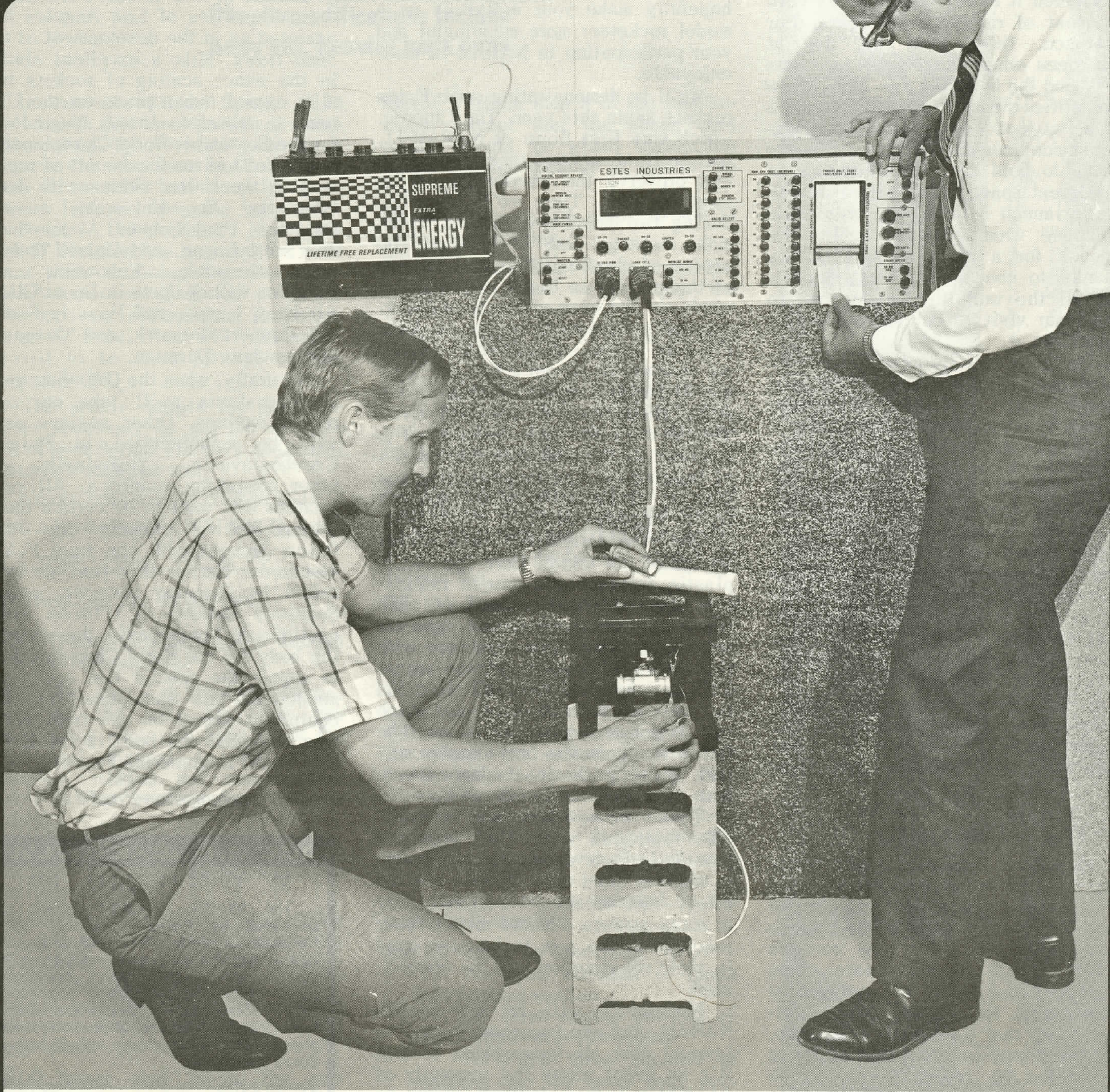
MODEL ROCKET NEWS

NARAM 12

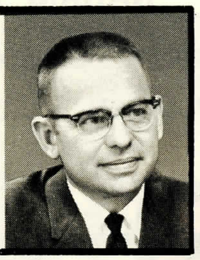
NASA MANNED SPACECRAFT CENTER

HOUSTON, AUGUST 1970



Estes electronics go to Yugoslavia (see Page 2)

NOTES FROM THE BOSS



Houston, Texas! Site for NARAM-12? My first reaction was "That's probably the hottest place on Earth! . . . Nobody but a 'nut' would go to Houston in August!" But then I remembered it hasn't been exactly cold at most of our national meets. For instance, there was that day at Aberdeen when the temperature was 100° and the humidity was 104%. (New scientific theory on super-saturation of air at rocket ranges caused by exhaust contamination). But what better place to hold a rocket meet than at this great space center where we can share launch buttons with astronauts and see what goes on behind the scenes for a moon voyage? A big thanks to the Apollo-NASA Section for all the work they have done to make our visit an enjoyable event to remember.

But there is a lot more to having a successful NARAM than just a good launch site and many interesting things to do and see. It also takes a group of model rocket sportsmen who, according to the Pink Book, are officially called "contestants". This is the most important element of the meet and their sportsman-like attitudes toward each other can not only make the meet run smoothly, but can also go a long way in helping each of us gain more benefits from our short time together. Sure, there will be moments when things don't go the way you planned. But the fellow who can bounce back, without a gripe, after a clumsy scale judge smashes his bird with a big foot is the type of individual who will someday be found qualified to share a spot on our team to land on Mars or to design an intricate system for a future spacecraft.

Many of you have worked for weeks, months, or perhaps even years on special projects in preparation for NARAM-12. Let me tell you, it's been the same here at Estes. We started preparing for NARAM-12 right after good 'ol Eleven. Many man-hours went into the design and construction of the ESTES SEMIAUTOMATIC PORTABLE ENGINE TEST SYSTEM (ESPETS). We've also come up with some small goodies for you which will hopefully make your activities as a model rocketeer more meaningful and your participation in NARAM-12 more enjoyable.

We'll be demonstrating some Estes rockets again this year. The Cineroc, which was first flown at NARAM-11, will be flown several times to capture and preserve the excitement of the meet on film. Then we'll be introducing two brand-new rockets which make selected use of plastic. The choice of plastic in the construction of these birds is based on particular needs. In the case of the *Sand Hawk,* originally designed for us by Mike Poss as a conventional scale model, we've made an all-out effort to give you a highly detailed bird to exact scale right down to the last rivet. Yet, at the same time, we've tried to not take all the challenge and fun out of building the bird by presenting you with a "shake it out of the box and fly it" beginner outfit.

The new *Interceptor* is a rocket design of the future. Here the use of plastic represents a unique integration concept. Plastic has been used where it does the job best, and its advantages have been combined with the merits of balsa wood and paper. This is a detailed bird you'll be proud to own - but definitely not one which the beginner will find easy. The fellow who puts this bird together will take great pride in its appearance both on and off the launch pad.

These two new birds will be available later this year. They both use plastic in their construction. Plastic is used in order to achieve a desired effect - not because it's an easy way to mass-produce a model rocket. Your reaction to the new techniques used in their construction will be appreciated.

NARAM-12 will be my twelfth NARAM, and one important thing I've learned over all these years is that it's an event where the ingenuity of America's best rocketeers shows us (manufacturers) what can really be done in this exciting hobby. That's why Estes Industries is proud to furnish the R & D trophies this year. Thus, we are expressing our appreciation for the contributions you make toward furthering this challenging hobby.

As a courtesy to all contestants and range crews we're also going to have a supply of cold water and suntan lotion. This won't make the "warm" Texas sun disappear, but it will make your "enjoyment" of it a little greater.

On To Yugoslavia!

Earlier in this column I mentioned that Mike Poss of Los Angeles had assisted us in the development of the Sand Hawk. Mike's excellent ability in the exact scaling of rockets has also earned him a place on the U.S. team to travel to Vrsac, Yugoslavia for the September World Championship meet. He'll share the honors of representing the United States with Jerry Gregorek, Jim Kukowski, George Pantalos, Paul Conner, Al Kirchner, Jr., Scott Layne, and Bryant Thompson. Gregorek, Kukowski, and Pantalos will compete in Boost/Glide; Kirchner, Layne, and Poss in Scale; and Conner, Gregorek, and Thompson in Parachute Duration.

