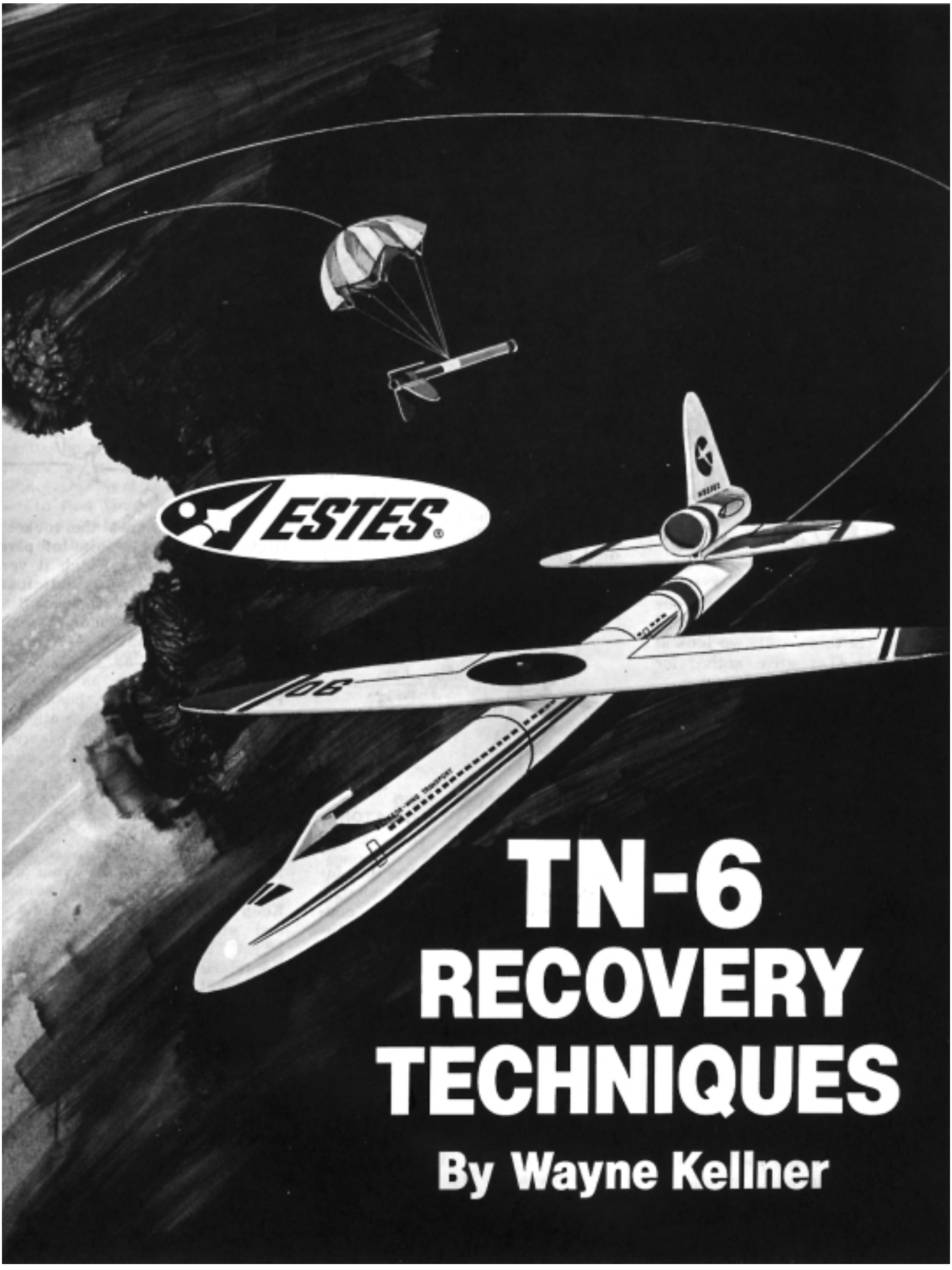


TN-6 RECOVERY TECHNIQUES

By Wayne Kellner

TN-6 Recovery Techniques

Reprinted from Model Rocket News, Vol. 13, No. 2

Finders, Keepers Part I

By Wayne Kellner

First installment in a three part technical report on model rocket recovery - techniques, types, and tips. In this article we look at a simple, but effective method for finding your rockets.

