MODEL ROCKETRY CATALOG

Cat. No. 701

Estes Industries, Inc.
Box 227
Penrose, Colorado 81240

ESTES

A SUBSIDIARY OF DAMON

Discipline of mind and hand

This is Model Rocketry!

The moment of truth

That great feeling when everything's "A-OK"

Estes dedicates this catalog to you, the model rocketeer. Happy flying!

ESTES
A SUBSIDIARY OF DAMON

ORDERING INFORMATION

GENERAL INFORMATION

This catalog takes effect as of April 15, 1970 and replaces all previous catalogs. Please be sure that you use the correct and full catalog number for each item you order. All prices are subject to change without notice. WHEN SENDING ORDER BE SURE TO GIVE ZIP CODE IN YOUR ADDRESS.

POSTAGE

Estes Industries ships all retail orders postpaid in the U.S. by regular land mail unless the purchaser specifies otherwise. On a few items our price is slightly higher than normal list on the item. The difference in prices is due to our policy of paying postage on all items.

PAYMENT ON ORDERS

Full payment must accompany all orders. Please send all remittances by either check or money order, both for your protection and our convenience. If you do send currency, be sure your envelope has sufficient postage, is properly sealed, and is addressed correctly, so we will receive your order. Coins should be attached to a separate sheet of paper, not to the order blank. Use a single strip of masking tape to hold the coins in place. Avoid the mailing of coins, as they are easily lost in the mail. We cannot assume responsibility for the loss of coins, currency or orders in the mail. Remember to include sufficient funds with your order. For your protection, **we do not ship orders C.O.D.** Proper attention to these details will result in speedier service for you.

CAUTION

We believe that we have the safest program offered in the field of rocketry today. However, it is still important that the utmost care be exercised in the use of our products. We DO NOT assume any responsibility for accidents. No warranty is either made or implied as to reliability or performance. We assume no liability beyond the cost of replacement of a product, if any, which misfunctions or is found defective.

Your order may, for various reasons, have to be shipped in more than one package. For example, postal regulations permit us to ship no more than 27 engines per parcel. If all of your order does not come at the same time, please be patient--give the post office or freight company a few days to mix things up and sort them out again.

NOTE: All foreign orders require additional postage. Please write for more information.

ORDER FORM

ORDER FORM

CNX712G

USE THIS CONVENIENT ORDER FORM FOR FAST SERVICE

YOUR ROCKET SUPPLIES WILL BE ON THEIR WAY TO YOU THE SAME DAY WE RECEIVE YOUR ORDER!

ESTES

A SUBSIDIARY OF DAMON

Welcome to the Exciting World of Rocketry!

Vernon Estes, president of Estes Industries, explains cluster ignition techniques to local rocketeers.

Welcome . . .

to Estes Industries and to model rocketry—America's fastest growing scientific hobby. It is our wish to make your participation in the Estes program of model rocketry mean more than just finding a place to buy rockets.

As an Estes customer, you will not only have the advantage of obtaining the best materials at the lowest price, but you will also be kept informed of the latest developments as you receive the "Model Rocket News." Our Technical Reports (TR's) offer a helping hand when it comes to designing your own rockets.

We invite you to send us your own rocket designs, project ideas and safety suggestions. Each one will be carefully studied and many put to use. Thus you will play an important part in helping to establish and maintain the safest and most educational rocket program in the world.

If you have the opportunity, please stop in and see us. We will be pleased to show you around.

Sincerely,

Vern

PS: To improve our ability to serve you, Estes Industries merged with Damon Corporation in late 1969. By combining our efforts we are now able to also work with you in other areas of science. Write for a copy of the new Estes/Damon Science Catalog of about 200 exciting items.

Meeting the Space Age Challenge

Model rockets are not toys. They are flying, miniature counter-parts of the vehicles of the space age. Constructed primarily of lightweight balsa and paper tubing, model rockets use and demonstrate principles of orbital launch and space vehicles.

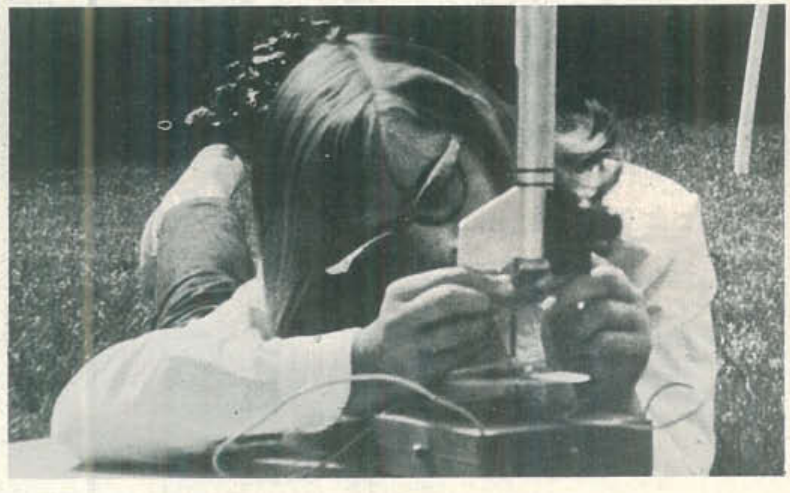
Because their design and flight characteristics are similar to space rockets, model rockets present a way for young people of today to meet the challenge of the space age for tomorrow.

The ESTES program begins with basic model rockets which are easy to build and fly. Then as the model rocketeer's knowledge and skills develop the program provides more advanced and difficult rockets and projects. Throughout his "rocketry career" his success will be assured by the use of the safety-engineered ESTES solid propellant engines.

The most effective learning comes through doing. As a rocketeer develops skill and knowledge by building and flying rockets, he develops an active and inquiring mind. The ESTES program of model rocketry guides young people in this direction. This program is effective because it includes the finest rocketry materials available and a continuing flow of helpful information. Model rocketry as a form of youth science study has no equal for practical experience aimed at a space age career.

The future holds an exciting promise for young people who are prepared to meet its challenge. The greatest frontier man has ever known is opening. Young rocketeers are taking their first steps as pioneers in this great frontier.

Model Rocketry Meets the Space Age Challenge



ESTES

MODEL ROCKET SAFETY

DEVOTED TO SAFETY SINCE 1958 IN MODEL ROCKETRY

A recognized safety code — plus
safe rocketry materials — equals
20 million safe rocket launches

This Solid Propellant Model Rocketry Safety Code Is Approved by The National Association of Rocketry and the Hobby Industry Association of America.

1. CONSTRUCTION — My model rockets will be made of lightweight materials such as paper, wood, plastic and rubber, without any metal as structural parts.
2. ENGINES — I will use only pre-loaded, factory-made model rocket engines in the manner recommended by the manufacturer. I will not change in any way nor attempt to reload these engines.
3. RECOVERY — I will always use a recovery system in my model rockets that will return them safely to the ground so that they may be flown again.
4. WEIGHT LIMITS — My model rocket will weigh no more than 453 grams (16 ozs.) at liftoff, and the engines will contain no more than 113 grams (4 ozs.) of propellant.
5. STABILITY — I will check the stability of my model rockets before their first flight, except when launching models of already proven stability.
6. LAUNCHING SYSTEM — The system I use to launch my model rockets must be remotely controlled and electrically operated and will contain a switch that will return to "off" when released. I will remain at least 10 feet away from any rocket that is being launched.
7. LAUNCH SAFETY — I will not let anyone approach a model rocket on a launcher until I have made sure that either the safety interlock key has been removed or the battery has been disconnected from my launcher.
8. FLYING CONDITIONS — I will not launch my model rocket in high winds, near buildings, power lines, tall trees, low-flying aircraft, or under any conditions which might be dangerous to people or property.
9. LAUNCH AREA — My model rockets will always be launched from a cleared area, free of any easy to burn materials, and I will only use non-flammable recovery wadding in my rockets.
10. JET DEFLECTOR — My launcher will have a jet deflector device to prevent the engine exhaust from hitting the ground directly.
11. LAUNCH ROD — To prevent accidental eye injury, I will always place the launcher so the end of the rod is above eye level or cap the end of the rod with my hand when approaching it. I will never place my head or body over the launching rod. When my launcher is not in use, I will always store it so that the launch rod is NOT in an upright position.
12. POWER LINES — I will never attempt to recover my rocket from a power line or other dangerous places.
13. LAUNCH TARGETS & ANGLE — I will not launch rockets so their flight path will carry them against targets on the ground and will never use an explosive warhead nor a payload that is intended to be flammable. My launching device will always be pointed within 30 degrees of vertical.
14. PRE-LAUNCH TEST — When conducting research activities with unproven designs or methods, I will, when possible, determine their reliability through pre-launch tests. I will conduct launchings of unproven designs in complete isolation from persons not participating in the actual launching.

Revised 2/4/70

ROCKETEER'S PLEDGE

I am proud to be a model rocketeer. I feel it is important to do my part in upholding the outstanding safety record that model rocketry has gained. In all my rocketry activities I will act in a mature manner and will always be considerate of other people and property rights. I pledge to follow the Rocketeer's Code of Safety.

ESTES

building and flying
MODEL ROCKETS

One of the best things about this rewarding hobby is that it's easy to get started. Everything you need is right here in this catalog. Basic materials are light weight balsa wood, paper tubing and a little glue. With ordinary modeling tools you'll be on your way.

You have a challenging selection of ready-to-assemble, precisely engineered kits to build and fly. Easy to follow instructions guide you step by step. These kits, together with materials and technical information for your own designs, will help you to get the most from model rocketry.

In addition to all of this you will be flying your models with inexpensive and reliable Estes model rocket engines.

From the ranks of today's rocketeers will come many of tomorrow's space scientists. As an Estes model rocketeer you can open the door to the future. There are unlimited scientific horizons ahead for the person who enjoys this creative activity.

Have fun with safety-proven Estes model rockets while you continue to learn.

For real success, follow this planned Model Rocket Program

model rocket program

1 Basic Building

Start your program by building and flying the Astron Alpha, an outstanding basic rocket design. Study technical report TR-1 (included in the kit) to gain a good understanding of rocket stability principles so important to performance.

2 Stability Studies

Increase your understanding of stability principles by building and flying the Astron Scout.

3 Design Planning

Gain skills in rocket design by studying technical report TR-9. It is an excellent guide for creating your own single stage rocket. Build and flight-prove your own design.

4 Multi-Staging

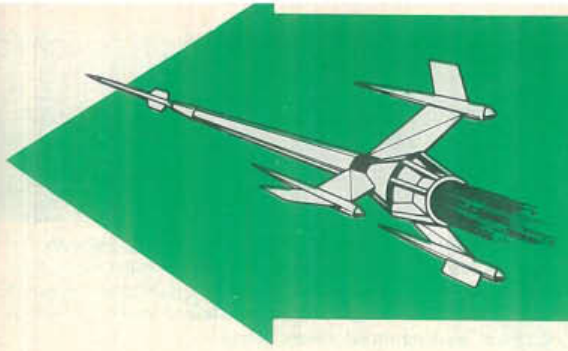
Introduce yourself to multi-staging with a 2-stage Astron Apogee. Technical report TR-2, with the kit, explains stage coupling, separation and upper stage ignition. Study carefully as you build and fly.

5 Advanced Multi-Staging

Add to your skill in multi-staging by building and flying a 3-stage Farside, using experience gained from the Apogee.

6 Custom Design I

Challenge yourself by designing, building and flying your own multi-stage model, using the techniques you've learned.



7 Boost-Glide

This is departure from the traditional rocket. Build and fly the Astron Falcon which combines rocket and glider characteristics. Technical report TR-7 (with kit) gives precise instructions on FRONT ENGINE models.

Broaden your boost-glide skills with the Astron Space Plane, a REAR ENGINE model. By studying included technical report TR-4, you'll gain further knowledge in the art of balancing for maximum performance.

8 Custom Design II

Now test the boost-glide principles you've learned from the Space Plane and Falcon. Design and build your own boost-glider.

9 Clustering

This is the technique of simultaneously igniting more than one engine. Master it by building the Astron Scrambler, studying TR-6 (with kit) and launching a payload with your model. Continue studies of clustering by building and flying the Astron Ranger or one of the clustered Estes scale models. Then build a cluster model of your own.

Technical Information Services

Rocketeers have a wealth of valuable information available from the Estes research department: New product innovations; information on new techniques; technical reports (TR's); and the informative and educational Model Rocket News.

Educational Services Department

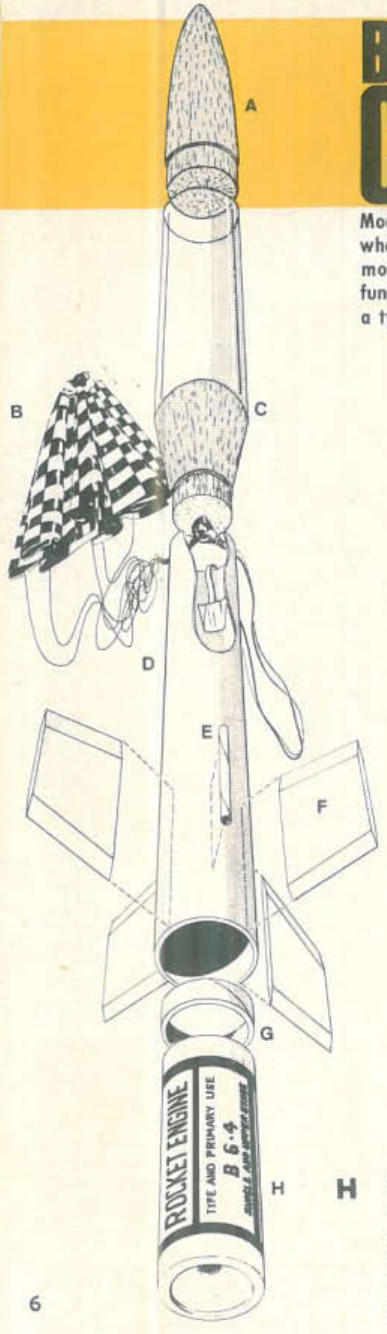
Headed by an experienced science teacher, this department provides many services to educators at all levels. Instructional materials are available at no cost to schools. As a teacher, please write your request on your school letterhead.

Through your studies and research you will learn that there is more to model rocketry than just the thrill of the launch. You will have discovered practical applications of the science subjects you've studied in school. You'll look forward to new fields to explore.

Look for research projects for your own research program. To assist you, several good books are listed in our catalog. Your school or public library has many more. Aerial photography, space medicine, electronics, aerodynamics, meteorology and physics are but a few of the fields open to ambitious model rocketeers.

Keep studying and researching. Use your studies to develop a prize winning project. Look to the future — the frontiers of space have barely opened. Curiosity and research of young people like yourself will expand these frontiers.

BASIC MODEL ROCKET COMPONENTS



Model rockets vary greatly in appearance and purpose, but whether for sport and recreation or scientific experiment, most models use certain basic components. The arrangement and functions of these components are explained in the diagram of a typical working rocket shown below.

A NOSE CONE
The front end of a rocket. Usually shaped to minimize air resistance.

B RECOVERY SYSTEM
Slows rocket descent, bringing it back to earth in an undamaged, reflyable condition. In this model a parachute deployed by an ejection charge in the engine is used.

C PAY LOAD SECTION
Used to carry instruments, specimens, etc. Some models may omit this section for sport or high-performance flights.

D BODY TUBE
The basic airframe of the rocket, around which all other parts are built or attached.

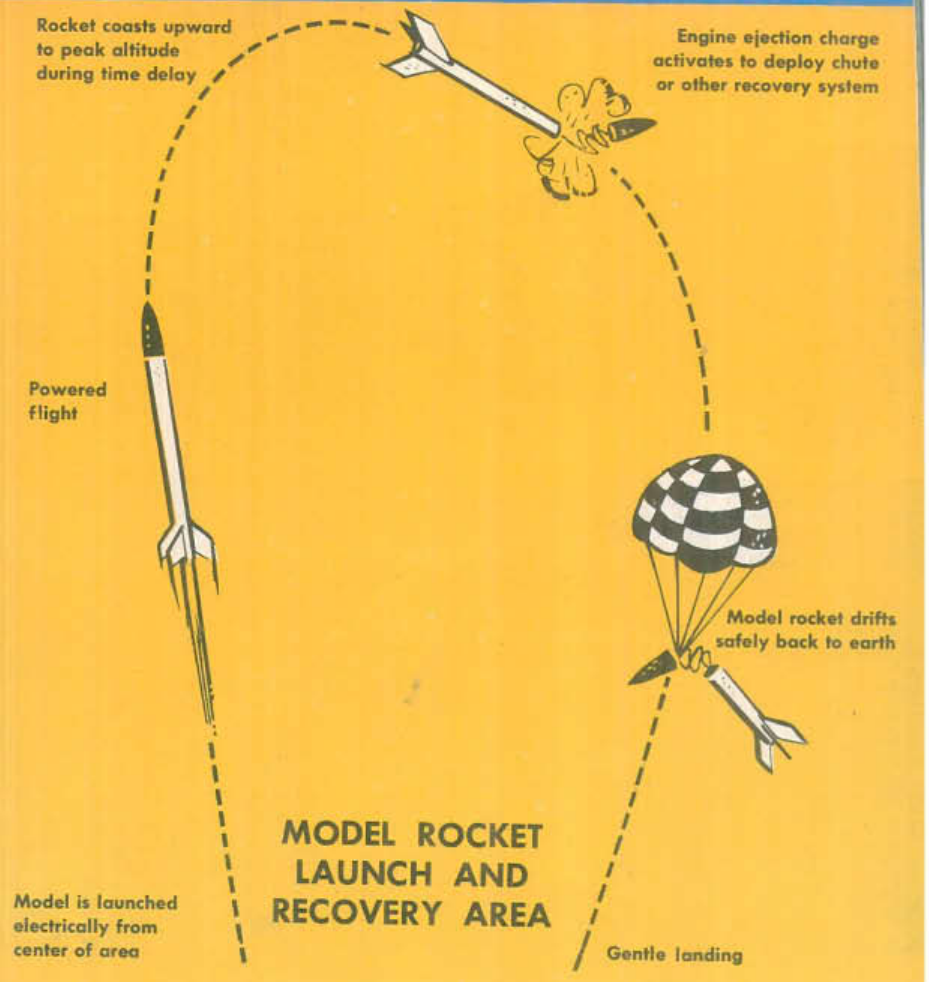
E LAUNCH LUG
A tube which slips over the launch rod to guide the model until it reaches the speed necessary for the fins to control the flight.

F FINS
Act like the feathers on an arrow, guiding the rocket in a precise flight pattern.

G ENGINE RETAINER
A block or ring used to position the engine in the body tube.

H ENGINE
A pre-packaged solid propellant device which provides the power to make the rocket fly. Single and upper stage engines contain a smoke tracking/delay charge to let the model coast up to peak altitude before the ejection charge pops out the parachute.

MODEL ROCKET FLIGHT



Complete instructions for launching model rockets are included with all engines sold by Estes Industries.

START RIGHT FLY RIGHT

with the safe and educational program of Estes model rocketry

STARTER KIT INCLUDES: Alpha Rocket Kit, K-25; 3 engines—½A6-2, A8-3, B6-4; Launch Control System, FS-5; Porta-Pad Launcher, RL-4; Design Manual P-1; instructions. Batteries not included. Recommended batteries: Ray-O-Vac No. 918, Eveready No. 731, Burgess TW-1, or any 6 or 12 volt car battery.

Astron STARTER KIT

High flying, easy-to-assemble Alpha kit, 3 engines, instructions

Porta-Pad — sturdy tripod rod launcher — electrical Launch Control System

Fact-filled Design Manual

Shipped in a sturdy field box with handle and compartments for engines, supplies, tools, etc. Ideal range box.

Deluxe Starter Special including building and finishing materials on page 10.

LIFT OFF WITH CONFIDENCE

Start with this complete outfit. The Astron Alpha is an easy rocket to build and fly. Demonstrating most rocketry principles, it can attain altitudes of 1000 feet or more. Parachute recovery brings your "bird" back for flight after flight. Both the Porta-Pad launcher and the complete Launch Control ignition system will serve you well throughout your rocketry career (see pages 100 and 101). To get you off to the right start, the comprehensive Estes Design Manual is included. Shipping weight 2 lb. 7 oz.

Cat. No. 701-KS-7 ..... $7.00

$2.25 BEGINNER'S SPECIAL

For those who have a launcher available or wish to build their own (instructions included) all the above items except the launcher and launch controller are included. Shipping wt 11.5 oz.

Cat. No. 701-KS-2 ..... $2.25

DELUXE STARTER SPECIAL

It's all here! This is the most complete outfit offered to build, finish and fly a model rocket. At one low price you get everything needed to get ready for launch: rocket, instructions, engines, launcher, electrical ignition system, tools and paints. All you need is the battery power for ignition.

Packaged in a reusable field box with handles and compartments for engines, supplies, tools, etc., this outfit is perfect—especially if you've done no model building before.

Deluxe Special Includes:

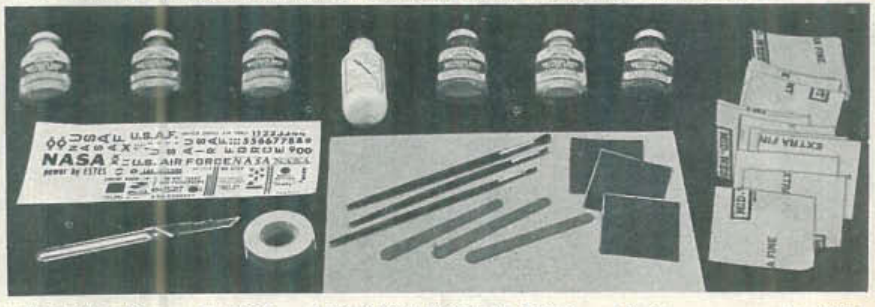
Alpha Rocket Kit
Launch Control System
Porta-Pad Launcher
Design Manual
3 safety engineered engines
plus a knife, glue, sandpaper, paints, brush, brush cleaner—supplies which can be used in building several more rockets. Shipping wt 3 lb. 8 oz.

Cat. No. 701-KS-8 ..... $8.50

ASSEMBLY SPECIAL

A Complete Construction and Finishing Set

One convenient package containing all the tools and supplies recommended for assembling, painting, and decorating most model rockets. Ideal for the beginner who doesn't already have modeling equipment. This set helps you build the best models right from the start.



1 Bottle White Glue	No. WG-1	1 Bottle Dope Thinner	No. BDT-1	1 Knife	No. KNS-3
3 Emery Boards	No. BE-1	1 Bottle White Dope	No. BRD-1	18 Sheets Sandpaper	No. SPA-2
1 Bottle Sanding Sealer	No. SS-1	1 Roll Masking Tape	No. MT-1	3 Paint Brushes	No. PB-3
1 Bottle Silver Dope	No. BRD-1	1 Bottle Black Dope	No. BRD-1	1 Bottle Orange Dope	No. BRD-1

3 Sheets Sanding Material No. SP-320 1 Gold Mine Special Decal Sheet No. D-5

Cat. No. 701-CK-3A, shipping wt. 1.5 lb. $3.50

EASY-TO-BUILD
PARACHUTE RECOVERY

Astron

ALPHA

"OUT OF THIS WORLD" performance from an easy-to-build model! First choice for beginning and experienced rocketeers, the Alpha offers dependable high performance from lift-off through parachute recovery. Easy to prep, easy to fly, this "bird" will be one of your favorites as your rocket fleet grows. (Engines not included.) Shipping weight 8 oz.

Cat. No. 671-K-25 ..... $1.50

SPECIFICATIONS

Length ..... 12.25 in (31.1 cm)
Body Dia. .... 0.976 in (24.8mm)
Weight ..... 0.8 oz (23 gr)

RECOMMENDED ENGINES

½A6-2
A8-3
A5-4
B4-4
B6-4
C6-5

EASY-TO-BUILD

PARACHUTE RECOVERY

Astron

SKY HOOK

You'll really enjoy building and flying your Astron Sky Hook. Easy to build and durable, parachute recovery brings it back gently for flight after flight. Kit comes complete with all parts and instructions (but no engines). Shipping weight 5 oz.

Cat. No. 651-K-8 ..... $1.35

SPECIFICATIONS

Length . . . . . 12 in (30.5 cm)
Body Dia. . . . 0.765 in (19.4 mm)
Weight . . . . . 0.7 oz (20 gr)

RECOMMENDED ENGINES

½A6-2, A5-4, A8-3,
B4-4, B6-6, C6-7
(For first flights use ½A6-2)

3 ENGINE POWER

VISIBLE PAYLOAD

Astron

SCRAMBLER

Huge see-through payload compartment holds an egg or other large payload . . . cluster design gives the power to boost it. A great sports model; perfect for contests too. Can carry an egg to over 1000 feet and set it down safely. Has 2 'chutes for extra gentle recovery. Comes with all parts and instructions, a complete technical report on clustering and an unusual decal sheet for unique decorating (less engines). Shipping wt. 13 oz.

Cat. No. 701-K-37 . . . . . $4.25

SPECIFICATIONS

Length . . . . . 23.5 in (59.7 cm)
Body Dia. . . . 1.637 in (41.6 mm)
Payload Dia. . .1.796 in (45.6 mm)
Weight . . . . . 2.8 oz (79 gr)

RECOMMENDED ENGINES

A8-3 B6-4
C6-5 B14-5

VISIBLE PAYLOAD

PARACHUTE RECOVERY

Astron

constellation

The perfect high performance bird for single stage payload work or just flying for fun. The long slender lines and the "landing shocks" at each fin tip lend the appearance of a space vehicle of the future. Parachute recovery, "see-through" payload section plus a quick change engine mount make the Constellation easy to fly and reliable. Kit comes complete with all parts and instructions (less engines). Shipping weight 6 oz.

Cat. No. 681-K-35 . . . . . $2.00

SPECIFICATIONS

Length . . . . . 16.2 in (41.4 cm)
Body Dia. . . . 0.976 in (24.8 mm)
Weight . . . . . 1.0 oz (28 gr)

RECOMMENDED ENGINES

½A6-2, A8-3, A5-4
B6-4, C6-5

Astron

VISIBLE PAYLOAD

X-RAY

An easy-to-build high performance single stage payload rocket, the Astron X-Ray features parachute recovery and a large see-through payload compartment. Perfect for research work and sport flying too. Kit comes complete, ready to assemble. Engines not included. Shipping wt. 6 oz.

Cat. No. 651-K-18 . . . . . $1.75

SPECIFICATIONS

Length . . . . . 16.75 in (42.5 cm)
Body Dia. . . . 0.736 in (18.7 mm)
Payload Sec. Dia. 0.976 in (24.8 mm)
Weight . . . . . 0.7 oz (20 gr)

RECOMMENDED ENGINES

½A6-2
A8-3
B6-4
C6-5
B14-5

STREAMER RECOVERY
EASY-TO-BUILD

Astron MARK

An excellent bird for novice or experienced rocketeer. Easy to build, ideal for sport and demonstration flying, the Astron Mark gives top notch performance. Kit comes complete with all parts and instructions (but no engines). Shipping weight 5 oz.

Cat. No. 651-K-2 ..... $1.25

$1.25

RECOMMENDED ENGINES
½A6-2 A5-4
A8-3, B6-4, C6-5
(Use ½A6-2 for first flights)

SPECIFICATIONS
Length . . . . . 9.1 in (23.1 cm)
Body Dia. . . . 0.765 in (19.4 mm)
Weight . . . . . 0.7 oz (20 gr)

BIG BERTHA

SINGLE ENGINE OPERATION
PARACHUTE RECOVERY

$3.00

Easy-to-build, reliable and impressive in flight, Big Bertha is an ideal model for demonstration flights. Features a slow, realistic takeoff that fascinates spectators. Big 18" chute gives slow descent and gentle landings. Kit comes complete with all parts and easy to follow instructions (but no engines). Shipping weight 16 oz.

Cat. No. 701-K-23 . . . . . $3.00

SPECIFICATIONS
Length . . . . . 24 in (61 cm)
Body Dia. . . . 1.637 in (41.6 mm)
Weight . . . . . 2.25 oz (64 gr)

RECOMMENDED ENGINES
A5-2, A8-3, B4-2, B6-4, C6-5

GREAT FOR
COMPETITION OR SPORT

Astron DRIFTER

Spectacular in upward flight and recovery, the Astron Drifter combines low weight with large chute capacity. Perfect in any competition with its 24" chute, the Astron Drifter is a great performer with its 12" chute for test and sport flying too! Parachutes are easily interchanged. Shipping weight 8 oz. Engines not included.

Cat. No. 651-K-14 ..... **$1.75**

ONLY $1.75

SPECIFICATIONS

Length . . . . . 14.3 in (36.3 cm)
Body Dia. . . . 0.976 in (24.8 mm)
Weight . . . . . 1 oz (28 gr)

RECOMMENDED ENGINES

½A6-2
A8-3
B6-4
C6-5

Astron STARLIGHT

Unique Design — Parachute Recovery

Advanced design incorporates large fin area for exceptional stability. Launches straight up to extreme altitudes. Graceful in flight, its unique fin design makes it ideal for sport, demonstration, or display. Engines not included. Shipping wt. 9 oz.

Cat. No. 681-K-32 . . . . . **$2.35**

SPECIFICATIONS

Length . . . . . 18 in (45.7 cm)
Body Dia. . . . 0.976 in (24.8 mm)
Weight . . . . . 2 oz (57 gr)

RECOMMENDED ENGINES

½A6-2 A8-3
B6-4 C6-5

Astron PHANTOM

Complete Cutaway Model

This bird will never fly, but it will certainly help get your science fair project or special demonstration off the ground! The Astron Phantom has a transparent body to show all the insides of a model rocket—plus a special dummy engine cut in half to show its insides. A great help in answering questions on model rocketry, the Astron Phantom kit comes complete with all parts and instructions (but no fins). Shipping weight 5 oz.

Cat. No. 651-K-7 . . . . . **$1.75**

SPECIFICATIONS

Length . . . . . 8.7 in (22 cm)
Body Dia. . . . 0.736 in (18.7 mm)
Weight . . . . . 0.7 oz (20 gr)

FUTURISTIC DESIGN
RELEASES RE-ENTRY GLIDER IN FLIGHT

ORBITAL TRANSPORT

Spectacular in flight and a true show model on the ground, the Orbital Transport is the launch vehicle of the 80's. Based on the latest proposals for a reusable air breathing (scramjet) booster for orbital vehicles, the Transport is exciting to build and fly. The Transport itself lifts off under rocket power. At ejection the "re-entry vehicle" detaches and glides back to earth. The booster returns by parachute. Kit comes complete with colorful decals and a fact-filled data sheet on the air breathing booster concept, but no engines. Shipping weight 16 oz.

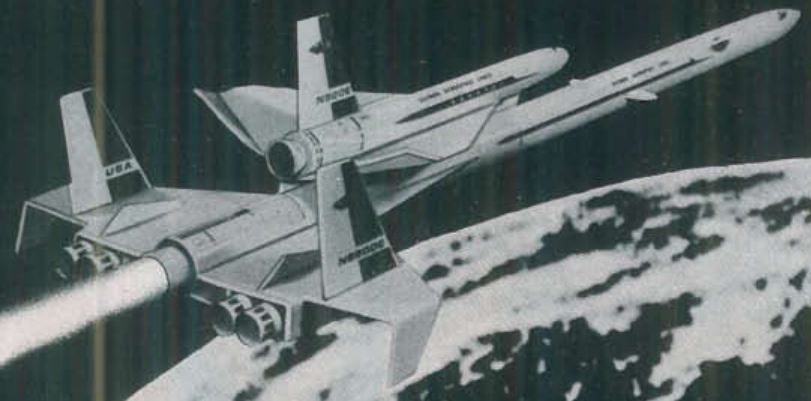
Cat. No. 701-K-42 ..... $3.25

SPECIFICATIONS

Booster		Re-entry Vehicle
23 in (58.4 cm)	Length	8.6 in (21.8 cm)
0.976 in (24.8 mm)	Body Dia.	0.736 in (18.7 mm)
7.9 in (20 cm)	Wing Span	5 in (12.7 cm)
2 oz (57 gr)	Weight	0.5 oz (14 gr)

RECOMMENDED ENGINES

B6-4 C6-5



Astron

TRIDENT

REVOLUTIONARY MODEL DESIGN

Futuristic rocket design introduces ejection ducting. This system directs ejection gases through openings in the power tube into three ducting tubes to pressurize the parachute compartment for deployment of the 'chute. You'll want to build this model because it presents a new idea to test, and gives excellent reliability, stability and performance. Uses single parachute recovery; gives impressive performance flight after flight. Engines not included. Shipping weight 16 oz.

Cat. No. 681-K-33 ..... $4.00

SPECIFICATIONS

Length..... 31.6 in (80.3 cm)
Main Body Dia.0.976in (24.8mm)
Weight..... 2.7 oz (77 gr)

RECOMMENDED ENGINES

A8-3 B6-4
C6-5 B14-5

EXPERIMENTAL CONCEPT
PARACHUTE RECOVERY

MARS LANDER

This authentic, futuristic concept in planetary exploration vehicles lands upright on spring-loaded landing gear after parachute recovery. Highly detailed body panels and four-color decals make this a beautiful bird to fly and display. Shipping weight 16 oz. (Engines not incl.)

Cat. No. 701-K-43 . . $6.00

SPECIFICATIONS

Height . . . . . 12 in (30.5 cm)
Body Dia. . . . . 3.8 in (96.5 mm)
Landing Gear Span 13.2 in (33.5 cm)
Weight . . . . . 3 oz (85 gr)

RECOMMENDED ENGINES

B4-2
C6-3

FUTURISTIC DESIGN
CHALLENGING KIT

MARS SNOOPER

A truly different model which combines unique appearance with reliable performance. Great for show or demonstration flying. Features payload section, 18" chute, and precut fins for easy assembly. Recommended for the careful modeler. Engines not included. Shipping weight 12 ounces.

Cat. No. 701-K-20 . . $3.25

SPECIFICATIONS

Length . . . . . 21.7 in (55.1 cm)
Body Dia. . . . 0.976 in (24.8 mm)
Weight . . . . . 2.2 oz (62 gr)

RECOMMENDED ENGINES

A8-3
B6-4
C6-5

BUILD THE BIG ONE THAT TOOK US TO THE MOON!

SATURN V

Scaled to 1/100th actual size, it stands 43½" tall. Precision molded plastic tower and other details make this an easy model for the experienced rocketeer to build. Authentic full color decals included. Realistic plastic engine nozzles remove for flight. Majestically soars hundreds of feet to peak altitude where separation occurs. The Apollo capsule returns safely to earth on its 12" chute; two big 24" chutes gently return the main power section for its next launch. Use a 12 volt car battery and a 12 volt Estes FS-5 (or similar launch control system) for dependable ignition. Engines not included. TR-6 on clustering included. Shipping wt. 2 lb. 4 oz.

Cat. No. 701-K-36 . . . . . $13.50

NOW
Fly with 'D' POWER!