Naturally, when the U.S. team goes to Yugoslavia we'll take our own rocket engines. Other engines used will be manufactured in Poland, Czechoslavakia, Yugoslavia, and other competing countries. All competitors will want to be certain those strange-looking engines the other fellow brought with him meet F.A.I. standards. Earlier this year we were asked by Svetozar Metrovic, acting Secretary General of L'Union Aeronautique de Yougoslavie, the organizing body for the World Championship, to supply the special test equipment needed for this assurance. Thus the equipment shown on the front cover was designed and built in the Estes Electronic Engineering Facility.

(continued on Page 12)

Cover photo

Our cover shows Mack Eppler (L), Estes electronics technician, and Earl Estes (Vern's brother), director of the company's Electronics Laboratory, with the brand new portable model rocket engine tester they designed and built. All mechanical components for the unit were fabricated in the Estes Machine Shop.

The highly-sophisticated tester is scheduled to travel to Europe in September with Vern and Gleda Estes for the World Championships at Vrsac, Yugoslavia.

MODEL ROCKET NEWS

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The MODEL ROCKET NEWS is published by Estes Industries, Inc., Penrose, Colorado. This publication is written for America's model rocketeers to promote safe youth rocketry, distribute current technical information and make model rocketry more enjoyable and educational. Current issues of the MRN are distributed free of charge to all active Estes customers.

Vernon Estes------------------------Publisher
Frank Genty-----------------------------Editor
Gene Street------------------Chief Illustrator

REAR-EJECTION SPRINT FOR ULTIMATE PERFORMANCE

by
Larry Renger
Research and Development Division
Estes Industries

Simple modifications include body cut, heavier nose cone

In contest altitude flying, it is well known that rear ejection systems reduce drag. By eliminating the break between the nose cone and body tube, flow is smoother and more likely to remain laminar along the body tube.

Design Development at Estes R & D Division has removed the nose joint while retaining the total reliability expected of Estes products. The recovery system from Estes Industries Free Plan #40 "Mitosis" proved to be ideal for use on the Astron Sprint.

The article details the modifications necessary to get the ultimate out of your Sprint. The only additional materials required are:

1 nose cone weight (701-NCW-1)

1 tube body putty (651-FM-1)

1 stage coupler (651-JT-50C)

Modifications are as follows:

(1) Proceed with steps 1 through 5 in the instructions.

(2) Do step 7 in the instructions, then cut the body tube into two lengths (as shown on page 64 of the Technical Manual in the Estes catalog), making the rear section 2-1/4". The front section will be 7-1/4".

(3) Install the engine holder into the short rear tube, as per step 6 in the instructions.

(3a) Cut the launch lug (Part #LL-2A) into two 1/4" lengths, as illustrated in step 8 of the instructions. Glue one launch lug 4-1/4" forward from the body break and the other one immediately ahead of the body break.

(4) Smear glue inside the rear body tube ahead of the engine holder. Slide the stage coupler down flush with the top of the engine holder.

(5) Perform step 9 of the instructions, except that the shock cord mount should be glued inside the stage coupler instead of inside the body tube.

(6) Proceed with steps 10 and 11 of the instructions.

(7) In step 12 of the instructions, install the nose weight under the screw eye.

(8) Perform step 13 of the instructions.

(9) Run the shock cord through the body tube, tie it to the screw eye, and then glue the nose cone into the front of the body tube.

(10) Using body putty, fill and smooth out the nose cone and shroud joints until they are completely gone. Body putty is useful for smooth fin fillets, too.

(11) Proceed with steps 14 through 16 of the instructions. For streamer recovery, attach the streamer in the manner specified, but about 3" from the rear body section. If a parachute is to be used, attach it as follows: Fold a tape disc double over the shock cord about 3" from the lower body section. Poke a hole through the disc just beside the cord. Clip the snap swivel around the cord through the hole. (To get reliable chute deployment, pass the last wrap of the shroud lines over the top of the chute as it is inserted in the upper body section).

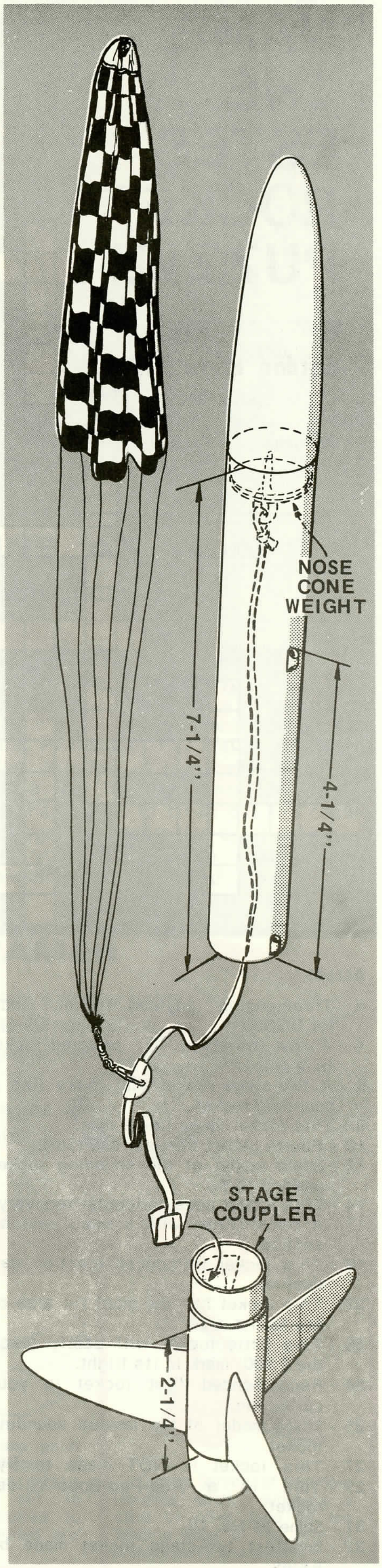
(12) Setup for launching:

(a) Load streamer or chute into forward section.

(b) Load engine per #12 of the Countdown instructions.

(c) Pack three squares of wadding into the lower body section.

(d) Slide the two body sections together.



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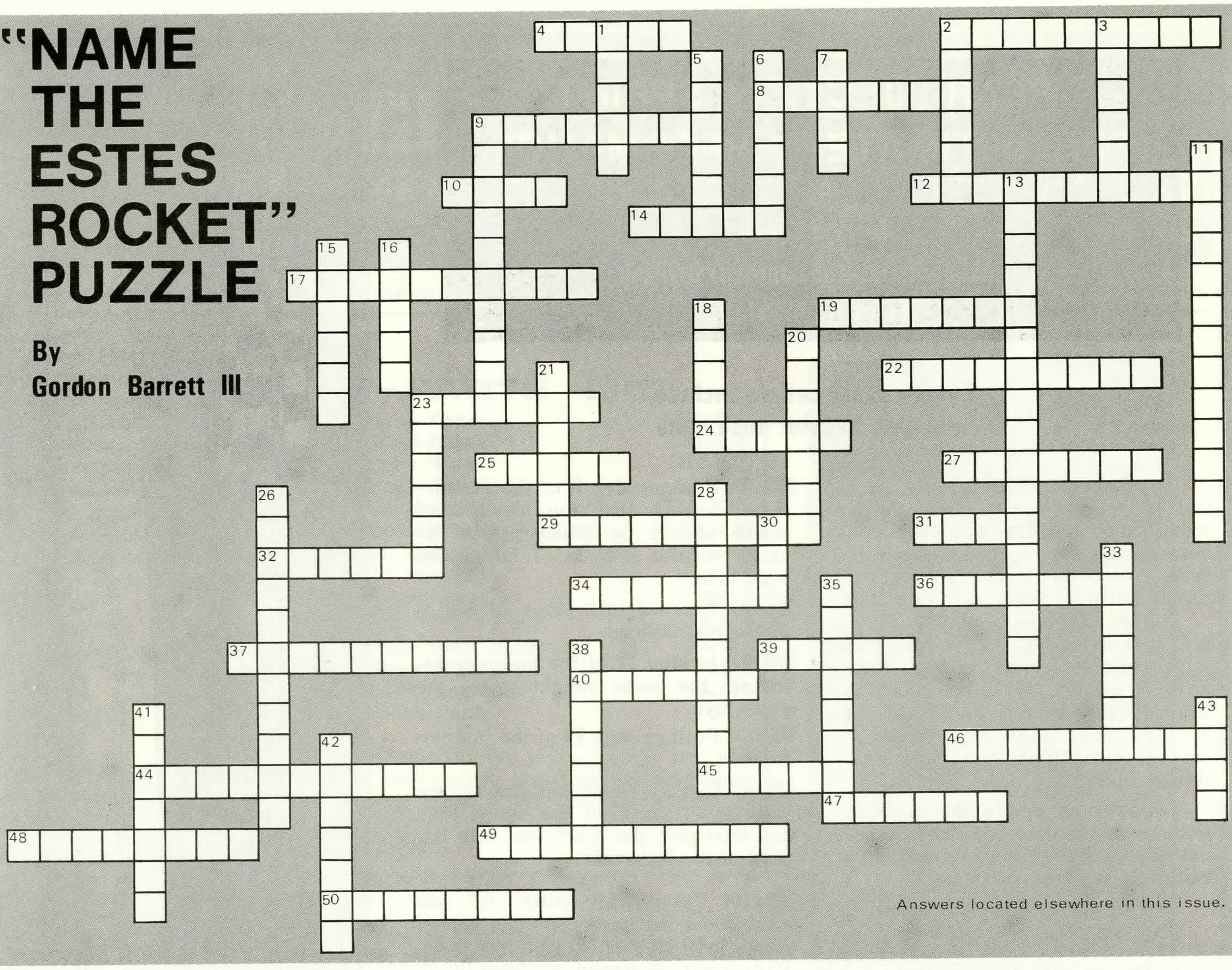
"NAME THE ESTES ROCKET" PUZZLE