Before reading further, please check the appropriate box or boxes below.

- ☐ My last name is Bill Gates.
- ☐ My mailing address is Fort Knox, Kentucky.
- ☐ I just inherited $1,000,000 provided I spend it all on model rockets.
- ☐ None of the above.

If you checked one or more of the first three boxes, go out and buy some more rockets. This article is definitely not for you. But, if you're like me and thousands of other rocketeers, "a rocket found is a rocket earned" (apologies to Ben Franklin).

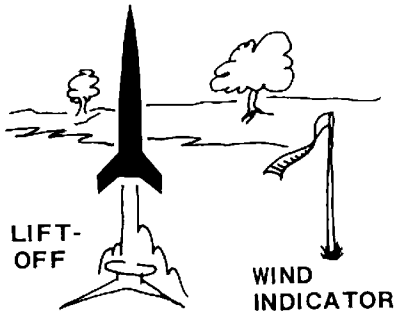
No rocketeer enjoys spending many hours building and finishing a super-nifty model only to lose it on its first flight. That's really grimsville. Perhaps you are about to launch an unusual payload or instrumented device. Or maybe you've just blown your life savings on a model rocket to land on Mars. Whatever the case, losing them to the Great Golden Chute Hook in the Sky can be expensive in time and materials. Well, don't despair, 'cause we're gonna lay some suggestions on your grey matter to help you find those rockets and possibly have more fun at the same time.

Line Search Method

The military "line search" method is the most reliable way to locate a rocket's exact touchdown location. Here's how it works. Before launching, you should know in which direction the wind will be drifting your bird during recovery.

Look for obvious wind direction signs such as movement of trees, tall grasses, or smoke. You might even wish to construct a simple wind direction indicator as shown

FIGURE 1



in Figure 1. Attach an 18" long, brightly colored crepe paper streamer to a 3-foot wooden dowel. Place this into the ground near your launch pad. The streamer will keep you constantly informed as to wind direction and speed.

Should you be launching multi-stage rockets or "D" powered birds, try flying a wind marker rocket first. It is not unusual for the wind to be traveling in different directions and speeds at various low altitudes. Select an Alpha-size rocket, preferably something you can afford to lose. Launch it with a B or C engine. Watch the rocket closely to get an idea of changes in winds aloft and recovery drift conditions for your flying site. Once you have flown the marker rocket you can determine exactly where to place your launch site. This will greatly increase your chances of keeping all rockets within your launch and recovery area. Then as in Figure 1, preflight and launch your rocket as usual.

FIGURE 2

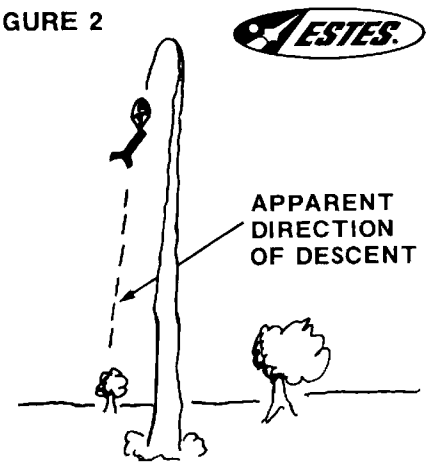
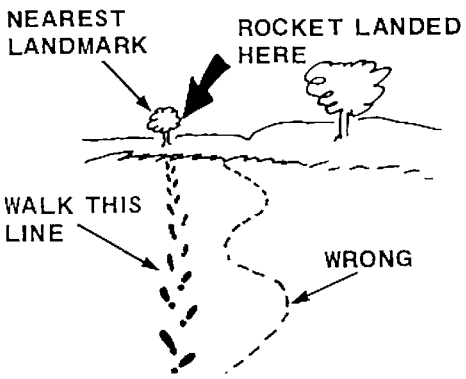