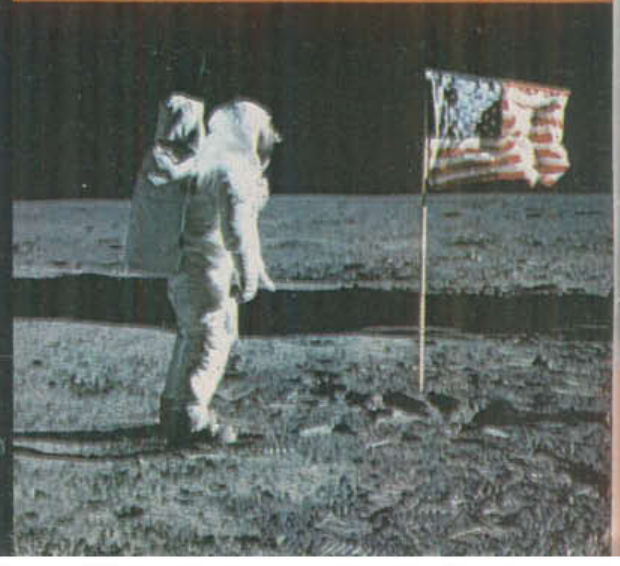
'D' engine mount adapter included

SPECIFICATIONS

Length . . . . . 43.5 in (110.5 cm)
Body Dia. . . . 3.938 in (100 mm)
Weight . . . . . 9.9 oz (280 gr)

RECOMMENDED ENGINES

Cluster Power
C6-3 (3 required)
'D' Power:
D13-3 (1 required)



Lofted the lunar module in its first flight test

SATURN 1-B

1 to 70 scale

$10.95

3 Parachute Recovery

4 Engine Power

A thrilling scale model for even the most advanced rocketeer, this bird will be a real challenge to your building and flying skill. A four engine cluster lifts the uprated Saturn model into the air. Two 24" parachutes on the main body and a 12" parachute on the command escape structure return it gently. A real beauty, both in the air and on display. Kit comes complete with all parts, decals, detailed instructions and a copy of Technical Report No. TR-6. Engines not included. Shipping wt. 4 lbs.

Cat. No. 701-K-29 . . . . . $10.95

Uses a 12 volt car battery and a 12 volt Estes FS-5 (or similar launch control system) for dependable ignition.

RECOMMENDED ENGINES

(All four must be the same)
A8-3, B6-4, C6-5

SPECIFICATIONS

Length . . . . . 37 in (94 cm)
Body Dia. . . . 3.938 in (100 mm)
Weight . . . . . 9.9 oz (280 gr)

SEMI-SCALE

SATURN V

PARACHUTE RECOVERY

PRACTICAL SIZE

SINGLE ENGINE RELIABILITY

Though not fully detailed, this model of the Saturn V is an amazingly good representation of our nation's biggest launch vehicle. Scaled at 1 to 242 it is a practical size to build. With single engine reliability you can count on precise launchings and steady flights. Parachute recovery gives gentle landings. Instructions and all parts included, but no engines. Shipping weight 13 oz.

Cat. No. 701-K-39 ..... $3.50

SPECIFICATIONS

Length ..... 18.1 in (46 cm)
Body Dia. ... 1.637 in (41.6 mm)
Weight ..... 1.9 oz (54 gr)

RECOMMENDED ENGINES

A8-3, B6-4, C6-5

1 to 70 SCALE MODEL

APOLLO SPACE CAPSULE

with launch escape structure

Fits BT-70 Body Tubes — Average Weight .36 oz.

Realistic 6.6 inch long scale model of the space capsule that carried our astronauts on the first trip to the moon. Precisely detailed, it can be built for either launching or display. Identical to the capsule on the Estes Saturn 18 and Little Joe II kits. Step-by-step instructions, assembly jig and die cut parts make it relatively easy to build. Shipping weight 5 oz.

Cat. No. 681-NCK-29 ..... $1.75

LITTLE JOE II

SUBORBITAL APOLLO LAUNCH VEHICLE

SPECIFICATIONS

Length ..... 14.5 in (36.8 cm)
Body Dia. ... 2.217 in (56.3 mm)
Weight ..... 2 oz (57 gr)

RECOMMENDED ENGINES

A5-2, A8-3, B4-2
B6-4 C6-5

Flying scale model complete with Apollo capsule

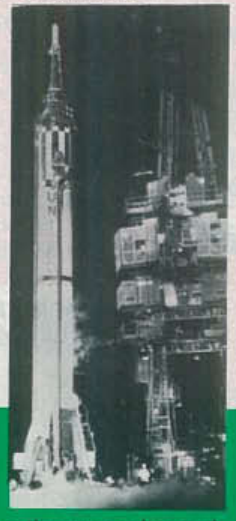
Great for display and for flying. This 1 to 70 scale model is designed for great lift-off capability and stable trajectory. The command module, with launch escape structure, has its own 12″ recovery 'chute; the booster module is returned safely by a big 24″ parachute. Though detailing on the model is intricate, the Little Joe II is easy to build after you've gained experience with less complex models. Engines not included. Shipping weight 16 oz.

Cat. No. 701-K-30 ..... $3.25

SCALE MODEL
DUAL PARACHUTE RECOVERY

MERCURY REDSTONE

THE VEHICLE THAT STARTED AMERICA ON THE WAY TO THE MOON



ONLY
$3.50

A beautiful rocket to thrill even the most advanced rocketeer. The Mercury Redstone is an exact scale model of the vehicle that boosted Commander Alan Shepard on America's first manned space flight. Scaled at 1 to 42, the model is accurately detailed and includes a complete decal sheet. Although it requires care and precision in construction, the completed model will become one of your favorite rockets. Kit comes complete with all parts and instructions. Shipping weight 16 oz. Engines not included.

Cat. No. 701-K-41 ..... $3.50

SPECIFICATIONS
Length ..... 23.5 in (59.7 cm)
Body Dia. ... 1.637 in (41.6 mm)
Weight ..... 2.1 oz (60 gr)

RECOMMENDED ENGINES
A8-3
B6-4
C6-5

EASY TO BUILD
PARACHUTE RECOVERY

THOR AGENA-B

Scale model of the launch vehicle for the Discoverer program

ONLY
$3.25

Actual scale model of the famed N.A.S.A. booster that lofted such satellites as Alouette (Canada's first satellite), Nimbus (the U.S. weather satellite) and many more. Colorful 18" chute brings it back gently. Features clear plastic fins to stabilize model in flight without detracting from its appearance. Easy to build, comes complete with all parts and easy-to-follow instructions (but no engines). Shipping wt. 13 oz.

Cat. No. 701-K-28 ..... $3.25

SPECIFICATIONS
Length ..... 17.25 in (43.8 cm)
Body Dia. ... 1.637 in (41.6 mm)
Weight ..... 2.2 oz (62 gr)

RECOMMENDED ENGINES
A8-3
B6-4
C6-5

SEMI-SCALE MODEL
PARACHUTE RECOVERY
2 ENGINE POWER

GEMINI-TITAN GT-3

Spectacular on the ground and in the air, the Gemini-Titan is a challenge to build and fly. Requires experience to build, but the GT-3 is a rocket that the modeler can point to with real pride when he's finished it. Features clear plastic fins to stabilize it in flight without detracting from its appearance, full 24" parachute for soft landings. Use a 12 volt car battery and the Estes FS-5 (or similar launch control system) for dependable ignition. Kit is complete with all parts and detailed instructions (but no engines). Shipping wt. 16 oz.

Cat. No. 701-K-21 ..... $5.25

RECOMMENDED ENGINES
A8-3
B6-4
C6-5

SPECIFICATIONS
Length ..... 24.4 in (62 cm)
Body Dia. ... 2.217 in (56.3 mm)
Weight ..... 3.8 oz (108 gr)

Kit includes technical report TR-6

EASY-TO-BUILD SCALE MODEL PARACHUTE RECOVERY

V2

High performance scale model of the rocket that started the space age. Easy but interesting to build, the V-2 features reliable parachute recovery for gentle landings. Detailed instructions provide full information on assembly and finishing. Kit comes complete with all parts (but no engines). Shipping weight 7 oz.

Cat. No. 701-K-22 ... $2.00

SPECIFICATIONS
Length ..... 11.2 in (28.4 cm)
Body Dia. ... 1.325 in (33.7 mm)
Weight ..... 1.4 oz (40 gr)

RECOMMENDED ENGINES
½A6-2
A8-3
B6-4
B14-5
C6-5

CHALLENGING SCALE MODEL
PARACHUTE RECOVERY

HONEST JOHN

Scale Model of the U.S. Army's Surface-To-Surface Ballistic Missile

A beautiful scale model that performs with brilliance. Lifts off the launch pad fast and streaks skyward straight and true. Recommended for experienced modelers, the kit comes complete. An exciting flight model and a historic one for your display shelf. Shipping wt. 14 oz.

Cat. No. 671-K-27 . . . . . $2.00

SPECIFICATIONS	
Length	13.75 in (35 cm)
Body Dia.	0.976 in (24.8 mm)
Weight	1.2 oz (34 gr)

RECOMMENDED ENGINES
½A6-2
A8-3
A5-4
B6-4
C6-5

FLYING SCALE MODEL
EASY TO BUILD
PARACHUTE RECOVERY

AEROBEE 300

Easy to build scale model of a great sounding rocket. Gives top performance in flight after flight. Features parachute recovery for gentle landings, payload section for small specimens. Kit is complete with all parts and easy-to-follow instructions (but no engines). Shipping weight 14 oz.

Cat. No. 651-K-17 . . $2.00 each

SPECIFICATIONS	
Length	20 in (50.8 cm)
Body Dia.	0.976 in (24.8 mm)
Weight	0.9 oz (26 gr)

RECOMMENDED ENGINES
A8-3
B6-4
½A6-2
C6-5

FLYING SCALE MODEL
EASY-TO-BUILD
PARACHUTE RECOVERY

WAC CORPORAL

High-flying scale model is easy enough for the novice to build, yet interesting enough for the experienced rocketeer. The famous WAC CORPORAL gives top scale model performance. Parachute recovery gives gentle landings flight after flight. Comes in easy to assemble kit form. (Engines not included.) Ship. wt. 5 oz. Kit includes technical report TR-1.

Cat. No. 651-K-11 . . . . . $1.50

ONLY
$1.50

SPECIFICATIONS
Length . . . . . 11.8 in (30 cm)
Body Dia. . . . 0.736 in (18.7 mm)
Weight . . . . . 0.7 oz (20 gr)

RECOMMENDED ENGINES
½A6-2
A8-3
B6-4
C6-5
(Use ½A6-2 for first flights)

SLEEK AND SLENDER

SCALE MODEL
PARACHUTE RECOVERY

ARCAS®

Precise scale model of the famous ARCAS® sounding rocket. A handsome model to display, an exciting one to launch. Zooms hundreds of feet into the sky; returns gently by its 18" multi-color parachute ready for a fresh engine and another flight. Easily assembled, kit comes complete with all parts, decal and instructions, but no engines. Shipping weight 14 oz.

Cat. No. 701-K-26 . . $2.25

SPECIFICATIONS
Length . . . . . 22.8 in (58 cm)
Body Dia. . . . 1.325 in (33.7 mm)
Weight . . . . . 1.4 oz (40 gr)

RECOMMENDED ENGINES
A5-2 A8-3
B6-4 C6-5

® Registered Trademark of the Atlantic Research Corp., Alexandria, Va.

2-STAGE MINI-ROCKET

Astron

MIDGET

No midget in performance, this unique 2 stage rocket is designed to get the most out of the smaller series III engines. Graceful in flight and fast at liftoff, the Astron Midget is an exciting design to fly. Upper stage features chute recovery while the booster flutters gently back to earth. Kit contains all parts and instructions (less engines). Shipping weight 6 oz.

Cat. No. 682-K-40 . . . . . $1.25

Pat. No. 3,292,302

SPECIFICATIONS

Length . . . . . 9.25 in (23.5 cm)
Body Dia. . . . 0.976 in (24.8 mm)
Weight . . . . . 0.6 oz (16 gr)

RECOMMENDED ENGINES

Booster
½A6-0S
Upper Stage
½A6-4S

Astron

EASY-TO-BUILD
1 OR 2 STAGE

BETA

Sleek and trim, this bird really goes! Easy to build, the Beta can be flown single stage or with a booster for really high flights. The Beta features low weight, streamlined design, and parachute recovery. Engines not included. Shipping weight 5 oz.

Cat. No. 701-K-45 . . . . . $1.50

Pat. No. 3,292,302

SPECIFICATIONS

Body Dia. . . .0.736 in (18.7 mm)
SINGLE STAGE
Length . . . . . 12.5 in (31.8 cm)
Weight . . . . . 0.6 oz (17 gr)
TWO STAGE
Length . . . . . 13.75 in (34.9 cm)
Weight . . . . . 0.75 oz (21 gr)

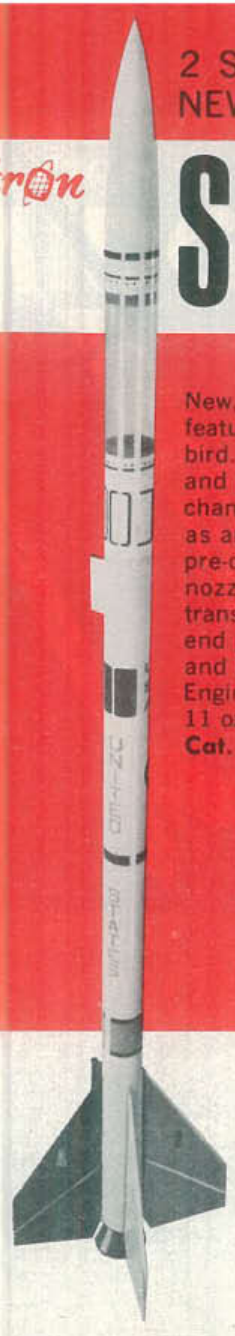
RECOMMENDED ENGINES

SINGLE OR UPPER STAGE
½A6-2S ½A6-4S A5-4S
BOOSTER
½A60S A5-0S

2 STAGE
NEW "POP-AND-GO" STAGING

Astron

SHRIKE



New, easy staging method is just one feature of this sleek, high performance bird. No taping; just insert engines and plug stages together. Two interchangeable parachutes are included, as are two multi-color decal sheets, pre-cut fins, pre-cut and embossed nozzle parts and body wrap-on, and transparent payload section with foam end pads. The Shrike is easy to build and is a bird you'll be proud to own. Engines not included. Shipping weight 11 oz.

Cat. No. 701-K-46 . . . . . $4.75

SPECIFICATIONS

Length . . . . . 29.5 in (74.9 cm)
Body Dia. . . . 0.976 in (24.8 mm)
Weight . . . . . 2.25 oz (64 gr)

RECOMMENDED ENGINE COMBINATIONS

Booster	Upper Stage
A8-0	½A6-4, A5-4, A8-5
B6-0	B6-4, B6-6
B14-0	B14-7, C6-7
C6-0	B14-7, C6-7

2 STAGE
HIGH ALTITUDE

Astron

AVENGER

Long slender lines give this bird the appearance of a sounding rocket. Two stage design gives the Astron Avenger high altitude capabilities for sport or demonstration flights. A clean, good-looking rocket, it gives great flights and is an impressive addition to your fleet. Large 18" parachute brings payload section back gently, while booster section flutters in softly. Comes complete with all parts, instructions, and TR-2 on staging. (Engines not included). Shipping weight 16 oz.

Cat. No. 701-K-38 . . . . . $3.25

Pat. No. 3,292,302

RECOMMENDED ENGINES

Booster
A8-0, B6-0, B14-0, C6-0
Upper Stage
A5-4, B6-6, C6-7

SPECIFICATIONS

Length . . . . . 32 in (81.3 cm)
Body Dia. . . . 1.325 in (33.7 mm)
Weight . . . . . 2.7 oz (77 gr)

2 STAGE
HIGH ALTITUDE

Astron APOGEE II

VISIBLE PAYLOAD

Pat. No. 3,292,302

This is the ultimate in 2-stage performance and reliability. Featuring a see-through payload capsule to let you observe specimens without removing them from the rocket, soft parachute landings for safe recoveries and revolutionary discoveries in multi-staging, the Astron Apogee II is perfect for research or experimental flights. Comes complete with all parts and instructions, but no engines. Shipping weight 6 oz.

Cat. No. 651-K-5 . . . . . $2.00

Kit includes technical report TR-2

SPECIFICATIONS

Length . . . . . 14.75 in (37.5 cm)
Body Dia. . . . 0.736 in (18.7 mm)
Weight . . . . . 0.6 oz (17 gr)

RECOMMENDED ENGINES

Booster
½A6-0, A8-0, B6-0
B14-0, C6-0
Upper Stage
¼A3-4, ½A6-4, A5-4, A8-5
B4-6, B6-6, B14-7, C6-7

$2.00

3 STAGE
FLIGHTS OVER 2500'

Astron FARSIDE

Pat. No. 3,292,302

A sophisticated ultra-high altitude probe or a workhorse vehicle for high altitude studies with large payloads — take your choice with the Astron Farside. Advanced stage coupling gives dependable ignition and stage separation. Perfect for your advanced research programs. Top stage flies to well over 2500', returns gently by parachute. Available with standard 1" payload section (No. 651-K-12) or with extra large 1½" dia. capsule for large payloads (No. 701-K-12X). Be sure to specify model type when ordering. Kit comes complete with all parts and assembly instructions (but no engines). Includes technical report TR-2. Shipping weight 8 oz.

SPECIFICATIONS

K-12
Length . . . . 21.5 in (54.6 cm)
Diameter . 0.976 in (24.8 mm)
Weight . . . . . 2 oz (57 gr)

K-12X
Length . . . . 25 in (63.5 cm)
Diameter . 1.637 in (41.6 mm)
Weight . . . . . 2.5 oz (71 gr)

RECOMMENDED ENGINES

First Stage
½A6-0, A8-0, B14-0
Second Stage
½A6-0, A8-0, B6-0
B14-0 C6-0
Top Stage
½A6-4, A8-5, B4-6
B6-6, B14-6, C6-7

STANDARD MODEL
Cat. No. 651-K-12
$2.75

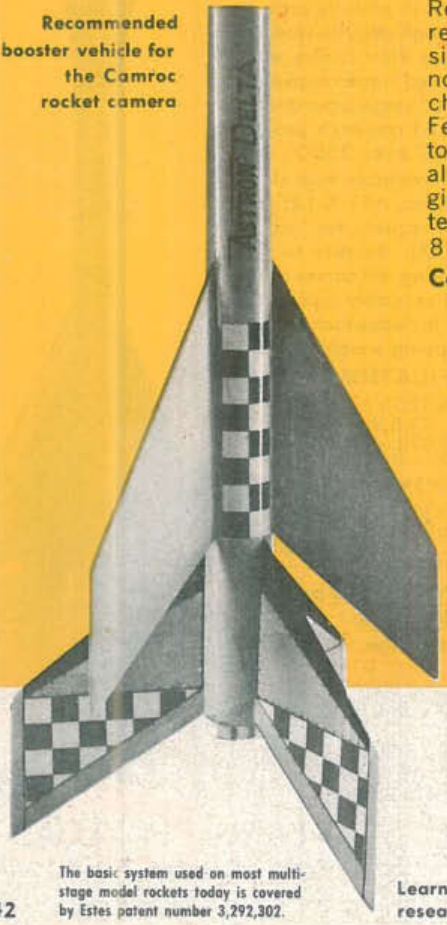
NOTE: Other booster engines may be used if there is no wind.

LARGE PAYLOAD
Cat. No. 701-K-12X
$3.75

2 STAGE BOOSTER FOR BIG PAYLOADS

Astron DELTA

Recommended booster vehicle for the Camroc rocket camera



The basic system used on most multi-stage model rockets today is covered by Estes patent number 3,292,302.

Reliable workhorse booster for payload research. Accommodates all BT-50 size payload sections. For use with nose cone or payload section of your choice. Fly either single or 2-stage. Features advanced stage coupling for top dependability. Kit is complete with all parts (except nose section and engines), easy-to-follow instructions, and technical report TR-2. Shipping weight 8 ounces.

Cat. No. 701-K-16 . . . . . $2.25

SPECIFICATIONS

Length . . . . . 13.6 in (34.5 cm)
Body Dia. . . . 0.976 in (24.8 mm)
Weight . . . . . 1.5 oz (43 gr)

RECOMMENDED ENGINES

FOR REGULAR PAYLOAD USE ONLY

(See page 46 for engines recommended for use with Camroc)

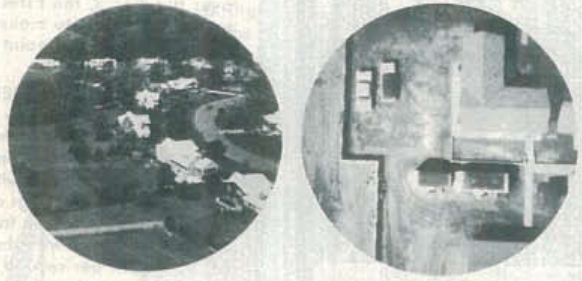
Single-Stage Flights
A8-3, B6-4, B14-5
B14-6 C6-5
Multi-Stage Flights
Booster
B6-0, B14-0, C6-0
Upper Stage
B6-6, B14-6, B14-7, C6-7

Learn multi-stage techniques with this versatile research vehicle for payload and altitude tests.

AN ESTES EXCLUSIVE

ROCKETS THAT TAKE PICTURES

ROCKET PHOTOGRAPHY



Explore this new and exciting challenge in model rocketry! Imagine making either a still or moving photographic record of your launches . . . from the rocket itself! Sound incredible? Not with the Estes Cineroc and Camroc model rocket cameras! If you've mastered the building and launching phase of model rocketry and consider yourself an experienced rocketeer, you're ready for the most exciting challenge of model rocketry!

EXPLORE THIS NEW FIELD WITH CINEROC & CAMROC!

estes industries presents

estes industries presents

THE WORLD'S ONLY COMMERCIAL MODEL ROCKET MOVIE CAMERA

MAKE COLOR MOVIES OF YOUR FLIGHTS... FROM THE ROCKET ITSELF!

the incredible CINEROC

The most important model rocket development in over five years, the Estes CINEROC enables the advanced rocketeer to make moving photographic studies from a vantage point never before possible: the rocket itself!

Fully loaded, the CINEROC weighs only 3 ounces, a weight easily lofted by the Estes "D" engines. The fully-assembled Super-8mm camera is also an engineering marvel. The single element 10mm acrylic lens gives the best possible image with the greatest depth of field. You'll see the launch lugs and fins of the launch vehicle as clearly as the terrain far below. A semi-slow motion effect is obtained with the CINEROC's exposure rate of 30 frames per second, ideal for studying ignition, booster separation, stability, and parachute opening actions.

An essential part ot the CINEROC is the Flight-Pak film cartridge. No threading problems; just slip it into the camera. The Flight-Pak also provides protection for the film before, during, and after the flight. Each CINEROC comes with one Flight-Pak film cartridge and two batteries. See page 48 for processing information and information about ordering more Flight-Paks.

The photos at the left were taken from CINEROC films and show the clarity and detail possible. You see everything . . . from lift-off to deployment of the recovery system!

Comes completely assembled! Includes Flight-Pak loaded with color film, 2 batteries, and 18" parachute. Shipping weight 1.5 lbs.

Cat. No. 701-CM-8 (less launch vehicle) $19.95

NOTE: The CINEROC, CAMROC, and the "D" engine rockets are recommended only for experienced rocketeers.

CAMERA SPECIFICATIONS:

10 mm focal length lens	Takes color film
F11—1/500 sec. shutter	Diameter: 1.75 in.
30 frames per second	Length: 9.9 in.
6" to infinity depth of field	Fits BT-60

Super-8mm film can only be shown on Super-8mm projectors — or this hand viewer from Estes! Crank fast for a quick flight or slowly for slow motion. Ideal for frame-by-frame analysis of your flight. Shipping weight 12 oz.

Cat. No. 701-MV-8 . . . . . $4.95

Combination Offer

The recommended launch vehicle for the CINEROC is the Astron Omega, a "D" engine bird specially designed to loft the CINEROC. (See page 99 for information regarding the Omega.) You can order the CINEROC and Omega together. Shipping weight 2 lbs. 4 oz.

Cat. No. 701-RC-8 . . . . . $22.95

ONLY
$4.75

CAMROC
ROCKET CAMERA

Lens opening — f/16
Shutter speed — 1/1600
Focal Length 3" (76 mm)

Launch your own aerial rocket camera! The Camroc automatically takes a photograph from hundreds of feet in the air and then returns safely. Uses a single exposure film disc mounted in a light-tight holder for quick and easy replacement in the field. Fits body tube BT-50. Negative is 1½ inches in diameter. In kit form with all parts and instructions for assembly and operation: 1 film holder loaded with unexposed film; 1 empty film holder and exposed film disc for practice loading and experimenting. Shipping weight 7.5 oz.

Cat. No. 701-C-1 . . . . . $4.75

SPECIFICATIONS

Length . . . . . 5.3 in (13.5 cm)
Body Dia. . . . 1.637 in (41.6 mm)
Weight . . . . . 1.3 oz (37 gr)

RECOMMENDED ENGINES

Multi-Stage Flights

Booster	Upper Stage
B14-0	B14-6, B14-7, C6-7

Single-Stage Flights
B14-5, B14-6, C6-7

SPECIAL OFFER

SAVE 50c

Complete Camroc kit plus the Astron Delta kit shown on page 42. This gives you the best basic outfit for making aerial photos. Engines not included. Shipping wt. 10 oz.

Cat. No. 701-RC-1 . . . . . $6.50

Patent Pending

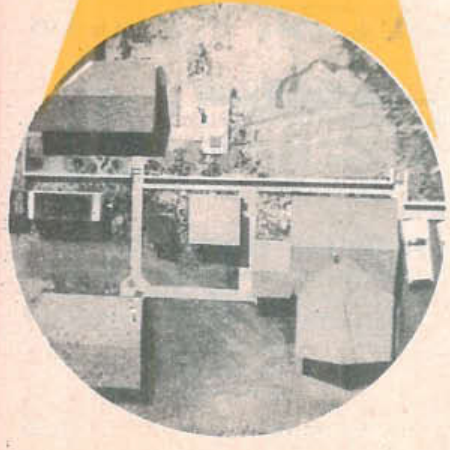
CAMROC

OPENS NEW VISTAS TO THE ADVANCED ROCKETEER

Aerial photography has long been acknowledged for its value in map making, geographical studies, reconnaissance and related research fields. The Camroc aerial camera opens a new field of science studies to the rocketeer who wants to get a better understanding of the scientific uses of aerial photography. Recommended booster vehicle is the Delta. Other models can be adapted.

In addition to learning principles of camera construction and operation, many challenging aerial photographic projects can be developed.

Study space science reconnaissance techniques the practical way — over familiar terrain with known objects. Map your flight area with Camroc photos. Use photo pairs, which produce a stereoptic image when properly viewed, to emphasize geological features or estimate heights of different objects quite accurately.



Negative 1½" dia.
Print size . . 3" dia.

Processing information on page 48

FILM PROCESSING & SUPPLIES

CAMROC

Rocketeers who have access to a photographic darkroom can develop and print negatives from the Camroc with no difficulty. For those who would rather not do their own processing, Estes Industries offers developing and printing service. Prints produced are enlarged to twice the negative size. Recommended film is Estes Industries Astropan 400 or identical Kodak Tri-X. Both films are rated at A.S.A. 400 but pushed to A.S.A. 1200 in development. IMPORTANT: All Camroc film not in light-tight holders MUST BE HANDLED IN TOTAL DARKNESS.

DEVELOPING-PRINTING

Film is developed under controlled conditions. One glossy print is made at 2 times enlargement (3" dia. image). A refund of $ .20 will be made on any negative which does not meet the requirements for a satisfactory print. This can be caused by incorrect exposure or improper handling. In this case negative will be returned unprinted. We recommend sending your film for processing in its original container or other totally light-tight container.

Cat. No. 691-FDP-1 . . . . . $ .50

EXTRA PRINTS

You can order additional prints of negatives which have been previously developed. The negative(s) must be enclosed in a suitable protective package with the order. (Please do not order extra prints without first checking the negative and original print to determine if it is suitable for extra prints.)

Cat. No. 651-NP-1 . . . . . $ .30 ea.

ALL PROCESSED NEGATIVES AND PRINTS ARE RETURNED BY AIR MAIL WHEN DISTANCE IS OVER 400 MILES

LOADED FILM HOLDERS

Extra film holders for in-the-field changing are available for the Camroc. They come 4 to an order, each pre-loaded with a fresh Astropan 400 film disc. Film holders may be returned with the film for processing. They are re-usable and subject to refund when returned as explained below. Shipping weight 2 oz.

Cat. No. 651-FFH-4 . . . . . 4 for $2.00

REFUND PLAN ON FILM HOLDERS

A refund of $ .15 will be allowed for all film holders returned to us in good re-usable condition. When returning film holders for any reason you may deduct $ .15 for each holder returned. Unless you specifically request their return, all holders sent us will be automatically retained and the refund will be made or credit allowed.

FILM ONLY

Precision cut Astropan 400 film discs to fit Camroc film holder. Packaged in light-proof double envelope. Envelope should be opened ONLY IN TOTAL DARKNESS to avoid ruining the film. Handling and loading instructions included. Shipping weight 1.5 oz.

Cat. No. 651-NF-6 . . . . . 6 for $ .75

CHANGING BAG

Light-tight "portable darkroom". Fits over operator's arms, provides total darkness for changing film in the field or reloading your own film holders. Shipping weight 8 oz.

Cat. No. 701-FCB-1 . . . . . $1.75

CINEROC

FLIGHT-PAK MOVIE CARTRIDGE

Cartridges contain 10 feet of Super-8mm film for approximately 40 seconds of projection time. Two PFB-2 batteries (good for one flight) included with each cartridge. Shipping weight 4 oz.

Cat. No. 701-CFH-8 . . . . . $4.00

FLIGHT-PAK PROCESSING

You'll want top quality processing of your Flight-Pak film! After exposure, place the Flight-Pak back in its black plastic bag, package it for safe mailing, enclose $2.00, and send to:

Estes Film Lab
3911 Sinton Road
Colorado Springs, Colo. 80907

Cat. No. 701-FDP-2 . . . . . $2.00

FANTASTIC SINGLE STAGE PERFORMANCE STREAMER RECOVERY

Astron sprint

An impressive altitude model! Designed to give the highest performance in its class, the Astron Sprint incorporates the most efficient aerodynamic shapes for the velocities it will encounter. Altitudes of up to 1600 feet are possible using C6-7 engines. This model is perfect for the advanced rocketeer, yet simple enough for the beginner to build. Kit features include pre-cut fins and tail cone, two color Sprint emblem decal, one color trim decal and complete illustrated assembly instruction.(Engines not included) Shipping weight 14 oz.

Cat. No. 701-K-49 . . . . . $1.75

SPECIFICATIONS

Length . . . . . 13.8 in (35 cm)
Body Dia. . . . 0.976 in (24.8 mm)
Weight . . . . . 1 oz (28 gr)

RECOMMENDED ENGINES

½A6-2, A8-3, A5-2
B4-6, B6-6, C6-7
B14-5

CHALLENGING KIT
PROGRAMMABLE BOOST PHASE

Astron

NIGHTHAWK

POP-POD BOOST GLIDER

Swish! Straight up for hundreds of feet . . . then pop! The power pod separates and drifts down on its own parachute as the glide vehicle circles lazily against the blue sky.

Revolutionary pop-pod system is pre-programmable for perfect upward flights. Glider portion's unique design features minimum weight and drag for long flight duration.

The Nighthawk is ideal for duration contests, research flying, and demonstrations of boost glide operation. Recommended for the experienced rocketeer, the kit comes complete with all parts and instructions (but no engines). Shipping weight 14 oz.

Cat. No. 701-K-34 . . . . . **$2.00**

Pat. No. 3,452,471

SPECIFICATIONS

Length . . . . . 19.75 in (50.2 cm)
Body Dia. . . . 0.736 in (18.7 mm)
Wing Span . . . 16.25 in (41.3 cm)
Weight (Complete) 1.4 oz (40 gr)
Weight (Glider only) 0.7 oz (20 gr)

RECOMMENDED ENGINES

½A6-2
A5-2
B4-2

GLIDE RECOVERY
LONG DURATION FLIGHTS

Astron

FALCON

ROCKET GLIDER

Get sky-high performance with the Astron Falcon boost-glider. Beautiful climb — glide durations up to and over 1½ minutes on ½A engines, even more with larger engines. (For normal flying ½A6-2 engines are recommended — the Astron Falcon can easily glide out of sight with larger engines if it is built and balanced carefully.) A great bird for the experienced rocketeer. Glide recovery brings it back gently, ready for a fresh engine and another flight. Kit comes complete with all parts and instructions (Engines not included). Shipping wt. 5 ounces.

Cat. No. 651-K-13 . . . . . **$1.00**

Patent No. 3,114,317

Kit includes technical report TR-7

SPECIFICATIONS

Length . . . . . 12 in (30.5 cm)
Body Dia. . . . 0.736 in (18.7 mm)
Wing Span . . . . . 10 in (25.4 cm)
Weight . . . . . 0.4 oz (11 gr)

RECOMMENDED ENGINES

¼A3-1 ½A6-2
A5-2 B4-2

TUMBLE RECOVERY

Astron

SPRITE

Ideal for small field sport and demonstration flying

Patent No. 3,114,317

The perfect model for small fields and sport or demonstration flying. The Astron Sprite is easy to build, with tumble recovery to teach principles of rocket balance and bring the model back safely—close to the launcher. Uses lightweight Series III engines only, gives top performance for its size. Kit includes a copy of TR-1 (but no engines) Shipping weight 5 oz.

Cat. No. 701-K-15 . . . . . $1.00

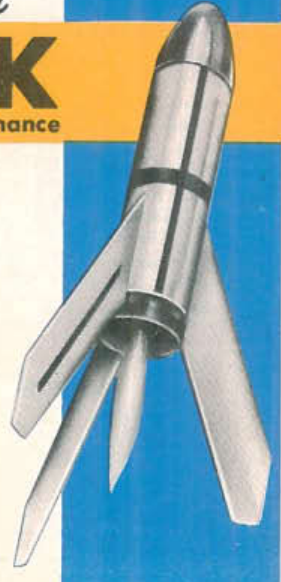
SPECIFICATIONS	RECOMMENDED ENGINES
Length . . . . . 5.3 in (13.5 cm)	¼A3-2S
Body Dia. . . . 0.765 in (19.4 mm)	½A6-2S
Weight . . . . . 0.3 oz (9 gr)	A5-4S

FEATHERWEIGHT RECOVERY

Astron

STREAK

Spectacular single engine performance



FLIGHTS TO 2000 FT

Low weight and wind cheating design give the Astron Streak fantastic performance. Uses mylar body tube for high strength and low weight—only 1/8 ounce without engine. Ideal for contests and records. Recommended engine for normal flying is the ½A6-4. Engines not included. Shipping weight 4 oz.

Cat. No. 701-K-4 . . . . . $ .70

SPECIFICATIONS	RECOMMENDED ENGINES
Length . . . . . 5.6 in (14.2 cm)	¼A3-2 A8-5
Body Dia. . . . 0.720 in (18.3 mm)	½A6-4 B6-6
Weight . . . . . 0.1 oz (3 gr)	A5-4 C6-7

Astron

TUMBLE RECOVERY

SCOUT

An easy-to-build model

Patent No. 3,114,317

Get valuable experience building and flying the Astron Scout. Kit teaches rocket balance principles. A must for the rocketeer who wishes to learn to design his own models. Kit includes technical report TR-1 (but no engines). Shipping weight 2 oz.

Cat. No. 651-K-1 . . . . . $ .70

SPECIFICATIONS	RECOMMENDED ENGINES
Length . . . . . 7 in (17.8 cm)	¼A3-2, ½A6-2, A5-4
Body Dia. . . . .0.765 in (19.4 mm)	A8-3, B6-4, C6-5
Weight . . . . . 0.3 oz (9 gr)	(Use ¼A3-2 for first flights)

Astron

GLIDE RECOVERY

SPACE PLANE

A boost-glider for the experienced modeler

A historic duration winner and record holder, the Space Plane is one of the most successful boost-gliders ever developed. Ascends vertically under rocket power, then glides safely back to earth. The Space Plane gives unlimited flying enjoyment. Features accurate glide adjustments plus a payload section for small specimens. Recommended for the experienced modeler. (Kit includes TR-4, but no engines). Shipping weight 5 oz.