By
Gordon Barrett III



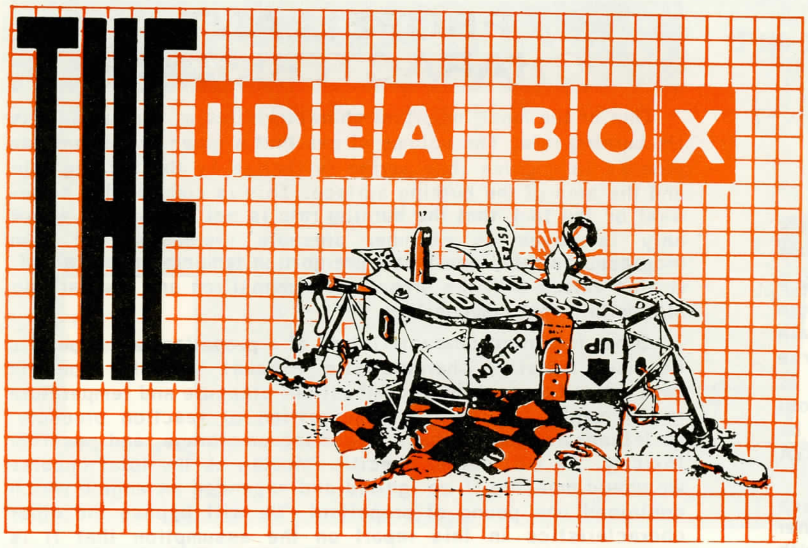
Answers located elsewhere in this issue.

Across

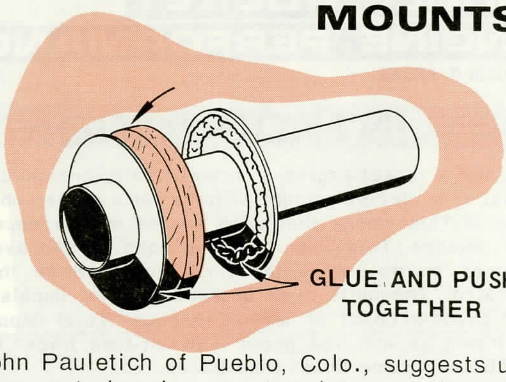
2 - Three-engine, payload rocket, made for EGGS!!!!
4 - A new two-stage "D" powered rocket by Estes.
8 - A two-stage rocket that looks like a sounding rocket.
9 - This rocket looks like a man.
10 - Fourth planet from our sun (Sol).
12 - Scale model of the sounding rocket used in IGY.
14 - This rocket uses helicopter recovery.
17 - A Boost-Glider with a small payload section.
19 - This rocket introduces ejection gas ducting.
22 - This rocket has the most fin area of any for its size.
23 - This little rocket will easily reach the 2,000' mark in its flight.
24 - Recommended first rocket in your collection.
25 - Scale model of the famous sounding rocket.
27 - This rocket is NOT made to fly.
29 - This is a Pop-Pod-Boost-Glider rocket.
31 - Same as No. 10.
32 - Smallest two-stage rocket made by Estes.
34 - Greatest breakthrough in rocket photography.
36 - This rocket is called the Mars ––––––––.
37 - Rocket used to test the Apollo capsule in suborbital flights.
39 - This rocket was named after a kind of RAY.
40 - Highest point of any rocket's flight.
44 - This rocket is called –H–R –G–N–.
45 - A perfect rocket for the Camroc.
46 - This rocket looks like the Ranger but uses one engine.
47 - This one is called Mars ––––––.
48 - The launch vehicle before the Saturn V.
49 - The Army's Surface-to-Surface Ballistic Missile.
50 - Booster for Alan Shepard's Mercury capsule.

Down

1 - The name of the company where these rockets are built.
2 - The first two-stage rocket with the Pop-and-Go staging.
3 - A little –––––– told me about this one.
5 - This rocket looks like the Big Bertha but it uses three engines.
6 - This rocket takes one picture per flight.
7 - A good looking two-stage rocket using series III engines.
9 - It has a forward crew cockpit canopy.
11 - This rocket has landing shocks on its fins and is also a payload rocket.
13 - This rocket is a possible way of inter-planetary travel in the 1980's.
15 - This rocket has a ring around its fins.
16 - This rocket's engine pops 1/2 way out to change the CG.
18 - Name of a snake found in India.
20 - This rocket is called –K–H–O–.
21 - A wonderfully performing Boost-Glider.
23 - This is a new high altitude rocket which will get to 1,600' with a C6-7.
26 - The rocket before Apollo.
28 - The first "D" powered rocket.
30 - The first part of the ––– Corporal.
33 - This rocket is called –RI–TE–.
35 - Its name is a military rank.
38 - The only three-stage rocket by Estes.
41 - The name of the rocket that put man on the moon.
42 - The first manned space program in the U.S.
43 - This rocket comes with streamer in the kit itself.



STRONGER ENGINE MOUNTS



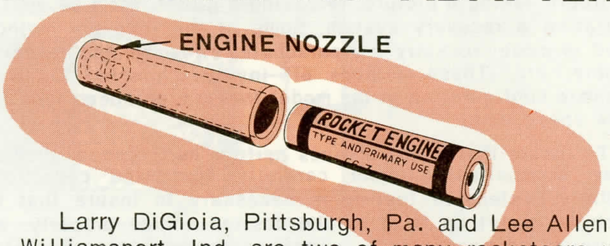
John Pauletich of Pueblo, Colo., suggests using a paper centering ring as a template to make a balsa centering ring. This gives extra gluing surface and strength to engine tube mountings in large body tubes.

HANDY IGNITER HOLDER

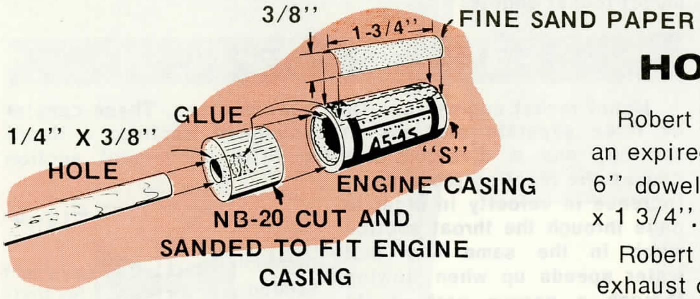
Ever have trouble keeping igniters ready and handy?

Joseph Lozito of Long Island City, N.Y. uses an empty match book to carry his igniters around. The abrasive portion of the match book can also be used to clean micro-clips.

"D" ENGINE AS ADAPTER



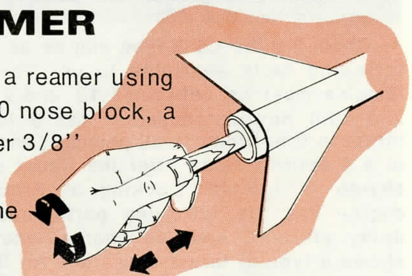
Larry DiGioia, Pittsburgh, Pa. and Lee Allen of Williamsport, Ind. are two of many rocketeers who have suggested a use for expended "D" engine casings. Use a sharp knife to clean out the casing and slightly enlarge the nozzle for ejection gases, thus converting your "D" engine casing to an adapter for launching a "D" bird with B or C engines.



