

## TUTORIAL: RECOVERY SYSTEM

PDF WITH ADDITIONAL INFORMATION AND PICTURES

If you want to build an advanced water rocket, and you don't want to start all over again after the first flight, we suggest building a recovery system for your rocket, which brings the rocket safely back to earth. Let's begin with the basics: A parachute deployment mechanism, the most common recovery system for a water rocket, ejects the parachute at the right time. That sounds pretty easy but in fact it is one of the most sophisticated tasks when building a water rocket. The system has to be small, light and reliable

### THE TOMMY TIMER



Wind-up toy



Modified Tommy Timer

There are numerous approaches for parachute deployment mechanisms. In this tutorial, we show you how to build a **mechanical system** based on a **Tommy Timer**. Tommy Timers can be found in wind-up toys which are available in toy stores and on the internet. After removing the case you can cut off all protruding parts of the timer using pliers. You should also remove the plastic handle from the main axel by repeatedly clamping it in a vice. After that, **bend the axel** using two sets of pliers. The modified timer will later be the centerpiece of the system. You may wonder why we use these mechanical timers and don't work with electronic

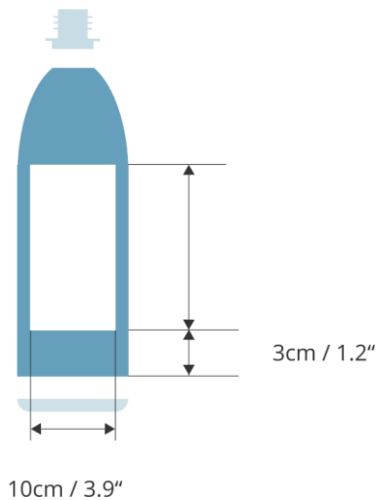
systems. Well, the answer is pretty simple: Mechanical systems are way **easier to build** and repair, are significantly **lighter** and a lot more **affordable** when compared to electronic ones – this is especially important when a rocket crashes and you have to build a new parachute deployment mechanism. But luckily, this shouldn't be the case all too often since the two systems we want to show you in this video have already proven their **reliability** with numerous flights.

### WHICH SYSTEM IS SUITABLE?

The first system we want to show you is called Phoenix 6. It's the latest version of our Phoenix Parachute Side Deployment System and is optimized for rockets with a single large pressure vessel. For rockets consisting of multiple pressure vessel segments we recommend building a Phoenix Radial Deployment System. This system was originally

developed by our colleagues from [U.S. Water Rockets](#), but we adjusted and optimized it for the use with a lightweight mechanical timer.

## PHOENIX 6



For the construction of the Phoenix 6 Side Deployment Mechanism you will need **two bottles**. It is necessary to use the same bottle type you have already used for your pressure vessel. Cut off the bottom of one of the bottles using scissors and remove the thread of the bottle with a saw. Now you have to cut a **big opening** in the cylindrical section of the bottle. In this case, the opening is about 10 cm / 3.9" wide and there should be about 3cm / 1.2" left to the lower edge. When you use bottles with a bigger or smaller diameter, you have to adjust the width of the opening. The bottle with the opening will later be the **case of the**

**parachute system**. But of course, your case will need a nosecone. You can either glue a half **table tennis ball** on top with epoxy or you can use the **nosecone of a fireworks rocket** for that. Now take the second bottle and remove both the bottom and the neck. The remaining cylindrical section will be separated in two equally large pieces. One of these pieces will be the **parachute door**.

If you want to **paint** your parachute system, you can do this now. First, sand and clean both the case and the door. We recommend using plastic primer before applying the paint. The spray paint can be applied as soon as the primer is dry. It's maybe necessary to spray several coats.

After that, you can cut out two round **base plates** out of a thin plastic plate. You should be able to put the plates into the system, but they shouldn't be too small and should remain in place without any glue. After you have placed the plates directly at the lower and upper edge of the opening, you can glue them in place using a hot glue gun. Please be careful and don't use too much adhesive.

Now it's time to mount the Tommy Timer you have modified at the beginning. All you need are three small holes in the case located slightly above the lower base plate. Put the bent axel of the timer through the hole in the middle and use a small cable tie to fasten it. The parachute door, which is placed over the opening, can be fastened by using a rubber band. Just mount a loop slightly under the upper base plate on the case. Now you can **wrap the rubber band multiple times around the system**. Just hook the rubber band over the bent timer axel.

To eject the parachute, you need a **spring**. For that, you can use a part of a thin walled plastic bottle. You can attach the bottle piece with wire on the case but you can also take the whole cylindrical section and glue it in place with a hot glue gun. However, if you use this method you have to watch out that the parachute will be pushed out of the opening and not to the side. The parachute door can now be attached with a rubber band on the parachute.



Painted system with nosecone



Base plates



Rubber band wrapped around the system



System with spring and parachute

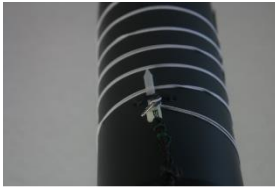
## PHOENIX RDS

But before we finish the construction of the Phoenix 6 mechanism, we want to take a look at the Phoenix RDS. The good news is, that it consists of even less components than the Phoenix 6. The most important component is a **thin but flexible plastic cover**. You can use a document cover or a thin walled bottle section for that. Mount the modified Tommy Timer at one edge of the cover using two little cable ties. On the opposite edge you can attach a rubber band loop. For the next steps, you will need a rocket with multiple pressure vessel segments. Wrap the cover around the **connection between two segments**, then wrap the rubber band around it and hook it on the timer axel. Another rubber band attached to the cover and the nosecone of the rocket will ensure that **the cover will be pulled away** when the parachute gets ejected. The Phoenix RDS is now already on the same level as the Phoenix 6 System, whose construction we described earlier in this video. The following steps are identical with both systems.

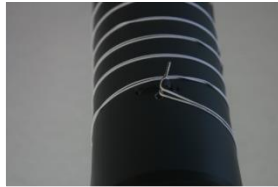


## LAST STEPS

To prevent the rubber band sliding over the bend of the timer axel, glue a **small cable tie head** with epoxy or superglue directly at the bend. Now you can hook in the rubber band once again and wind up the timer. A few seconds later, the rubber band will be released and the parachute ejected. Please be very careful when testing the system because you do not want to get the rubber band flick into your eyes. Now, the only thing you need to complete the construction is a small **trigger** which holds the timer in place until the rocket launches. Luckily the construction is fairly simple. You just need a big cable tie! Cut the long part off so that the remaining cable tie is only 5cm / 2" long. Now wind up the timer and place the trigger underneath the small cable tie you used to attach the timer so that the timer can't start running. Connect the trigger with wire and a rope to your launch pad and you are ready. But don't forget to attach the parachute and the system to your rocket first.



1) System with trigger (before launch)



2) Timer is running (launch)



3) System opens



4) Parachute is ejected