Figure 2 shows the rocket's flight path to the point of parachute deployment. Watch it very closely now. Try to anticipate which direction it will be drifting as it nears the ground. As the rocket finally lands, select a prominent landmark as close to the point of touchdown as possible. This might be a tree, bush, telephone pole, fence post, outhouse, or oil well as shown in Figure 3. If there isn't any landmark close by, select something farther in the distance. The landmark must be in a straight line between you and the rocket.

Once you have chosen that landmark, DON'T take your eyeballs away for even a second. Keep them peepers glued right on and start walking. Walk as STRAIGHT a line as you can towards the landmark until reaching the rocket. Almost without exception, you will walk right up to it. Or, on top of it as I've done a couple of times. An Estes AstroCam® camera sure makes a funny sound as it is being stepped on!

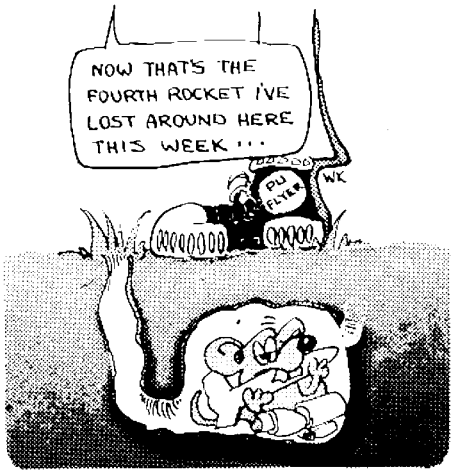
Should your rocket land behind a hill or other obstacle, merely select a landmark where the rocket disappeared from view. Now, walk towards that point. If you reach the landmark without sighting the rocket, select a second landmark and continue

FIGURE 3



walking. The second landmark MUST also be in line with the direction you have been traveling. Continue walking until you locate the rocket.

Keep one additional thing in mind. Distances are very deceiving to the eye. Your rocket will always be a bit closer than you think. Our next article tells you how to find your way back to the launching site, so try not to get lost in the meantime!



Summary

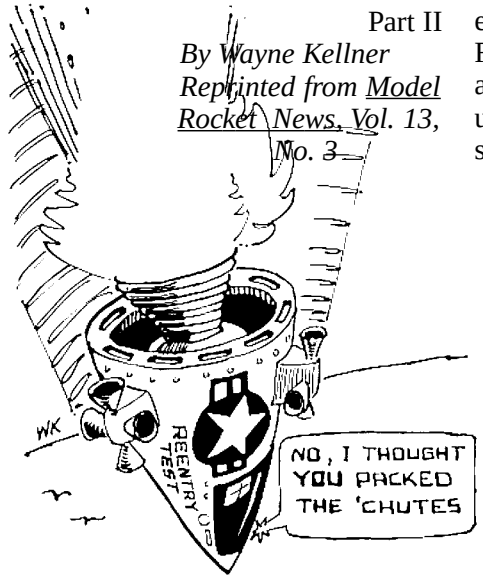
Let's summarize briefly the line search recovery method:

- ☐ 1. Check wind direction to determine which way rocket will drift during recovery descent.
- ☐ 2. Pre-flight and launch in the normal manner.
- ☐ 3. Follow rocket carefully during recovery phase of flight.
- ☐ 4. Select a prominent landmark nearest the touchdown point.
- ☐ 5. Glue your eyes to that spot and walk as straight a line as possible towards the landmark until reaching your rocket.
- ☐ 6. An unusual crunching sound may be your rocket.
- ☐ 7. Happiness is finding your rocket.