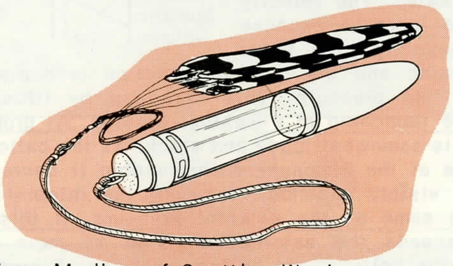
HOMEMADE REAMER

Robert Heil of Rosedale, N.Y. made a reamer using an expired "S" engine casing, a NB-20 nose block, a 6" dowel and a strip of fine sand paper 3/8" x 1 3/4".

Robert uses it for cleaning the engine exhaust deposits and glue out of his tumble and featherweight rockets.



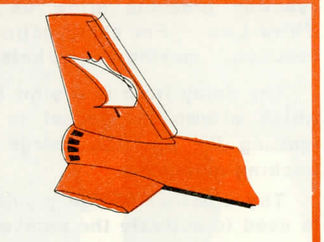
HINT TO ALL SCRAMBLER OWNERS



Tony Medina of Seattle, Wash., suggests using a shock cord between the parachute and the payload compartment of the Scrambler or similar bird.

PAINT CORNER

For easy to make paint designs, Bruce Burger of Syosset, N.Y., uses PRM-1 reinforcing paper cut to wanted design, applied to model, and then painted and removed.



Dennis Shively of Dearborn Heights, Mich., suggests a strip of clear tape on the leading edge of the fins to protect paint and decals.

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ESTES INDUSTRIES TECHNICAL NOTE TN-2 MODEL ROCKET ENGINE PERFORMANCE

BY EDWIN D. BROWN

INTRODUCTION

A model rocket engine is scientifically designed to produce a relatively precise amount of force for a predetermined length of time. This means that each engine will produce a certain total impulse. Total impulse being equal to the average force produced multiplied by the time during which the force is generated. The units used to measure total impulse are most often pound-seconds or newton-seconds. Total impulse can be illustrated as the area under a thrust-time trace. Figures 1A and 1B show some thrust-time traces.

When a model rocket engine finishes producing force, which we will refer to as thrust, it may be used to ignite another engine automatically (staging), or the engine may be made with a delay element which ignites an ejection charge at a predetermined length of time after thrust has ceased. This ejection charge provides a quantity of gas which is used to operate various secondary devices (activating or de-activating a circuit, taking a picture, releasing a glider, etc.) as well as operating a recovery system. Some of the recovery methods used in model rocketry are parachute, streamer, featherweight tumble, etc. These methods all involve changing the aerodynamic configuration of the model from a high speed form to a slow speed form.

To insure that Estes engines perform as intended, they are made automatically under carefully controlled conditions. Initially, extensive testing is necessary to insure that the machine is set up to make the desired engine properly, and continued testing must be performed throughout a production run in order to insure that they continue to conform to the intended standards.

Testing, in itself, does not assure quality unless we know what we are checking for and why. In the following sections we will attempt to describe the engine, its operation, and some of the general tests which are performed.

THE ENGINE

Choosing the C6-5 type engine as an example, we have the following facts available to us: The C means that the total impulse must be between 1.13 and 2.24 pound seconds (5.01 and 10.0 newton seconds); the 6 tells us that the average thrust is 6 newtons (1.35 pounds); and the 5 tells us that there is a 5 second delay after the thrust stops before the ejection charge is ignited. Looking at Figure 2, we see that this engine has the following parts: casing; nozzle; propellant; delay element; ejection charge; and retainer cap. Figure 3 shows a typical thrust-time trace for this engine.

The nozzle guides the products of the chemical reaction as they are ejected from the rocket engine.

The propellant is a composite which produces the reaction products by a self-sustaining combustion process. These reaction products allow us to take advantage of Newton's Third Law, "For every action there is an equal and opposing reaction," making our rockets fly.

The delay train is a slow burning, smoke producing mixture which allows the rocket to reach its peak altitude before igniting the ejection charge and provides a smoke trail for tracking purposes.

The ejection charge provides a fixed amount of gas which is used to activate the recovery system, etc.

The retainer cap serves only to retain the ejection charge until it is ignited.

Since the propellant and the nozzle determine the major portion of the engine's performance, we will discuss them further in the next sections.

PROPELLANT CHARACTERISTICS

One of the most important characteristics of a propellant is its burning rate. The volume of gas that a given propellant can produce in a given time period is limited by the burning rate and the area of the burning surface. This is complicated somewhat by the fact that the burning rate is not a constant. It not only increases as chamber pressure increases, but also increases as the propellant's preignition temperature is raised. It also varies with the propellant composition and the particle size within that composition.

Other important characteristics of a propellant are: specific impulse; density; characteristic exhaust velocity; specific heat ratio; temperature of combustion; pressure and temperature requirements for ignition; composition of reaction products; resistance to damage due to handling or storage, and possible toxicity. We will define specific impulse as the total impulse we would measure if we ignited and expended an engine which contained one pound of propellant. We will bypass the other characteristics in this report on the assumption that it is sufficient to know that it is not a simple subject.

PROPELLANT GRAIN DESIGN

The primary purpose of varying propellant grain design (grain geometry) is to give the burning area necessary to produce the desired chamber pressure. The most common grain design found in model rocket engines is a combination of core burning and end burning as shown in Figures 2 and 4. Core burning is also known as progressive burning since the burning area obviously increases with time. End burning is sometimes called neutral burning since the burning area remains constant. The purpose of combining the two types in model rocket engines is to provide a high initial thrust to accelerate the rocket to a high enough speed to stabilize it while it is still being guided by the launch rod, and to bring the model up to its maximum speed more or less gradually to minimize drag buildup. (Drag is proportional to the square of the velocity.) Figure 4 illustrates the burning of the propellant in a typical model rocket engine.

THE NOZZLE

Model rocket engines use De Laval Nozzles. These consist of three separate sections: a convergent section; a throat section; and a divergent section. The convergent section causes the reaction products to increase in velocity in order to pass through the throat section much in the same way that water speeds up when flowing through a narrow part of its channel. The model rocket engine has no true convergent taper; the gases are forced to exit through the small throat of the nozzle. In the divergent section things become slightly more complicated. The velocity continues to increase because we are exhausting to a lower pressure region and the gaseous reaction products are expanding to this pressure. This idea can be illustrated by watching the launching of a weather balloon. At ground level the balloon is somewhat loose and slack. As the balloon rises, the pressure of the atmosphere surrounding it decreases, and the balloon visibly expands. However, the internal pressure remains the same as the external pressure. If this internal pressure exceeds the external pressure by more than the strength of the balloon, the balloon ruptures. Figure 5 illustrates what happens to the velocity, pressure and specific volume (volume occupied by a unit of mass) of gaseous reaction products in a De Laval nozzle.