Cat. No. 651-K-3 . . . . . $1.80

SPECIFICATIONS	RECOMMENDED ENGINES
Length . . . . . 10 in (25.4 cm)	½A6-2, A5-2, B4-2
Body Dia. . . . 0.765 in (19.4 mm)	(Use ½A engines for first flights)
Wing Span . . . . . 9 in (22.9 cm)	
Weight . . . . . 0.5 oz (14 gr)	

STAR BLAZER

PARACHUTE RECOVERY

Here's one that's just plain fun! You can count on the Star Blazer for high performance sport flying. Streamlined fins, forward crew cockpit canopy, and structural fairing strips give it a real 'space ship' look. Flies with the Series III (short) engines . . . giving it low initial weight for fast lift-off and excellent altitudes. Recovery is by parachute. Engines not included. Shipping weight 5 oz.

Cat. No. 701-K-31 . . . . . **$1.25**

SPECIFICATIONS	RECOMMENDED ENGINES
Length . . . . . 12.5 in (31.8 cm)	Series III Engines Only
Body Dia. . . . 0.736 in (18.7 mm)	½A6-2S
Weight . . . . . .1 oz (28 gr)	A5-2S
	A5-4S

GYROC

HELICOPTER RECOVERY

Excellent performance and amazing recovery system make the unique Gyroc a "bird" you'll want to own. Its unusual design gives this rocket the ability to reach high altitudes and return safely with helicopter recovery for minimum drift with wind. Comes complete with all instructions and parts. Engines not included. Shipping weight 5 oz.

Cat. No. 671-K-24 . . . . . **$1.25**

SPECIFICATIONS	RECOMMENDED ENGINES
Length . . . . . 9.8 in (24.9 cm)	½A6-2
Body Dia. . . . 0.736 in (18.7 mm)	A8-3
Weight . . . . . .0.6 oz (17 gr)	B6-4
	C6-5

COBRA

PARACHUTE RECOVERY

Ideal for your first cluster bird. The Astron Cobra gives you top performance with medium size payloads (to 4 oz) in a 1" dia. capsule. Kit includes TR-6 report on clustering. Engines not included. Shipping weight 13 oz.

Cat. No. 701-K-10 . . . . . **$3.00**

SPECIFICATIONS	RECOMMENDED ENGINES
Length . . . . . 22.25 in (56.5 cm)	A8-3, B6-4, C6-5
Body Dia. . . . 1.637 in (41.6mm)	(Use B6-4 for
Weight. . . . . 2.5 oz (71 gr)	first flights)

RANGER

PARACHUTE RECOVERY

Lift those BIG payloads off the pad with the powerful Astron Ranger. Perfect for launching and recovering those special instruments and specimens. The Ranger Kit includes TR-6 report on clustering. Engines not included. Shipping weight 13 oz.

Cat. No. 701-K-6 . . . . . **$3.00**

SPECIFICATIONS	RECOMMENDED ENGINES
Length . . . . . 24 in (61 cm)	A8-3, B6-4, C6-5
Body Dia. . . . 1.637 in (41.6 mm)	(Use B6-4 for
Weight. . . . . .3.4 oz (96 gr)	first flights)

BIRDIE

FEATHERWEIGHT RECOVERY

You can change a badminton "bird" to a rocketeer's "bird" with this unusual kit . . . and watch it fly! Kit has everything you'll need for building the Birdie. Includes plastic shuttlecock, body tube, engine block, adapter ring, and launch lug. Engines not included. Shipping weight 5 oz.

Cat. No. 701-K-44 . . . . . $ .60

SPECIFICATIONS

Length . . . . . 2.8 in (7.1 cm)
Weight . . . . . 0.3 oz (9 gr)

RECOMMENDED ENGINES

¼A3-2S ½A6-2S
(Use Series III engines only)

SPACEMAN

FEATHERWEIGHT RECOVERY

Great for demonstrating that a rocket doesn't always have to look like a rocket to fly well. Requires a little patience and artistic ability to build. Uses the featherweight recovery system. Engines not included. Shipping weight 7 oz.

Cat. No. 651-K-9 . . . . . $ .75

SPECIFICATIONS

Length . . . . . 7.25 in (18.4 cm)
Width . . . . . 4 in (10.1 cm)
Weight . . . . . 0.5 oz (14 gr)

RECOMMENDED ENGINES

½A6-2, A5-4, B4-4
B6-6, C6-7
(Use ½A6-2 for first flights)

MODEL ROCKETRY TECHNICAL MANUAL

Welcome to the exciting world of model rocketry! This brief technical manual for model rocketeers was written to provide both an easy to-follow guide for the beginner and a handy reference volume for the experienced rocketeer. In the next few pages you'll find the answers to the questions most commonly asked by model rocketeers. More complete technical information on all the subjects covered can be found in the many publications listed in the current Estes catalog.

We hope this manual will help make model rocketry as exciting and enjoyable for you as it is for us.

TABLE OF CONTENTS

ESTES
A SUBSIDIARY OF DAMON

Prepared by Vernon Estes
and William Simon
Gene Street, Illustrator

P.O. Box 227, Penrose, Colo. 81240

YOUR FIRST ROCKET

BUILDING THE ASTRON ALPHA

A TYPICAL MODEL ROCKET

The construction of the Astron Alpha is shown here both to give the beginning rocketeer plans for a good first model and to illustrate the way a typical model rocket is built. The assembly techniques used in this and other model rockets are explained in greater detail on the following pages.

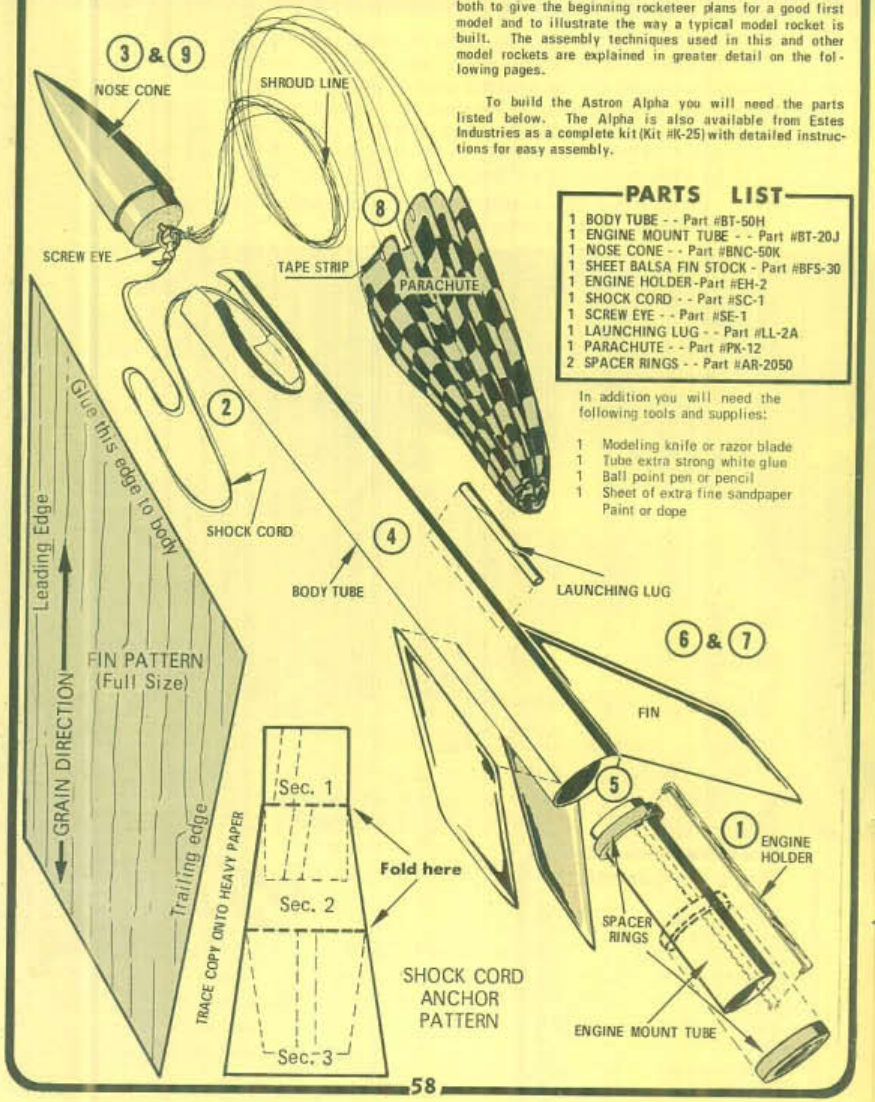
To build the Astron Alpha you will need the parts listed below. The Alpha is also available from Estes Industries as a complete kit (Kit #K-25) with detailed instructions for easy assembly.

PARTS LIST

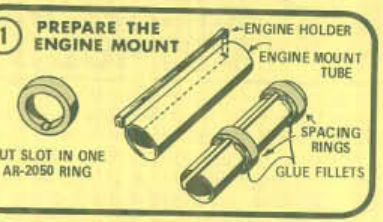
1 BODY TUBE - - Part #BT-50H
1 ENGINE MOUNT TUBE - - Part #BT-20J
1 NOSE CONE - - Part #BNC-50K
1 SHEET BALSA FIN STOCK - Part #BFS-30
1 ENGINE HOLDER - Part #EH-2
1 SHOCK CORD - - Part #SC-1
1 SCREW EYE - - Part #SE-1
1 LAUNCHING LUG - - Part #LL-2A
1 PARACHUTE - - Part #PK-12
2 SPACER RINGS - - Part #AR-2050

In addition you will need the following tools and supplies:

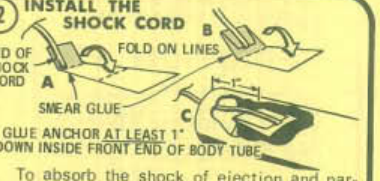
1 Modeling knife or razor blade
1 Tube extra strong white glue
1 Ball point pen or pencil
1 Sheet of extra fine sandpaper
Paint or dope



1 PREPARE THE ENGINE MOUNT



2 INSTALL THE SHOCK CORD



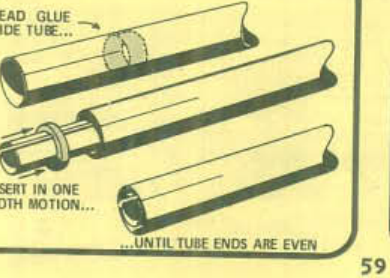
To absorb the shock of ejection and parachute opening a rubber cord connects the parachute and nose cone to the main rocket body. This shock cord must be securely attached to the body with an anchor as shown.

3 INSTALL THE SCREW EYE

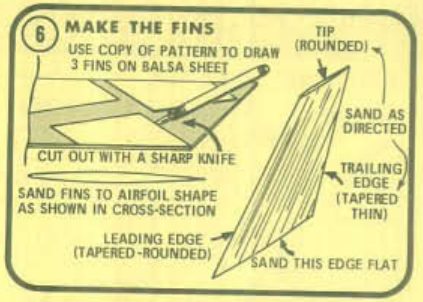
Attach the screw eye to the nose cone as directed in section 3, page 61.

4 MARK THE BODY

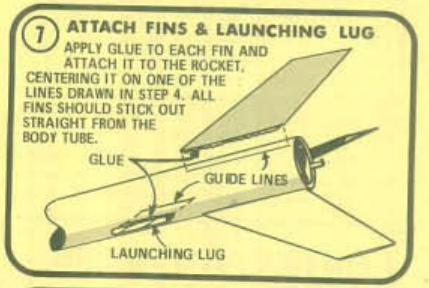
5 INSTALL THE ENGINE MOUNT



6 MAKE THE FINS



7 ATTACH FINS & LAUNCHING LUG



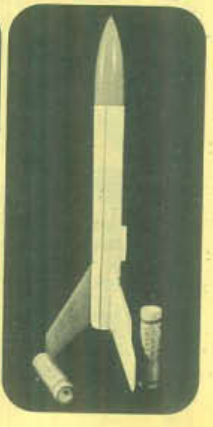
8 ASSEMBLE PARACHUTE

9 CONNECT IT ALL TOGETHER

Connect the nose cone, parachute and shock cord together as shown in the overall view on page 58.

10 PAINT THE MODEL

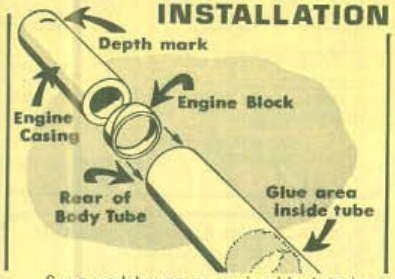
Finish your model by sanding and painting it. See section 10, page 63 and the chapter on finishing (page 76) for detailed information.



CONSTRUCTION TECHNIQUES

1 ENGINE MOUNTING METHODS

ENGINE BLOCK INSTALLATION



Some models use an engine block to keep the engine from traveling too far forward in the rocket body both when it is installed and when the rocket is launched.

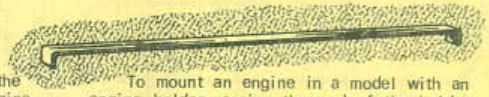
When building a model, use an engine casing to press the engine block into position. After applying glue to the inside of the tube, place the engine block just inside the rear of the body. Push the block forward into position with the engine casing in one smooth motion so the glue will not freeze the block in the wrong place.

When the mark on the engine casing is even with the rear of the body tube the block will then be in the correct position. Remove the engine casing immediately.

FRICTION FIT

When mounting the engine in a model with an engine block, wrap the engine with masking tape until it will make a tight friction fit in the tube. Then slide the engine into place.

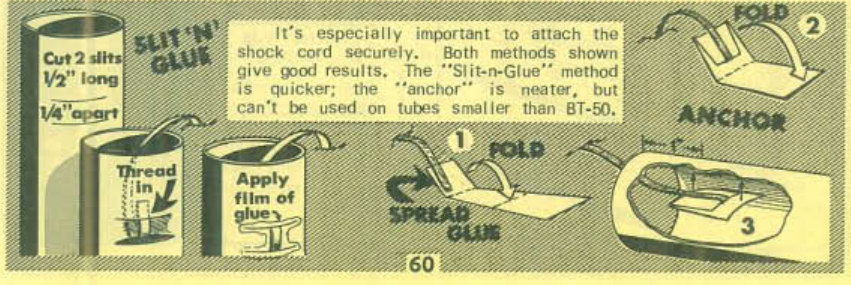
ENGINE HOLDERS



In many models an engine holder is the best device to use for mounting an engine. The drawings show how engine holders are mounted for different sizes of rockets.

To mount an engine in a model with an engine holder, spring the end of the holder up and slide the engine into place. Check to make sure the end of the holder latches securely over the end of the engine.

2 SHOCK CORD MOUNTS

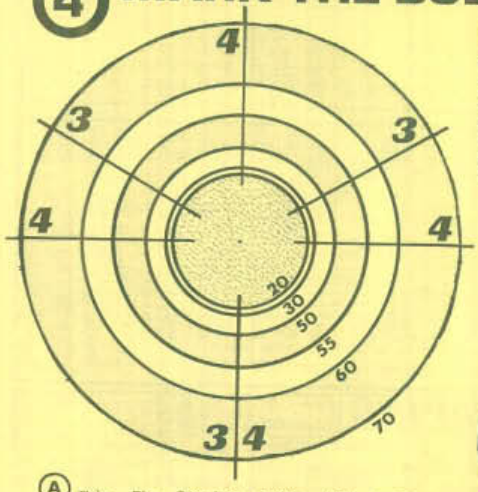


It's especially important to attach the shock cord securely. Both methods shown give good results. The "Slit-n-Glue" method is quicker; the "anchor" is neater, but can't be used on tubes smaller than BT-50.

3 SECURING A SCREW EYE

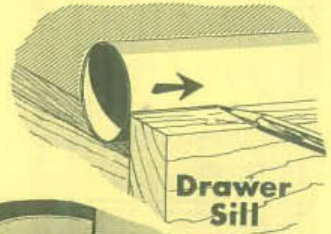
To avoid losing your nose cone, make sure the screw eye is securely attached. Make a hole by inserting and removing the eye. Squirt glue into the hole and replace the eye.

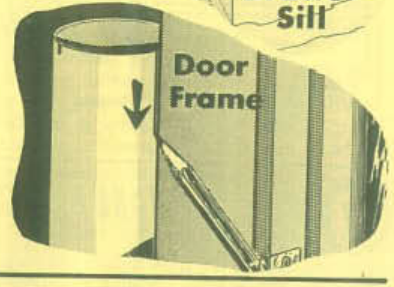
4 MARK THE BODY



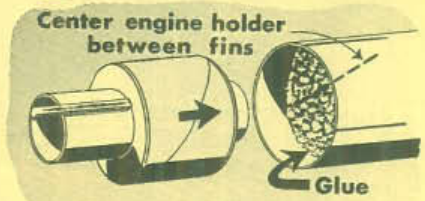
(A) This Fin Spacing Guide will space equally three or four fins on all popular body tubes sold by Estes Industries. To space the fins, center the end of the tube in the circles, then mark at the (4) lines for four fins or on the (3) lines for three fins. Draw lines from these marks as shown in the drawings at right.

(B) When marking the body tube for fin alignment, use the "V" notch of a drawer sill or door frame as shown. Match the edge of the notch with a spacing mark; run a pencil along the edge to draw your guide line. When all three or four lines are drawn, glue the fins to the body on the lines and they will be straight.





5 INSTALL THE ENGINE MOUNT

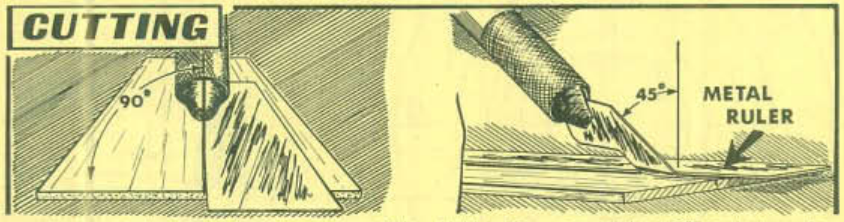


It's best to draw the fin alignment lines on the body *before* installing the engine mount. Position the mount so the engine holder is midway between two fin lines for easier operation. First make sure the mount slides easily in the body tube. If it's tight, sand it until it does slide easily. Smear a liberal amount of glue around the inside of the body over the area where the mount's rings or coupler will fit. Insert the mount into position in one smooth motion. DON'T pause, or the glue will "grab" with it in the wrong place. Support the tube "nose-up" while the glue dries.

6 MAKE THE FINS

Model rocket fins are almost always made from thin sheets of balsa wood. When making fins, *always* be sure the grain of the wood is *parallel* to the leading edge of the fin.

Draw a full-size fin pattern on stiff paper or cardboard. Cut out the pattern, position it on the fin stock, and trace around it with a pencil or ball point pen to mark the balsa for each fin.



Use a metal straightedge whenever possible. Hold knife or saw blade at 90° angle to surface being cut, & handle at about 45° for clean cut. If blade is dull or held too high balsa tends to tear.

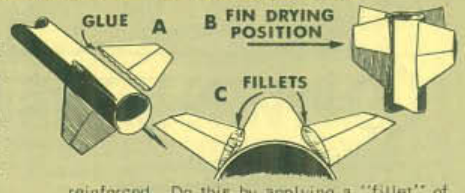
For general purposes, sand all edges round except the root edge (the edge that glues to the body). Make the root edge straight and square. The sides of the fins should be sanded smooth.

On high performance models try to sand the fins to the shape shown. The front (leading) edge of the fin should be slightly rounded; the back (trailing) edge should come to a knife edge.

7 ATTACHING THE FINS...

Always use a high-strength adhesive such as white glue for attaching fins. After marking the tube and sanding the fins, apply a line of glue to the root edge of a fin. Let it set a minute or two, then press it into place on the body tube. Attach the other fins in the same way. Support the rocket body in a vertical position while the glue dries.

Sometime after the first glue on the fins has dried completely, the joints should be reinforced. Do this by applying a "fillet" of glue as shown. Always support the body in a *horizontal* position while fillets are drying.

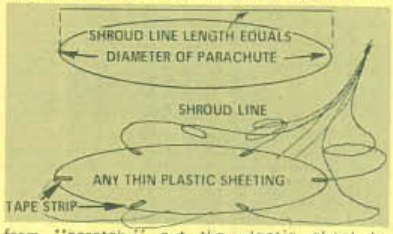


...and LAUNCHING LUG

Launch lugs are attached in much the same way as fins. If a stand-off is used to keep the rod from hitting a large diameter payload section, attach the lug to the stand-off piece first, then attach the unit to the body.

8 ASSEMBLE PARACHUTE

In addition to regular, pre-printed model rocket parachutes, a rocketeer can use a wide variety of thin plastic sheeting to slow his model's descent. When making a chute from "scratch," cut the plastic sheet to shape, then attach 6 or 8 shroud lines, each as long as the diameter of the parachute, as shown. Gather all the loose ends of the shroud lines and tie a knot at the extreme end of the group.

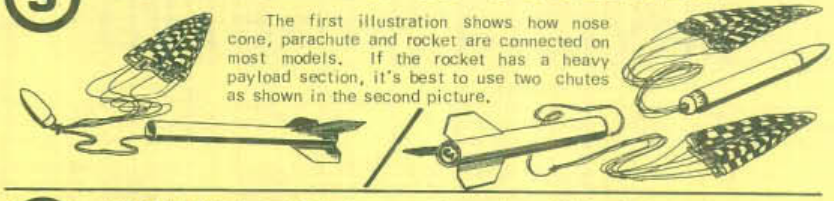


It's often worthwhile to be able to quickly switch a parachute from one model to another or to replace a 'chute with a new one.

To install a snap swivel, simply gather the ends of the shroud lines and dampen them so as to form a fairly stiff "point," then thread this point through the eye of the snap swivel as shown. Once through the eye the lines are tied together in a tight knot and pulled back against the eye. Apply a drop of glue to the knot.

9 CONNECTING IT TOGETHER

The first illustration shows how nose cone, parachute and rocket are connected on most models. If the rocket has a heavy payload section, it's best to use two chutes as shown in the second picture.



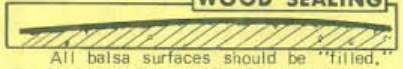
10 PAINT THE MODEL

Nothing does quite as much for the appearance of a model as a good paint job. Before the paint can go on, though, a lot of careful preparation should be done.

FILLETS

Make sure all glue fillets are smooth and have no air holes. If a fillet isn't right, apply another layer of glue and smooth it out with your finger tip.

WOOD SEALING



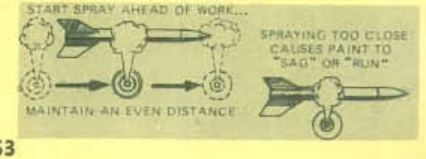
All balsa surfaces should be "filled." To do this, apply a coat of sanding sealer, let dry completely, and sand with extra-fine (or finer) sandpaper. Apply another coat, let dry, and sand again. Continue this procedure until all the tiny holes (pores) in the wood are filled and the surface is perfectly smooth.

. . BRUSH-ON PAINTS

If you use a brush, make sure the brush is clean. Old dope will mix with and discolor fresh dope. Dope can be thinned 50% for a smoother finish. Avoid "brushing over" as the surface sets rapidly. Unnecessary brushing can produce an uneven finish. Always let the paint dry completely between coats.

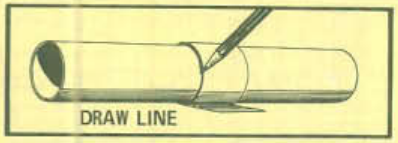
SPRAYING . . .

Spray paints will give the beginner a better than average finish. Apply spray paint in light, even coats. Let each coat dry completely before applying the next coat.

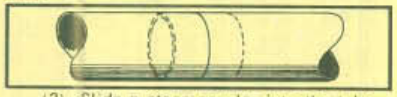


CUTTING TUBES

Many models call for special lengths of body tubes; the rocketeer has to cut the tube himself to build the rocket. Here's how to get a neat cut every time.

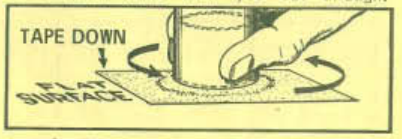


(1) Mark the tube at the point where the cut is to be made. Wrap a straight strip of paper around the tube and align the edge with the mark. Draw a line completely around the tube.



(2) Slide a stage coupler into the tube--center it under the cut position to support the tube.

(3) Cut lightly along the line, rotating the tube as you cut. Use a sharp blade but don't try to cut all the way through on the first turn. Use a light pressure on the knife for several turns until you cut through.

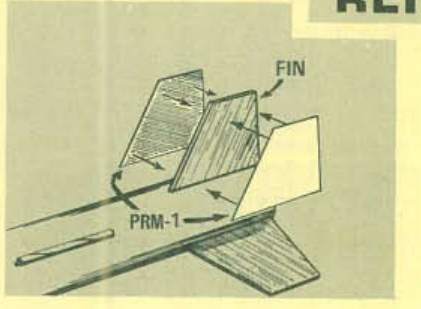


(4) Slide the stage coupler into the cut end of the tube. Hold the tube near the cut end and work it over a flat sheet of *very* fine sandpaper with a circular motion as shown to remove burrs and rough edges.

MYLAR BODIES

BT-10 is an ultra-light mylar plastic tube which is recommended for use with the featherweight recovery system. It will withstand the heat of an ejection charge only when the engine is ejected from the rocket body by the charge. Paper reinforcing material must be used to glue parts to the tube, as ordinary glues will not stick to mylar.

REINFORCING FINS



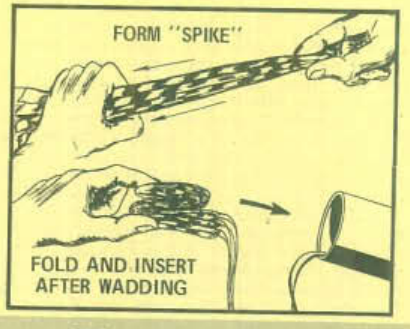
When a model is built to be flown many times, it's often wise to strengthen the fins. The easiest way of doing this is to use self-adhesive paper reinforcing material (PRM-1).

Cut out two "mirror-image" pieces of reinforcing material for each fin. Peel off the backing and apply one piece to each side of the fin. Rub the reinforcing down on both sides so it is securely attached, then seal around the edges with white glue.

Fins reinforced in this manner give up to four times the strength of plain balsa wood with only a little more weight.

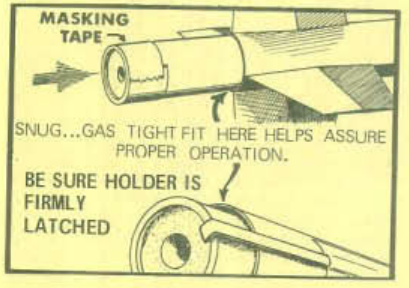
Preparing for Flight

Parachutes and streamers must be protected from the heat of the ejection charge. This protection is supplied by first loosely packing enough flameproof recovery wadding into the tube to fill it for a depth of at least twice the body diameter. The wadding should fit against the side of the tube all the way around to give a good seal.



To fold the parachute, hold it between two fingers at its center and pass the other hand down it to form a "spike" shape. Fold this spike tightly into several sections as shown. Push the folded 'chute down into the tube on top of the wadding. Pack shroud lines and shock cord in on top of the 'chute, then slide the nose cone into place.

To activate streamer or parachute recovery gear correctly, the engine MUST be held in place SECURELY. This may be done by wrapping the nozzle end of the engine with tape until it makes a snug fit in the body tube or engine mount.



On models using engine holders, make sure the end of the holder latches securely over the end of the engine.

Countdown Checklist

Use a countdown check list when you launch your models. You'll find it makes your rocket flights more successful and enjoyable. The following procedure is recommended for most 'chute or streamer models. For other types of rockets, try to develop your own complete check list.

☐ 12) Pack flameproof recovery wadding into the body tube. Insert the parachute or streamer.

☐ 11) Install the nose cone or payload section. Check condition of the payload (if any).

☐ 10) Apply enough masking tape to the engine(s) for a tight friction fit in the body tube(s). When launching a multi-stage rocket be sure that the engines are in their proper relative positions and that a layer of cellophane tape is wrapped tightly around each engine joint. Mount the engine in the rocket.

☐ 9) Install a nichrome igniter in the engine.

☐ 8) Place the rocket on the launcher. Clean and attach the micro-clips.

☐ 7) Clear the area, check for low flying aircraft, alert recovery crew and trackers.

☐ 6) Arm the launch panel.

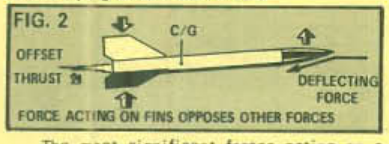
☐ 5) ☐ 4) ☐ 3) ☐ 2) ☐ 1) LAUNCH!

STABILITY

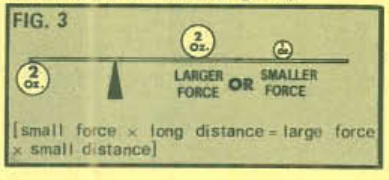
One of the first things a model rocket designer learns is that a vehicle will not fly unless it is *aerodynamically stable.* By stable we mean that it will tend to keep its nose pointed in the same direction throughout its upward flight. Good aerodynamic stability will keep the rocket on a true flight path even though some force (such as an off-center engine) tries to turn the model off course.

If a model is not stable, it will constantly turn its nose *away* from the intended flight path. As a result, it will try to go all over the sky, but end up going 'nowhere.' An unstable rocket will usually tumble to earth after the engine burns out, damaging the model.

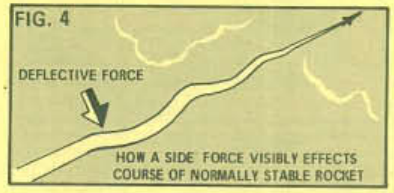
When a free-flying object rotates, it always rotates around its balance point. (The proper term for the balance point is the *center of gravity,* abbreviated as C.G.) Thus the balance point (C.G.) is the pivot for all forces trying to turn the rocket.



The most significant forces acting on a model rocket in flight are caused by the thrust of the engine, the action of air on the nose and the action of air on the fins. Off-center thrust and the forces on the nose try to bring the nose of the rocket around to the rear. They are opposed by the forces acting on the fins. All these forces are amplified by the distance from the location of the force to the center of gravity.

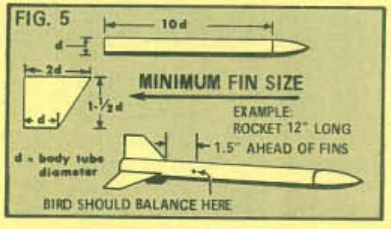


As long as the forces on the fins of the rocket are great enough to counteract the forces on the nose and any off-center thrust, the rocket will fly straight. If the fins are too small and/or too close to the center of gravity, there will not be enough force to counteract the force on the nose. As a result, the nose will swing out to the side and the model will try to chase itself around the sky.



The side forces on the nose and fins of a rocket that is flying straight are very small. When something disturbs the rocket and it starts to turn sideways, the side forces on both nose and tail increase. (There is some aerodynamic force on the body; however, it is small and can usually be ignored.) Depending on the size and shape of the nose and fins and their distances to the center of gravity, one will overpower the other and force the rocket to turn its way. If the nose overpowers the fins, it's too bad. However, if the fins overpower the nose, the rocket will swing back into line and continue on its way.

Although determining the exact relationships between various forces on a model rocket requires higher mathematics, certain practical rules can be used by even the beginning rocketeer to design stable rockets. The first rule is to use a long body. Until you have considerable experience in designing models, the length of the body tube used should be at least 10 times its diameter. This makes it easier to get enough distance between the center of gravity and the fins.



The second rule is to make the fins large. The larger the fins, the more force they will produce when the rocket starts to turn. For the first few designs, use a fin which is *at least* as large as the example in the illustration.

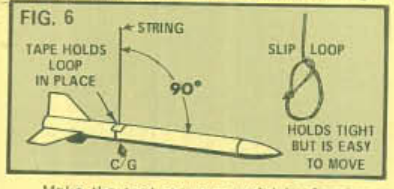
The third rule is to place the fins as far back on the rocket as possible. Generally, this means that the rear edge of the fin will meet the rear end of the body and the fin will be swept back. Do not place *any* fins ahead of the center of gravity.

Finally, the rocket should balance *at least* 1/8 its length ahead of the front of the fins. This gives the fins the leverage they will need to counteract the force on the nose.

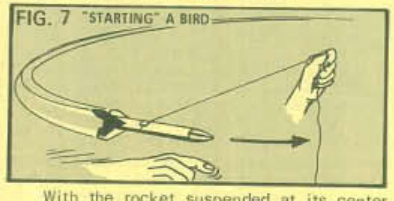
Remember that these rules are general; they are based on experience rather than precise mathematical analysis. By using more exact methods (See TR-1 and TR-9) it's possible to build rockets with less stability margin. In any event, *always* remember to test your model for stability *before* you launch it.

Testing for Stability

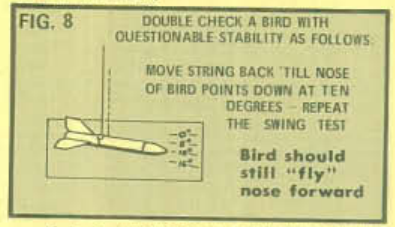
The easiest way of testing the stability of a model is to fly it--without launching it. This is done by attaching a string to the model and swinging it through the air. If the string is attached at the rocket's CG, its behavior as it is swung through the air will indicate what it will do in powered flight.



Make the test on your model by forming a loop in the end of a six to ten foot string. Install an engine in the rocket. (The center of gravity is always determined with an engine in place.) Slide the loop to the proper position around the rocket so the model balances horizontally. Apply a small piece of tape to hold the string in place.



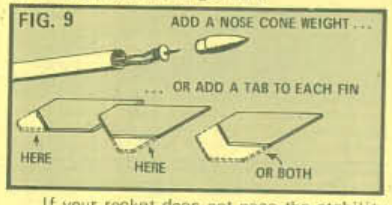
With the rocket suspended at its center of gravity, swing it overhead in a circular path. If the rocket is very stable, it will point forward into the wind created by its own motion. Some rockets which are stable will not point forward of their own accord unless they are started straight. This is done by holding the rocket in one hand with the arm extended and then pivoting the entire body as the rocket is started in the circular path. It may take several attempts before a good start is achieved.



If it is necessary to hold the rocket to start it, an additional test should be made to determine whether the model is stable enough to fly. Move the loop *back* on the body until the tube points down at a 10° angle *below* the horizontal. Repeat the swing test. If the model will keep its nose pointed ahead once started, it should be stable enough to launch.

Be careful when swinging a rocket overhead: A collision with a nearby object or person could be serious. Always do your testing in an open, uncluttered area.

Don't try to fly a rocket that has not passed the test. Most unstable rockets loop around in the air harmlessly. However, a few marginally unstable models will make a couple of loops and then become stable due to the lessening of the propellant load. When this happens, the model can crash into the ground at high speed. A person standing in the wrong place could get hurt.