Aw 'Chute'

Part II

By Wayne Kellner
Reprinted from Model Rocket News, Vol. 13, No. 3



Second installment in a three part technical report on model rocket recovery - techniques, types, and tips. In this article we pass along a bagful of suggestions and tips on rocket tracking and parachute recovery techniques.

Now that I've got your attention, let's look at a few ideas to help you follow a rocket during its flight.

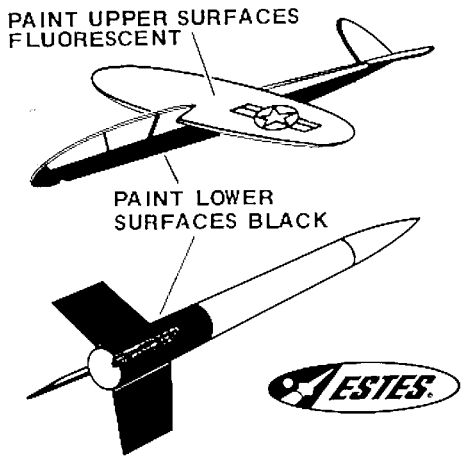
Painting

We will consider here primarily sport flying rockets, payload and contest rockets, or any bird where a specific paint scheme is not required.

First, examine your flying field. You will want to select a contrasting paint color which will make your rocket stand out from the recovery area background. Is the launch and recovery area rather dark in color - trees, bushes, green grass, etc? If so, paint the rocket a bright contrasting color such as white, yellow, or orange. When flying against a light background color, use a dark contrasting paint. Bright red, orange, perhaps even blue or black will show up well.

Obviously, for winter launching a white rocket would be somewhat difficult to locate in the snow. Or, for our Amazon friends, I wouldn't recommend flying green rockets. A bright red-orange fluorescent paint is best for most flying conditions. This color is easy to follow during flight and especially easy to spot on the ground. For brightest and best results, always apply a fluorescent color over a white undercoat. Fluorescent paints are slightly transparent by themselves and

FIGURE 1



will allow wood grain or any dark base surface to show through.

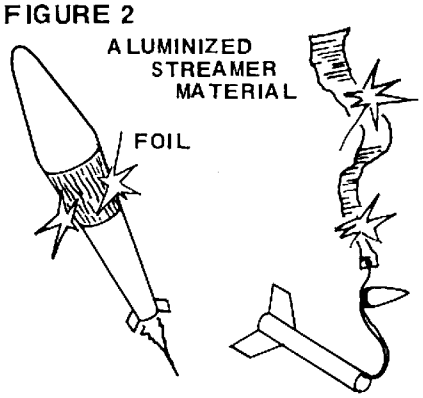
Black, believe it or not, is the easiest color to follow during flight. Although it may not always be easy to spot on the ground, you might try the following idea. For gliders, paint all bottom surfaces black in order to help you follow it during flight. See Figure 1. Then paint all upper surfaces fluorescent orange so that you have a bright color to help locate the glider on the ground. For rockets, paint the lower 1/3 black, then paint the remainder of the rocket a fluorescent color. Why not experiment to determine which colors are best for your flying area?

A quick note here about weight. Paint adds weight to any bird, much more than you would imagine. The darker the color is, the more color pigment it has. Therefore, the darker the color the heavier the paint. If you are building a model which you wish to keep ultra-lightweight, finish it with white, yellow, or orange paint. A very light coat (or "dusting") of paint may be sufficient to color the model.

Keep on Trackin

Have you ever tried attaching shiny silver foil to your rocket? During flight, sunlight reflecting from the foil looks just like a bright blinking light. Especially for those "outasight" D-powered birds, the flashing foil will help you track the rocket clear to touchdown.