Fig. 5

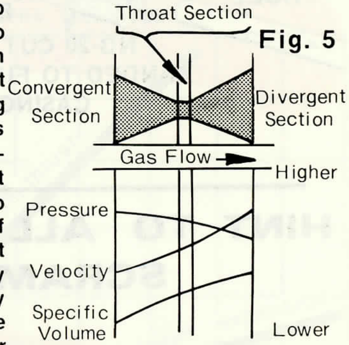


Fig. 1A

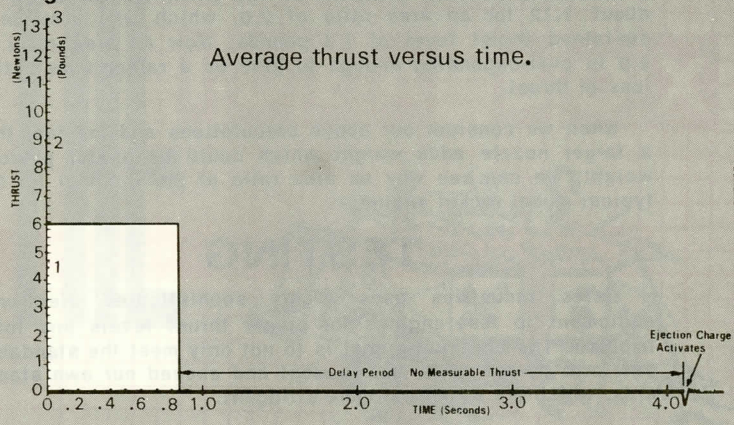


Fig. 1B

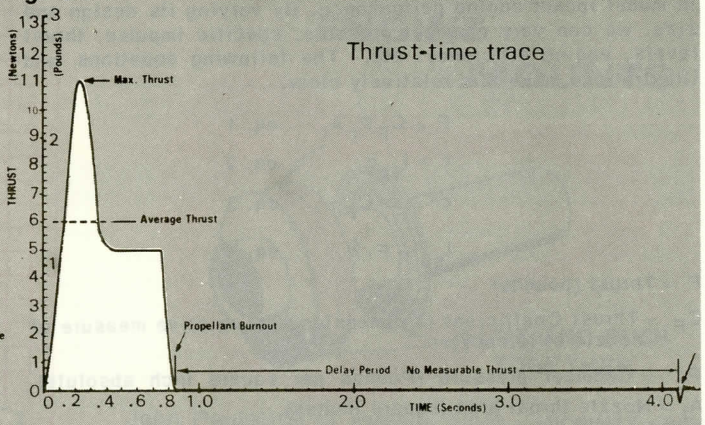
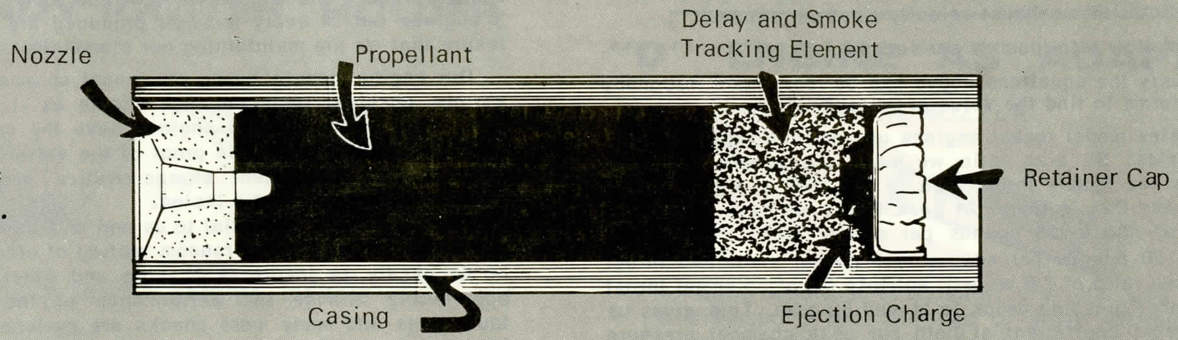
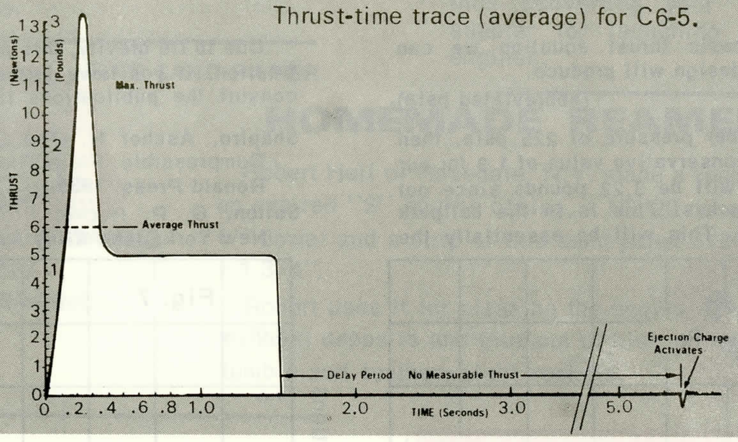


Fig. 2



Cutaway of C6-5 engine. Fig. 2

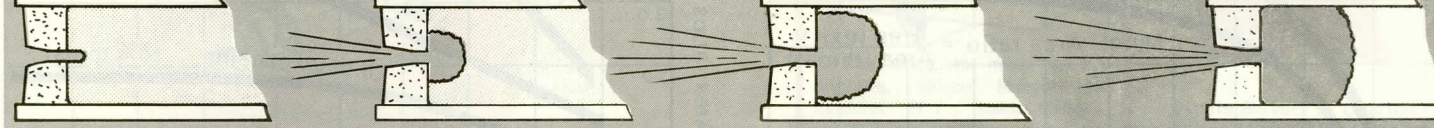
Fig. 3



Thrust-time trace (average) for C6-5.

Fig. 4

Transition from core to end burning



T=0 Time Increasing →

Once grain design and propellant composition are fixed, then the nozzle and its design become the controlling factors in model rocket engine performance. By varying its design and size, we can vary chamber pressure, specific impulse, thrust levels, engine efficiency, etc. The following equations and illustrations make this relatively clear.

$$F = C_F P_c A_t \quad \text{eq. 1}$$

$$c = I_{sp} g \quad \text{eq. 2}$$

$$c^* = c / C_F \quad \text{eq. 3}$$

$$I_{sp} = F / \dot{W} \quad \text{eq. 4}$$

F = Thrust (pounds)

C_F = Thrust Coefficient (a dimensionless, relative measure of nozzle efficiency).

P_c = Chamber pressure (Pounds per square inch absolute).

A_t = Nozzle throat area (square inches).

c = Effective exhaust velocity (feet per second).

I_{sp} = Specific Impulse (seconds). A measure of propellant efficiency.

g = Acceleration due to gravity (32.17 feet per second^2).

c^* = Characteristic exhaust velocity (feet per second).

$\dot{W}$ = Weight flow rate (pounds per second).

Obviously the equations above can be rearranged into many different forms to find the value of various terms.

The Estes model rocket engines use an area ratio of 2.0 in their nozzles. By area ratio we mean the nozzle exit area divided by the nozzle throat area. If you look at figure 7, you will see why this is done. At peak thrust we have a chamber pressure of about 225 pounds per square inch†. This drops to about 100 pounds per square inch during sustained thrust. With an area ratio of 2.0 we will not lose 5% of potential thrust until chamber pressure drops to around 60 psia. This gives us a good thrust coefficient at both our peak chamber pressure and at our sustained chamber pressure. With an area ratio of 4.0 there would be a loss of more than 5% until a chamber pressure of 160 psia is reached. A few simple calculations should show this more clearly.

Using equation 1 as a basic thrust equation we can determine the thrust an engine design will produce.

† (abbreviated psia).

If we assume a peak chamber pressure of 225 psia, then refer to figure 6 and choose a conservative value of 1.3 for our C_F, we know that our thrust will be 3.22 pounds since our throat area is 0.011 square inches. This is in the ballpark that we indicated in Figure 3. This will be essentially the same for an area ratio of 2.0 or 4.0. However, when we assume a sustained chamber pressure of 100 psia, we get a C_F of about 1.12 for an area ratio of 2.0, which will give us a sustained thrust level of 1.3 pounds. Now an area ratio of 4.0 is over-expanding enough to give us a rather substantial loss of thrust.

When we consider our above calculations and the fact that a larger nozzle adds weight which could be useful payload weight, we can see why an area ratio of 2.0 is ideal for the typical model rocket engine.

TESTING

Estes Industries uses highly sophisticated electronic equipment to test engines for proper thrust levels and total impulse. The continuing goal is to not only meet the standards set forth by the NAR, but to meet and exceed our own standards, which are somewhat more stringent.

As we set up to manufacture a certain type of engine, we may need to test only 5 engines before we are within our specification, but it is not uncommon to test upwards of 20 engines and discard several hundred before we are satisfied. As we produce the engine we continue to test. Approximately 3 engines out of every hundred produced are static tested to insure that we are maintaining our standards.

Our engine manufacturing equipment automatically performs various physical tests on each engine as it is made. These tests help insure that all engines have the correct amount of propellant, delay, etc. The proof of the validity of these tests is that very consistent characteristics are maintained as sample engines are static tested.

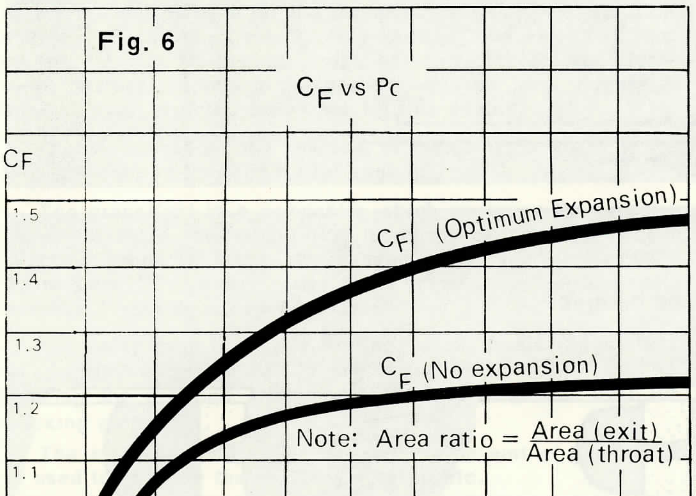
Since quality is essential to us and to America's rocketeers, our testing also includes random testing of older engines. This is necessary to insure that aging and other factors do not appreciably change the performance of the engines. Test launchings and many more checks are performed on a random basis.