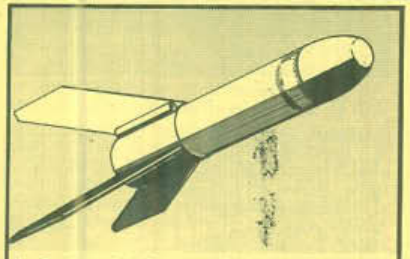


If your rocket does not pass the stability test, it can usually be made stable. Two methods can be used: The balance point can be moved forward or the fins can be enlarged. To move the balance point forward, attach nose cone weights to the base of the nose cone. Fins can either be replaced with larger ones or extra tabs can be glued to the rear or tip edges of the fins. (Some scale models use supplementary plastic fins.) After making your changes, test the model again to be sure it is now stable.

RECOVERY SYSTEMS

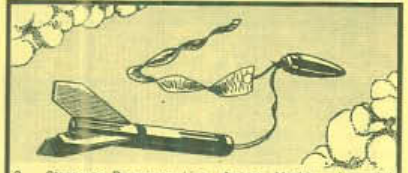
The recovery system is one of the most important parts of a model rocket. It is designed to provide a safe means of returning the rocket and its payload to earth without damaging the rocket or presenting a hazard to persons on the ground. Also, the recovery system provides an area for competition when rocketeers hold contests to see whose rocket can remain aloft the longest. In addition, rocket recovery is an area for valuable experimentation and research as rocketeers develop new and better methods of returning their models to earth or study air currents.

Most recovery systems in use today depend on drag (or wind resistance) to slow the rocket. Each changes the model from a streamlined object to one which the air can "catch against" and retard its descent. Six main recovery methods are used by model rocketeers today. Following is a brief description of each:

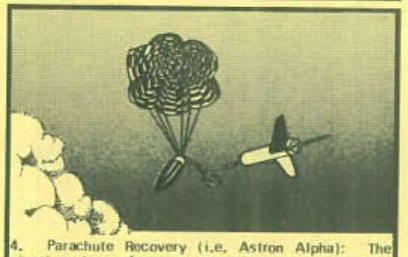


1. Featherweight Recovery (i.e. Astron Streak): The model is designed for extra light weight (under 1/4 ounce without engine) and has a blunt nose. When the engine is ejected from the rocket, the model is so light compared to its size that it lands safely. The lightweight, aerodynamically unstable, spent engine casing tumbles back separately.

2. Tumble Recovery (i.e. Astron Scout, Sprite): The ejection charge shifts the weight of the engine in the rocket rearward. This makes the rocket unstable. With the balance point of the rocket further toward the rear, air pressures ahead of the balance point are greater than behind, forcing the rocket to start turning. When the rocket is tumbling, air drag on it is much higher and it falls slowly. Estes Pat. No. 3,114,317



3. Streamer Recovery (i.e. Astron Mark): A model with a small streamer will act like a tumble model. If the streamer is large though, it develops enough drag by fluttering to actually hold the rocket back in its descent and it lands gently.



4. Parachute Recovery (i.e. Astron Alpha): The ejection charge forces a parachute connected to the model out of its body tube. The parachute deploys, filling with air, and supports the model on its return.

5. Helicopter Recovery (i.e. Astron Gyroc): Vanes on the model, activated by the ejection charge, catch the air in a way that makes them spin on the way down. The spinning vanes disturb the flow of air past the rocket creating a large amount of drag.

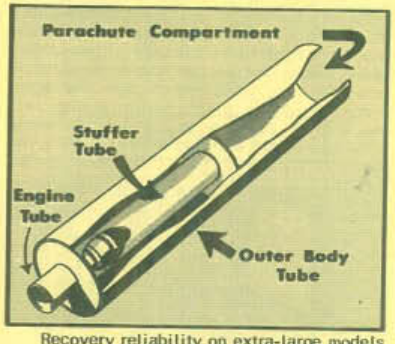
6. Glide Recovery (i.e. Astron Falcon, Nighthawk): The model ascends vertically like a conventional rocket. At ejection either the balance of the model or the position of its aerodynamic surfaces is changed. Instead of streamlining straight down, the wings generate lift, pulling the nose up, and the model goes into a glide. Models of this type are called "Boost-gliders". Estes Pat. No. 3,157,960. Other pat. pending.

Reliable Recovery

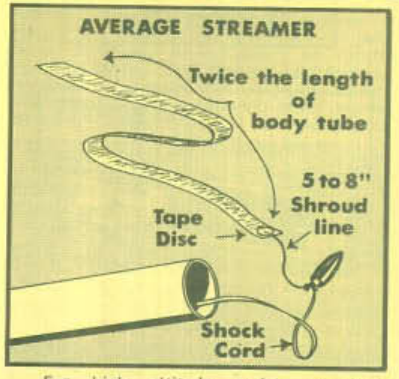
No rocketeer likes to see the product of many hours' labor broken because the recovery system didn't work properly. Recovery failures are almost always due to an error in building the model or in preparing it for flight.

The most common error on parachute and streamer models is failing to install the engine properly. If the engine is not held securely, it will be ejected instead of the streamer or parachute. On models with engine holder hooks, make sure the hook latches properly over the end of the engine. If the model relies on a friction fit to hold the engine, wrap enough masking tape around the engine to make it fit *tightly*.

A second error is leaving a hole that ejection gasses can leak through. Incorrect engine mount design or construction is often the villain. For reliable recovery the rear of the rocket *must* be air tight when an engine is in place.



Recovery reliability on extra-large models can be improved by using a stuffer tube. This reduces the volume that the ejection charge must pressurize, resulting in more force to eject the nose cone and 'chute. A stuffer usually is made from BT-20 or BT-50 body tube, centered inside the model's body, with paper rings glued on each end. The rings should also be glued to the inside of the body so there is no gas leakage into the space between the stuffer and outer body tube.



For high altitude models parachute recovery is often too good; the bird can be miles away by the time it finally touches down. Streamer recovery is often the answer. A strip of 1" wide flameproof crepe paper, usually at least twice as long as the rocket itself, will supply enough drag at the nose to make the rocket fall sideways. In this condition it falls enough faster than with a parachute to bring it back close to the launch area. It falls slow enough, however, to avoid damaging the model.

Whether the model has a parachute or streamer, always be sure to use enough flameproof wadding. The wadding not only serves as an insulating layer between the hot ejection gases and the 'chute or streamer; it also works as a gas seal and piston to insure that the ejection charge works evenly against the recovery device. Wadding should be *loosely* packed, filling the entire area of the tube for a distance equal to twice its diameter.

By following these suggestions, you'll find you get many more successful flights. Not only will your models last longer, but you'll also find that reliable recovery makes model rocketry more enjoyable.

MULTI-STAGING

Ignition

The first stage of a multi-stage rocket is always ignited by standard electrical means. Second stage ignition occurs automatically upon burnout of the first stage. Figure 1A

shows that the first stage engine has no delay or ejection charge. This gives instant ignition of the next stage at burnout.

In figure 1B the propellant is partially burned, leaving a large combustion chamber. As the propellant continues to burn, the wall of propellant becomes thinner until it cannot withstand the high pressure inside the chamber. At this point the remaining propellant wall ruptures, and the high pressure exhausts forward toward the nozzle of the next stage, carrying hot gases and small pieces of burning propellant into the nozzle of the second stage engine. This action is illustrated in figure 1C.

For this system to work, the stages must be held together until the upper stage engine has ignited. When this happens, the stages must then separate in a straight line. This is accomplished by wrapping one layer of cellophane tape around the joint between engines and then recessing this joint 1/2" rearward in the booster body tube, as in fig. 2. Recessing the joint forces the stages to separate in a straight line.

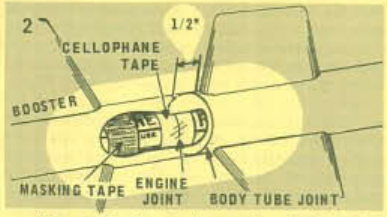
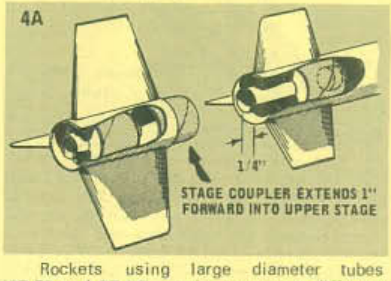


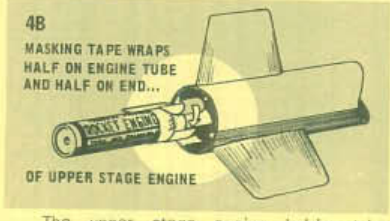
Figure 2 shows the engine installation in a typical two-stage model. Always tape the engines together before inserting them into the rocket. Check carefully before and after taping to be sure the engines are in their proper positions (nozzle of upper stage engine against top end of booster engine). Failure to check carefully can be highly embarrassing as well as damaging to the rocket.

After taping the engines together, wrap masking tape around the upper stage engine at the front and near the rear as in fig. 3 to give it a *tight* fit in the body. Push it into place. Wrap the booster engine and push it into position. Failure to get the upper stage engine in place tightly enough will result in the recovery system misfunctioning; failure to secure the booster stage tightly can result in its dropping off under acceleration.

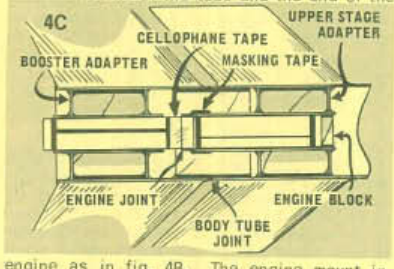


Rockets using large diameter tubes (BT-50 and BT-60) require somewhat different methods, but the same principles of tight coupling and straight line separation must be followed. The recommended coupling

method for large diameter tubes is illustrated in fig. 4. The stage coupler is glued to the booster body tube, with the adapter for the upper stage engine mount positioned forward to allow the stage coupler to fit into the upper stage, while the tube adapter in the booster is positioned to the rear.



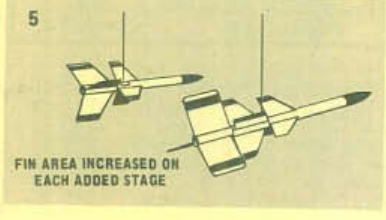
The upper stage engine holder tube projects 1/4" rearward from the end of the upper body tube. The engine is held in place by wrapping a layer of masking tape *tightly* around the end of the tube and the end of the



engine as in fig. 4B. The engine mount in the booster must be built to leave space for this system (see fig. 4C).

Stability

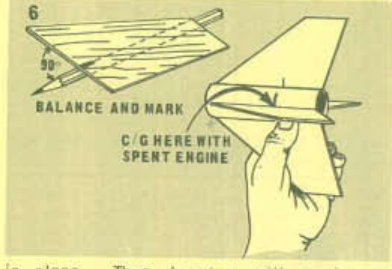
Since two or more engines are mounted near the rear of a multi-stage rocket, it has a tendency to be tail-heavy. To compensate for this, extra large fins are used on lower stage. Generally, the lower set of fins on a two-stage rocket should have two to three times the area of the upper set. Each additional stage requires even greater fin area.



When checking for stability, test first the upper stage alone, then add the next lower stage and test, and so on. In this way you can be sure that the rocket will be stable in each step of its flight, and you can locate any stage which does not have sufficient fin area. Always check for stability with the largest engines to be used in place.

Booster Recovery

Most lower stages are designed to be unstable after separation. The booster should be built so that the center of the area of the fin (its balance point) matches or is up to 1/4" ahead of the booster's balance point with an expended engine casing



in place. Thus, boosters will require no parachute or streamer, but will normally tumble, flutter or glide back to the ground. If the booster is to be used again, it should be painted an especially bright color, as it does not have a parachute or streamer to aid in spotting it once it is on the ground.

Types of Engines

Lower and intermediate stages always use engines which have no delay and tracking charge, and no parachute ejection charge. There is no delay so that the next stage will receive the maximum velocity from its booster. The engines which are suitable are those which have designations ending in zero, such as the A8-0, B6-0, 1/2A6-0S, and B14-0.

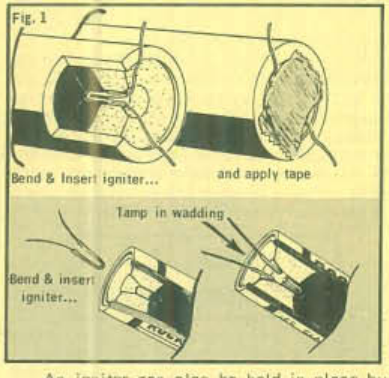
In the upper stage an engine with a delay and tracking charge and parachute ejection charge is used. As a general rule the longest possible delay should be used. Engines suitable for upper stage use are those with long delays such as the B6-6, A8-5, C6-7, etc.

LAUNCHING

Model rockets, like professional rockets, are launched electrically. This provides both safety and realism. Each engine sold by Estes Industries is supplied with an igniter and complete instructions; still more information is supplied with launcher kits. However, the basic information needed to launch models successfully is included in these pages.

Igniter Installation

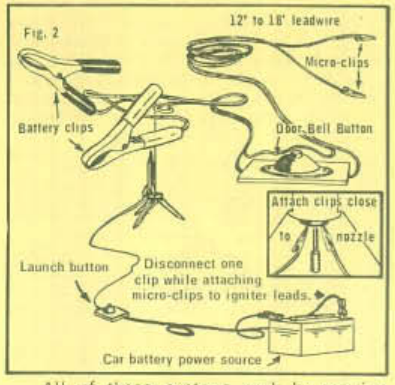
Estes igniters are supplied in strips of three. Cut the igniters apart (scissors will work) midway between the coated sections. Bend the igniter at the middle as shown and push it into the engine as far as it will go. To operate properly the igniter must touch the propellant grain. Spread the leads and apply a square of masking tape to the nozzle and leads as shown in Fig. 1. The eraser on the end of a pencil is good for pressing the tape securely into place.



An igniter can also be held in place by rolling a 1" square of flameproof wadding into a ball and inserting it into the nozzle with a pen or pencil to hold the igniter firmly in place.

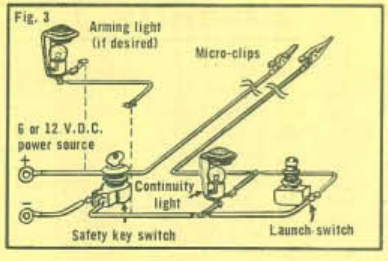
Electrical Systems

The electrical system which operates the igniter can be made in many ways. It can be a simple home-made unit, as the one shown in Fig. 2, or it can be one of the more complete systems sold by Estes Industries.

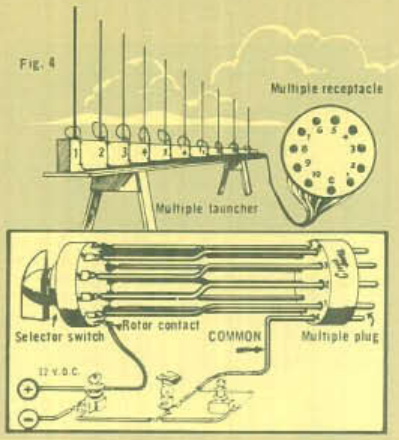


All of these systems work by passing enough electrical current through the high-resistance igniter to heat it to 1100°F. This ignites the coating on the igniter which in turn ignites the engine. The system is attached to the igniter with micro-clips as shown. When connecting the micro-clips to the igniter make sure the clips do not touch each other or the rod or blast deflector. If they do touch, the current from the battery will "short" through the clips, rod or deflector and not reach the igniter.

Any electrical system *must* have a spring-return launch switch so the current turns off automatically when the button is released. In addition a safety disconnect must be provided. On simple systems the battery clips should be disconnected when the micro-clips are being attached to the igniter. More complete systems may have safety key switches or safety plugs to do the same job.



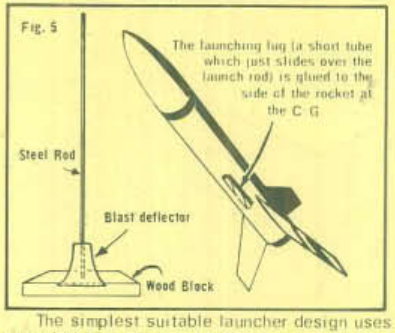
The circuit shown in Fig. 3 also includes a continuity check pilot light. This is a small bulb (no more than ¼ ampere for safety) which lights when the safety interlock is closed *if* the clips make good connections at both the battery and the ingiter. When lit, it indicates that the rocket can be launched.



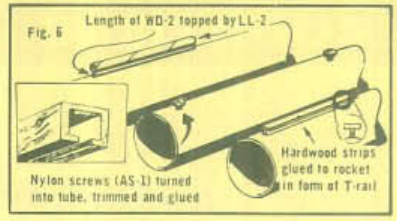
Most rocket clubs prefer a multiple launcher system for group launchings. The basic electrical circuit can be adapted by adding a rotary "pad selector" switch as shown in Fig. 4. Each launch pad then has *one* micro-clip which is connected to the "common" line to the battery and *one* micro-clip which is connected to one of the individual terminals on the selector switch.

Launcher Design

A rocket cannot be simply set on its fins and launched; some method of holding it in position before ignition and guiding it during the first few feet of its flight is necessary. The launcher must perform these functions.



The simplest suitable launcher design uses a wood block to support a 36" long, 1/8" diameter steel rod. A short tube, slightly larger than the rod, is glued to the side of the rocket near its balance point. This tube slips easily over the rod and keeps the rocket pointed in the right direction. Fig. 5 shows a rod launching system.



Some launching guides are designed to fit around the lug instead of inside it. The "C" rail is typical of these. Rails generally have the advantage of being stronger and more rigid than rods. However, most model rockets will fly very well with either system. Fig. 6 illustrates a rail and some lugs to fit.

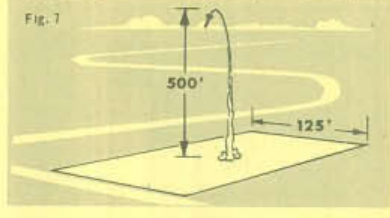
When building a launcher be sure to use a base that is big enough and heavy enough to provide a secure foundation. A piece of 3/4" plywood a foot square works well for most rockets. Bricks or rocks can be used to weight the base when extra-large models are being launched.

Safety

Make sure the area around the launcher is clear and has no dry weeds or highly flammable materials. When approaching the launcher to mount a rocket or check it, put your hand on the end of the rod before leaning over. This helps protect you against the possibility of eye injury from the rod.

Launch Areas

The best place to fly models is on a model rocket range. Many such ranges have been set up by organized groups of rocket enthusiasts. However, if such a range is

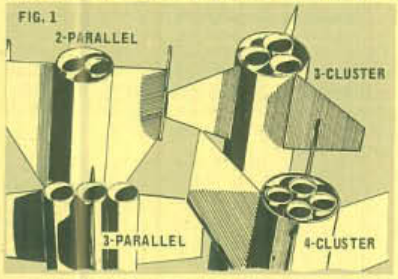


not available, it is best to select a place, free of trees and houses, large enough to recover the rocket within the area. Generally the smallest side of the field should be at least one fourth the maximum altitude your rocket will reach. Set the launcher at the center of the area as shown in Fig. 7.

CLUSTERING

When large models and heavy payloads have to be launched, one engine often cannot supply enough power. A cluster of several engines is generally the answer to this problem.

ENGINE ARRANGEMENTS



In designing a clustered model the first rule to remember is that thrust must be balanced around the centerline of the rocket. Figure 1 shows several engine arrangements that satisfy this requirement. All engines should be located close together to keep unbalanced thrust from forcing the model off course.

ENGINE MOUNTING

The engine mounting system serves three purposes: First, it holds the engines securely in place throughout the flight. Second, it aligns the engines so they work together as a unit and give a straight flight. Finally, it must seal the rear of the rocket so that recovery system ejection gases cannot leak out through cracks and holes in the back of the model.

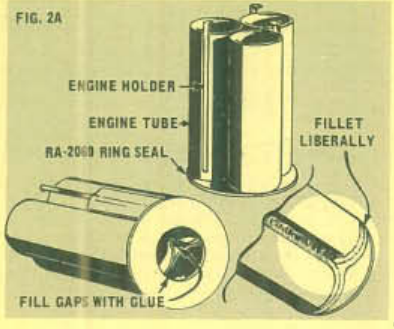
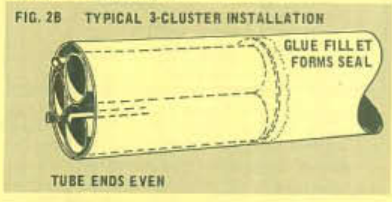
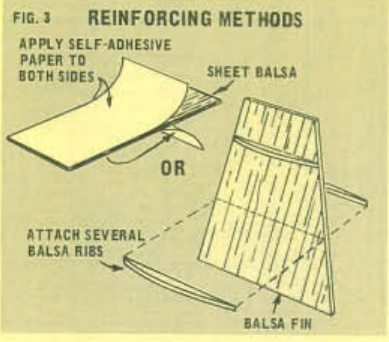


Figure 2 shows a typical engine mounting system for a three-engine model. The spaces between tubes are sealed at the front of the engine mounting tubes by gluing an adapter ring which fits the inside of the body in place as shown. To install the engine mount, smear a liberal amount of glue around the inside of the rear of the body tube. Immediately slide the engine mount unit into place so the rear of the engine mount tubes is even with the rear of the body and the engine retainer hooks project from the tube. Do not pause while inserting the engine mount or the glue may stick with the mount in the wrong place. Set the unit on its *rear* end while the glue dries.

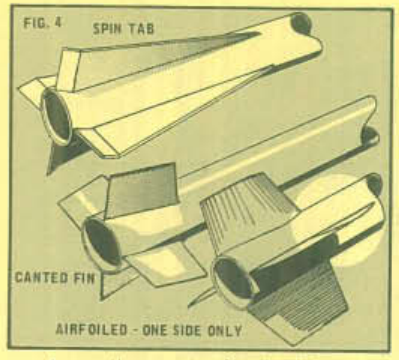


STABILITY

Because the weight of several engines is concentrated in the rear of a cluster rocket, extra attention should be given to designing the rocket so it is stable. Since the engines will not always all be producing exactly the same amount of thrust at the same time, an extra margin of stability is needed. Pay extra attention to the rules in the stability chapter.



The extra load on a cluster model's fins requires that they be made extra strong. One-eighth inch thick balsa sheet is the most popular fin material for cluster birds. Thinner fin stock can be used, but it should be reinforced for best results.

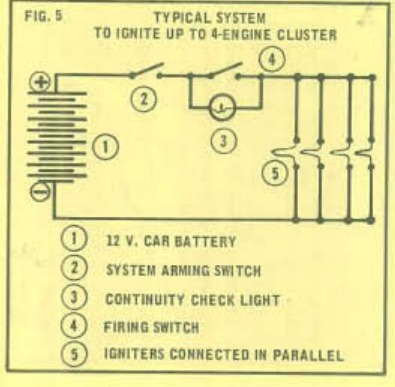


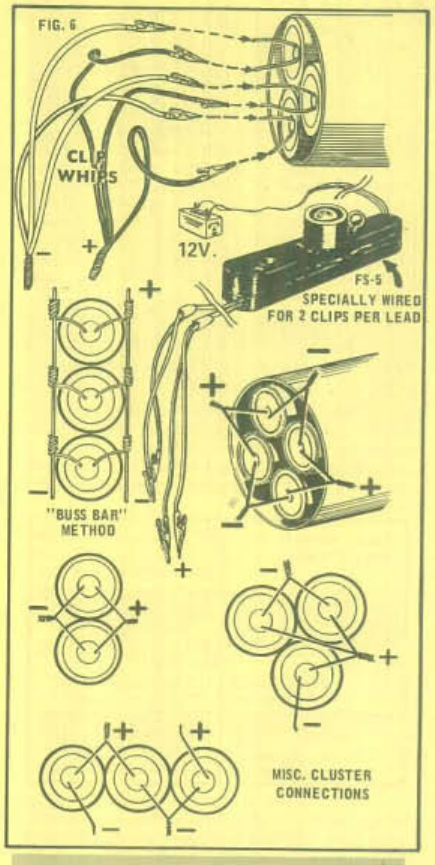
A small amount of spin helps give straighter flights by averaging out uneven thrust. (Too much spin increases drag and reduces performance.) Three methods of providing spin are illustrated. With any system, make sure that all fins or tabs are made to spin the rocket in the same direction.

IGNITION

Ignition is the most important part of successful clustering. All engines must be ignited at the same time. To do this, always use a 12 volt car battery for the power supply and a heavy duty electrical system (such as the Estes FS-5 Launch Control System). Install the igniters carefully and connect them in parallel.

Several typical methods of connecting igniters are shown in figures 5 and 6. Make connections carefully to get good contact and to avoid pulling the igniters from the engines. Always connect igniters in parallel--*never* in series.





GENERAL INFORMATION

Use a heavy-duty launcher such as the Tilt-a-Pad with cluster models. When heavy rockets are being flown, the launcher should be anchored to the ground with rocks or bricks.

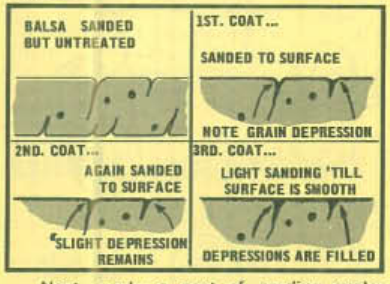
Before installing the engines in your cluster rocket, pack the front of each engine above the ejection end cap with flame-proof wadding. This eliminates the possibility of one engine's ejection charge igniting the ejection charge of another engine and damaging the rocket when one engine in a cluster fails to ignite at lift-off. For more complete information on clustering, see Estes Technical Report #TR-6.

FINISHING

The finish of a rocket starts with the very first steps of assembly. Sloppy gluing and other messy habits will ruin the appearance of a rocket so that nothing can be done to get the perfect appearance which is desired. On the other hand, careful construction will make a model look good even before the paint is applied.

SANDING and SEALING

Paint cannot replace sandpaper. If a balsa surface is not sanded and sealed carefully, it will be impossible to get a smooth paint job. Begin by sanding all balsa surfaces with extra-fine sandpaper until smooth.

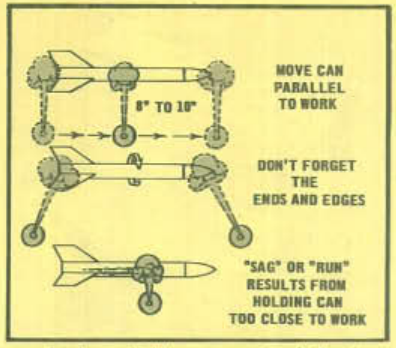


Next, apply a coat of sanding sealer to the balsa. Let this dry completely, then sand with 320 grit (or finer) sandpaper until the surface is smooth again. Apply more sealer, repeating the procedure until all the pores in the balsa are filled.

Practically all of the sealer should be sanded off after each coat. This is because the purpose of the sander is to fill the holes, not the smooth areas of the balsa.

BASE COLOR

Once you feel the balsa surfaces are prepared, it's time to apply the base color. The base color is the lightest of the colors to be used on the model. Usually this will be white. If the model is to be painted with fluorescent colors, the base coat *must be white.*

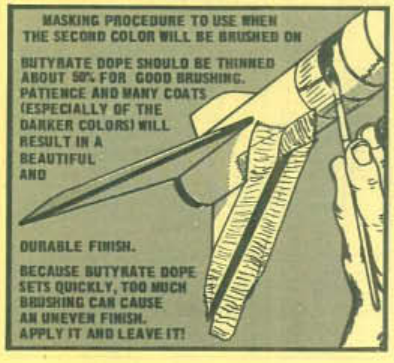


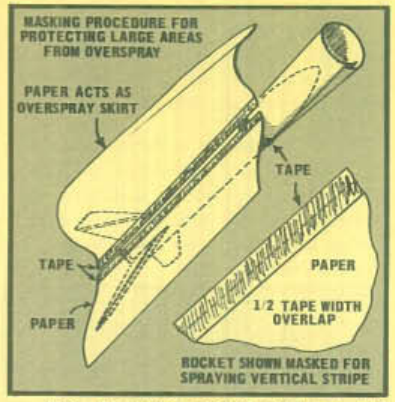
Apply a light, even coat of the base color and set the model aside to dry. Always spray or brush thin coats; thick ones dry slow and tend to "sag". When the first coat has dried completely, sand lightly with extremely fine sandpaper. Wipe any dust off with a clean, slightly damp cloth and apply another coat. Let this dry, then follow with additional light coats until the model has a clear, pure color.

Let the base coat dry completely. Allow at least four hours in a warm, dust-free area (a day is better when possible). Don't let the temperature get over 120° while the model is drying.

THE SECOND COLOR

When the base color has dried, cover all areas on the model which are to remain this color. Cover small areas with masking tape. Large areas should be covered with typing paper, held down at the edges with masking tape. It's important to seal the tape down tightly along the edge.



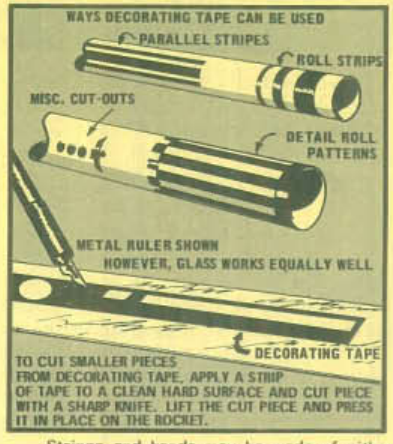


With the model masked, apply an additional thin coat of the first color to finish sealing the edges of the tape. When this is dry, apply the second color in several thin coats. Use just enough paint to get good color. After the last coat is dry, remove the masking carefully to avoid peeling the paint. A third color would be applied in the same way as the second.

FINAL TOUCHES

For best results let the paint dry overnight before applying decals. Most decals should be soaked in lukewarm water for

30 seconds or until they slide on their backing sheets. The decal is then slid so one edge is off the backing. This edge is positioned and held in place on the rocket and the backing pulled out from under. Smooth the decal down with a damp finger and blot away any excess water with a rag.

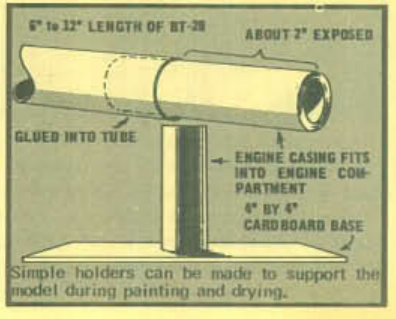


Stripes and bands may be made of either decal material or decorating tape. The pieces should be cut to size before application.

When a model has been finished with fluorescent paint, apply a light coat of clear spray before applying tape or decals. With any paint finish, it is best to apply several coats of clear after the decals have dried to protect them.

Wax may be applied over most enamel or butyrate finishes, but never directly over fluorescent paints. Test the finish to be waxed by applying the wax to an inconspicuous corner of the model or a scrap of tubing with the same paint finish. Some paints will rub off when wax is applied.

NOTE: Enamel paint may be applied over butyrate dope, but NEVER APPLY BUTYRATE DOPE OVER ENAMEL PAINT. If in doubt, test the compatibility of different paints on a piece of scrap material.



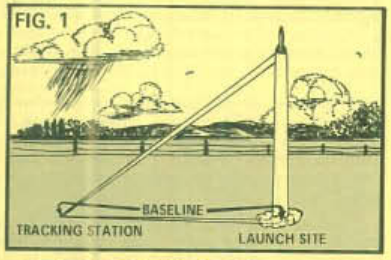
Simple holders can be made to support the model during painting and drying.

TRACKING

Every rocketeer wants to know how high his models fly. Many methods of determining a model's peak altitude have been tried, but only one method has proven itself. This method is known as triangulation.

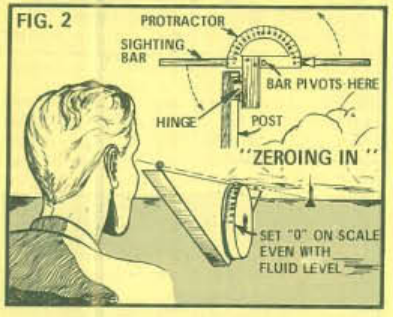
The simplest form of triangulation uses only one very simple tracking device. With it, the rocketeer measures the angle between the ground and the line of sight to the rocket at its peak altitude. When this angle and the distance from tracker to launcher are known, it is very easy to determine the altitude.

FIG. 1



TRACKERS

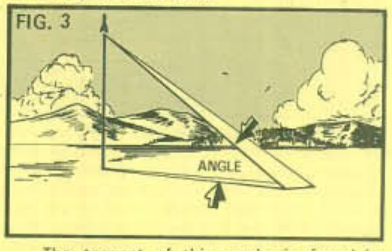
FIG. 2



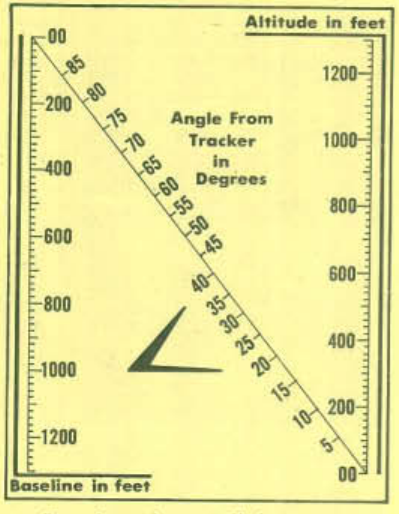
The Estes Altiscope is one of the best all-around basic tracking devices. However, the rocketeer can also easily make his own tracker. An inexpensive plastic protractor, mounted securely on a post set in the ground, with a sighting stick pivoted at the "center" of the protractor, will do the job. The tracking device must be set so that it reads 0° when aimed at the rocket on the launcher and 90° when aimed straight up. If the tracker is not "zeroed in" on the launcher, it will give incorrect information.

When the operator at the tracking station is ready, the rocket is launched. He follows the rocket with his tracker as it rises. When it reaches its peak altitude he stops or locks the tracker. The indicated angle is then read from the protractor scale.

FIG. 3



The tangent of this angle is found by checking the table on the next page. Multiply the tangent by the distance from tracker to launcher (baseline distance) to find the altitude.

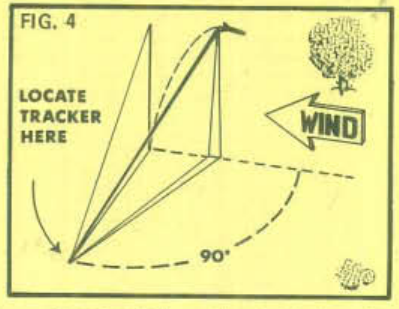


The chart above, called a nomogram, provides a simpler, quicker but less precise method for performing the altitude calculation. Draw a straight line from the correct baseline point on the chart, through the measured angle and on across the altitude scale. The correct altitude is the point at which the line crosses the altitude scale.