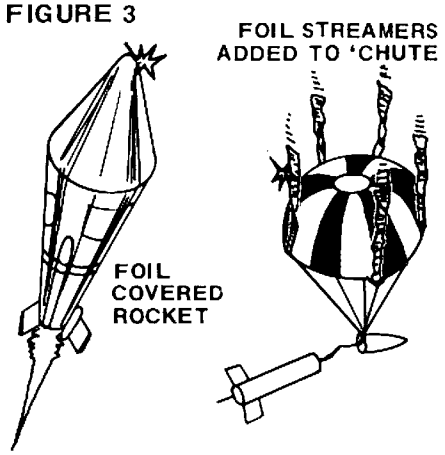
FIGURE 2



Some rocketeers have even attached small foil streamers to the corners of their parachutes for added visibility. Whether you add model aircraft silver Monocote, chrome mylar foil, stick-on silver foil, or ordinary aluminum foil, make a neat job of it. You don't want unnecessary drag or loose corners affecting the rocket's stability. Double-sided sticky tape or contact cement work well for attaching aluminum foil. You might even try building an all-foil-covered research-looking rocket.

Now, for you "try anything once" rocketeers. Next time you're out at the flying field, put a small amount of

FIGURE 3

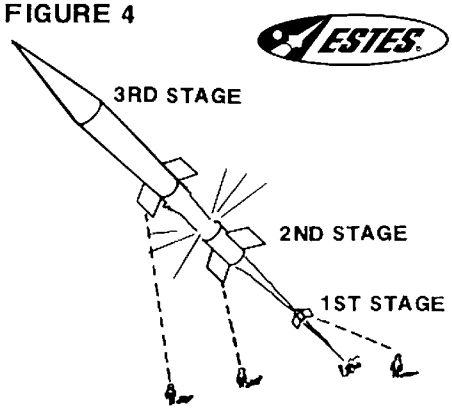


flour, talcum powder, or colored tempra powder paint into the rocket's parachute compartment. At ejection, the powder will quickly disperse into a small puff or cloud. This technique is often used at contests to give tracking stations a visual marker of a rocket's peak altitude. Pack your recovery wadding and parachute first. Then insert a square of wadding atop the parachute. Use more wadding for larger body tubes. This will prevent the powder from sifting down into the body tube. Add the powder and secure the nose cone. When launching against a clear blue sky, use a light colored powder. A dark color is easiest to spot on an overcast or cloudy sky background. It is a fun technique, but be prepared to find your rocket a bit messy after a couple of flights.

When launching a multi-stage bird, everyone wants to watch the whole show. But after the launch, no one seems to know what happened to the booster stages. Always assign one person to watch the first stage, another to watch the second stage, and so on as in Figure 4. The same procedure should be used when a payload is recovered separately, or for those rockets which eject the engine or power pod. Then you will be sure to recover all portions of your rocket.

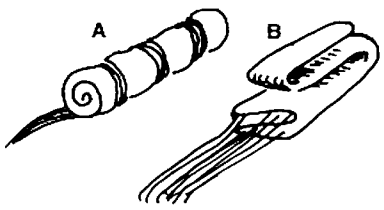
Flameproof recovery wadding is designed to protect your recovery sys-

FIGURE 4



tem from the heat of the ejection charge. Always use enough wadding to fill the rocket body for a distance of 1-1/2 to 2 times the body diameter. Before launching, check each rocket's assembly instructions for the exact amount of wadding required. DO NOT pack it so tightly that it cannot be ejected. Loosely packed wadding works best. If your 'chute returns looking like Swiss cheese or a burnt shish kebob, then you're not using enough wadding. Be sure to wrap one end of the rocket engine with enough masking tape so that it makes a snug airtight seal in the engine tube. This will prevent leakage of ejection gases past the engine.

