get CO2 cartridges that are certain to work with your RAPTOR!

Some discussion on CO2 and the RAPTOR CO2 Ejection system

The RAPTOR is another CO2 ejection system designed and manufactured by Tinder Rocketry for parachute deployment in high powered rockets at any altitude. The RAPTOR, is lightweight, compact and versatile! It is designed to be easy to use and works with many CO2 cartridges ranging in size **from 20 to 85 grams!** Best of all, **the RAPTOR is for all practical purposes <u>acceleration immune</u>** regardless of mounting orientation!

Some have asked "Why would I want to use a CO2 ejection system in my rocket?" Well, there are actually two reasons you might want to consider CO2 deployment. The first and most obvious reason is that it is clean! There is very little flame or the resulting BP residue all over the inside of your rocket! As a result of not having a large BP flame, you can do away with a lot of the flame resistant cloths that now protect you valuable parachutes! (Note: There is still a small amount of pyro exhaust so **some parachute protection is strongly advised**!) If there was no other reason for going to CO2 deployment, a clean interior is more than enough motivation! However there is another reason that you might want to consider CO2 Deployment and that is high altitude flights.

It is well known that BP begins to burn inconsistently at much over 20,000' ASL and will not even sustain a burn at over 50,000'. There have been many attempts and devices made to try and contain BP so that it will burn at high altitudes, some of them have worked, many have not. CO2 deployment systems, such as the RAPTOR, where a small pyro charge is completely sealed from the outside air (or the lack there of), are capable of deployment at any altitude.

The RAPTOR has been tested after being pulled from a deep freeze and down past 29" Hg and both at the same time!

Final note:

This device has been specially designed and manufactured to the highest standards to do a job and do it well. I have gone to great effort to explain how to use this most excellent little device! If this device is used exactly as described, you can expect it to work 100% of the time, 100% as expected!

Contact me if you see or feel that there have been omissions or if you still have questions.

cameron@tinderrocketry.com