TABLE OF TANGENTS

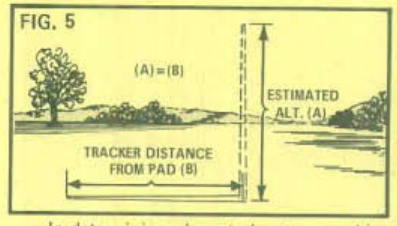
Angle	Tan.	Angle	Tan.	Angle	Tan.
1°	.02	28°	.53	54°	1.38
2	.03	29	.55	55	1.43
3	.05	30	.58	56	1.48
4	.07	31	.60	57	1.54
5	.09	32	.62	58	1.60
6	.11	33	.65	59	1.66
7	.12	34	.67	60	1.73
8	.14	35	.70	61	1.80
9	.16	36	.73	62	1.88
10	.18	37	.75	63	1.96
11	.19	38	.78	64	2.05
12	.21	39	.81	65	2.14
13	.23	40	.84	66	2.25
14	.25	41	.87	67	2.36
15	.27	42	.90	68	2.48
16	.29	43	.93	69	2.61
17	.31	44	.97	70	2.75
18	.32	45	1.00	71	2.90
19	.34	46	1.04	72	3.08
20	.36	47	1.07	73	3.27
21	.38	48	1.11	74	3.49
22	.40	49	1.15	75	3.73
23	.42	50	1.19	76	4.01
24	.45	51	1.23	77	4.33
25	.47	52	1.28	78	4.70
26	.49	53	1.33	79	5.14
27	.51			80	5.67

FIG. 4



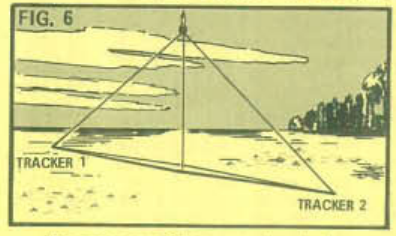
A single tracker will give best results on calm days. Wind interferes with accuracy since models tend to tilt over into the wind as they fly. The result is that the rocket will not be straight over the launch site at peak altitude, but instead will be some distance over in the direction of the wind. To keep error due to wind drift to a minimum, locate the tracker at a 90° angle to the wind direction as shown.

FIG. 5



In determining where to locate a tracking station, estimate the altitude your model will reach. The tracking station should be approximately this distance from the launcher (usually 500 to 1000 feet). Measure the distance from launcher to tracker carefully to insure accurate altitude calculations.

FIG. 6



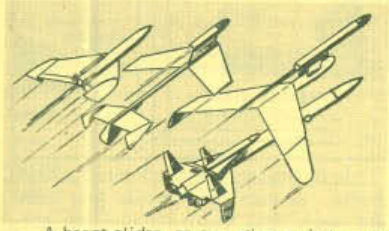
For more precision, use two trackers on opposite sides of the launcher. The easiest way of calculating rocket height using two trackers is to find the altitude for each tracking station and then take the average of these two altitude figures.

More elaborate tracking systems and more elaborate mathematics can be used to gain greater accuracy when the rocket doesn't fly straight up. However, a simple tracking system will do the job very well when good models are flown on calm days. More complete information on basic altitude tracking is contained in Estes Industries Technical Report TR-3.

BOOST-GLIDE

Boost-gliders are models which fly straight up like any other rocket. However, they glide back to earth instead of coming down suspended from a parachute.

There are four main types of boost-gliders: Conventional front engine, conventional rear engine, pop-pod and parasite. Although these types appear very different, many of the same principles apply to all.



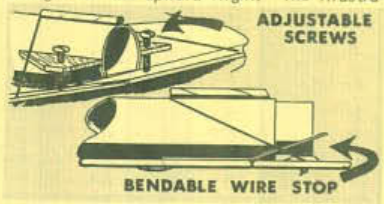
A boost-glider, as any other rocket, must be stable to fly upward. For this reason, most boost-gliders are designed with their engine mounts as far forward as possible. During glide a model must still be stable, but not by nearly so great a margin. If most or all of the engine is positioned ahead of the model's balance point, it will help make the model fly correctly.

Rear-Engine Models

Based on conventional model rockets, the rear-engine boost-glider was the first type developed. Two fins are made extra-large to form wings. Control surfaces, called elevons, are mounted on these wings. The elevons are held straight by the engine during powered flight and coasting. At ejection the engine is expelled from the

rear of the rocket, and the elevons swing up as shown. This forces the rear of the model down slightly so the wing meets the air at an angle, providing lift to support the model.

Many rear engine models are made with extra empty engine casings mounted to the front of the engine to provide extra weight up forward for better stability. With all rear engine models it is important to remember that all control surfaces must be perfectly straight for the upward flight. The illustra-

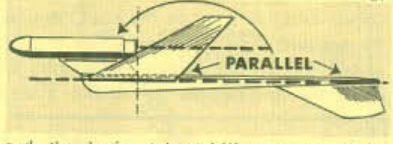


tion above shows the control systems of a typical model. Estes Industries Technical Report TR-4 contains more information on rear engine boost-gliders.

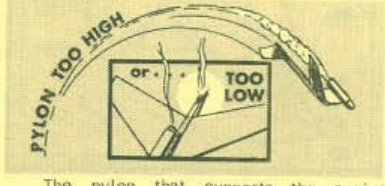
The big problem with rear-engine designs is getting the balance point far enough forward for a good upward flight and still having it far enough rearward for a good glide. The front-engine model solves this by putting the weight of the engine at the extreme front on the way up.

Front-Engine Principles

The engine in a front engine model should be positioned so that its rear is at least as far forward as the middle of the root of the wing. Looking at the model from the side, the centerline of the engine, the bottom surface of the wing,



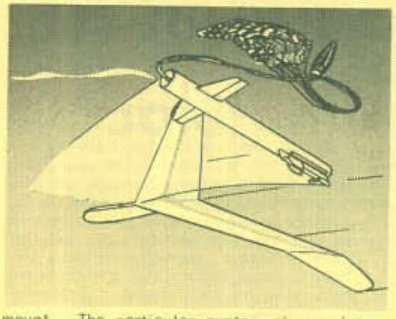
and the horizontal stabilizer must all be perfectly parallel. If any of these is at an angle, the model will tend to travel in one big loop and will probably be on the ground before ejection.



The pylon that supports the engine holder should be about 1/2 inch high. If it is too high, off-center thrust will force the nose of the rocket down. If it is too low, the tail will either be scorched or struck by the ejecting engine. For more information on front-engine models, see Estes Technical Report TR-7.

Pop-Pods

For the highest performance from a glider, its weight and drag must be kept to a minimum. The Pop-Pod helps by removing both the weight and drag of the engine



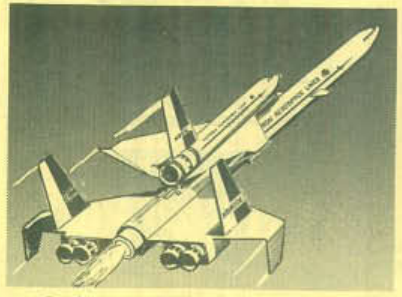
mount. The particular system shown, introduced by Estes Industries, has been adopted by almost every boost-glider designer.

The Estes Pop-Pod (also known as strip pod) can best be explained as a finless parachute or streamer model rocket with a forward-slanting pin on which a glider is hooked. The glider, which fits loosely on the pin, serves to stabilize the whole assembly on the way up. At ejection, the reaction of the nose cone ejecting slows the pod while the inertia of the glider carries it forward and off the hook. (If the pin is a *little* tight, the drag of the parachute will usually pull the pod off.)

For this system the pod must be supported on the launch rod with the glider hanging from it. The pod must be loose enough so it will fall off if the glider is held with its nose up. As with conventional front-engine models, the engine, wing and stabilizer must be parallel.

Parasite Gliders

The first parasite glider systems were built with two gliders fitting on opposite sides of a finless, parachute-recovered core. Since then, a wide variety of models has been built on this principle.



For best results, a parasite model should be built with a long, very stable core vehicle. The glider should be mounted close to the center of gravity of the core. One loose pin at the front of the glider is enough to hold it in place on the way up.

Glide Testing

A boost-glider must be "trimmed" to glide correctly before launching. Most rear engine models are trimmed by adjusting the elevons until a straight flat glide is achieved. Other models are trimmed by adding or removing weight at the nose.

When trimming a model, give it a straight, smooth, level toss into the wind and note how it performs. If it stalls, add weight to the nose. If it dives, remove weight from the nose. If it turns too much, place a *very small* weight on the wing which is on the *outside as it turns.*

Few models are as spectacular in flight and as enjoyable to watch as a good boost-glider. The rocketeer looking for a challenge will find that developing improved boost-glide designs is one of the most rewarding areas of research in model rocketry.

SAFETY

THE DANGEROUS PAST

Most of today's model rocketeers were not concerned with rockets during the "dangerous years" of youth rocketry. These years, from 1957 to 1965, were the years between the time Russia launched the first earth satellite, Sputnik, and the time model rocketry became well known.

Dean Bisbee of 5272 E. Dartmouth ave. tries to comfort his son, Lynn, 16, as the youth receives emergency treatment at Denver General Hospital after a homemade rocket exploded and blew off part of his right hand Wednesday. "Just tell the other kids to be more careful when they're working with explosives," the science student asked.

—Rocky Mountain News Photo by Harry M. Rhoads.

In those "early days" when a newspaper article told about a young rocket experimenter, it was usually a tragic story . . . like the boy in California who loaded a metal pipe with match heads which exploded, killing him instantly and crippling his friend for life . . or the teacher who was killed, and seven of his students injured, when he filled an improvised rocket with explosive chemicals. Still another case was of a young man losing an eye using zinc dust and sulphur in a CO_2 cartridge.

These unfortunate incidents happened to thousands of America's young rocketeers. Why? Because the space age had started and practically every science-oriented young man wanted to build a rocket. However, no safe way was readily available for him to do so. The situation was so bad that the Institute of Aeronautics and Astronautics estimated that a "basement bomber" experimenter had a 1 in 7 chance of being seriously injured or killed for each year he participated. A careful analysis pointed to the following contributing factors as the major reasons for these rocketeer accidents:

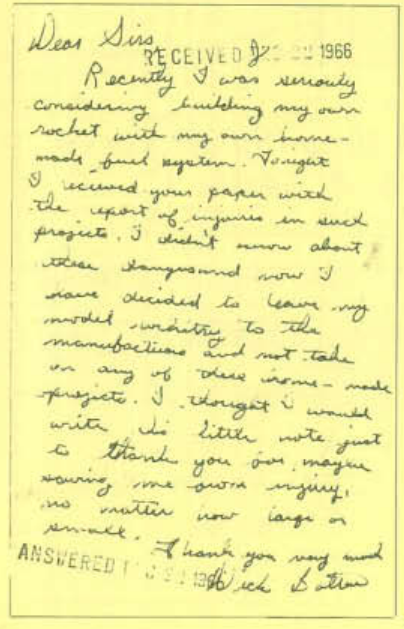
1. A strong desire to build and launch a rocket.
2. A plentiful supply of low cost, (readily available) dangerous materials for use in rocket experiments.
3. A lack of knowledge of the dangers involved.
4. The unavailability of safe materials for the experimenter.

A "ROCKET" THAT KILLS

The most frequent killer in "basement bomber" tragedies has been a combination of match heads and metallic CO_2 cartridges. Match heads, when confined, are a powerful, sensitive and highly dangerous explosive--wholly unsuitable for rocket experiments.

The Solution..

The Estes approach to safety for American rocketeers has taken three directions. First--we've tried to make every potential rocket builder aware of the disastrous results of "basement bomber" type activities by telling him of the dangers of home-compounded fuels and metal rockets. Secondly--we've marketed a line of rocket products which can be flown with a high degree of safety. Then, to make it a complete program, we've provided, along with these carefully engineered products, a wealth of safety oriented literature and technical information. Thus, the rocketeer is guided through his "rocket career" with little chance of serious injury.



Dear Sirs RECEIVED 1966
Recently I was seriously considering building my own rocket with my own home-made fuel system. Tonight I received your paper with the report of injuries in such projects. I didn't know about these dangers and now I have decided to leave my model rocketry to the manufactions and not take on any of these home-made projects. I thought I would write this little note just to thank you for saving me extra injury, no matter how large or small. Thank you very much
ANSWERED Rick Estes

Over the past few years, we've received a number of letters from young men saying, "Thank you for saving my life." It's the kind of letter which makes us very proud because it may indeed be the case--and we've met the prime objective of our program.

POSITIVE SAFETY VALUE: These are the words often used to describe the overall safety effect of model rocketry. By using the word POSITIVE we are making reference to a PLUS or ADDITIVE situation. We are, in effect, saying that America's rocketeers will have fewer accidents resulting in personal injury or property loss because model rocketry exists and is widely and freely available.

From YOUTH ROCKET SAFETY REPORT
by Vern Estes -- March, 1967

A Word on Making Rocket Engines...

At the Estes plant rocket engines are made automatically, under controlled conditions, with limited amounts of propellant being measured by explosion proof metering devices. We've spent many thousands of dollars in engine development work and plant layouts. Only highly-trained personnel are permitted near this operation. We still consider it a dangerous job, but a necessary one if we're to provide you with a safe form of rocketry.

If you would like to someday make rocket engines, we'd recommend you first get a college degree. Then you'll need some expensive special equipment, a safe place to work, and some specialized training.

If you attempt to build rocket engines with less than the above, you may find as some chemistry teachers, students and many others have, that through the rest of your life you will be without a finger, hand, arm, eye, ear, face, or you may be badly burned or even killed. Our country needs live rocket scientists and engineers who have all their fingers and hands. We are looking forward to fellows like you who have a special interest in rocketry to fulfill this need.

ROCKET ENGINE DESIGN

Today's model rocketeer can choose from an amazing variety of engines to power his models. He has an engine available for almost every purpose.

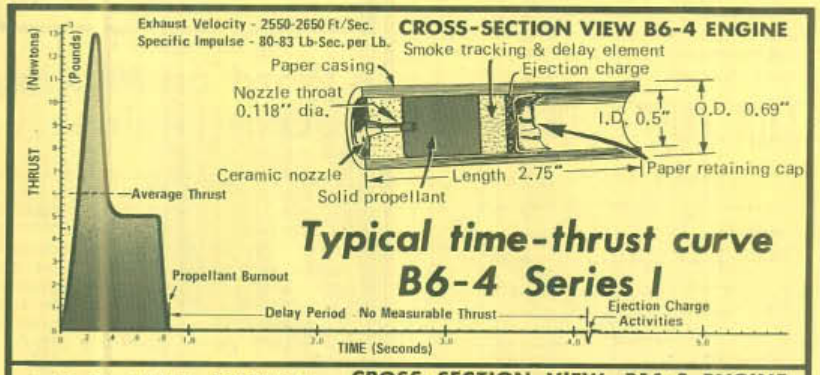
The engines the rocketeer uses come in two main types: end-burning and center-burning. End-burning engines are by far the most popular with model rocketeers. They have a big advantage because they can be built to give a dual level thrust action as shown by the B6-4 thrust curve.

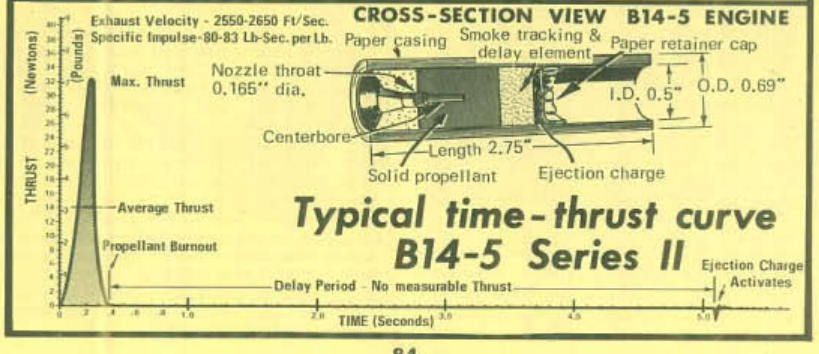
This design is especially effective with light-weight high performance rockets. The high initial thrust boosts the rocket to a suitable flying speed almost immediately; thrust then drops to a lower sustaining level to maintain speed and gain the most distance with the least fuel consumption.

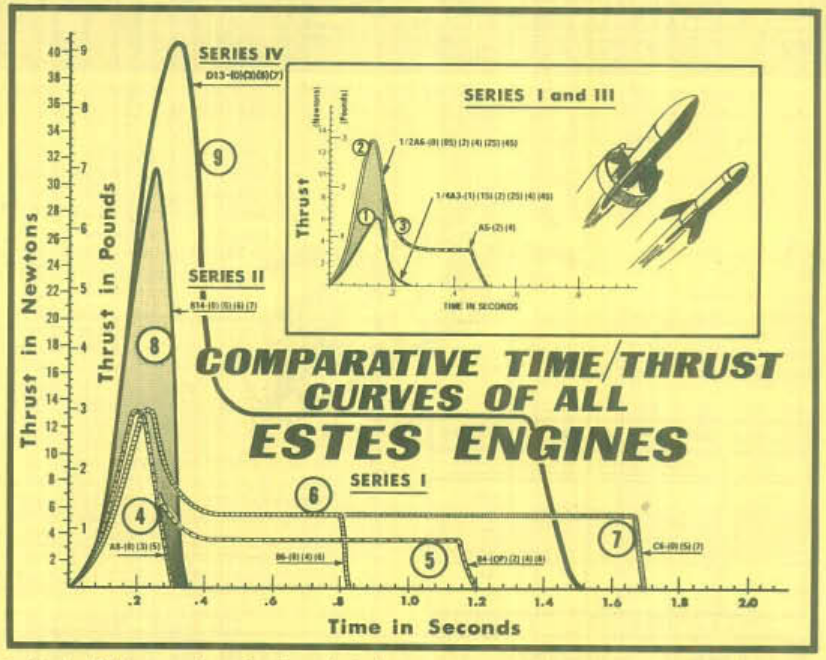
For heavy rockets especially those carrying large payloads, a second type of engine is available. The center-burning engine produces a very high average thrust, but only for a short period of time. This is more efficient for the heavy rocket since it brings the rocket to an adequate flying speed with less fuel than would be used by low thrust engines. The B14-5 thrust curve is typical of center-burning engines.

Single and upper stage model rocket engines of both types operate the same after the propellant has been burned. The end of the propellant ignites a slow-burning smoke tracking/delay element. This "delay charge" produces no thrust, but lets the model coast upward, leaving a smoke trail behind.

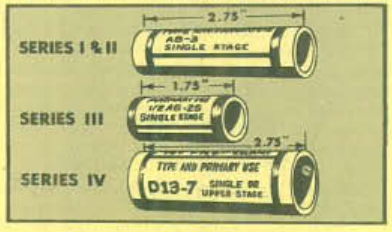
After several seconds the delay charge ignites an ejection charge which pressurizes the forward end of the rocket body to force the parachute out of the tube. (This gas pressure can be used instead to operate many types of recovery system other than parachutes.) If the correct engine is selected, ejection should occur at about the time the rocket has reached its peak altitude.







End-burning engines come in three sizes. The most common, known as Series I, is 2.75 inches long and 0.69 inches in diameter. A smaller type, the Series III engine, is 1.75 inches long, and the same diameter. It is simply a shorter version of certain lower power Series I engines. A large engine, Series IV, providing twice the power of the largest Series I engine, is also available.



Center-burning engines are classified as Series II. For more complete information, see the performance graphs and cut-away drawings.

THRUST CURVES

By studying the chart above you can learn much about the expected performance of your model using any type of engine.

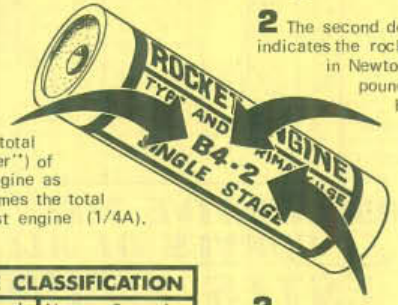
For instance, looking at Curve 8 and noting the extremely high thrust of the B14 engine, you'd know your rocket would accelerate quickly to a high velocity. Then, of course, at propellant burn out, it would also slow down quickly due to the high drag of a rocket traveling so fast. The question you'd ask yourself then is...Would my rocket go higher using one of the other B engines which provides less acceleration but keeps pushing for a longer period of time?

NOTICE

This rocket engine design and performance information is given for educational purposes only. We believe that if you understand how your rocket engine works you are in a better position to gain scientific knowledge from your activities and to design your rockets for specific purposes such as payload experimentation, altitude studies, drag racing, etc. We DO NOT grant permission for you to attempt to copy our design nor do we recommend that you attempt to build your own rocket engines.

ENGINE CLASSIFICATION

All engines sold by Estes Industries are stamped with a code designation which, when understood, will give the rocketeer important and useful data on the engine's performance capabilities. Here's how to read this coding:



1 The first designation in the code indicates the total impulse (total "power") of the engine. The C engine as shown below has 16 times the total impulse of the smallest engine (1/4A).

2 The second designation, a whole number, indicates the rocket engine's *average* thrust in Newtons. (1 Newton equals 0.225 pounds). For normal and most high performance flying an average thrust of 3 to 8 Newtons is best. For high lift off weights and high acceleration studies, the Series II engine with an average thrust of 14 Newtons is recommended.

3 The last number following the dash gives the delay time in seconds from thrust burn out to activation of the recovery system (parachute) ejection charge. Engines with an "0" in this position have no delay or ejection charge and are used only in the bottom stage(s) of multi-stage rockets. Series III engines have an "S" following this designation indicating the engine is shorter.

TOTAL IMPULSE CLASSIFICATION

Code	Pound-Seconds	Newton-Seconds
1/4A	0.14	0.625
1/2A	0.28	1.25
A	0.56	2.50
B	1.12	5.00
C	2.24	10.00
D	4.48	20.00

OTHER ENGINE INFORMATION

ENGINEERING:

Today the Estes engine represents the end result of over 11 years' efforts in engineering, craftsmanship and quality control. The total impulse of the Estes engine is closely controlled which allows us to make our engines very near the maximum permissible size in a given class. In addition, the average thrust, peak thrust and delay times are set to give the best overall performance for sport flying and competitive events.

QUALITY CONTROL:

Three out of every hundred engines made by Estes Industries are static tested on a recording type of test stand which graphically records the maximum thrust, thrust variations, minimum thrust, overall thrust duration, length of time delay, and the strength of the ejection charge. Any batch of engines which does not meet rigid standards is discarded. In addition, the engine production machines automatically reject all engines which do not contain the correct amount of propellant. All tolerances are kept as small as possible so that these engines make excellent propulsion units for contests, exhibitions and science studies.

SAFETY:

Rocket engines are not toys, but scientific devices. With common sense and close adherence to safety rules, model rocketry is as safe as any other sport, hobby or scientific study: Carelessness can make it dangerous, as with model airplanes, baseball or swimming. If you are hit by a model rocket traveling 300 or more miles per hour, you will be hurt. Use common sense and follow the safety code. Don't spoil model rocketry's excellent record of safety.

LABEL COLOR:

The label color indicates the recommended use. Green for single stage, purple (or blue) for top stage of multi-stage rockets and red for booster or intermediate stages.

MODEL ROCKET PERFORMANCE

The kits, components and engines produced by Estes Industries have been designed to cover the entire performance range from low altitude sport and demonstration models to high altitude, high performance payload and competition rockets. By choosing his kits, materials and engines carefully, the rocketeer can fill his performance needs exactly. Complete specifications are given on all items to make this selection easy.

HOW HIGH WILL YOUR MODEL GO? The chart below shows the approximate altitudes that can be achieved with single stage rockets.

Engine Size	Altitude Range (depending on rocket size and weight)	Approximate Altitude in a typical 1 oz. model
1/4A3-2	50' to 250'	100'
1/2A6-2	100' to 400'	190'
A8-3	200' to 650'	450'
B6-4	300' to 1000'	750'
C6-5	350' to 1500'	1000'
D13-5	400' to 2000'	1600*

(Some high performance models will reach higher altitudes than shown above.)

*(When flown in a 2 oz. model.)

ENGINE SIZE:

There are several things that affect the performance of a model. The first of these is engine size. The greater the total impulse of an engine, the higher it will boost a model.

WEIGHT:

In most cases, the heavier a rocket, the less altitude it will reach. A baseball can be tossed higher than an 8 pound cannon ball; the same holds true for model rockets. In addition heavier rockets are more apt to tilt at an angle as they leave the launcher, reducing altitude even more.

Weights listed for rocket kits in the catalog do not include engines. To determine the lift-off weight of a model, add the engine weight, shown in the engine selection chart, to the kit weight.

WIND RESISTANCE:

Drag, or wind resistance, is the third item which affects performance. The more drag on a rocket, the less altitude it will reach. A number of factors determine the amount of drag on a rocket. The more frontal area the rocket has, the greater its drag will be. As a result, large diameter model rockets will generally not reach as great an altitude as smaller diameter rockets with the same engine power. Rough surfaces create turbulence in the air as it flows past the rocket, increasing drag. Smooth finishes will increase the capability of the model. The stability of the rocket also affects drag--if it wobbles in flight, it will have greater drag. Careful attention to reducing drag can sometimes double a rocket's altitude capability.

MEASUREMENTS

METRIC and ENGLISH

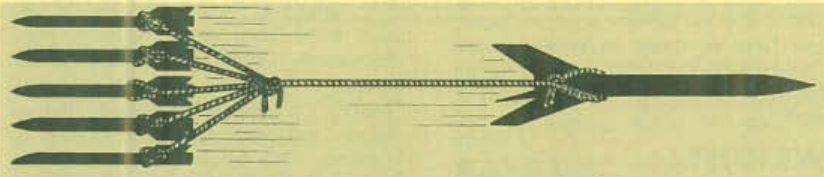
Although model rocketry started in the United States, there are today many thousands of active rocketeers in other countries around the world. Because the metric system is standard in almost every nation in which model rocketeers are active, engine specifications based on the metric system have replaced the former English system specifications.

Since rocketeers in this country use both systems of measure, some information will appear using one system, other items will use the other system. The conversion table below makes it easy to change English measurements to metric and vice versa.

CONVERSION TABLE

English to Metric Measure

MULTIPLY	BY	TO OBTAIN	MULTIPLY	BY	TO OBTAIN
centimeters	0.3937	inches	meters	39.37	inches
feet	0.3048	meters	meters	3.281	feet
feet per second	0.3048	meters per second	meters per second	3.281	feet per second
grams	0.0353	ounces	newtons	0.225	pounds (force)
kilograms	35.3	ounces	newton-seconds	0.225	pound-seconds
kilograms	2.207	pounds	ounces	28.35	grams
inches	25.4	millimeters	pounds (force)	4.45	newtons
millimeters	0.0394	inches	pound-seconds	4.45	newton-seconds



4.45 Newtons = 1 Pound of Force

Energy is required to make an object move. This energy which causes motion is applied as a FORCE. Scientists express forces in units of measurement call NEWTONS. A newton is the amount of force needed to move a mass of one kilogram with an acceleration (change in velocity) of one meter per second each second. In other words, a force of one newton will make a mass of one kilogram change speed by one meter per second during every second the force is acting.

ACCELERATION (in meters per second per second) = FORCE IN NEWTONS ÷ MASS IN KILOGRAMS

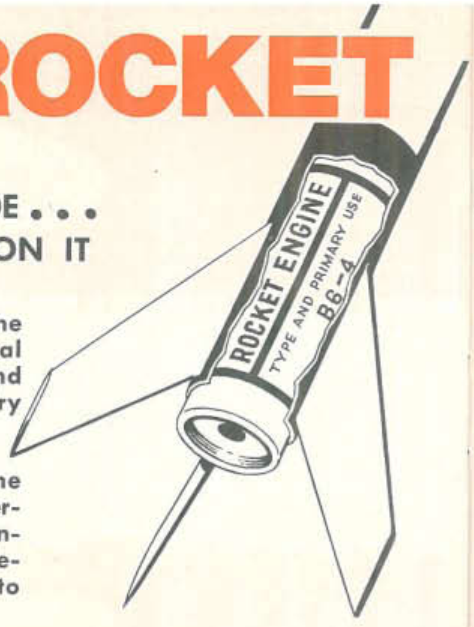
EXAMPLE:

A Saturn model rocket of 0.36 kilograms (12.54 oz.) mass, acted upon by a force of 24 newtons (5.400 lb.), will be accelerated at the rate of 66.6 meters (218 ft.) per second per second.

ESTES

ROCKET ENGINES

THE FINEST ENGINE MADE . . .
. . . YOU CAN DEPEND ON IT

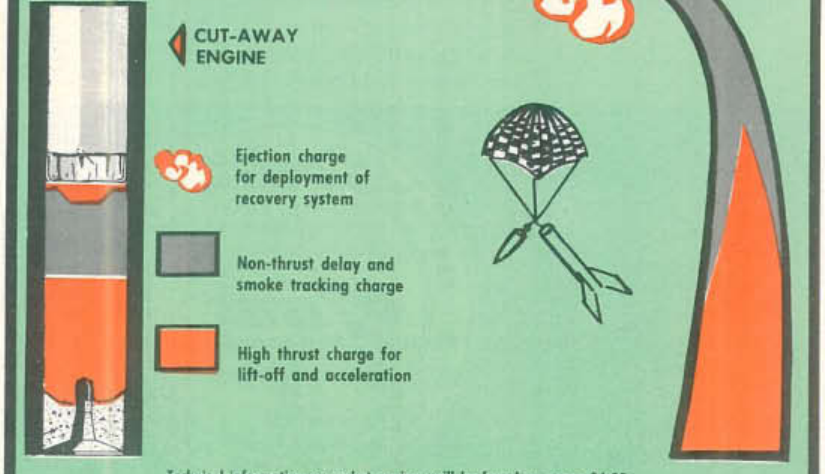


The design and development of the Estes model rocket engine was the real beginning of the safe, educational and exciting program that model rocketry has become.

Today's modern rocket engine is the result of over 11 years of engineering efforts at Estes Industries. Consequently, today's rocketeer has dependable, safety-proven engines to carry on his rocket activities.

Designed for specific launch and flight functions, rocket engines are expendable — not re-usable.

Graphic explanation of a rocket engine's fundamental construction and functions.



Technical information on rocket engines will be found on pages 84-85

ENGINES QUALITY TESTED ENGINES FOR HIGH PERFORMANCE FLIGHTS

. . . *for every flight application*

The energy-packed, solid propellant Estes model rocket engine is a complete power system for your rocket. It is designed and pre-manufactured to perform all power functions for dependable launch and activation of a recovery system. In one compact package it provides thrust for quick lift-off and acceleration to high altitudes, allows for a timed delay period to reach peak altitude while delivering smoke trail for easy tracking, and supplies ejection power for the parachute or other system for your rocket's safe return to earth.

Reliability-proven in over 20 million launchings, Estes engines are manufactured under controlled conditions within exacting tolerance limits. You can count on them for consistent performance from one launch to the next. You'll launch with confidence in contest and exhibition flying.

Six power levels are available in Estes engines. Total impulse is tailored to fit the various NAR-FAI classes. Average thrust, peak thrust and delay times are set up to give the best performance within these classes and to provide the most useful selection of engines for all rocketeers.

Engine prices and basic data are listed on pages 92-95.

ENGINE CODING FOR QUICK-N-EASY IDENTIFICATION

1. Label color indicates recommended use of the engine.

a. GREEN . . . . . Single stage rockets
b. PURPLE & BLUE . . . Top stage of multi-stage rockets
c. RED . . . . . Booster and intermediate stages of multi-stage models

2. Code designation stamped on the engine gives useful and important information on its performance capabilities.

a. This portion indicates total impulse or total power produced by the engine.

b. This portion shows the engine's average thrust in newtons and helps you choose the right engine for your rocket's flight

c. This number gives you the delay in seconds between burnout and ejection charge. Lets you choose the engine with the delay time you want for any flight.

Igniters and complete instructions are included with Estes engines.

ESTES ROCKET ENGINE

Prices and Specifications

Cat. No. and Engine Type	Prices Each	Prices 3 for	Total Impulse lb sec ①	Total Impulse n-sec ②	Time Delay (±15%)	Maximum Lift-off Weights With Engines
SINGLE STAGE ENGINES						
1/4A3-1	$ .35	$ .70	0.14	0.625	1 sec	1.5 oz.
1/4A3-2	$ .35	$ .70	0.14	0.625	2 sec	1.0 oz.
1/2A6-2	$ .40	$ .80	0.28	1.25	2 sec	2.5 oz.
A5-2	$ .45	$ .90	0.56	2.50	2 sec	3.0 oz.
A8-3	$ .45	$ .90	0.56	2.50	3 sec	4.0 oz.
B4-2	$ .50	$1.00	1.12	5.00	2 sec	4.0 oz.
B4-4	$ .50	$1.00	1.12	5.00	4 sec	3.5 oz.
B6-4	$ .50	$1.00	1.12	5.00	4 sec	4.5 oz.
B14-5*	$ .55	$1.10	1.12	5.00	5 sec	5.0 oz.
C6-3	$ .60	$1.20	2.25	10.00	3 sec	4.0 oz.
C6-5	$ .60	$1.20	2.25	10.00	5 sec	4.0 oz.
UPPER STAGE ENGINES ④						
1/4A3-4	$ .35	$ .70	0.14	0.625	4 sec	.75 oz.
1/2A6-4	$ .40	$ .80	0.28	1.25	4 sec	1.0 oz.
A5-4	$ .45	$ .90	0.56	2.50	4 sec	1.5 oz.
A8-5	$ .45	$ .90	0.56	2.50	5 sec	2.0 oz.
B4-6	$ .50	$1.00	1.12	5.00	6 sec	1.5 oz.
B6-6	$ .50	$1.00	1.12	5.00	6 sec	2.0 oz.
B14-6*	$ .55	$1.10	1.12	5.00	6 sec	3.5 oz.
B14-7*	$ .55	$1.10	1.12	5.00	7 sec	2.5 oz.
C6-7	$ .60	$1.20	2.25	10.00	7 sec	2.5 oz.
BOOSTER ENGINES						
1/2A6-0	$ .40	$ .80	0.28	1.25	none	4.0 oz.
A8-0	$ .45	$ .90	0.56	2.50	none	4.0 oz.
B6-0	$ .50	$1.00	1.12	5.00	none	4.0 oz.
B14-0*	$ .55	$1.10	1.12	5.00	none	6.0 oz.
C6-0	$ .60	$1.20	2.25	10.00	none	4.0 oz.
STATIC TEST ENGINES ⑥						
B4-0(P)	$ .50	$1.00	1.12	5.00	none	Don't Fly It!

92 * Series II Engine.

Estes "D" power engines (Series IV) and short engines (Series III) are listed on pages 94-95.

SELECTION CHART

Data for correct engine choice

Maximum Thrust	Thrust Duration	Initial Weight Oz.	Initial Weight Gr.	Propellant Weight Oz.	Propellant Weight Gr.	Replaces Old ⑤ Engine Type
GREEN LABEL						
22 oz.	0.24 sec	0.48	13.6	0.027	0.78	1/4A.8-2
22 oz.	0.24 sec	0.50	14.2	0.027	0.78	.....
46 oz.	0.20 sec	0.53	15.0	0.055	1.56	1/2A.8-2
46 oz.	0.50 sec	0.59	16.7	0.110	3.12	.....
48 oz.	0.32 sec	0.57	16.2	0.110	3.12	A.8-3
48 oz.	1.20 sec	0.70	19.8	0.294	8.33	B.8-2
48 oz.	1.20 sec	0.74	21.0	0.294	8.33	B.8-4
48 oz.	0.83 sec	0.78	22.1	0.220	6.24	B.8-4
7 lb.	0.35 sec	0.69	19.6	0.220	6.24	B3-5
48 oz.	1.70 sec	0.88	24.9	0.440	12.48	.....
48 oz.	1.70 sec	0.91	25.8	0.440	12.48	.....
PURPLE or BLUE LABEL						
22 oz.	0.24 sec	0.51	14.5	0.027	0.78	1/4A.8-4
46 oz.	0.20 sec	0.54	15.3	0.055	1.56	1/2A.8-4
46 oz.	0.50 sec	0.64	18.1	0.110	3.12	A.8-4
48 oz.	0.32 sec	0.62	17.6	0.110	3.12	.....
48 oz.	1.20 sec	0.78	22.1	0.294	8.33	B.8-6
48 oz.	0.83 sec	0.71	20.1	0.220	6.24	B.8-6
7 lb.	0.35 sec	0.71	20.1	0.220	6.24	B3-6
7 lb.	0.35 sec	0.73	20.7	0.220	6.24	B3-7
48 oz.	1.70 sec	0.95	26.9	0.440	12.48	.....
RED LABEL						
46 oz.	0.18 sec	0.48	13.6	0.055	1.56	1/2A.8-0⑥
48 oz.	0.30 sec	0.51	14.2	0.110	3.12	A.8-0
48 oz.	0.80 sec	0.58	16.4	0.220	6.24	B.8-0
7 lb.	0.35 sec	0.61	17.3	0.220	6.24	B3-0
48 oz.	1.68 sec	0.80	22.7	0.440	12.48	C.8-0
BLACK LABEL						
48 oz.	1.20 sec	0.69	19.6	0.294	8.33	B.8-0(P)

Notes:

Complete instructions and igniter (NWI-1) are included with each rocket engine ordered from Estes Industries.