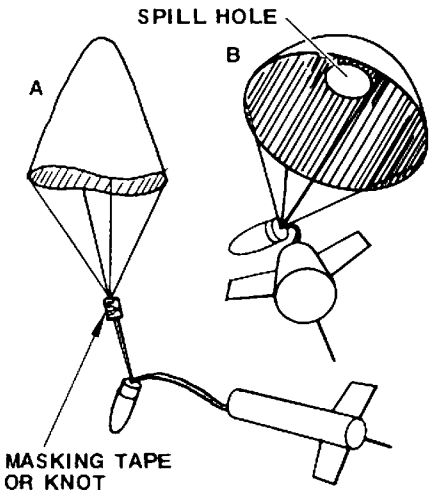
FIGURE 5



Considerable controversy still exists as to which is the best way to pack a parachute. Some prefer a tightly rolled and wrapped 'chute as in Figure 5A. This method is good when you must pack a large parachute into a small space. A tightly wrapped parachute will however, take longer to open. Others prefer a loosely packed 'chute (B). Our observation and experience has been that the loosely packed (even sloppy) method gives the most reliable recovery. This is due to the ability of the loose edges and folds to catch the wind. The plastic material also has a tendency to "spring back" when loosely crumpled. Plastic 'chutes also have a special tendency to take a "set" after being stored for a while. When cold, they become stiff and are very stubborn to open. So just before launching, remove the parachute, open it, refold, and repack it. For best results, always dust the 'chute lightly with talcum powder before folding, every other flight or so. This prevents the plastic from sticking to itself.

PARACHUTE MOD'S

FIGURE 6



There are several ways to modify a parachute in order to make your rocket fall faster but safely. You can "reef in" or shorten the shroud lines as in Figure 6A by taping them or typing a knot in the lines. The shorter you make the lines the less your 'chute can open. Shorten the shroud lines all the way and your parachute becomes an instant streamer. Or you can cut a "spill hole" (B) out of the parachute center. This decreases the parachute's drag and also seems to reduce the rocket's swaying movements during descent. Don't make the hole too large or the parachute will not open at all.

ROCKET RECOVERY

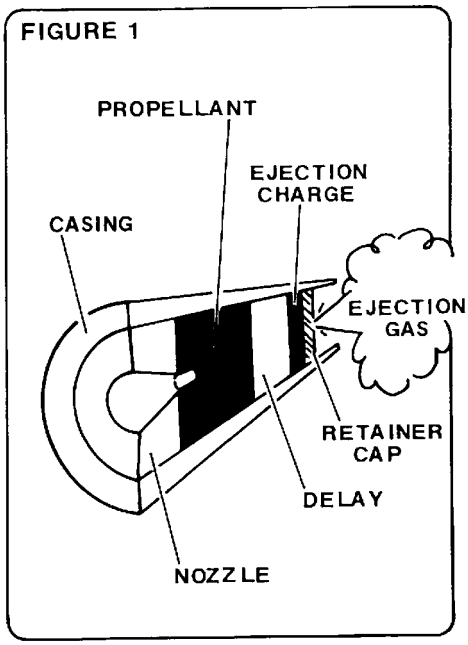
Part III

Reprinted from Model Rocket News, Vol. 13, No. 4

Third and final article in a technical report on model rocket recovery - techniques, types, and tips. In this article we examine the basic mechanics and types of solid-propellant model rocket recovery systems.

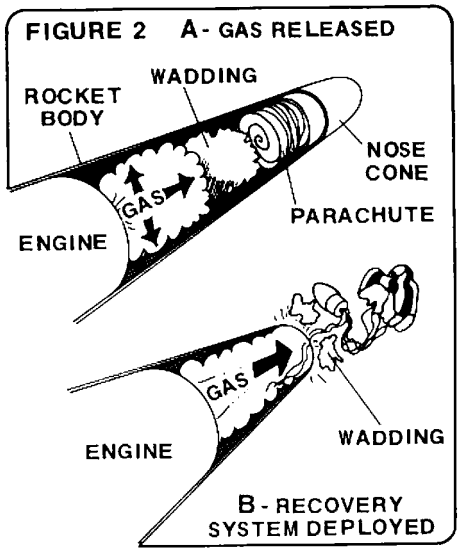
As soon as one has grown tall enough to fall over, you quickly discover Mother Nature's own recovery system, gravity. Gravity has been doing its thing in the Universe for some time now. So when model rocketry came along, we needed to make some refinements to this business of "what goes up must come down". Our rocketry safety code states that "a model rocket will always use a recovery system to return it safely". Not only is this important to the safety of our hobby, but it insures that you can recover your bird in the same number of pieces as when it was launched. The owner of your flying field might also get a bit up-tight should you begin excavating the local ecology trying to find the remains of an afternoon's launching. Well, writing rules and safety codes are easy, but here is how Estes and many rocketeers have solved this problem.