NOTE TO READER

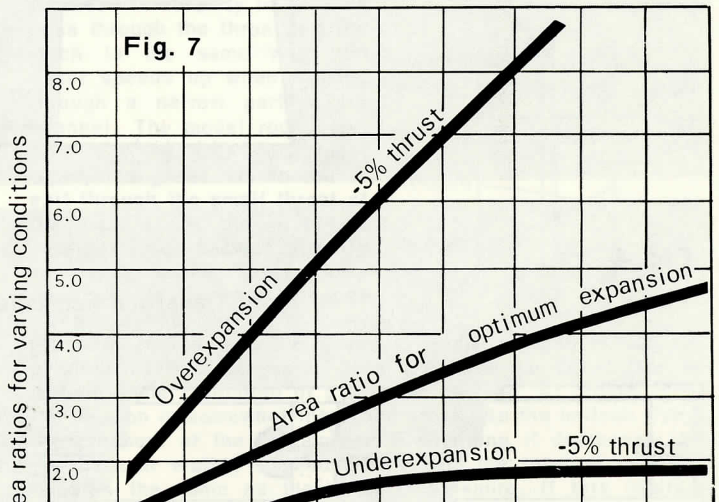
Due to its brevity, this paper suffers much from over simplification. If you have further questions, we suggest that you consult the publications listed below or similar references.

Shapiro, Ascher H. The Dynamics and Thermodynamics of Compressible Fluid Flow. Volumes 1 and 2. New York: Ronald Press, 1953

Sutton, G. P. Rocket Propulsion Elements, Third Edition. New York: John Wiley and Sons, Inc., 1963

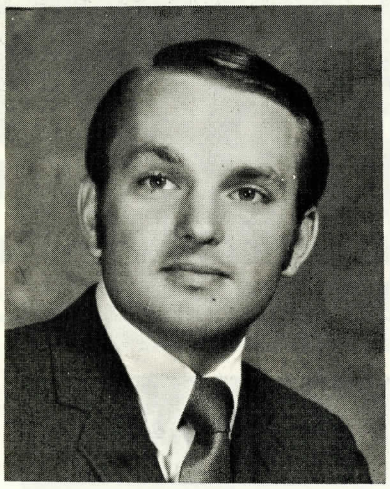


Pc Chamber Pressure (psia)



CF Chamber Pressure (psia)

JOINS ESTES



DANE BOLES

Effective September 1, Dane Boles, 22, formerly NAR Pacific Division Manager, will become Director of the Rocketeer Communications Department at Estes Industries. Dane, a graduate of the University of Southern California, has been Recreation Leader for the Recreation and Parks Department in West Covina, California, as well as Head Recreation Advisor for the West Covina Model Rocket Society. In his new responsibilities with Estes Industries, Dane will report to Robert L. Cannon, executive director of the Communications Division.

ANSWERS TO PUZZLE

Across

2 - Scrambler
4 - Omega
8 - Avenger
9 - Spaceman
10 - Mars
12 - Aerobee 300
14 - Gyroc
17 - Space Plane
19 - Trident
22 - Starlight
23 - Streak
24 - Alpha
25 - Arcas
27 - Phantom
29 - Nighthawk
31 - Mars
32 - Midget
34 - Cineroc
36 - Snooper
37 - Little Joe II
39 - X-Ray
40 - Apogee
44 - Thor Agena-B
45 - Delta
46 - Big Bertha
47 - Lander
48 - Saturn 1B
49 - Honest John
50 - Redstone

Down

1 - Estes
2 - Shrike
3 - Birdie
5 - Ranger
6 - Camroc
7 - Beta
9 - Starblazer
11 - Constellation
13 - Orbital Transport
15 - Sprite
16 - Scout
18 - Cobra
20 - Skyhook
21 - Falcon
23 - Sprint
26 - Gemini Titan
28 - Cherokee-D
30 - Wac
33 - Drifter
35 - Corporal
38 - Farside
41 - Saturn V
42 - Mercury
43 - Mark

Careful preparation of your rocket can eliminate "bad luck" in contests

by Larry Renger

Your club is going to have a meet, right? You are going to wipe 'em out with your just built Super-Secret-Gee-Whiz-Mark 7-a, right?

So, Contest Day is here and you are "on-line", count-down, and launch! That surely did wobble going up, better add some nose ballast! Oh, well, you have another attempt, this time you're just a leetle nervous, the hands maybe shake just a bit? Count down, ignition! Ignition? Nobody home! Well, why does bad luck always have to come to contests? Retrieve the rocket and find that the igniter burned, but the motor was not started. "Why me?" you say! Well, maybe you rushed and installed the igniter poorly.

This article is intended to change your "luck". "Bad luck" is a malfunction taking the opportunity you gave it to go wrong.

FIRST: The model. It pays to have a specific model for each event, and duplicates for some! The model for contest work requires your best building ability.

Take your time. Build long before the contest. Sand thoroughly where needed with fine paper. Polish with rubbing compound and wax the finish on high altitude and payload models. For boost glider, spend several different calm evenings hand gliding the glider to achieve minimum sink rate and a smooth wide turn.

Test launch your model and get it trimmed; rockets shouldn't wobble or spin (unless spin stabilized, of course). A boost glider should make the transition to glide almost at the peak altitude.

Then put the model away till contest day! Once it is working right, leave it alone so you won't accidentally damage it. Be sure to pack up your model so it is not resting on its fins. Balsa warps and will ruin all that careful trim.

SECOND: Motor preparation. About a week before "THE DAY", choose the motors to be used in the contest. Install the igniters beforehand if possible. If you are really a perfectionist and live in a damp climate, purchase some silica-gel from your local drug store and put it in a "Baggie" with the engines you plan to use. Silica-gel is a "desiccant" and will absorb the moisture out of the air much more readily than the propellant will. This prevents possible alteration of the thrust the rocket engine can produce.

If the contest is on a very cold day keep your "Baggie" of motors inside your jacket so they will stay near body temperature. Cold motors and damp motors lose impulse.

THIRD: Flying technique. Here is where that testing you did will pay off. By now you should know the flight characteristics of your model thoroughly. On altitude flights tilt the launcher to compensate for wind so that the rocket flies straight up. Pick the chute size for the prevailing wind conditions so you get your model back! A superb flight ending in a lost rocket is a lost contest. A little talcum powder poured between the engine and the wadding helps trackers by giving a nice white puff.

As with cold engines, cold parachutes are a "loser". Plastic gets hard as it cools down, and a cold 'chute can fail to open. For altitude shots use streamer recovery to cut down on drift.

Keep a check list in your field box and go over it the evening before the contest. The next morning all you have to do is pick up your box and rockets and go. Nothing is more frustrating than to get to the field and find you forgot some vital item like glue, tape, scissors, chutes, igniters, motors, launch stand, model, batteries, etc.

Use the shortest launcher that you are sure will give you a stable launch and which the contest director permits for the meet you are attending. A launcher has much more drag than air does.

When it is your turn to fly, be sure to prepare the stand carefully. Clean the micro-clips with sandpaper. Wipe down the launch rail or rod or tower with a silicone-treated rag. The exhaust of previous launches leaves a gritty film which will slow down your bird and tend to rotate it if you launch off a rod or rail. Do not use graphite as a lubricant for the launch rod. When the rod is clean, it may be very lightly oiled or treated with silicone spray or a silicone-treated cloth. Always wipe off all visible films from the launch rod.

When setting your micro-clips onto the igniter, set them so as to have as short an igniter wire as possible. For boost-gliders, be sure that the clips will not hit a part of the glider as they fall free.

In closing, the most powerful secret weapon in your contest arsenal is careful preparation. GOOD LUCK!