All Series I and II engines are 2.75 in. long and 0.690 in. dia.

① Pound seconds

② Newton seconds (figures shown are maximum

③ Closest previous equivalent is shown

④ OR single stage engines if used in very light rockets

⑤ Replaces both ¼A.8 and ½A.8 booster engines

⑥ Static test engine with plug to prevent blow through.

Comparative time thrust curves on all Estes engines are shown on pages 84 & 85.

Shipping wt. of each engine is approximately 1-1/3 oz.

93

MIGHTY ESTES

Cat. No. and Engine Type	Prices Each	Prices 3 for	Total Impulse lb sec ①	Total Impulse n-sec ②	Time Delay (±15%)	Maximum Lift-off Weights With Engines
D13-0	$ .75	$2.00	4.48	20.00	none	13.0 oz.
D13-3	$ .75	$2.00	4.48	20.00	3 sec	13.0 oz.
D13-5	$ .75	$2.00	4.48	20.00	5 sec	10.0 oz.
D13-7	$ .75	$2.00	4.48	20.00	7 sec	8.0 oz.

ESTES 'D' POWER FOR HIGH ALTITUDE PERFORMANCE, BIG PAYLOAD LAUNCHES

RECOMMENDED ONLY FOR EXPERIENCED ROCKETEERS

'D' ENGINES

Maximum Thrust	Thrust Duration	Initial Weight Oz.	Initial Weight Gr.	Propellant Weight Oz.	Propellant Weight Gr.	Recommended Use
9 lb.	1.48 sec	1.44	40.9	0.879	24.93	Booster Engine
9 lb.	1.50 sec	1.49	42.2	0.879	24.93	Single Stage
9 lb.	1.50 sec	1.52	43.1	0.879	24.93	Single Stage
9 lb.	1.50 sec	1.55	44.0	0.879	24.93	Single or Upper

With the advancement of model rocketry to bigger birds, larger payloads and higher altitude demands, Estes Industries has developed the 'D' engine (Series IV).

The Estes big 'D' provides twice the power of the largest Series I engine. It's the first dependable 'D' engine to provide the consistent high-thrust and total impulse levels necessary for peak performance in its class.

Precision manufacturing capability, experience and quality control at Estes Industries assure superior and consistent performance for Estes 'D' power—the same quality and reliability which have been proven in over 20 million Estes-powered launches.

When flying your rockets with the more powerful 'D' engines give even greater consideration to normal safety precautions. Refer to items 5, 6, 7, 13 and 14 in the safety code on page 3.

Helpful notes on page 96 covering design of rockets for Estes 'D' power are important to study when you are ready to build your big 'D' birds. Previous rocketry experience is essential before going to 'D' power rockets.

Complete instructions and igniter (NWI-1) are included with each rocket engine ordered from Estes Industries.

Shipping wt. of each engine is approximately 2-1/3 oz.

All Series IV engines are 2.25 in. long and 0.945 in. dia.

① Pound seconds

② Newton seconds (figures shown are maximum)

③ Closest previous equivalent is shown

④ OR single stage engines if used in very light rockets

Comparative time thrust curves on all Estes engines are shown on pages 84 & 85.

Series III engines are 1.75 in. long and 0.690 in. dia.

SHORT ESTES

Cat. No. and Engine Type	Prices Each	Prices 3 for	Total Impulse lb sec ①	Total Impulse n-sec ②	Time Delay (±15%)	Maximum Lift-off Weights With Engines
SINGLE STAGE ENGINES						
1/4A3-1S	$.35	$ .70	0.14	0.625	1 sec	1.5 oz.
1/4A3-2S	$.35	$ .70	0.14	0.625	2 sec	1.0 oz.
1/2A6-2S	$.40	$ .80	0.28	1.25	2 sec	2.5 oz.
A5-2S	$.45	$ .90	0.56	2.50	2 sec	3.0 oz.
UPPER STAGE ENGINES ④						
1/4A3-4S	$.35	$ .70	0.14	0.625	4 sec	.75 oz.
1/2A6-4S	$.40	$ .80	0.28	1.25	4 sec	1.0 oz.
A5-4S	$.45	$ .90	0.56	2.50	4 sec	1.5 oz.
BOOSTER ENGINES						
1/2A6-0S	$.40	$ .80	0.28	1.25	none	4.0 oz.
A5-0S	$.45	$ .90	0.56	2.50	none	3.0 oz.

Series I & II engines listed on pages 92-93.

ENGINES

Maximum Thrust	Thrust Duration	Initial Weight Oz.	Initial Weight Gr.	Propellant Weight Oz.	Propellant Weight Gr.	Replaces Old Engine Type ③
GREEN LABEL						
22 oz.	0.24 sec	0.36	10.2	0.027	0.78	1/4A.8-2S
22 oz.	0.24 sec	0.38	10.8	0.027	0.78	.....
46 oz.	0.20 sec	0.41	11.6	0.055	1.56	1/2A.8-2S
46 oz.	0.50 sec	0.47	13.3	0.110	3.12	.....
PURPLE or BLUE LABEL						
22 oz.	0.24 sec	0.39	11.1	0.027	0.78	1/4A.8-4S
46 oz.	0.20 sec	0.42	11.9	0.055	1.56	1/2A.8-4S
46 oz.	0.50 sec	0.52	14.7	0.110	3.12	.....
RED LABEL						
46 oz.	0.18 sec	0.36	10.2	0.055	1.56	1/2A.8-0S
46 oz.	0.48 sec	0.42	11.9	0.110	3.12	.....

DESIGN NOTES

BUILDING "D" POWERED MODELS

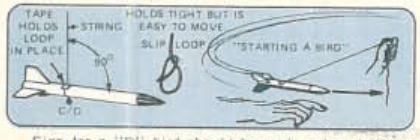
Estes "D" engines open a whole new world of performance to the model rocketeer. Its greater total impulse and higher initial thrust make it easy to fly larger, more advanced designs.

Although most conventional model rocket building and flying techniques can be used, there are a few important differences to remember when building models for "D" power. Special attention is important in three areas – stability, engine mounting and multi-staging.

STABILITY

A "D" engine weighs about twice as much as a conventional Series I or II engine. This results in a rearward concentration of weight in a rocket that must be allowed for in designing the model to make sure it will be stable.

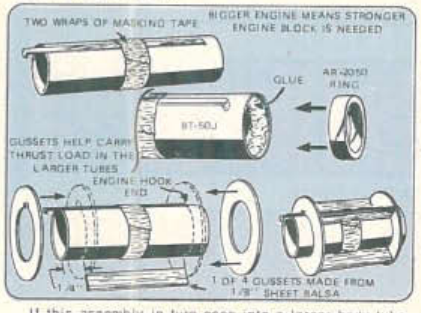
Don't just stick a "D" engine mount in a standard model and expect it to fly. Always string test your model before flying it (see the technical section of your Estes catalog). If necessary, add nose cone weights or enlarge the fins until it does pass the string test.



Fins for a "D" bird should be made extra strong to withstand the higher acceleration and speed the model will encounter. One-eighth inch thick balsa sheet is generally the best fin stock to use.

ENGINE MOUNTING

A Series IV (D) engine will mount inside a BT-50 body tube much the same as a standard engine fits a BT-20. However, the engine mount in a "D" bird must be made extra strong. For best results use an EH-2 engine holder to retain the engine and use an AR-2050 ring as an engine block.

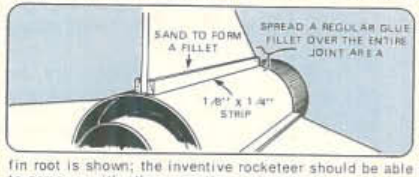


If this assembly in turn goes into a larger body tube, the adapter system must be extra strong. For a BT-55 size rocket the AR-5055 rings should be used. In larger tube sizes the rings should be reinforced with gussets as shown. Always use plenty of glue and let it dry completely.

MULTI-STAGING

The greatest difficulty in multi-staging with "D" engines comes in keeping the fins on booster stages. The problem arises when booster and upper stages separate -- the booster starts to tumble at high speed, causing extremely high forces on the fins. The result is that the fins will break off at staging unless they are attached very strongly.

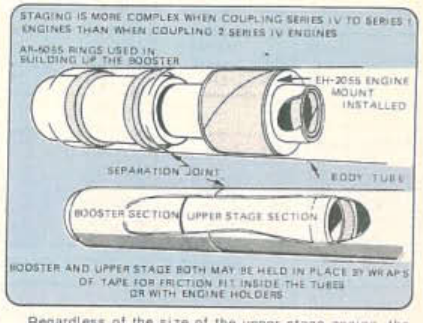
Booster fin material must be strong. One-eighth inch thick balsa is best. Don't make the fins excessively large. Generally, booster fins on D birds shouldn't need to be more than 1-1/2 times the size of upper stage fins. Attach the fins securely. One method of reinforcing the



fin root is shown; the inventive rocketeer should be able to come up with other, equally good methods.

It isn't necessary to tape "D" engines together when multi-staging. However, the rocket must be built so that the stages slide apart in a straight line when they separate. The engines must be positioned so the nozzle of the upper stage engine is directly in line with the top of the booster engine.

If a Series I, II, or III upper stage engine is used it should be positioned so its nozzle end touches the top end of the booster engine. Again, it is not necessary to tape the engines together, but it is necessary to make sure that the stages will slide apart in a straight line.

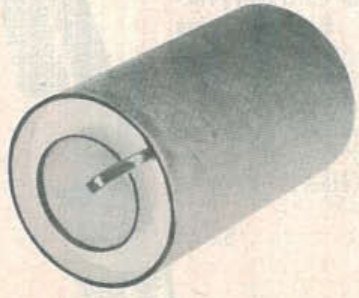


Regardless of the size of the upper stage engine, the stage coupling should be designed so the stages slide apart in a straight line for at least 3/4" before they separate. This helps the upper stage continue a straight flight and makes ignition more reliable.

Whether your "D" bird is a single or multi-stage model, fly it on a calm day when there's good visibility so you don't lose it. Always follow the safety code -- you'll find it makes rocketry more enjoyable, too.

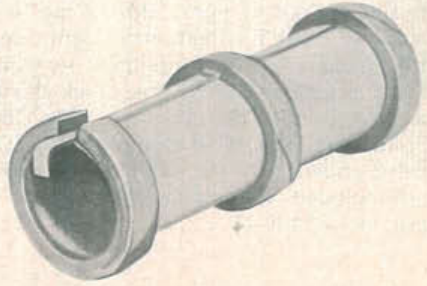
'D' ENGINE ADAPTERS

LAUNCHING VERSATILITY WITH QUICK CHANGE ENGINE MOUNT ADAPTERS



Fly your Saturn V with a single "D" engine or with its regular cluster power. Complete adapter kit is interchangeable with Saturn's present engine mounting system. Holds "D" engine securely in place. (Adapter now included free with all K-36 Saturn V kits.) Weighs only 0.4 oz. (11.3 gr.). Shipping weight 5 oz.

Cat. No. 694-EM-5063 . . . . . $ .50



Fly your Series IV "D" bird with a Series I or II engine. Here is a quick change engine mounting that lets you convert easily to lower power for special flights. Heavy duty construction with a weight of only 0.19 oz. (5.3 gr.). Shipping weight 5 oz.

Cat. No. 694-EM-2050 . . . . . $ .35

INTERCHANGE "D" ADAPTER OR CLUSTER WITH EASE

1

2

3

Figure 1 shows cluster launching system in position on Saturn V. It is retained securely by an EH-2 engine holder. Figure 2 shows cluster removed, ready for insertion of "D" adapter. Figure 3 shows "D" engine system in position, secured and ready to launch the easy way. Making the change is a matter of less than a minute.

Astron

CHEROKEE-D

The Astron Cherokee comes on strong! Especially designed for the Estes "D" engine, this sleek bird will practically sail out of sight. But its big 18" chute will bring it safely down for flight after flight. Comes with a beautiful decal sheet to compliment its trim lines. Other kit features include die-cut fins, quick-change engine mount, and heavy-duty construction. The Cherokee is easy to build, but because of the powerful "D" engine, it's recommended only for experienced rocketeers. Engines not included. Shipping weight 11 oz.

Cat. No. 694-K-47 . . . . . $2.75

SPECIFICATIONS

Length . . . . . 21.6 in (54.9 cm)
Body Dia. . . . . 1.325 in (33.7 mm)
Weight . . . . . 2.75 oz (78 gr)

RECOMMENDED ENGINES

D13-5
D13-7

Astron

OMEGA

The ultimate in big engine performance, the two-stage Astron Omega blasts off with "D" power, boosting heavy loads such as the Cineroc to high altitudes. Use the lighter payload section for even greater altitude probes. The Omega features the simplified "pop-and-go" staging method for reliable booster separation and an 18" chute for safe recovery. Two huge and handsome decal sheets add more beauty to this bird, a relatively easy model for the experienced rocketeer.

Cat. No. 701-K-52P
(with payload sec. Shpg.wt.1 lb, 8 oz) $5.00

Cat. No. 701-K-52
(without payload section or nose cone for use as Cineroc booster. Shipping wt 1 lb) . . . $3.50

RECOMMENDED ENGINES

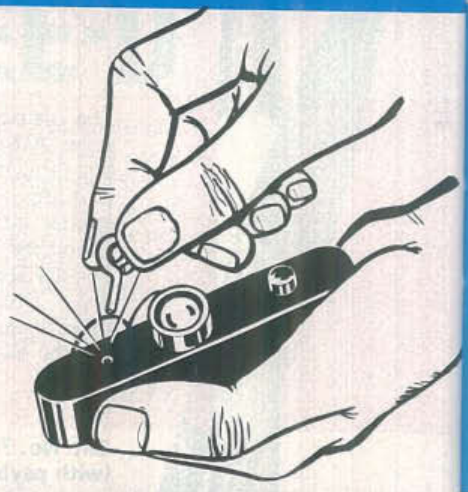
Booster
D13-0
Upper Stage
D13-7

SPECIFICATIONS

	With Payload Sec.	Without Payload Sec.
Length. .	30.5 in (77.5 cm)	19.0 in (48.3 cm)
Body Dia	1.637 in (41.6 mm)	1.637 in (41.6 mm)
Weight. .	4 oz (113 gr)	2.6 oz (74 gr)

THE KEY TO SAFE DEPENDABLE LAUNCHES

Estes Launching systems and components are designed for perfect lift-off of your rockets. Advanced features include space age miniaturization, self-powered, launch-anywhere units with push button control, key-controlled safety interlock and continuity check light. The next 8 pages have everything you need to get those birds off the ground.

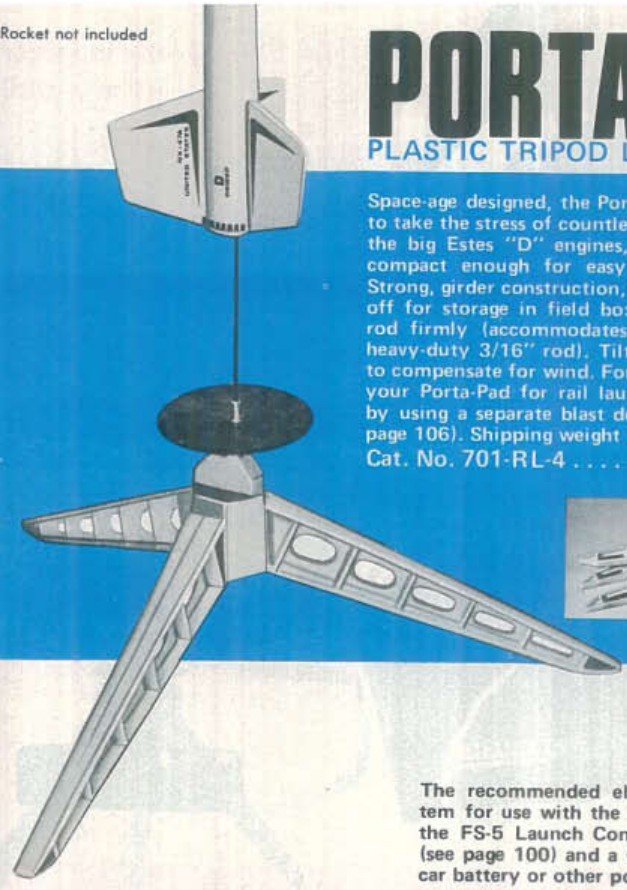


COMPLETE LAUNCH CONTROL SYSTEM

The perfect system to modernize and add flexibility to your launching program. Use with a 12 volt car battery for any model, including the large birds. Kit includes the above launch controller panel, 18 ft. of No. 18-2 zip cord, micro clips, battery clips, and assembly instructions. Use with either 6 or 12 volt power supplies. Shipping weight 12 oz. **Cat. No. 701-FS-5 . . . . . $3.50**

Use with a 12 volt car battery (no need to remove battery from car; just connect the Launch Control System's battery clips to the battery terminals) for any model, including the large birds. If you don't have access to a car battery, use a Ray-O-Vac No. 918, Eveready No. 731, or a Burgess TW-1, available at most hardware stores.

Rocket not included



PORTA-PAD

PLASTIC TRIPOD LAUNCHER

Space-age designed, the Porta-Pad is rugged enough to take the stress of countless launchings, even with the big Estes "D" engines, yet is lightweight and compact enough for easy carrying and storage. Strong, girder construction, yellow plastic legs snap off for storage in field box. Friction grip secures rod firmly (accommodates standard 1/8" rod or heavy-duty 3/16" rod). Tilt adjustment allows you to compensate for wind. For extra versatility, adapt your Porta-Pad for rail launchings (see page 104) by using a separate blast deflector No. BD-1 (see page 106). Shipping weight 1 lb, 8 oz.

Cat. No. 701-RL-4 . . . . . $2.50

The recommended electrical system for use with the Porta-Pad is the FS-5 Launch Control System (see page 100) and a 6 or 12 volt car battery or other power source.

Rocket not included

The biggest little launcher in the world!

ELECTRO LAUNCH

THE completely self-contained launching system for "all in one" ease and mobility. A high impact plastic base and extra large blast deflector assures dependable operation throughout your rocketry career. Features push button ignition control from a hand held unit with a safety interlock and check light to prevent misfiring. Requires 4 size D photoflash cells (not included) for 6 volt operation. Easily converts to 12 volts for extended battery life and heavy duty use by adding 4 extra batteries and changing to a 12 volt pilot bulb. Use it for rockets weighing up to 6 oz., or anchor the base to the ground for heavier models. For launching cluster models, add extra battery pack (page 106) or use LAUNCH CONTROL SYSTEM FS-5 (page 103) with 12 volt car battery. Shipping weight 30 oz.

Cat. No. 701-FS-4 ..... **$4.50**

Same kit as above, but batteries for 6 volt operation included. Shipping wt. 46 oz. **Cat. No. 701-FS-4B** **$5.50**

TILT-A-PAD LAUNCHER

$3.00

Rocket not included

This flexible launcher gives you ideal launch control and convenience. Tripod stand permits launching of rockets up to 12 oz. (and adjusts to fit uneven ground). Tilts to compensate for wind direction and speed. Legs fold down for compact storage. Use with Launch Control System FS-5 (page 100) or any other electrical ignition system. Comes in easy to assemble kit form with complete instructions. Shipping wt. 2 lbs.

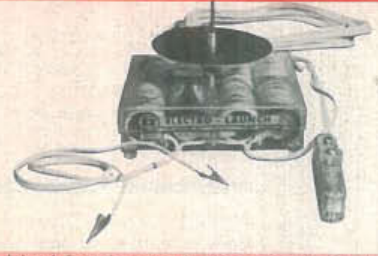
Cat. No. 701-RL-3 ..... **$3.00**

LAUNCH CONTROL SWITCH

Designed for a perfect countdown and launch sequence. Same as in the ELECTRO-LAUNCH, it features safety interlock, continuity check light and push button controlled launching. Comes in a kit with 12 volt pilot light and instructions for wiring into your system or portable launcher. Shipping weight 6 oz.

Cat. No. 701-FSS-4 ..... **$1.60**

PHANTOM ELECTRO LAUNCH



Ideal for demonstrations and regular launch duty. Clear plastic construction shows the inner workings. 12 volt circuit comes complete with 8 size D photoflash cells for instant ignition flight after flight. Comes with all parts, instructions, and launch systems manual. Shipping weight 62 oz.

Cat. No. 701-FS-8B **$7.50**

Without photoflash cells. Shipping weight 30 oz.

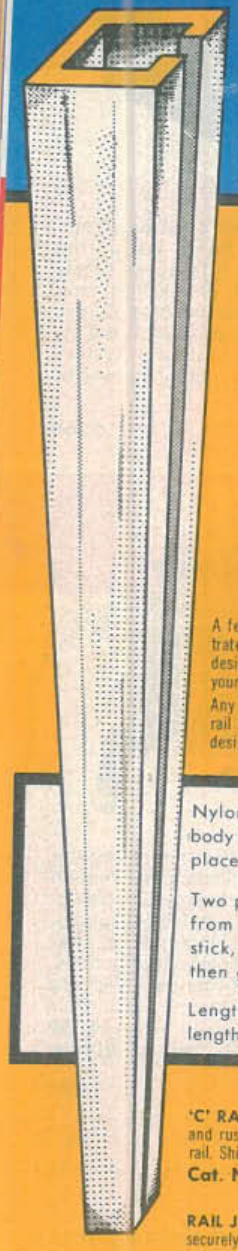
Cat. No. 701-FS-8 ..... **$5.00**

EXTRA INTERLOCK KEY

for Electro-Launch and above systems.

Cat. No. 651-FSK-4 ..... **$.10**

RAILS FOR RAIL LAUNCHING



Rigid aluminum 'C' rails offer countless new possibilities for your launcher designs

The rail is a hollow square shape with its cross section in the form of a squared C. This new concept in lift-off guidance permits greater flexibility in launcher design and construction. With the rail your rocket is guided at lift-off by lugs travelling smoothly inside the length of the hollow opening, making possible many structural adaptions not useable with a rod-type launcher. The rail can be attached to rigid structures for launcher designs or devices for precise angle adjustment. It offers great possibilities for scale or semi-scale models of America's space launch facilities.

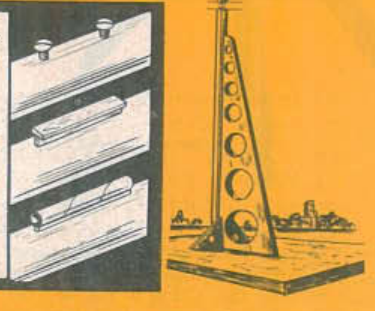
A few design possibilities are illustrated. Many other exciting rail launch designs of the future will come from your own experiments.

Any model rocket can be adapted to rail launching and several proven lug designs are shown in the box below.

Nylon screws (AS-1) turned into body tube, trimmed and glued in place.

Two pieces of thin hardwood cut from tongue depresser or stir stick, glued into "T" rail form, then glued to rocket.

Length of WD-2 topped by a length of LL-2.



'C' RAIL: ¾" square (outside). Comes in 18"-long sections. Durable aluminum for long life and rust-free service. Use at least 2 sections connected with a joiner (see below) for launch rail. Shipping weight 6 oz.

Cat. No. 681-LR-18A ..... **$.50 each section**

RAIL JOINER: Spring clip 2" long by ¼" wide, fits inside rail ends, holds two rail sections securely together for assembling launch rails 36" long and longer. Shipping weight 2 oz.

Cat. No. 691-RJ-18A ..... **$.30 each**

ELECTRICAL EQUIPMENT

PILOT LIGHT HOLDER: Add visual control to your launch panel by wiring in an arm or continuity check pilot light. Holder is steel with ½" red plastic jewel, mounts in 7/16" hole. Takes either 6 or 12 volt bulbs, bulb not included. Shipping weight 4 oz.

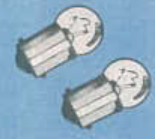
Cat. No. 701-LH-1 ..... **$ .80**

6 VOLT BULB: Fits holder No. LH-1. Shipping weight 1 oz. (Type 51.)

Cat. No. 651-AL-6 ..... **$ .20**

12 VOLT BULB: Fits holder No. LH-1. Shipping weight 1 oz. (Type 53.)

Cat. No. 651-AL-12 ..... **$ .20**



KEY SAFETY SWITCH: A must for every control panel. Prevents accidental launching of rockets. SPST, turns on with key, must be turned off to remove key. Mounts in ½" hole. One key included with switch. Shipping weight 4 oz.

Cat. No. 691-KSW-1A **$2.75**

EXTRA KEY: Cat. No. 651-KSW-1K ..... **$ .25**

PUSH BUTTON SWITCH: Heavy duty construction momentary type, SPST, normally open. Excellent for use as a firing switch. Mounts in ½" hole. Shipping weight 4 oz.

Cat. No. 651-SWM-1 ..... **$ .90**

ROTARY SWITCH: Twelve position single pole rotary switch — just right for use as a selector switch with firing systems using more than one launcher. With twelve positions, this switch should handle almost any need. Non-shorting, mounts in ⅜" hole. Shipping weight 5 oz.

Cat. No. 701-SWR-1 ..... **$1.45**

DIAL PLATE: Numbered 12 position plate for use with rotary switch No. SWR-1. Mounts on panel with same nut used to hold switch. Etched aluminum on black background. Shipping weight 1 oz.

Cat. No. 701-DP-1 ..... **$ .30**

SOLDERING IRON: 25 watt, top quality tool for making good connections in launchers and other electrical circuits. Does the work of irons of higher wattage. Develops up to 720° F. Handle remains cool. Replaceable, pre-tinned nickel-plated tip gives extra long life. Use with ROSIN core solder. Shipping wt., one pound.

Cat. No. 671-SI-1 ..... **$4.00**

LAUNCHING SUPPLIES

BATTERY PACK: Durable plastic cased 12 volt battery pack, ideal for use as a booster for the Electro-Launch, a power supply for other launchers, phone systems or any other range power application. Can be set up to deliver 3, 6, 9, or 12 volts, requires 2, 4, 6, or 8 size D cells (not included) depending on voltage desired. Comes in kit form with complete instructions. Shipping weight 1 pound.

Cat. No. 701-BP-2 ..... $3.00

TWO PIECE ROD: Handy collapsible two piece rod for portable launchers. Pieces slip together to make a 36" long rod. Base rod has a diameter of 1/8". Shipping weight 6 oz.

Cat. No. 651-RLR-1 ..... $ .35

ADD ON ROD: Sturdy 1/8" diameter, 18" long launch rod section expands two piece rod (see above) to 53" length, gives extra control of flight path — especially with heavier models. To assemble, separate two piece rod, insert tapered end of add-on rod into hole in lower rod, insert upper rod into hole in add-on section. For a constant 1/8" diameter launch rod, join two or three add-on sections together. Shipping weight 6 oz.

Cat. No. 701-RLR-3 ..... $ .25 per section

DELUXE BLAST DEFLECTOR: Durable pressed steel plate deflects engine blast out and away from launcher. Two inches wide, five inches long. Ideal for launchers that receive extensive use. Shipping weight 5 oz.

Cat. No. 701-BD-1 ..... $ .50

BLAST DEFLECTOR PLATE: Slip-on metal deflector plate fits any launcher using 1/8" rod, protects launcher base from rocket blast. Four inch diameter. Shipping weight 5 oz.

Cat. No. 701-BD-2 ..... $ .40

PIVOT: Adjustable launch rod mounting pivots up to 25° to compensate for tilt of launcher base, windage, etc. Easy-to-assemble, mounts to launcher base with 2 #4 screws. (Rod not included.) Shipping weight 2 oz.

Cat. No. 701-LP-1 ..... $ .45

IGNITERS: Easy-to-use, extra reliable igniters — the same type as supplied with all Estes engines. Suitable for ignition systems using 6 volts or more, see engine instructions for installation procedure. (Patent No. 3,363,559) Shipping weight 1 oz.

Cat. No. 701-NWI-1 ..... 6 for $ .20

NICHROME WIRE: Electrical heating wire for model rocket ignition. #30 recommended for use with car batteries, #32 for use with other power supplies. Shipping weight 1 oz.

No. 30, 15 FOOT ROLL: Cat. No. 651-NW-30A ..... $ .50

No. 32, 15 FOOT ROLL: Cat. No. 651-NW-32A ..... $ .50

BATTERIES: Extra powerful size D photoflash batteries pack the energy needed for rocket launching. These are the type specified for the Electro-Launch, deliver up to 16 amperes of current on a complete short when fresh. Shipping weight 4 oz. each.

Cat. No. 651-PFB-1 ..... $ .30

MASKING TAPE: Use to secure engines in models, mask for painting, etc. Strong, flexible 1/2" wide tape comes in 30' rolls. Shipping weight 5 oz.

Cat. No. 701-MT-1 ..... $ .40

MICRO-CLIPS: Equip your launcher with the best. Spring-loaded solid copper clips attach lead wires to igniters. Easy to clean and highly conductive with flat contact surfaces. Only 1.1 inches long, attach to leads with or without solder. Shipping weight 1 oz.

Cat. No. 651-MC-1 ..... 2 for $ .25

GIANT BATTERY CLIPS: Ideal for hookup to car batteries, heavy duty clips connect to terminals up to 1" in dia. Clips are 3" long, available with black or red insulators. Specify color(s) when ordering. Shipping wt. 5 oz.

Cat. No. 701-BC-1 ..... $ .45

BATTERY CONTACTS: Spring brass battery clips for special battery installations, replacement part for the Electro-Launch. Fit size D cells, can be trimmed to fit smaller batteries. Shipping weight 1 oz.

Cat. No. 651-BC-2 ..... 2 for $ .20

LEAD WIRE: Flexible, durable size 18 two conductor insulated wire. Ideal as a lead from firing panel to launcher, zip the conductors apart for wiring inside the panel. In 12 foot lengths. Shipping weight 5 oz.

Cat. No. 701-LW-12 ..... $ .75

TERMINAL LUGS: Tiny 1/2" long solderless lugs make electrical connections a snap — insert bare wire into the end of the lug and crimp in place with pliers. 1/8" hole for terminal. Shipping weight 1 oz.

Cat. No. 651-TL-1 ..... $ .05

COMPLETE STARTER OUTFIT

★ *the high flying, easy-to-assemble Alpha kit, 2 engines, instructions*

★ *Electro-Launch — self contained electric launcher, with batteries*

★ *fact filled design manual*

The DSK-75 kit includes a Field Operations Box at no extra cost!

This starter outfit features the famous self-contained Electro-Launch, "the biggest little launcher in the world". Its advanced features are explained on page 102. Also included is the easy-to-assemble, high-flying Alpha kit, 2 engines, 4 Electro-Launch batteries, and design manual. Shipping wt 2 lb 8 oz.

Cat. No. 701-DSK-75 ..... $7.50

Estes offers the finest assortment of parts for building your own designs or modifying existing rockets.

BUILDING WITH ESTES SUPPLIES

RECOVERY EQUIPMENT & SUPPLIES

PARACHUTE KITS: Get the best in parachute recovery! Two color printed plastic 'chutes give maximum visibility — feature easy-to-see pattern. Lightweight, durable and easily folded, these 'chutes are only 0.0007.5" thick, allowing the most material to be packed into the least body space. Each kit comes complete with 'chute material, tape strips and shroud lines.

Shipping weight 2 oz.

Cat. No.	Parachute Diameter	Color Combinations Available	Net Weight	Price Each
701-PK-8	8 inches	Orange and White Red and White Red and Yellow Yellow and Black Orange and Black	.035 oz.	$ .25
701-PK-12	12 inches		.078 oz.	$ .25
701-PK-18	18 inches	Red and White Red and Yellow Orange and Black	.144 oz.	$ .35
701-PK-24	24 inches	Red and White Orange and Black	.298 oz.	$ .50

PARACHUTE MATERIAL: You get a big square yard of extra strength, high visibility black plastic 'chute material. Each sheet can be cut to make one or more round or square parachutes up to 36" across. Net weight .98 oz. Shipping weight 5 oz.

Cat. No. 701-PM-2 . . . . . **$ .50 each**

STREAMER MATERIAL: Bring light weight models back to earth with bright orange, flame resistant crepe paper streamers. In 7½ foot lengths, enough for two to eight streamers. Available in 1" and 2" widths. Specify size when ordering. Shipping weight 1 oz.

1" wide Net wt. .092 oz. **Cat. No. 651-SM-1** . . . . . **3 for $ .30**

2" wide Net wt. .184 oz. **Cat. No. 651-SM-2** . . . . . **3 for $ .40**

RECOVERY WADDING: Extra soft and flexible, light weight tissue paper (bathroom type), specially treated to make it flame resistant. Gives the very best protection from hot ejection gases for parachutes and streamers. Each package contains approximately 75 4½" squares — enough wadding for up to 25 flights. Instructions included in package. Shipping weight 6 oz. **Cat. No. 701-RP-1A** . . . . . **$ .40**

SHROUD LINES: Build reliable, durable custom parachutes with this strong, hard surface shroud line cord. Comes in 72 yard spools. Shipping weight 5 oz.

Cat. No. 701-SLT-1 . . . . . **$ .35**

SCREW EYES: Attach recovery systems to nose cones or nose blocks with these light weight metal screw eyes. Available in three sizes, specify size when ordering. Shipping weight for 3 eyes 1 oz.

LARGE EYE: 1" long; .04 oz.; **Cat. No. 651-SE-1 3 for $ .10**

SMALL EYE: ¾" long; .03 oz.; **Cat. No. 651-SE-2 3 for $ .10**

EXTRA SMALL EYE: ⅜" long; .01 oz.; **Cat. No. 651-SE-3 3 for $ .10**

TAPE DISCS: Fasten shroud lines to plastic 'chutes or streamers with these ¾" pressure sensitive tape discs. Shipping weight for 12 discs, 1 oz.

Cat. No. 651-TD-1 . . . . . **12 for $ .15**

TAPE STRIPS: For top strength, low bulk and low weight, fasten shroud lines with these ¼" x ¾" tape strips. In sheets of 35 strips, shipping weight 1 oz.

Cat. No. 651-TD-2 . . . . . **$ .30 per sheet**

SHOCK CORD: Convenient 18" lengths of model airplane contest rubber to absorb shock of ejection and recovery system deployment. In ⅛" widths for normal models, ¼" widths for heavy rockets. **Specify width when ordering.** Both are .03" thick. Shipping weight 1 oz.

⅛" wide: Net wt. 0.039 oz., **Cat. No. 671-SC-1. . . .$ .10**

¼" wide: Net wt. 0.078 oz., **Cat. No. 671-SC-2 . . . $ .15**

Also 36" long for greater stretch on those larger birds.