To fully understand and appreciate any recovery method, we must first know something about the heart of the system, the rocket engine. Each Estes engine first contains a precisely measured propellant section (Figure 1). At ignition, the propellant burns to provide the necessary thrust to lift the model from the launch pad and accelerate it to a high velocity. After pro-



pellant "burnout", the delay element continues to burn producing a "non-thrust" yet visible smoke-tracking trail. This also allows the rocket to coast upwards to peak altitude. Finally, the delay element ignites the ejection charge. A sudden burst of gas pressure is generated which breaks through the clay retainer cap. This gas is released from the engine to activate the model's recovery system.

The popular parachute or streamer recovery systems use this ejection gas to pressurize the forward end of the rocket. The engine acts effectively as a

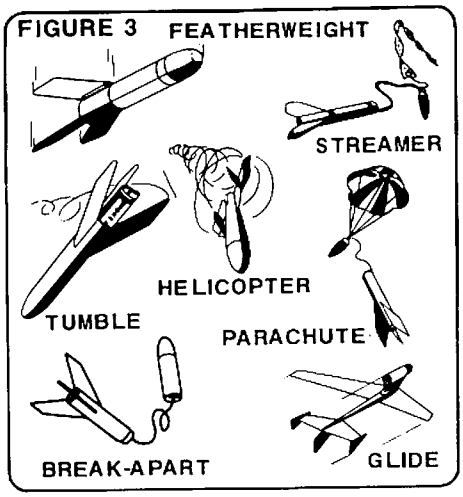


rear gas seal so that the gas must exit the front of the rocket as shown in Figure 2. (A very small amount of gas will escape back through he engine nozzle. This loss is minimal, but it is always good flight insurance to be sure that the nose cone does not fit exceptionally tight). Flameproof recovery wadding required for each flight protects the parachute or streamer material from the heat of the ejection gas. The wadding also acts as a forward gas seal and a piston to help push out the recovery device and nose cone.

RECOVERY TYPES

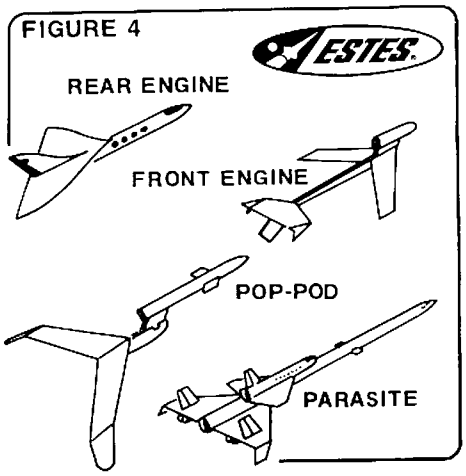
Nearly all recovery systems depend on drag or wind resistance to slow the rocket and return it safely. Each system changes the model from a streamlined object to one which the air can "catch against" and slow its decent. The seven main recovery methods used by rocketeers today are shown in Figure 3.

Featherweight recovery is used with very small, ultra-lightweight rockets. At peak altitude, the engine is ejected from the model. Both engine and rocket tumble or free-fall to the ground. The descent of the lightweight body is slow enough that it presents no hazard to spectators or models.



A tumble recovery model uses the ejection charge to move the engine rearward in the rocket. By moving the center of gravity (CG or balance point) to the rocket's rear, it becomes unstable and tumbles harmlessly to the ground. The added engine weight causes the model to fall faster than the featherweight bird. Therefore, you should expect occasional fin or body damage. These models must be built stronger to withstand a harder landing.