Estes Industries Rocket Plan No. 72

KAMIKAZE BAKA

MAY 1970 DESIGN OF THE MONTH WINNER

by Ted Nomura Las Vegas, Nevada

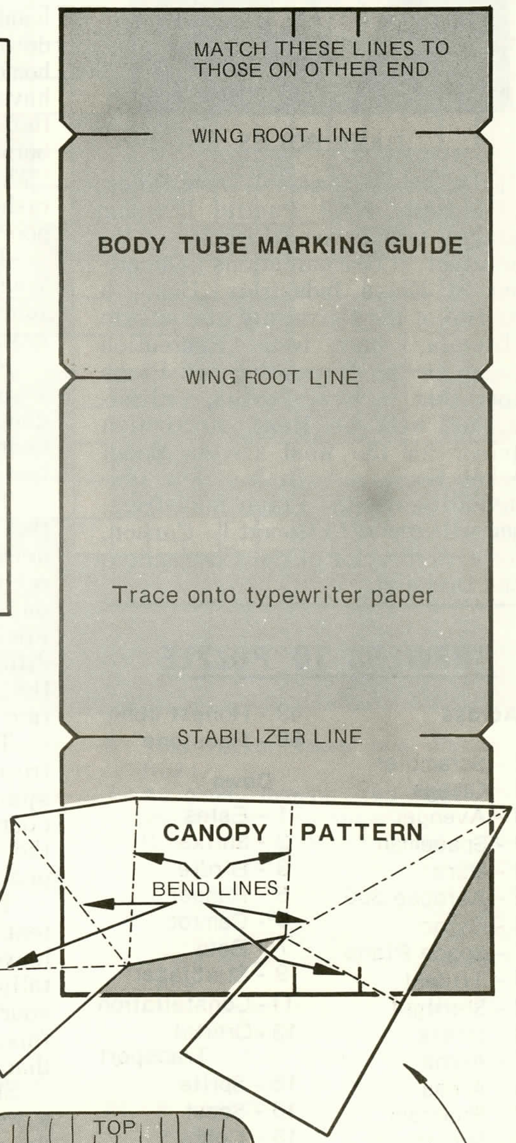
PUBLISHED AS A SERVICE TO ITS CUSTOMERS BY ESTES INDUSTRIES, BOX 227, PENROSE, COLO. 81240

The "Kamikaze Baka" presented here is a striking replica of one of the most fearful aerial weapons of World War II. Developed by the Japanese toward the end of the global conflict, this rocket-powered flying weapon was designed to be crashed onto the decks of American warships. It was flown by dedicated men who knew they would never come back from their suicidal missions.

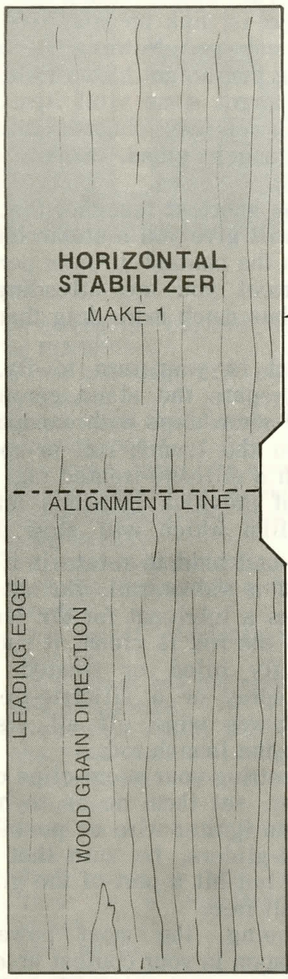
PARTS LIST

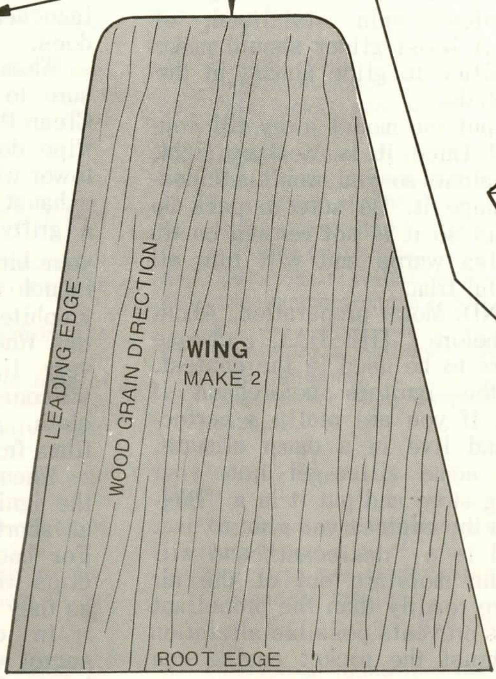
1	Nose Cone	BNC-60L
2	Sheet Balsa	BFS-30
1	Body Tube	BT-60D
1	Body Tube	BT-20B
4	Centering Ring	RA-2060
1	Clear Plastic Fin Stock	CFS-20
1	12'' Parachute	PK-12
1	8'' Parachute	PK-8
1	Engine Holder	EH-2
5	Balancing Weight	NCW-3
2	Nose Cone Weight	NCW-2
1	Screw Eye	SE-2
2	Launching Lug	LL-2A
1	Shock Cord	SC-1

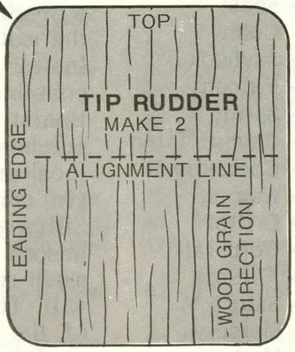
In addition to the parts listed, you will need white glue, model knife, sandpaper, masking tape, white and red enamel or dope and a 3'' x 3'' piece of scrap PRM-1 for insignia.



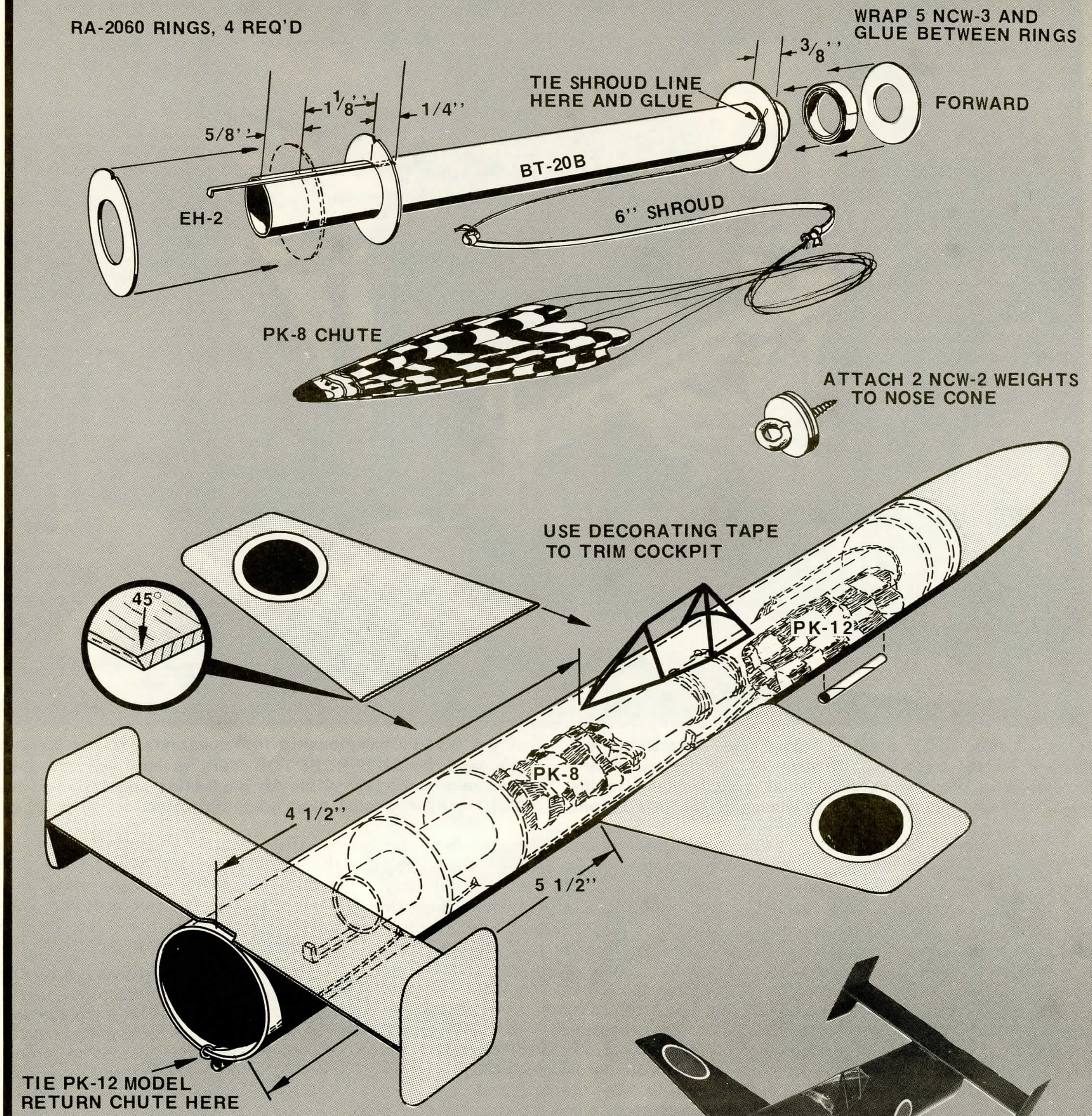
Trace these patterns directly onto the sheet balsa