⅛" wide: Net wt. 0.078 oz., **Cat. No. 681-SC-3 . . . $ .20**

SNAP SWIVELS: For quick changes and reduced tangling in your recovery systems, use these tiny 1" long snap swivels. Net weight .01 oz. Shipping weight for 6 swivels 1 oz.

Cat. No. 701-SV-12 . . . . . **6 for $ .25**

ROCKET BODY TUBES

FOR BUILDING ROCKETS OF YOUR OWN DESIGN

Cat. No.	Price Each	Length	Inside Diameter	Outside Diameter	Wall Thickness	Wt. in Ounces Net	Wt. in Ounces Ship.
BT-5, Spiral-Wound Paper Tube, for nose sections and strap-on payloads							
651-BT-5	$ .30	18"	0.515"	0.541"	0.013"	.219	11
651-BT-5P	$ .15	5.1"	0.515"	0.541"	0.013"	.062	4
BT-10, Mylar Plastic Tube, for featherweight models							
701-BT-10	$ .30	9"	0.710"	0.720"	0.005"	.088	4
701-BT-10H	$ .15	3.062"	0.710"	0.720"	0.005"	.029	1
BT-20, Spiral-Wound Paper Tube, for competition and sport models							
651-BT-20	$ .30	18"	0.710"	0.736"	0.013"	.288	11
651-BT-20B	$ .15	8.65"	0.710"	0.736"	0.013"	.138	4
651-BT-20D	$ .15	6.5"	0.710"	0.736"	0.013"	.104	4
651-BT-20G	$ .10	3.5"	0.710"	0.736"	0.013"	.056	4
651-BT-20J	$ .10	2.75"	0.710"	0.736"	0.013"	.044	4
651-BT-20M	$ .10	2.25"	0.710"	0.736"	0.013"	.036	4
BT-30, Parallel-Wound Paper Tube, for sport models							
701-BT-30	$ .30	9"	0.725"	0.767"	0.021"	.270	4
651-BT-30F	$ .25	7"	0.725"	0.767"	0.021"	.210	4
651-BT-30B	$ .20	6.125"	0.725"	0.767"	0.021"	.184	4
651-BT-30C	$ .20	5.5"	0.725"	0.767"	0.021"	.165	4
651-BT-30A*	$ .30	3.5"	0.725"	0.767"	0.021"	.105	4
701-BT-30J	$ .15	2.75"	0.725"	0.767"	0.021"	.082	4
BT-50, Spiral-Wound Paper Tube, for sport and high performance payload models							
651-BT-50	$ .40	18"	0.950"	0.976"	0.013"	.378	11
701-BT-50L	$ .35	12.7"	0.950"	0.976"	0.013"	.242	5
701-BT-50W	$ .30	9.5"	0.950"	0.976"	0.013"	.200	5
651-BT-50H	$ .25	7.75"	0.950"	0.976"	0.013"	.163	4
701-BT-50S	$ .20	4"	0.950"	0.976"	0.013"	.084	4
651-BT-50J	$ .15	2.75"	0.950"	0.976"	0.013"	.058	4
BT-55, Spiral-Wound Paper Tube, for sport and demonstration models							
701-BT-55	$ .60	18"	1.283"	1.325"	0.021"	.672	11
701-BT-55V	$ .55	16.35"	1.283"	1.325"	0.021"	.687	11
651-BT-55S	$ .20	4"	1.283"	1.325"	0.021"	.268	4
BT-60, Spiral-Wound Paper Tube, for sport and demonstration models							
701-BT-60	$ .65	18"	1.595"	1.637"	0.021"	.960	11
701-BT-60D	$ .50	11"	1.595"	1.637"	0.021"	.583	11
651-BT-60K	$ .35	7"	1.595"	1.637"	0.021"	.371	6
651-BT-60R	$ .25	5"	1.595"	1.637"	0.021"	.265	6
651-BT-60J	$ .15	2.75"	1.595"	1.637"	0.021"	.146	6
BT-70, Spiral-Wound Paper Tube, for monster models and tail rings							
651-BT-70	$ .85	17.5"	2.175"	2.217"	0.021"	1.30	14
RT-70, Spiral-Wound Paper Tube for tail rings							
671-RT-70A	$ .15	0.7"	2.175"	2.217"	0.021"	.050	4
Clear Plastic Tubes — for payload sections							
651-PST-20	$ .30	8"	0.710"	0.736"	0.013"	.168	4
651-PST-20J	$ .15	2.75"	0.710"	0.736"	0.013"	.058	4
701-PST-50S	$ .25	4"	0.950"	0.976"	0.013"	.110	4
701-PST-60R	$ .50	5"	1.595"	1.637"	0.021"	.350	6
701-PST-65R	$ .55	5"	1.750"	1.796"	0.023"	.450	6

*Replacement part for the Astron Scout, with holes punched. Be sure to give catalog number and length when ordering body tubes.

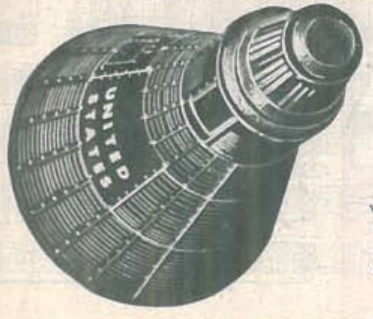
PAYLOAD SECTIONS

Ideal for payload launchings! Carry instruments, biological specimens, etc., in these light-weight, high capacity payload sections. These capsules come complete with all needed parts, including nose cone, body tube, nose block or adapter and screw eye.

Cat. No.	Price Each	Body Mat'l.	Weight oz. Net	Weight oz. Ship.	Fits	Inside Dia.	Inside Length	Overall Length
651-PS-20A	$ .80	Clear Plastic	.16	1	BT-20	.710"	2"	4"
651-PS-20C	$ .85	Clear Plastic	.40	4	BT-20	.950"	3"	7"
651-PS-30B	$ .65	Regular Tube	.24	1	BT-30	.725"	2"	3.75"
651-PS-50A	$ .90	Clear Plastic	.39	4	BT-50	.950"	3"	6.50"
651-PS-50B	$ .85	Regular Tube	.36	4	BT-50	.950"	3"	6.50"
701-PS-50C	$1.60	Clear Plastic	1.0	11	BT-50	1.59"	4"	10.5"
701-PS-50D	$1.50	Regular Tube	.95	11	BT-50	1.59"	4"	10.5"
701-PS-50E	$1.75	Clear Plastic	1.1	11	BT-50	1.75"	4"	10.5"
701-PS-55B	$1.25	Regular Tube	.53	11	BT-55	1.28"	3"	7.63"
701-PS-60A	$1.60	Clear Plastic	.98	11	BT-60	1.59"	4"	9.50"
701-PS-60B	$1.50	Regular Tube	.90	11	BT-60	1.59"	6"	10.5"
701-PS-60C	$1.75	Clear Plastic	1.0	11	BT-60	1.75"	4"	9.50"

MERCURY CAPSULE

PERFECT FOR PAYLOADS. Add a special touch to your rockets. Get this model Mercury Capsule. A big 1.8 inches in diameter and 3.2 inches high, this capsule is equipped with a removable base for easy payload access. Comes in easy to assemble kit form with a full set of adapters to fit the capsule to most Estes body tubes. Makes an ideal display model too. Shipping weight 3 ounces.



Cat. No. 651-PSM-1 ..... $1.00

NOSE CONES

Made of lightweight balsa, Estes nose cones are accurately machined to give you smooth surfaces, snug fit and uniformity.

Nose cone dimensions on opposite page — columns 1, 2 and 3.

BALSA BLOCKS FOR MAKING NOSE CONES OF YOUR OWN DESIGN

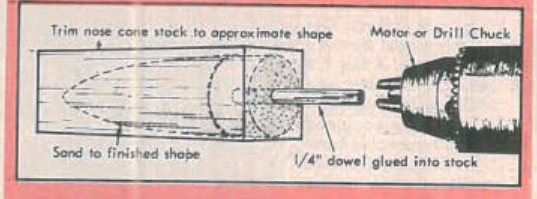
You can order nose cone stock in 4" to 6" lengths, perfect for turning your own nose cone shapes. These are cut-off pieces from our manufacturing process. Slightly damaged corners will not interfere with their usability. WITH EACH BLOCK ORDERED, ESTES INCLUDES A NOSE CONE DOWEL, NCD-2.

1" x 1" blocks, shipping wt. 1 oz.
Cat. No. 691-NCS-1A.....ea. $ .15

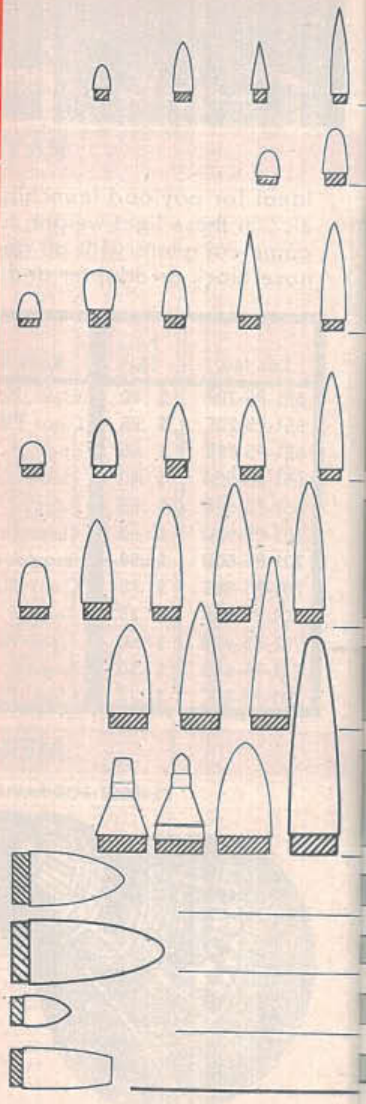
2" x 2" blocks, shipping wt. 3 oz.
Cat. No. 691-NCS-2A.....ea. $ .20

NOSE CONE DOWELS: ¼" dia. x 2" long, hardwood. Use dowels as shown in drawing for making nose cones.

Shipping weight 2 oz.
Cat. No. 651-NCD-2.....3 for $ .10



SUGGESTION: When designing rockets using light-weight nose cones, be sure to follow procedures in TR-1 on rocket balance and stability. Don't forget to order screw eyes and nose cone weights: See pages 111 and 126



Precision made for finer performance

Catalog No.	Price Each	Dimensions 1	2	3	Average Weight	Ship. Weight
LIGHTWEIGHT GEMS FOR BT-5						
651-BNC-5V	$ .25	3/4"	0.541"	1/4"	0.013 oz.	1 oz.
651-BNC-5E	$ .25	1 3/8"	0.541"	1/4"	0.020 oz.	1 oz.
651-BNC-5S	$ .25	1 1/2"	0.541"	1/4"	0.016 oz.	1 oz.
651-BNC-5W	$ .40	2 7/8"	0.541"	1/4"	0.039 oz.	2 oz.
PERFECT FOR BT-10						
651-BNC-10A	$ .25	13/16"	0.728"	1/4"	0.03 oz.	1 oz.
701-BNC-10B	$ .30	1 11/16"	0.728"	5/16"	0.05 oz.	1 oz.
VARIETY FOR A BT-20						
651-BNC-20A	$ .25	13/16"	0.736"	1/4"	0.03 oz.	1 oz.
701-BNC-20P	$ .40	1 5/16"	0.900"	7/16"	0.07 oz.	4 oz.
701-BNC-20B	$ .30	1 11/16"	0.736"	5/16"	0.05 oz.	1 oz.
651-BNC-20R	$ .40	2 3/4"	0.736"	3/8"	0.07 oz.	2 oz.
651-BNC-20N	$ .45	2 3/4"	0.736"	1/2"	0.08 oz.	2 oz.
BALSA BEAUTIES FOR BT-30						
651-BNC-30C	$ .30	3/4"	0.767"	3/8"	0.04 oz.	1 oz.
701-BNC-30D	$ .35	1 1/2"	0.767"	3/8"	0.06 oz.	1 oz.
651-BNC-30M	$ .40	1 1/2"	0.767"	1/2"	0.06 oz.	1 oz.
701-BNC-30E	$ .45	2 3/16"	0.767"	7/16"	0.07 oz.	1 oz.
701-BNC-30N	$ .50	2 3/4"	0.767"	1/2"	0.08 oz.	2 oz.
DESIGNED FOR THE BT-50						
651-BNC-50J	$ .40	1 3/8"	0.976"	1/2"	0.08 oz.	4 oz.
701-BNC-50K	$ .50	2 3/4"	0.976"	1/2"	0.13 oz.	4 oz.
701-BNC-50X	$ .60	3 1/4"	0.976"	1/2"	0.15 oz.	4 oz.
671-BNC-50AD	$ .75	4 1/16"	1.300"	1/2"	0.25 oz.	6 oz.
651-BNC-50Y	$ .75	4 3/8"	0.976"	3/8"	0.16 oz.	6 oz.
JUST RIGHT FOR THE BT-55						
651-BNC-55AA	$ .75	3 1/8"	1.325"	1/2"	0.15 oz.	4 oz.
701-BNC-55F	$ .80	3 7/8"	1.325"	1/2"	0.19 oz.	4 oz.
701-BNC-55AC	$ .90	5 3/8"	1.325"	3/8"	0.32 oz.	6 oz.
EXCLUSIVELY FOR THE BT-60						
701-BNC-60AB	$ .75	2 5/8"	1.637"	3/8"	0.23 oz.	4 oz.
651-BNC-60T	$ .75	2 7/8"	1.637"	1/2"	0.17 oz.	4 oz.
651-BNC-60L	$ .75	3 1/8"	1.637"	5/8"	0.34 oz.	4 oz.
681-BNC-60AH	$1.50	6 5/8"	1.637"	7/8"	1.0 oz.	6 oz.
IDEAL FOR THE PST-65						
701-BNC-65L	$ .85	3 1/4"	1.796"	1/2"	0.41 oz.	4 oz.
FITS THE BT-70						
681-BNC-70AJ	$1.50	4 1/4"	2.217"	1"	0.85 oz.	6 oz.
ESPECIALLY FOR OUR ENGINE MAILING TUBE						
701-BNC-MTD	$ .40	1 1/2"	1.002"	3/8"	0.06 oz.	4 oz.
AND A TAIL CONE FOR BT-55 (with pre-drilled hole)						
701-BTC-55Z	$1.00	3"	1.325"	1/2"	0.25 oz.	4 oz.

LIGHTWEIGHT PRECISION MADE PARTS
for building your own rockets

NOSE BLOCKS

Use these top quality, featherweight balsa nose blocks in payload sections and anywhere else a solid bulkhead is required. Precision turned for exact fit in body tubes.

Catalog No.	Price Each	Outside Diameter	Length	Fits	Weight oz. Net	Ship.
651-NB-20	$ .30	.710"	3/4"	BT-20	.014	1
701-NB-30	$ .35	.725"	3/4"	BT-30	.014	1
701-NB-50	$ .40	.950"	1"	BT-50	.040	4
671-NB-55	$ .45	1.283"	1 1/4"	BT-55	.115	4
651-NB-60	$ .50	1.595"	1 1/2"	BT-60	.190	4
701-NB-1MT	$ .40	.937"	1"	Mailing Tube	.040	4

STAGE COUPLERS

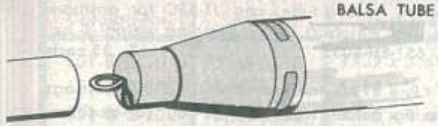
Little tubes with many uses, stage couplers exactly fit the inside of the tube designated. Great for multi-staging, joining body tubes, positioning adapter rings, etc. Make perfect guides for cutting body tubes and sanding cut edges of body tubes, too. Extra durable, lightweight. Shipping weight for all stage couplers is 3 oz. each.

Catalog No.	Price Each	Outside Diameter	Inside Diameter	Length	Fits	Average Weight
651-JT-5C	$ .10	.513"	.455"	3/4"	BT-5	.020 oz.
651-JT-20C	$ .10	.708"	.650"	3/4"	BT-20	.027 oz.
651-JT-30C	$ .10	.724"	.650"	3/4"	BT-30	.030 oz.
651-JT-50C	$ .15	.949"	.920"	1"	BT-50	.051 oz.
651-JT-55C	$ .15	1.28"	1.25"	1.3"	BT-55	.088 oz.
651-JT-60C	$ .15	1.59"	1.55"	1 1/2"	BT-60	.124 oz.
671-JT-70A	$ .20	2.175"	2.115"	1 1/4"	BT-70	.140 oz.

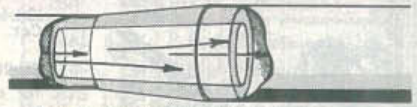
BALSA ADAPTERS

Super light, precision made balsa adapters give unlimited flexibility for model rocket design. Switch from one size body tube to another for payload capsules, parachute compartments, propulsion sections, etc. Adapters fitting BT-20 can be built up with masking tape to fit BT-30. Any adapter can be hollowed with a knife or drill to make a passage for ejection gases. All adapters have at least ½" mating surface on each end.

BALSA TUBE ADAPTER USES



Adapt large payload tube to small booster

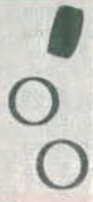


Pass ejection gases into larger tube

Catalog No.	Price Each	Mates	Length	Taper Length	Weight oz. Net	Ship.
651-TA-520	$ .30	BT-5 to BT-20	1.75"	0.75"	0.04	1
651-TA-550	$ .35	BT-5 to BT-50	2.2"	1.0"	0.06	4
701-TA-2050	$ .45	BT-20 to BT-50	3.0"	2.0"	0.15	4
651-TA-2050A	$ .35	BT-20 to BT-50	2.0"	1.0"	0.11	4
681-TA-2055	$ .45	BT-20 to BT-55	2.5"	1.5"	0.22	4
651-TA-2060	$ .60	BT-20 to BT-60	3.0"	2.0"	0.20	4
701-TA-5055	$ .55	BT-50 to BT-55	2.0"	1.0"	0.60	4
651-TA-5060	$ .60	BT-50 to BT-60	3.0"	2.0"	0.23	4
701-TA-5065	$ .65	BT-50 to PST-65	3.0"	2.0"	0.26	4
701-TA-5560	$ .60	BT-55 to BT-60	2.2"	1.0"	0.25	4
701-TA-5565	$ .65	BT-55 to PST-65	2.7"	1.5"	0.38	4
701-TA-6065	$ .60	BT-60 to PST-65	2.0"	0.5"	0.23	4
701-TA-6070	$1.00	BT-60 to BT-70	2.7"	1.5"	0.65	4

ENGINE BLOCKS

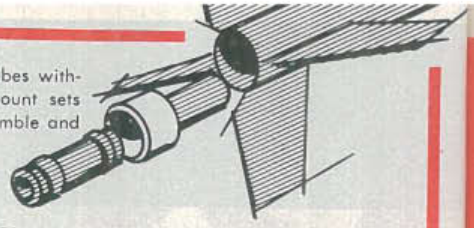
Use lightweight precision fitting engine blocks for the best internal construction on your models. Used for positioning the engine in your rocket for flight, engine blocks provide a hollow bulkhead against which the engine pushes as it develops its thrust, as well as an opening through which gases pass forward unobstructed for normal ejection.



Catalog No.	Price 2 for	Outside Diameter	Inside Diameter	Length	Fits	Weight oz. Net	Ship.
651-EB-20A	$ .20	.708"	.65"	1/4"	BT-20	.009	1
651-EB-20B	$ .20	.708"	.65"	1/8"	BT-20	.005	1
651-EB-30A	$ .20	.724"	.65"	1/4"	BT-30	.010	1

ENGINE MOUNTS

Get a precision engine fit in large body tubes without adding unnecessary weight. Engine mount sets come complete with instructions — just assemble and glue in place in your model.



EH-2050 Fits BT-50, includes BT-20J, EB-20A, 2 rings for centering holder tube, and JT-50C for positioning rings. Net weight 0.1 oz. Shipping weight 5 oz.
Cat. No. 651-EH-2050 ..... **$ .35 each**

EH-2055 Fits BT-55, includes BT-20J, EB-20A, 2 rings for centering holder tube, and JT-55C for positioning rings. Net weight 0.14 oz. Shipping weight 5 oz.
Cat. No. 651-EH-2055 ..... **$ .35 each**

EH-2060 Fits BT-60, includes BT-20J, EB-20A, 2 rings for centering holder tube, and JT-60C for positioning rings. Net weight 0.17 oz. Shipping weight 5 oz.
Cat. No. 651-EH-2060 ..... **$ .35 each**

Mounts for D engines are on page 97

PAPER ADAPTERS

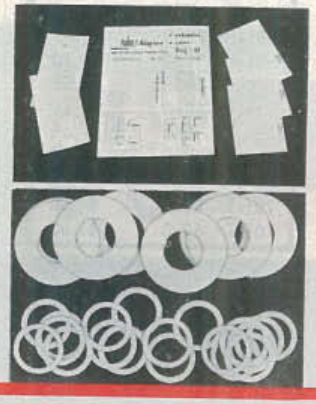
Add still another dimension to rocket design. Easy to use paper adapters are perfect for making transitions between tube sizes for countless designs.

MULTI-PURPOSE SET — Includes a total of 20 rings for positioning BT-5 in BT-20; BT-5, BT-20, BT-30 in BT-50; and BT-5, BT-20, BT-30, and BT-50 in BT-60. Also three universal tapered shrouds and instructions. Shipping wt. 2 oz.
Cat. No. 701-TA-1 ..... **$ .40**

20-50 RINGS — 20 rings for centering and mounting BT-20 in BT-50. Shipping weight 2 oz.
Cat. No. 651-RA-2050 ..... **$ .30 per set**

20-55 RINGS — 10 rings for centering and mounting BT-20 in BT-55. Shipping wt. 2 oz.
Cat. No. 671-RA-2055 ..... **$ .30 per set**

20-60 RINGS — 10 rings for centering and mounting BT-20 in BT-60. Shipping weight 2 oz.
Cat. No. 651-RA-2060 ..... **$ .30 per set**



CENTERING RINGS

Easy to use for centering a BT-20 body tube with a BT-50. Offering good alignment and fit, the AR-2050 adapter rings' greater strength makes them a good choice for use in model rockets that are to be flown with high thrust engines. Weight per pair .285 oz. Shipping wt. 3 oz.
Cat. No. 681-AR-2050 ..... **10 for $ .40**

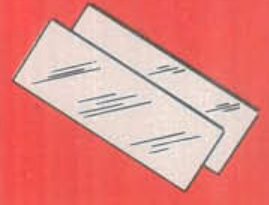
Use these rings to center a BT-50 tube in a BT-55 body tube. Extra strong for "D" engine mounts. Weight 0.062 oz. each. Shipping weight 2 oz. **Cat. No. 694-AR-5055** ..... **4 for $ .25**

FIN STOCK

Top quality balsa sheeting for making fins for model rockets. For maximum strength, grain of wood should follow the leading edge of fin. Read FINS in Vol. 3, No. 3 of the MODEL ROCKET NEWS for more information.

Catalog No.	Price	Dimensions (In Inches)	Weight oz. Net	Weight oz. Ship.	Major Use
701-BFS-10	3 for $ .50	1/32 x 3 x 9	.065	4	High Performance
651-BFS-20	3 for $ .40	1/16 x 3 x 9	.130	4	High Performance
651-BFS-20L	3 for $ .55	1/16 x 3 x 12	.173	6	High Performance
651-BFS-20B	2 for $ .10	1/16 x 1/2 x 6	.015	2	Glider Elevon
651-BFS-30	3 for $ .45	3/32 x 3 x 9	.150	4	Sport Models
651-BFS-30L	3 for $ .60	3/32 x 3 x 12	.200	6	Sport Models
701-BFS-40	3 for $ .55	1/8 x 3 x 9	.200	4	Cluster Rockets
701-BFS-40L	3 for $ .70	1/8 x 3 x 12	.265	6	Glider Wings
701-BFS-60S	3 for $ .20	3/16 x 1/2 x 3.7	.020	2	Scout Fin Replacement
701-BFS-80	$ .40 each	1/4 x 2 x 17	1.00	12	Sky Slash Body

CLEAR PLASTIC FIN STOCK: Build flyable models of finless space boosters and retain scale appearance. Clear plastic fins can be practically invisible; yet can also be as large as needed for proper stability. Recommended practice is to form a tube of 0.020" thick plastic to slide onto the outside of your model and glue fins made from 0.040" thick plastic to this tube. Use clear butyrate dope for gluing and filleting. In 3" x 9" sheets, shipping weight 4 oz.



Cat. No. 701-CFS-20 ..... $ .25 each
Cat. No. 701-CFS-40 ..... $ .50 each

FIN PATTERN SHEET NO. 2: Fourteen different popular fin designs, all tried and proven, printed full size on heavy index stock. Simply cut out and trace around pattern to transfer design to balsa. A must for the model rocket designer. Shipping weight 1 oz.
Cat. No. 651-PP-2 ..... **$ .25**

FIN PATTERN SHEET NO. 3: Fifteen different fin designs. Same stock as sheet No. 2. A great help in developing new rockets. Shipping weight 1 oz.
Cat. No. 681-PP-3 ..... **$ .25**

DECALS

Give your rockets the professional look

STARS AND BARS: Sheet of 12 red, white and blue Air Force emblems, each 1¼" wide. Fit on fins and body tubes, look great on gliders. Shipping weight 1 oz.
Cat. No. 651-D-1 . . . . . **$ .15 each**

LARGE STARS AND BARS: Add a special touch to your large models. Sheet contains two large 2" insignia, two medium 1¾" insignia and appropriate designations. Shipping weight 1 oz. **Cat. No. 651-D-2** . . . **$ .15 each**

¼" LETTERS AND NUMBERS: Ideal for code markings and identification on smaller rockets. Sheet contains 65 characters ¼" high. Available in black or white. **Specify color when ordering.** Shipping weight 1 oz.
Cat. No. 651-D-4 . . . . . **$ .15 each**

⅜" LETTERS AND NUMBERS: Identify and decorate models the easy way with these ⅜" high letter and number decals. Sheet contains 62 characters. Available in black or white. **Specify color when ordering.** Shipping weight 1 oz. **Cat. No. 651-D-3** . . . . . **$ .15 each**

LAUNCH PANEL DECAL: Identify controls and circuits on your launch panel with this easy-to-apply, pressure sensitive decal sheet. Aluminum letters on black background are easy to read, add extra eye appeal. Self-adhesive, just cut out and press in place. Extra-strong mylar sheet measures 3½" x 4¾". Shipping weight 1 oz.
Cat. No. 651-D-10 . . . . . **$ .50 each**

DECORATING TAPE, black: Thin, tough pressure sensitive tape is perfect for stripes, bars and other decoration. Easy to apply and only .0015" thick, decorating tape comes in rolls ½ inch wide and 144 inches long. Can be cut with knife and straightedge for special sizes.
Cat. No. 701-DT-1, shipping wt. 5 oz. . . . . . **$ .30 each**

1/5" CHECKERBOARDS: Glossy, colorful 1/5" square checks on clear background. Add color contrast to model for easy tracking and eye appeal. Extra-large sheets, 9½" x 4", available in red, black, gold or white. **Specify color and check size when ordering.** Shipping weight 1 oz.
Cat. No. 651-D-7 . . . . . **$ .25 each**

⅜" CHECKERBOARDS: Big ⅜" square checks for your large models. Cut out special patterns for even more striking effects. Large 9½" x 4" sheets, available in red, black, white, gold or silver. **Specify color and check size when ordering.** Shipping weight 1 oz.
Cat. No. 651-D-8 . . . . . **$ .25 each**

"20" DECAL: 3" x 4½" decal just right for BT-20 size models. Printed black on clear backing. Shipping wt. 1 oz.
Cat. No. 693-KD-45 . . . . . **$ .15 each**

"50" DECAL: 4-color, 4" x 9" decal for BT-50 size models. Shipping wt. 1 oz.
Cat. No. 693-D-13 . . . . . **$ .50 each**

MODEL MARKINGS: Collection of black markings, numbers, patterns, etc., on 4" x 9" clear backing. Shipping weight 1 oz. **Cat. No. 692-D-12** . **$ .25 each**

COLOR STRIPES: Put vertical stripes and horizontal rings on models the easy way. Each sheet has ten stripes, 1/32" through ½" wide and 9½" long. Available in red, black or yellow. **Specify color when ordering.** Shipping weight 1 oz.
Cat. No. 651-D-9 . . . . . **$ .25 each**

GOLD MINE SPECIAL: A real gold mine of decorative decals for your models. Lettering, vents, hatches, rivets and more, all on one big 3½" x 8½" sheet. Printed in brilliant red, white and black to add extra color. Shipping weight 1 oz. **Cat. No. 651-D-5** . . . . . **$ .25 each**

#1 KIT NAMES DECAL: Dress up models with these special kit names decals. Identify and decorate — easy to apply. Comes in black or white. **Specify color when ordering.** Shipping weight 1 oz.
Cat. No. 651-D-6 . . . . . **$ .25 each**

#2 KIT NAMES DECAL: Extra colorful, this decal includes names for kit numbers K-7, 9, 12, 14, 15, 16, 17, 18 and 20 on a big 3½" x 8½" sheet. Printed in stand-out colors of red, yellow, white and black, this sheet provides the extra touch for good looking models. Shipping weight 1 oz. **Cat. No. 651-D-11** . . **$ .25 each**

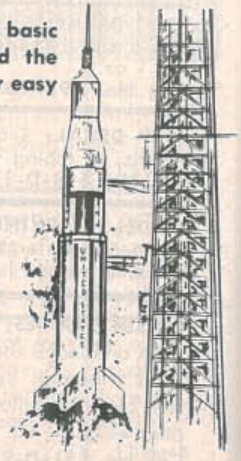
custom assortments

Many new, unique and useful rocket designs have been produced by imaginative rocketeers. In this section you'll find representative money-saving assortments of components for the beginner and for the experienced rocketeer who wants to explore new designs and ideas.

LAUNCH PAD SPECIAL

$10.14 VALUE ONLY $5.50!

Perfect starter assortment for a basic foundation. Designed around the durable BT-30 body tube . . . for easy to build, long-lasting "birds."



Contains all parts and supplies necessary for the experimentally minded rocketeer to explore techniques of successful rocket building. A comprehensive design manual guides you to hours of fun and satisfaction in building serviceable rockets. A good basic assortment for studies in aerodynamics, stability and recovery techniques.

Shipped in a sturdy field box with handle and compartments for engines, supplies, tools, etc. Ideal range box.

Cat. No. 701-ES-55, shipping wt 1 lb, 2 oz $5.50

BODY TUBES	
6 Body Tubes	#BT-30
NOSE CONES	
2 Nose Cones	#BNC-30C
1 Nose Cone	#BNC-30D
1 Nose Cone	#BNC-30E
1 Nose Cone	#BNC-30M
1 Nose Cone	#BNC-30N
RECOVERY EQUIPMENT	
2 Parachutes	#PK-12A
1 Parachute	#PK-8A
1 Parachute Material	#PM-2
1 Streamer Material	#SM-1
1 Sheet Tape Strips	#TD-2
1 Roll Shroud Lines	#SLT-1
6 Shock Cords	#SC-1
6 Screw Eyes	#SE-2
FIN MATERIAL	
4 Balsa Fin Stock	#BFS-20
2 Balsa Fin Stock	#BFS-30
MISCELLANEOUS	
6 Engine Blocks	#EB-30A
3 Launch Lugs	#LL-2C
1 Design Manual	#P-1
1 Fin Pattern Sheet	#PP-2
1 Fin Pattern Sheet	#PP-3

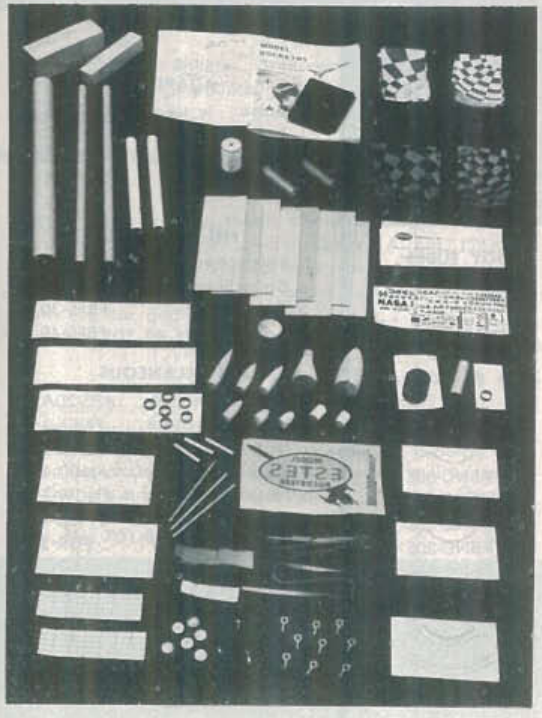
LIFT-OFF SPECIAL

$17.30 VALUE ONLY $11.00!

FOR BUILDING AN ALL-PURPOSE ROCKET FLEET

Lift-off to more rocket building enjoyment with this special-value assortment. A balanced selection of parts and supplies to build and decorate many different types of rockets. Real savings. Great for gifts, or for yourself as you build advanced or experimental models. Shipping wt 1 lb. 12 oz.

Cat. No. 701-ES-110 . . . . . $11.00



NOSE CONES			
1	#BNC-60L	1	#BNC-20B
1	#BNC-30E	1	#BNC-20N
1	#BNC-30M	1	#BNC-10A
1	#BNC-20A	1	#BNC-10B
FIN MATERIAL			
1	Balsa Sheet		#BFS-10
2	Balsa Sheets		#BFS-20
3	Balsa Sheets		#BFS-30
2	Balsa Sheets		#BFS-40
BODY TUBES			
1	#BT-60	2	#BT-20
2	#BT-30	2	#BT-10H
BULKHEADS AND HOLDERS			
1	#NB-60	3	#EB-30A
1	#NB-30	3	#EB-20A
1	#NB-20	1	#EH-2060
RECOVERY EQUIPMENT			
1	Parachute		#PK-8A
2	Parachutes		#PK-12A
1	Parachute		#PK-18A
1	Parachute		#PK-24A
1	Parachute Material		#PM-2
1	Streamer Material		#SM-1
2	Sheets Tape Strips		#TD-2
1	Roll Shroud Lines		#SLT-1
3	Snap Swivels		#SV-12
9	Screw Eyes		#SE-1
6	Shock Cords		#SC-1
1	Shock Cord		#SC-2
MISCELLANEOUS			
1	Balsa Adapter		#TA-2060
1	Adapter Set		#TA-1
1	Nose Cone Stock		#NCS-1
1	Nose Cone Stock		#NCS-2
3	Nose Cone Dowels		#NCD-1
6	Nose Cone Weights		#NCW-1
3	Reinforcing Mat'l.		#PRM-1
3	Launching Lugs		#LL-2C
1	Decal Sheet		#D-5
1	Design Manual		#P-1
1	Fin Pattern Sheet		#PP-2
1	Fin Pattern Sheet		#PP-3

Shipped in a sturdy field box with handle and compartments for engines, supplies, tools, etc. Ideal range box.

ORBIT SPECIAL

Shipped in a sturdy field box with handle and compartments for engines, supplies, tools, etc. Ideal range box.

You or your club members will "orbit" a whole host of rockets before this value-packed assortment has been used. With the representative selection of parts and supplies included, your imagination will have a chance to run free on many rocket projects and experiments. Valuable design manual included. Shipping weight 2 lbs.