Break-apart recovery models are becoming increasingly popular. The rocket's streamlining is broken by simply ejecting the nose cone or separating the body in the middle. Both rocket sections must remain connected with a length of shock cord. Some wadding may be necessary to prevent scorching the shock cord. This method is ideal for very high altitude sport models and medium sized rockets when flown from small launch sites. Surprisingly, this type of model is seldom damaged upon landing.



Glide recovery models are launched straight up like any other rocket. But they return to earth in a glide configuration like a model airplane. A boost-glider's graceful gliding return is spectacular to watch. Sometimes the glide is not so graceful in the case of a poorly trimmed model, but still exciting just the same. Boost-gliders are more difficult to construct and fly. However, the added challenge is important as you advance your model rocket knowledge and building skills.

There are four main boost-glider types (Figure 4). Once again the ejection charge activates the glide recovery system. It may be used to: eject an internal power pod (rear engine); change the model's center of gravity (eject the engine as in front engine type); separate an external power pod (action-reaction principle used with pop-pod systems); or release a piggy-backed parasite glider (action-reaction principle again).

ROGALLO FLEX-WING IN FLIGHT

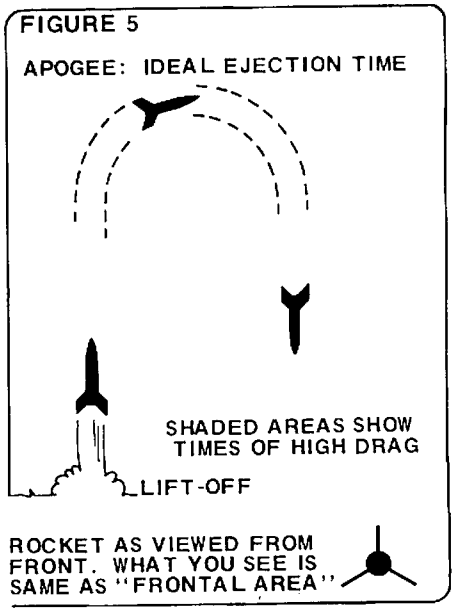
A fifth glider category would include the many weird and more complex glide recovery systems. An experimental Rogallo Flex-wing device shown in the photograph is one example. The plastic wings fold for storage in the rocket body during launch, then eject to return the payload section. Sorry, no plans available.

Helicopter recovery (Figure 3) is another interesting system. (No, it doesn't mean buying a helicopter to find your rockets). This method deploys flaps, blades, or other fin surfaces to cause high drag. These drag surfaces are held inside or against the rocket in a streamlined position during launch. The model usually spins or rotates as it returns.

Suggestions

Always select an engine so that the timed ejection occurs when your model has reached its peak altitude. At this high point (apogee), the wind resistance will be lowest. This is extremely important for rockets using an unusual or complicated drag device. Ejection should not occur during "fast coast" or too late when the model has streamlined into a fast free fall return. A recovery device suddenly exposed to high-speed wind resistance may turn into a mass of aerial confetti.

Rockets with large body diameters (BT 80 or larger) have a large frontal area, see Figure 5. Again, if ejection occurs too soon or too late, the wind resistance pushing against the nose cone may be greater than the pressure of the ejection charge. The recovery system will then be unable to eject from the rocket body.



Ejection charges build up a gritty residue inside the rocket body. Models which use internal, sliding power pods or piston devices must be cleaned occasionally. A toothbrush works well to brush away the residue. Frequent cleaning will prevent moving parts from sticking or binding and causing recovery failure.

Keep in mind the ejection charge "energy". You can put it to work pushing devices out of the rocket, moving internal actuating pistons, ejecting or relocating the engine. The possibilities are endless. Recovery is really half the enjoyment of flying. Experiment and have fun. That's model rocketry.