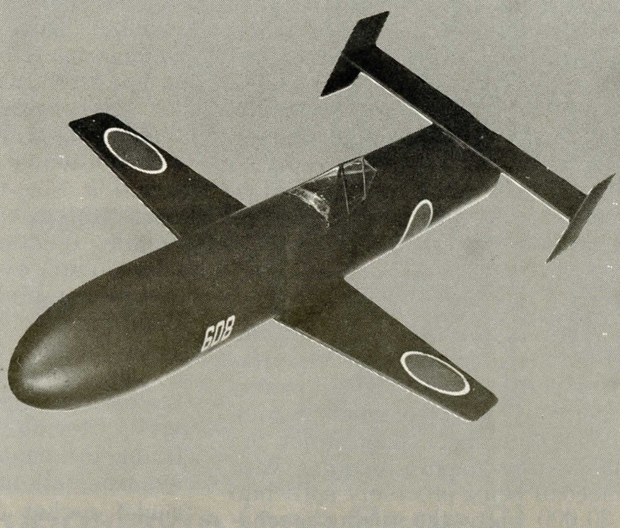






Tape clear fin stock over canopy pattern. Cut on heavy outlines. Bend on bend lines, tape joints, and apply clear dope to inside of joint edges.





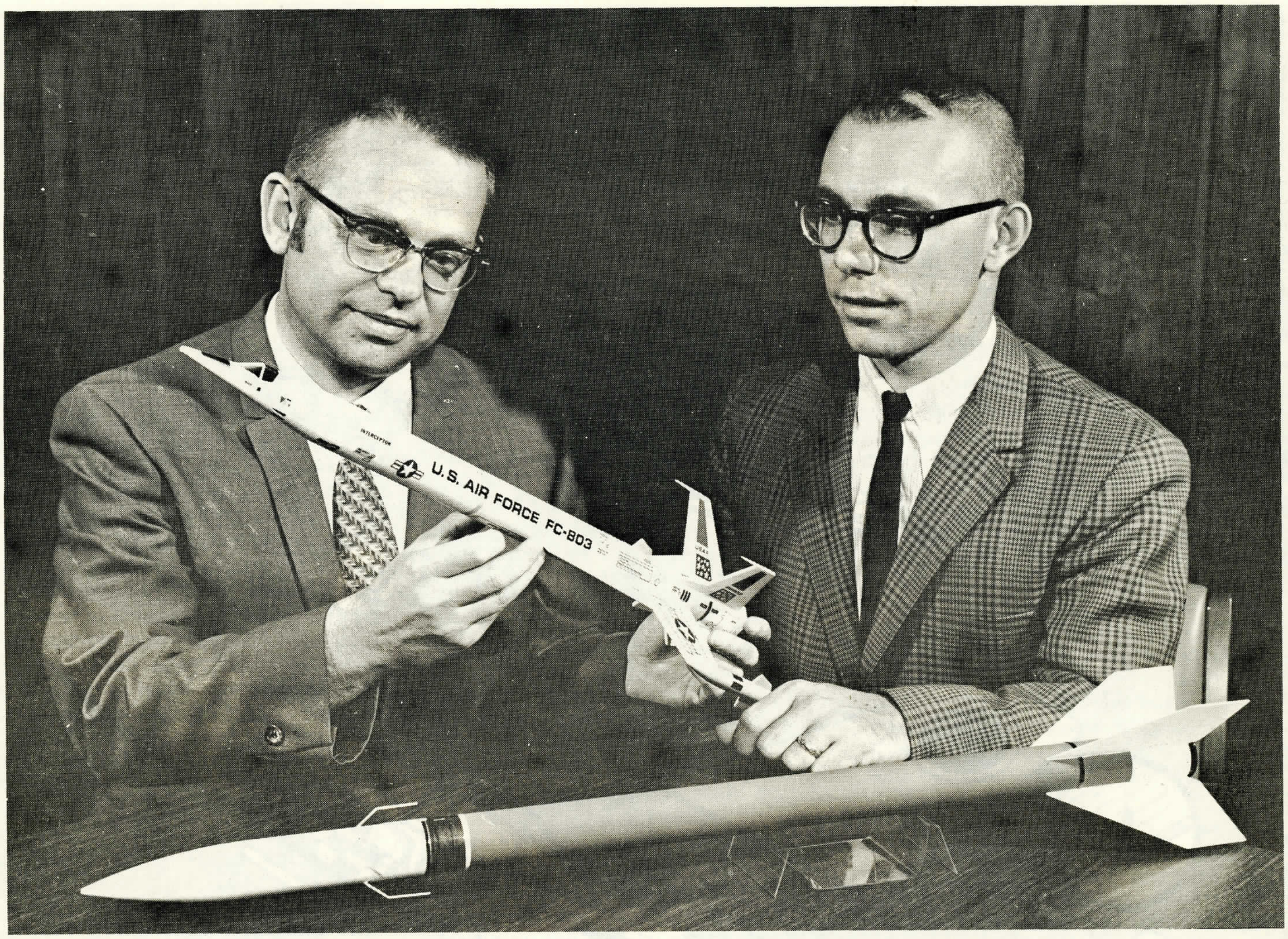
CONSTRUCTION NOTES

Rings must be sanded to slightly smaller diameter for slip fit in BT-60.

Do not wrap model return chute around tube or the 2 parts won't separate. Just pack the chute normally and stuff it in the center space.

The booster chute can be simply rolled around the booster tube.

Balance point "loaded" must be no further aft than 7 1/8" forward of rear of tube.



Vernon Estes (left), president of Estes Industries, and William Simon, executive director of the Research and Development Division, give a final visual check to the new Estes rockets that will be flown at NARAM-12 and at the World Championship in Yugoslavia. Wayne Kellner designed the INTERCEPTOR Vern is holding, and John Simmance was responsible for production adaptation of the SAND HAWK design that was submitted by Mike Poss.

(continued from Page 2)

Actually, this is Engine Tester Design No. 5 for Estes Industries and has been affectionately named ESPETS. Boy! We old-timers can hardly believe the complexity of a device like this. A few years ago it would have taken a whole room full of vacuum tubes to do the job. But now, using only 75 solid-state integrated circuits and a hundred or so transistors, its analog and digital computing devices can be packed into a mere 54 pounds - most of the weight being cabinet and framework.

Inside the 12-volt, battery-operated ESPETS is a crystal-controlled oscillator. This is the basis for all the timing and synchronization circuits. Counting down from 30.720 kilohertz, a 60 hertz signal is produced which provides exact speed control for the thermal writing graphic recorder. With each second being precisely split into over 30,000 parts the timing mechanism establishes an exact time base for accurate time function calibrations.

During tests, signals from the temperature-compensated load cell are fed into ESPETS' internal computer and logic system where they are electronically converted into meaningful information on peak thrust, total impulse, burn time, and time delay. Once computed the information is held in ESPETS' integrated circuit memory for later selective readout from the digital display. Simultaneously the self-contained graphic recorder produces a time-thrust curve, and then switches to an inverted mode to display ejection charge characteristics. Two event markers indicate periods of electronic thrust integration, thrust duration, and time delay measurements. In addition, the recorder can be set to graphically display the total impulse integration curves or verify timing integration linearity. Using the analog and digital readout systems, all the major parameters of model rocket engines can be determined and recorded in less than one minute per engine.

After returning from Yugoslavia the ESPETS system will be put into regular use along with the even more sophisticated, but not portable, Engine Tester No. 3 in the Engine Manufacturing Division at Estes.

Estes Industries will also have the privilege of sponsoring one of the U.S. team members. Gleda (Mrs. Estes) will be helping us demonstrate rockets such as the unique Cineroc, various scale models, and advanced design concepts like the Orbital Transport and Interceptor. It will be a busy time for exchanging rockets and engines and of course taking photos which we will later share with you through the pages of Model Rocket News.

The whole Estes family will be there rooting and cheering for the U.S. team as we strive to bring home the big trophies and keep our well-established lead in model rocketry.

Vern