Cat. No. 701-ES-165 ..... $16.50

$23.50 VALUE ONLY $16.50

NOSE BLOCKS, ENGINE BLOCKS, HOLDERS, ETC.

1 Nose Block	#NB-60
1 Nose Block	#NB-50
1 Nose Blocks	#NB-30
2 Nose Blocks	#NB-20
3 Engine Blocks	#EB-30A
3 Engine Blocks	#EB-20A
1 Engine Mount	#EH-2050
1 Engine Mount	#EH-2060
1 Stage Coupler	#JT-50C
1 Stage Coupler	#JT-60C

RECOVERY EQUIPMENT

1 Parachute Material	#PM-2
2 Parachutes	#PK-8A
3 Parachutes	#PK-12A
2 Parachutes	#PK-18A
1 Parachute	#PK-24A
3 Streamer Material	#SM-1
2 Sheets Tape Strips	#TD-2
1 Roll Shroud Lines	#SLT-1
6 Shock Cords	#SC-1
3 Shock Cords	#SC-2
12 Screw Eyes	#SE-1
3 Snap Swivels	#SV-12

BODY TUBES

1	#BT-60
1	#BT-50
3	#BT-30
2	#BT-20
2	#BT-10H

NOSE CONES

1	#BNC-60L
1	#BNC-50K
1	#BNC-30D
1	#BNC-30E
1	#BNC-30M
1	#BNC-20A
1	#BNC-20B
1	#BNC-20N
1	#BNC-10A
1	#BNC-10B

ADAPTERS

1 Balsa	#TA-2050A
1 Balsa	#TA-2060
1 Balsa	#TA-5060
1 Paper	#TA-1

FIN MATERIAL

3 Balsa Sheets	#BFS-10
3 Balsa Sheets	#BFS-20
3 Balsa Sheets	#BFS-30
3 Balsa Sheets	#BFS-40

MISCELLANEOUS

1 Payload Section	#PS-20A
1 Nose Cone Stock	#NCS-1
1 Nose Cone Stock	#NCS-2
3 Nose Cone Dowels	#NCD-1
6 Nose Cone Weights	#NCW-1
3 Reinforcing Mat'l.	#PRM-1
1 Reinforcing Mat'l.	#GR-2
6 Launching Lugs	#LL-2C
1 Decal Sheet	#D-5
1 Decal Sheet	#D-6
1 Design Manual	#P-1
1 Fin Pattern Sheet	#PP-2
1 Fin Pattern Sheet	#PP-3

$10.60 VALUE ONLY $7.00

RANGE KIT SPECIAL

A sturdy, all metal range box (RB-1), loaded with all these most needed items:

21 Igniters	1 Roll Shroud Lines	3 Screw Eyes	1 Engine Holder
1 Bottle White Glue	1 Sheet Tape Strips	3 Nose Cone Weights	1 Reinforcing Mat'l.
1 Knife Handle	2 Packs Flameproof Recovery Wadding	1 Roll Masking Tape	3 Snap Swivels
3 Knife Blades	4 Parachutes	2 Balsa Fin Stock	4 Shock Cords
1 Tweezers	1 Streamer Material	3 Launching Lugs	1 Emery Board
5 Flight Data Sheets	Sorry, no substitutions.	18 Sheets Sandpaper	2 Micro-Clips

Shipping weight 3 pounds.

Cat. No. 701-RBK-1 ..... $7.00

RANGE BOX

Good-looking, roomy, tough all-metal box — the same as included with the special above. A big 11½" x 5¼"x 4", complete with a three compartment tray for small parts. Has full-drawn seamless body, snap catch with eye for padlock. Shipping weight 2 pounds.

Cat. No. 701-RB-1 ..... $3.00

LARGE RANGE BOX

Big enough to hold an Altiscope, an Electro-Launch and a model or two, this sturdy all steel range box measures 19" x 7¼" x 6". Watertight construction protects your supplies, double action latch eliminates spilling, multi-section tray helps keep things organized. Shipping weight 6 pounds.

Cat. No. 701-RB-2 ..... $7.00

LARGE RANGE KIT SPECIAL

Includes the large range box with the same supplies as the regular range kit special. Shipping weight 7 lb.

Cat. No. 701-RBK-2 ..... $11.00

$14.60 VALUE ONLY $11.00

LITTLE ITEMS THAT GIVE BIG RESULTS IN ROCKETRY

PHANTOM ENGINE: For display and demonstrations, here's ½ an engine, cut the long way to show placement of nozzle, propellant, etc. Helps explain model rocket operation. Safe, uses only non-combustible materials. Shipping weight 1 oz.

Cat. No. 651-CE-1 . . . . . $ .50

ENGINE HOLDER: Flat spring steel design gives easy installation and low drag. Recommended for sport and demonstration models built from BT-20 and BT-30, the engine holder is 2.8" long, 0.1" wide and only 0.025" thick. Mount it on the model with gauze and glue as shown on page 60. Net weight 0.032 oz. Shipping weight 1 oz.

Cat. No. 701-EH-2 . . . . . $ .20

SHORT ENGINE HOLDER: Specially designed for use with Series III engines and BT-20 and BT-30 body tubes, this holder is 1.8" long and 0.1" wide for the same easy installation and low drag as the standard model. Net weight 0.022 oz. Shipping weight 1 oz.

Cat. No. 701-EH-3 . . . . . $ .20

FOAM PADDING: Protect payload specimens, pad payload capsules with plastic foam. Pieces are 6" x 6" x ¼". Can be cut and secured in place with white glue. Net weight 0.08 oz. Shipping weight 1 oz.

Cat. No. 651-PSP-1 . . . . . $ .20

PAYLOAD: How high can your rocket lift an ounce of lead? This 1 oz. payload weight, ¾" in diameter, is used in some altitude competition events. Shipping weight 2 oz.

Cat. No. 651-PL-1 . . . . . $ .50

NOSE CONE WEIGHT: Balance rockets for perfect stability with these 11/16" diameter lead weights. Center hole for easy attachment and alignment. Stack several for more weight, cut with scissors for less. Each weighs 0.12 oz. Shipping weight 1 oz.

Cat. No. 701-NCW-1 . . . . . 3 for $ .30

NOSE CONE WEIGHT: 7/16" diameter brass washers for delicate balancing. ⅛" center hole, weighs 0.023 oz. Attach up to four weights to nose cone by threading them on the screw eye. Shipping wt. 1 oz.

Cat. No. 701-NCW-2 . . . . . 10 for $ .20

BALANCING WEIGHT: Flexible lead strip makes glider trimming a snap. Great for other balancing purposes too. Comes in 3" x ¼" x 0.02" strips, net weight 0.085 oz. Shipping weight 1 oz.

Cat. No. 701-NCW-3 . . . . . 5 for $ .15

LAUNCH LUGS: Super strength laminated launch lugs feature mylar plastic core for durability, paper outer layer for easy gluing. Inside diameter 5/32", fit ⅛" rod. Shipping weight 1 oz.

1¼" long:	Cat. No. 691-LL-2A . . . . . 6 for $ .15
2⅜" long:	Cat. No. 651-LL-2B. . . . . 5 for $ .15
5" long:	Cat. No. 701-LL-2C . . . . . 3 for $ .20
8" long:	Cat. No. 701-LL-2D . . . . . 2 for $ .20

GAUZE REINFORCING: Attach shock cords, reinforce fin joints with unmarked gauze. Comes in 3" x 12" sheets. Apply by spreading a thin layer of glue over the area to be reinforced, smooth gauze down over the glue and spread one or more layers of glue over the gauze. Shipping weight 1 oz.

Cat. No. 651-GR-2 . . . . . .3 for $ .30

PAPER REINFORCING: Double fin strength with this easy to use self-adhesive treated paper. Cut to shape, strip off protective backing and press on the balsa. Apply to both sides of the balsa for best results. Provides smooth white surface for painting. In 3" x 9" sheets. Shipping weight 1 oz.

Cat. No. 651-PRM-1 . . . . . 3 for $ .20

TAPE HINGES: Easy to use elevon hinges for boost-gliders. Treated paper, 4½" x ¾", adhesive coated on one side. Strip off protective backing, apply to joint. Shipping weight 1 oz.

Cat. No. 651-TH-1 . . . . . 2 for $ .10

ELASTIC THREAD: Strong elastic thread, use as a spring to actuate elevons on boost-gliders. Each thread is 8" long, 1/32" diameter. Shipping weight 1 oz.

Cat. No. 651-ET-1 . . . . . 3 for $ .10

NYLON SCREWS: Extra light, high strength screws for elevon adjustment on boost-gliders. ½" long, 1/16" thread diameter. Read TR-4 for information on gliders and their design. Shipping weight 1 oz.

Cat. No. 651-AS-1 . . . . . .$ .10 each

STYROFOAM BALLS: Featherweight 3" diameter styrofoam balls for "odd ball" designs. Use white glue for best results in attaching legs, antennas, stabilizers, etc. Net weight 0.2 oz., shipping weight 5 oz.

Cat. No. 701-SB-3 . . . . . $ .30

DOWELS: Extra strong, light weight, seasoned maple dowels. Shipping weight 5 oz.

⅛" x 18" — Cat. No. 651-WD-1 . . . . . 4 for $ .20

1/12" x 12" — Cat. No. 671-WD-2 . . . . . 4 for $ .20

ALTISCOPE

Determine Rocket Altitudes
Learn Math and Trig

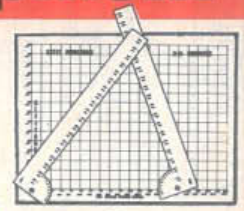
Patent No. 3,208,147

How high did it go? Find out with the Altiscope! Only one instrument is required for determining approximate altitudes (usually within ten percent). Use two together for even greater accuracy. Your altiscope can also be used to find heights of trees, buildings, mountains, poles, etc. Easy to assemble, easy to use, the Altiscope comes in kit form complete with instructions, trig tables, technical report TR-3 on altitude tracking and 2-D altitude computer. Shipping wt. 20 oz.

Cat. No. 701-A-1 . . . . . $3.00

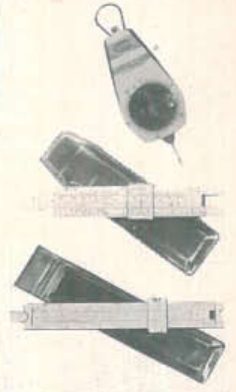
EASY TO USE!

Computing Equipment



2-D COMPUTER: Build your own easy-to-use altitude computer. Get this set of charts and instructions — everything you need except tape, thumbtacks and glue — assemble the 2-D computer in a few minutes. Designed for use with one or two Altiscopes, easily used with other tracking systems. Shipping weight 2 oz. Kit includes technical report, TR-3

Cat. No. 701-AC-1 . . . . . $ .30



DIAL SCALE: No more guesswork. Weigh your birds — or any of the parts. Calibrated in both grams and ounces, it is accurate to within 2 grams at full load. Weighs items up to 9 oz. For rockets just slip hook into launch lug, or a pan can be improvised. Shipping wt. 5 oz.

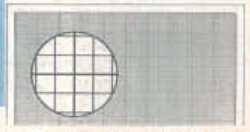
Cat. No. 701-WS-1 . . . . . $3.50

6" POCKET SLIDE RULE: Ideal companion to the Altiscope. This durable plastic rule is complete and accurate, features A, B, C, CI, D and K scales on front plus S, T, and L scales on back for computing altitudes and working logarithm problems. With vinyl case and instructions. Shipping weight 5 oz.

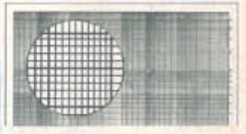
Cat. No. 701-SR-3 . . . . . $1.40

10" DECIMAL TRIG MULTI-LOG SLIDE RULE: A big rule at a small price. Complete with 22 scales in a functional grouping for mathematics, science and engineering — covers full log-log and trig requirements. Includes double faced, spring loaded adjustable cursor, operating instructions and protective carrying case. Shipping weight 11 oz. **Cat. No. 701-SR-4 $4.00**

See page 139 for book "Learn Basic Slide Rule" (inc. slide rule).



insets show actual size

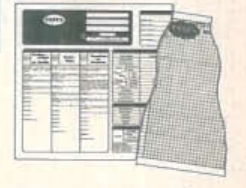


GRAPH PAPER: For rocket performance charts, stability graphs and countless other uses. 8½" x 11"sheets with 7½" x 10" grid area, divided into 1/10" squares. Shipping weight 4 oz.

Cat. No. 701-GP-1 . . . . . 20 sheets for $ .50

LOG-LOG GRAPH PAPER: Perfect for special performance graphs, altitude and velocity charts, etc. Two by two cycle grid on 8½" x 11" paper, can handle greater value ranges than standard graph paper. Shipping wt. 4 oz.

Cat. No. 701-GP-2 . . . . . 20 sheets for $ .50



FLIGHT DATA SHEETS: New double size (11" x 17"), printed on both sides. One side has spaces in sequence for pre-flight, countdown, launch and flight summary data. Other side is a rocket designers plan sheet with a large ¼" grid space for ease in drawing your plans.

Cat. No. 701-DS-2 . . . . . 5 for $ .25

WIND METER: Rugged, pocket-size instrument for determining wind velocity. Indispensible to the serious rocketeer for studying wind effects on rocket and parachute performance. Shipping weight 5 oz.

Cat. No. 693-WM-1 . . . . . $7.25

FINISHING SUPPLIES

For model finishing information, see page 76

ASTROSEAL balsa filler: The first step to a perfect finish. Astroseal contains an extra high percentage of selected fillers to completely fill the grain in balsa parts. Gives smooth surface for dope or enamel application. Brush on two to four coats, letting each dry thoroughly. Sand with #SP320 sanding material between coats. In four ounce jar. Shipping weight 7 oz.

Cat. No. 701-SS-2 ..... $ .80

HEAT RESISTANT PAINT: Protect exposed rocket parts from heat damage with easy-to-apply, brush-on, high heat aluminum paint. Protects to 1000°, gives a bright metallic finish. Recommended for swept fins and other parts exposed to hot exhaust gases. In 1½ ounce bottles. Shipping weight 6 oz.

Cat. No. 651-AP-1 ..... $ .35

FLUORESCENT SPRAY PAINT: The brightest colors anywhere — make rockets easy to spot in the air and on the ground. Glowing, high visibility paint comes in handy 6 oz. spray cans, dries in minutes. For maximum brilliance use glossy white enamel as an undercoat. Available in Cerise Red, Yellow Orange, Red Orange and Green. **Specify colors when ordering.** Shipping weight 16 oz. each.

Cat. No. 651-FP-1 ..... $1.40

ENAMEL SPRAY PAINT: Get that "professional" appearance for your best models. Top quality enamel in handy 5 oz. spray cans dries in minutes. Use indoors and outdoors. Not flourescent. Available in the popular colors of True Blue, Bright Silver, Bright Gold, Cherry Red, Glossy White, Glossy Black, Flat White, Ultra Flat Black. **Specify colors when ordering.** Shipping weight 16 oz. each.

Cat. No. 651-EP-1 ..... $1.20

CLEAR SPRAY: Crystal clear spray coating goes on clear — stays clear. Gives extra gloss to enamel finishes, protects decals and decorations, makes fluorescent finishes smooth, durable and glossy. For best results, let paint dry thoroughly before applying clear spray, use several light coats for maximum gloss. In handy 5 oz. spray can. Shipping weight 16 oz.

Cat. No. 651-EP-2 ..... $1.20

BUTYRATE DOPE: The dope preferred by expert modelers for perfect finishes. Brushes on smoothly, easily, comes in convenient 1 oz. bottles. Available in Insignia Red, International Orange, Dark Green, Gloss Black, Insignia White, True Blue, Sky Blue, Aircraft Gray, Orange Yellow, Silver, Gold and Clear. **Specify colors when ordering.** Shipping wt. 4 oz.

Cat. No. 701-BRD-1 ..... $ .25

SANDING SEALER: Fills small holes in balsa, paper and other porous materials, provides a smooth surface for paint or dope. To use, sand the surface, brush on sealer, let dry and sand again. Repeat as needed to obtain a glass-like surface. In 1 ounce bottles. Shipping weight 4 oz.

Cat. No. 701-SS-1 ..... $ .25

THINNER: For diluting butyrate dope, sanding sealer and Astroseal and for brush cleaning. Completely colorless — won't interfere with the drying action of the dope. Comes in 1 ounce bottles. Shipping weight 4 oz.

Cat. No. 701-BDT-1 ..... $ .25

WHITE GLUE: Preferred for rocket building! Sets fast, gives super strong joints with wood, paper, cloth and other porous materials. In 2 ounce plastic squeeze bottle. Shipping weight 6 oz.

Cat. No. 701-WG-1 ..... $ .50

BODY PUTTY: For super-sleek models. Fill cracks, holes, grain marks in balsa parts, make smooth fin-body joints. In 21 cc. tube. Shipping weight 5 oz.

Cat. No. 651-FM-1 ..... $ .30

FINISHING WAX: For the high gloss finish so important to appearance and low drag. Apply with soft cloth, let dry and polish with a soft, dry cloth. Recommended for use on enamel and butyrate finishes only. In 2 ounce jar. Shipping weight 5 oz.

Cat. No. 701-FW-2 ..... $ .85

SANDING MATERIAL: Fold, roll or crumple it for hard to reach places. Special mylar plastic backed abrasive sheet can be used over and over again. Helps you get a mirror finish. Extra fine 320 grit in easy to handle 2½" x 2¼" sheets. Shipping weight 1 oz.

Cat. No. 651-SP-320 ..... 3 sheets $ .10

SANDPAPER: Shape and smooth model rocket parts with these handy 3" x 3" sheets of top quality sandpaper. Available in three grades. **Specify grade when ordering.** Shipping weight 1 ounce for 6 sheets.

6 SHEETS MEDIUM —	Cat. No. 651-SPM-2	$ .10
6 SHEETS FINE —	Cat. No. 651-SPF-2	$ .10
6 SHEETS EXTRA FINE —	Cat. No. 651-SPEF-2	$ .10
18 SHEETS ASSORTED (6 each) —	Cat. No. 651-SPA-2	$ .25

PAINT BRUSHES: The set designed for model rocketry. You get one #1 brush for extra fine work, one #4 brush for normal work and one #6 brush for covering large areas rapidly. Brushes are 6" long with quality camel hair bristles set in nickeled ferrules. Available in sets of three only. Shipping weight 2 oz.

Cat. No. 691-PB-3 ..... $ .35

MASKING TAPE: Secure engines in model, mask for painting, etc. Extra strong ½" wide tape comes in 30 foot rolls. Flexible, seals tightly and strips off clean. Shipping weight 5 oz.

Cat. No. 701-MT-1 ..... $ .40

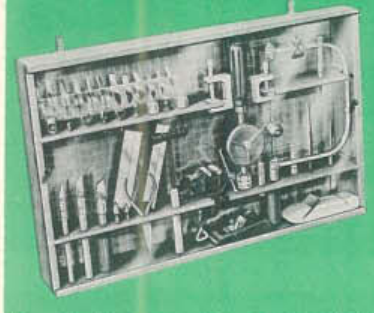
MODELING KITS

KNIFE CHEST: Small, medium and heavy-duty knives plus 9 assorted extra blades — one for practically every cutting job. In a handy, natural finish wood chest. Shipping wt. 1 lb. 8 oz.
Cat. No. 701-KNS-82 . . . . . $4.95

KNIFE AND TOOL SET: Contains small, medium and heavy-duty knives and an entire assortment of blades, gouges, routers, and punches. Has planer, 1" sander, spokeshave and balsa stripper. In wooden box, complete with see-through cover and fitted plastic tray insert that holds and shows every tool. Shipping wt. 2 lbs.
Cat. No. 701-KNS-84 . . . . . $13.50 each

KNIFE SET: Conveniently packaged in a clear plastic case, the set contains scribe and 9 assorted blades to take care of most cutting needs. Balanced, streamlined, light-weight aluminum handle. Shipping wt. 10 oz.
Cat. No. 701-KNS-24 . . . . . $3.00

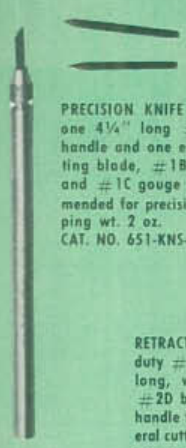
COMPLETE HOBBY DEN TOOL CABINET: A truly complete tool set for the model rocketeer. Has a full assortment of hobby tools, knives and blades against a blueprint silhouette background of each tool for easy replacement. Comes in a sturdy wooden fitted cabinet with a sliding, see-thru cover. (Size 13⅛ x 21¼ x 3"). Shipping weight 9 pounds.
Cat. No. 701-KNS-88N . . . . . $32.50 each



- 6 Extra Blades
- 6 Assorted Gouges
- 4 Assorted Routers
- 2 Punches
- 3 Knives (with blades)
- 1 Hobbycraft Saw (with extra blade)
- 2 Screw Drivers
- 2 "C" Clamps
- 1 Tweezer
- 1 Sander
- 3 Tweezer Clamps
- 1 Hand Drill
- 1 File
- 1 Planer
- 1 Hammer (with extra heads)
- 1 Bench Vise — imported
- 1 Pair Pliers — imported, service quality
- 1 Drill Bit, 2 Screw Driver Bits
- 2 Razor Saw Blades
- 2 Chucks

Plus **Free** copy of the 35¢ **"PROJECT HANDBOOK AND HOBBY TOOL GUIDE"** by X-Acto

MODELING TOOLS



PRECISION KNIFE SET: Includes one 4¼" long #1 aluminum handle and one each #1A cutting blade, #1B punch blade, and #1C gouge blade. Recommended for precision work. Shipping wt. 2 oz.
CAT. NO. 651-KNS-1 . . $ .75 each

RETRACTABLE BLADE KNIFE: Heavy duty #2 aluminum handle, 4¾" long, with one double ended #2D blade. Blade retracts into handle for safe carrying. For general cutting. Shipping weight 4 oz.
CAT. NO. 691-KNS-2 . . $1.25 each

UTILITY KNIFE: Includes 5 3/8" long #3 steel handle and one #3E general purpose blade. Shipping weight 3 oz.
CAT. NO. 651-KNS-3 . . $ .30 each

HEAVY DUTY KNIFE: Set of one 4¼" long #4 plastic handle with metal chuck and one general purpose knife blade similar to #4G. Shipping weight 6 oz.
CAT. NO. 651-KNS-4 . . $1.20 each

BLADES & ACCESSORIES

Fits #1 handle only: For cutting balsa and paper.
CAT. NO. 651-KNB-1A . . . $ .10 each

Fits #1 handle only: Punch and scriber.
CAT. NO. 651-KNB-1B . . . $ .25 each

Fits #1 handle only: Gouge for hollowing balsa nose cones, adapters, blocks, etc.
CAT. NO. 651-KNB-1C . . . $ .25 each

Fits #2 and #4 handles. For general cutting and trimming.
CAT. NO. 651-KNB-4H . . . $ .15 each

Fits #2 handle only: Double ended, for general cutting.
CAT. NO. 651-KNB-2D . . . $ .35 each

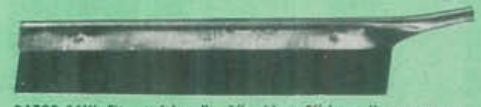
Fits #2 and #4 handles. For general cutting and carving.
CAT. NO. 651-KNB-4G . . . $ .15 each

Fits #2 and #3 handles: Double ended, for general cutting.
CAT. NO. 651-KNB-3E . . . $ .15 each

WHETSTONE: Keep knife blades extra sharp for easy cutting. Pocket size, 3½" x ¾" x 3/8". Use with oil for best results.
Cat. No. 651-W-1 . . . . . $ .50

TWEEZERS: For 1,001 uses in handling small parts, attaching shock cords, etc. Steel, 3" long, 1/8" jaw. Shipping weight 2 oz.
Cat. No. 701-T-1 $ .25 each

EMERY BOARDS: Perfect for cleaning micro-clips, shaping airfoils, turning nose cones, etc. 4½" x ½", medium abrasive on one side, fine abrasive on the other. Shipping weight 1 oz.
Cat. No. 701-BE-1 . . . . . 3 for $ .15



RAZOR SAW: Fits #4 handle. 1" wide x 5" long. Use razor saw blade for cutting balsa and body tube.
Cat. No. 701-KNB-4F. . . . . $ .50 each

Shipping weight on saw blade is 6 oz. all other blades, 1 oz.

DRAFTING AND DESIGNING EQUIPMENT

TRIANGLE SET

Clear plastic triangles are perfect for drafting and designing work. Set includes one 6" 45° triangle and one 8" 30°-60° triangle. Beveled edges — accurate — precise . . .recessed lifts from both sides permit clean, easy pick-up. Shipping weight 6 oz.

Cat. No. 701-DT-2 . . . . . $ .70 per set

FRENCH CURVE

Precision-made with sleek-finished edges of hairline accuracy. Perfect for designing nose cones, plotting curves, etc. Shipping weight 4 oz.

Cat. No. 651-DC-1 . . . . . $ .25

PROTRACTOR

Large 6" clear plastic protractor makes angle measurements a "snap." Features sharp graduations, accurate 6" ruler at the base. Shipping weight 4 oz.

Cat. No. 651-DP-6 . . . . . $ .15

RULE

All purpose steel rule is graduated in inches on one edge and millimeters on the other to give fast, accurate measurements. Ideal both for design and construction work, this flexible stainless steel rule has a new non-slip backing for precise positioning. Shipping wt. 11 oz. Cat. No. 701-DR-3 . . . . . $1.25 each

12" T-SQUARE

Precision-made, clear plastic 12 inch T-square is accurate and easy to use. Smooth straight edges are marked in inches and millimeters. Shipping weight 11 oz.

Cat. No. 701-DR-2 . . . . . $ .35

METAL COMPASS

Sheet metal German tool does double duty — can be used as pencil compass or divider. Includes metal capsule of leads. Shipping weight 4 oz.

Cat. No. 701-DC-2 . . . . . $ .40

BOW COMPASS

Giant bow compass features thumb screw adjustment, interchangeable points for use as divider, ink or pencil compass. Heavy gauge nickel plated steel. Shipping weight 6 oz.

Cat. No. 701-DC-3 . . . . . $1.25

Let your model design win an award!

Enjoy designing new models?

- Payload
- Duration
- Boost-glide
- Launchers
- Telemetry devices
- Odd-ball
- or you-name it

ENJOY IT MORE WITH A $50 MERCHANDISE AWARD

ESTES DESIGN OF THE MONTH COMPETITION

Here's a contest for every rocketeer. You can get a lot more from it than just an award. Estes Industries sponsors this contest to encourage and reward original thinking among model rocketeers. Put your originality to the test. Enter soon!

NEW CONTEST EVERY MONTH . . . Send as many entries as you like

All plans which reach Estes Industries during the calendar month will be considered for that month's award. Each month the winning designer will receive a $50.00 merchandise coupon and an award suitable for framing. We will send an acknowledgement of each entry received but will not be able to enter into any other correspondence concerning entries.

DESIGN OF THE MONTH RULES ARE FEW . . . AND EASY TO FOLLOW

Entries will be judged on practicality, originality, neatness and clarity. Plans do not have to be flight tested and proven. However, a proven design is more apt to win. Launchers and other accessory items will also receive extra points if they have been field tested and results noted with entry. Photos are not required, but you may include a picture of your completed design if you wish.

RULES: 1. All entries become the property of Estes Industries; none can be returned.

2. Employees of Estes Industries and members of their immediate families are not eligible to enter.

3. Designs should be sent to the Design of the Month Editor, Estes Industries, Inc., Box 227, Penrose, Colorado 81240. However, all plans sent to us which are not specifically addressed to another contest or department will be automatically placed in the Design of the Month competition.

4. Any type of model rocketry design can be entered (rockets, boost-gliders, launching or recovery devices, etc.).

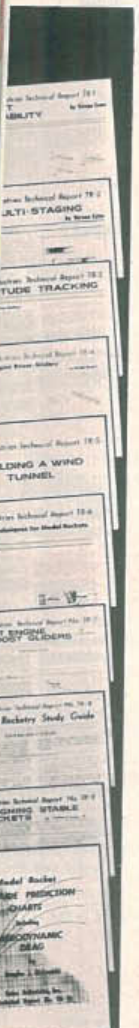
5. All designs reaching Estes Industries during the calendar month will be entered in that month's competition. (Date of receipt — not postmark — will determine the month in which a design will be judged.)

6. If two or more exceptional entries are received during any month, the judges may, at their discretion, make identical first-place awards or give additional special merit awards.

Award winners will be notified by mail. The name of the winner of each award will then be announced in the next issue of the Model Rocket News.

A FEW TIPS IN PREPARING YOUR ENTRY

Designs should be new, original and different — but they also need to be workable. The goal is to develop something that other rocketeers can build and use successfully, too. If you're not sure your design will work, a little extra effort to make it work will be worth while. This way you gain additional engineering experience and also have a better chance to win.



TECHNICAL REPORTS

ROCKET STABILITY: All about rocket stability. Easy to read, tells how to design your rockets to fly properly. No rocketeer will want to miss this one. Shipping weight 1 oz.

Cat. No. 651-TR-1 . . . . . **$ .25 each**

MULTI-STAGING: Tells all about the latest discoveries in multi-staging technique. Complete, easy-to-understand and well illustrated. A necessity for designing, building and flying multi-stage birds. Shipping weight 1 oz.

Cat. No. 651-TR-2 . . . . . **$ .25 each**

ALTITUDE TRACKING: The classic work on simple altitude tracking for model rocketeers. Thoroughly covers tracking and altitude computation. Easy to understand and apply. Shipping weight 1 oz.

Cat. No. 651-TR-3 . . . . . **$ .25 each**

REAR ENGINE BOOST-GLIDERS: Basic information to help you understand the operation of rear-engine boost-gliders and design your own. Covers design and construction for proper upward flight and good glide characteristics. Shipping weight 1 oz.

Cat. No. 651-TR-4 . . . . . **$ .25 each**

BUILDING A WIND TUNNEL: Full plans and information for building a wind tunnel to study rocket stability. Covers motor and handpowered versions, finding center of pressure, checking multi-stage rockets, etc. Great for clubs and experienced modelers — science fair projects too. Shipping weight 2 oz.

Cat. No. 651-TR-5 . . . . . **$ .25 each**

CLUSTER TECHNIQUES: The complete report on clustering engines in model rockets. Thoroughly illustrated, easy to understand. Especially valuable for the modeler who wishes to loft larger payloads. Shipping weight 1 oz.

Cat. No. 651-TR-6 . . . . . **$ .25 each**

FRONT ENGINE BOOST-GLIDERS: Valuable information on designing, building and flying front engine boost-gliders. Fully illustrated, recommended reading for anyone who wishes to build better gliders or get the best performance from the ones he has. Shipping weight 1 oz.

Cat. No. 651-TR-7 . . . . . **$ .25 each**

MODEL ROCKETRY STUDY GUIDE: Presents a logical program for model rocketeers who want to get the most good from their activities. Includes a listing of recommended books on subjects relating to model rocketry. Shipping weight 1 oz.

Cat. No. 651-TR-8 . . . . . **$ .25 each**

DESIGNING STABLE ROCKETS: Based on standard engineering practices, this report presents a method of designing rockets for proper stability on paper before any cutting or gluing is done. Worthwhile reading for beginner and experienced rocketeer alike. Shipping weight 1 oz.

Cat. No. 651-TR-9 . . . . . **$ .25 each**

ALTITUDE PREDICTION CHARTS: Contains reports and graphs which explain a relatively simple method by which aerodynamic drag and other effects can be taken into account in predicting rocket peak altitudes. With this data the probable altitude can be determined for any rocket and any Estes engine, including multi-stage and cluster power. Includes suggestions for experiments. Shipping wt. 3 oz.

Cat. No. 671-TR-10 . . . . . **$ .50 each**

MODEL ROCKET NEWS

BACK ISSUES

The MODEL ROCKET NEWS is a regular publication of Estes Industries featuring up-to-date information on developments in model rocketry, action articles on the science of rocketry, rocket plans and news about rocketeers and rocketeering. Current issues are distributed free to Estes customers. Back issues, an important source of rocketry ideas, are available at nominal cost in the bound volume groupings listed below.

BEST OF VOLUMES 1 & 2 — Sixteen pages packed with the best ideas, plans and info condensed from Volumes 1 and 2. Includes Model Rocket Glossary, Idea Box features, information on underwater rockets, Technical Report TR-3, plans for Dirty Bird III and Bug-A-Bye, and interesting stories on the Crickenauts and "Guppies into Inner Space". Shipping weight 4 oz. **Cat. No. 651-MRN-1** . . . . . **$ .50**

VOLUMES 3 & 4 — Seven issues containing information on Science Fair projects, problem solvers from the Idea Box, altitude tracking information, safety tips, Technical Reports TR-2, TR-4, TR-6, TR-7. Included is information on basic construction, fins, sectional construction, 'chute cutting, 'chute recovery, booster recovery, rocket math and plans with parts lists for 12 different and exciting rockets. Shipping weight 6 oz.
Cat. No. 701-MRN-34 . . . . . **$1.00**

VOLUMES 5, 6, 7 — Six issues with comprehensive articles on many phases of model rocketry: electric launching systems; interesting R & D projects; model finishing; designing, turning and finishing nose cones; altitude and drag calculation techniques; streamer information; how to display models; information on our nation's large space boosters. Plans and parts lists for 8 new and unusual rockets, plus some "odd balls". Dozens of helpful hints from the Idea Box. Shipping weight 6 oz. **Cat. No. 701-MRN-567** **$1.00**

VOLUMES 8 & 9 — Five issues with many informative, appropriately illustrated and easy-to-understand articles covering the science of rocketry. Included are explanations of Newton's 3rd law of motion, what keeps a satellite in orbit, why rockets are staged, the mathematics of altitude calculation and the orbital transport concept. Also a discussion of Metric vs English system of measurements. More "how-to" helpers from the Idea Box and 9 new rocket plans and parts lists. Shipping weight 6 oz. **Cat. No. 701- MRN-89** . . **$1.00**

MRN COLLECTION — All the above volumes at a savings of 50¢. Shipping weight 24 oz.
Cat. No. 701-MRN-17 . . . . . **$3.00**

BOOKS & LITERATURE

DESIGN MANUAL

Make sure you have this up to date and authoritative model rocket design and plan manual. Contains complete plans for the Arrow-C, Orange Bullet and many other well-known and much-flown model rockets. Also includes basic tech reports and lots of information on rocket construction. Thoroughly illustrated, this is a "must" for all beginners and a good review and reference book for experienced rocketeers. Shipping wt. 4 oz.

Cat. No. 651-P-1 ..... **Postpaid Price $ .50**

WHY MODEL ROCKETRY?

A 28 page booklet presenting clearly **why** model rocketry was developed. An ideal aid to explain your activities to a non-modeler. Shipping wt. 2 oz.

Cat. No. 651-BK-1 ..... **Postpaid Price $ .20**

OUR ATMOSPHERE By Theo Loebsack

A fascinating account of the Earth's atmosphere — its spectacular phenomena, its riddles, wonders and effects on life and the world. Probably the most complete book available to the amateur weatherman. Shipping wt. 10 oz.

Cat. No. 671-BK-4 ..... **Postpaid Price $ .75**

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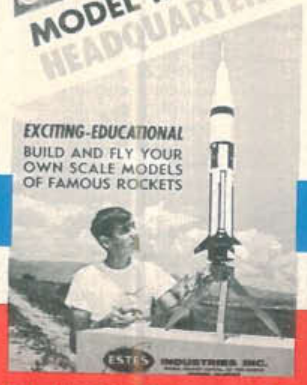

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