enerjet news

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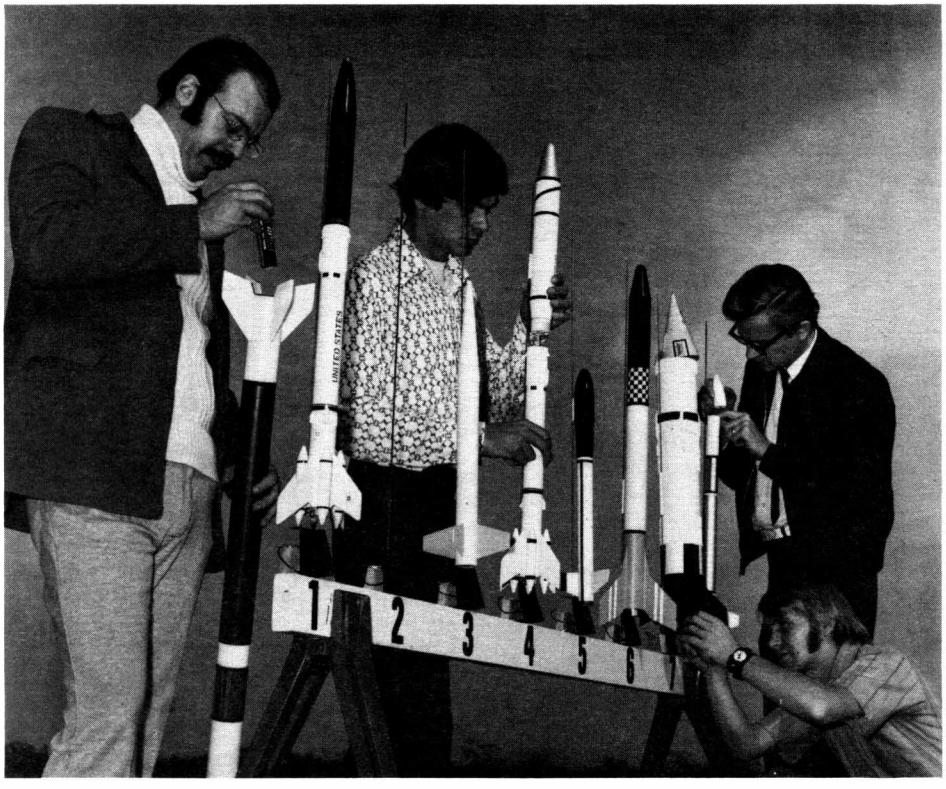
WE'RE STEPPING OUT!



INTRODUCING:

NEW ROCKETS

A whole new line of rocket kits especially for advanced modelers. Enormous Payload birds, contest rockets and much more!

FANTASTIC NEW MOTORS

The highest performance and quality model motors available anywhere . . . with high energy plastic fuel. You won't believe your eyes.

ENERJET NEWS

A special service to our customers. For experienced rocketeers: Everything you wanted to know, but were afraid to ask.

LETTER FROM THE EDITOR

For several years Enerjet Incorporated has manufactured small high performance rocket motors for science and industry. We are now involving ourselves in the model rocket market and simultaneously applying model rocket technology to develop low cost sounding rocket systems. Things are jumping. This newsletter is something else we have wanted to do for a long time.

Enerjet News is intended for serious modelers. By serious we don't necessarily mean humorless - just experienced. Enerjet rockets and motors aren't for novices, anyway. So this newsletter is not for neophytes. We'll be putting scale data in the news whenever possible. (Why should it stay locked up in our files?) Some tech reports will appear in the "News" from time to time.

The "News" will contain plans and ideas for the lesser model motors - "A" through "C" motors. You will notice Centuri Engineering products on these pages from time to time. Don't be surprised; we're very good friends. Occasionally you will read these pages and get the vague feeling we're trying to sell you something. That is not accidental. We earnestly hope you will like our products and buy them so we can continue to publish this newsletter, etc. Why should we apologize for being in business? You fly with confidence only because you know your motors are the work of professionals.

Cont. pg. 4 Col. 1

NIKE RAM TOPS ONE MILE!

This issue we want to feature one of our new kits - the Nike Ram. Model Rocketry's ultimate performer. With Sky Traks positioned one half mile away we recorded a flight of over 5200 feet. The trackers zeroed in on a white puff of chute powder packed with the streamer. Later the same rocket carried a 1/2 pound payload to 3500 feet. Power: one F67 motor.

TIR-10

Lawrence W. Brown

UNIBODY STAGING

A NEW SIMPLIFIED SYSTEM TO DOUBLE THE PERFORMANCE OF YOUR LARGER A THRU C POWERED ROCKETS

NECESSARY VOCABULARLY

To understand this report it will be necessary for you to be aquainted with a few terms that are part of the rocketeer's vocabularly:

AIRFRAME – The "body" of the rocket. The basic components of a model rocket. The other components and systems are either contained inside or attached to the airframe.

BOOSTER STAGE – In a two-stage rocket the booster stage is the first stage to fire. It "boosts" the rocket off the pad into the air, ignites the second-stage and falls away. In conventional two-stage model rockets the booster engine is contained in an airframe of its own with a set of large fins to stabilize the rocket in flight during the boosting phase. The second stage has its own airframe and its own set of fins to stabilize it in flight after the booster drops away.

For more information on model rocket fundamentals and staging operation, consult the Centuri Catalog, the Centuri Student's Guide to Model Rocketry, the Centuri Rocketeer's Guidebook, or TIR-123 on staging principles.

WHAT IS UNIBODY STAGING?

"Unibody Staging" refers to the use of two stages operating in a single airframe or rocket body. By the use of this system a booster airframe and fins are eliminated and a rocket flies during the booster phase freed from their weight and drag. A rocket using a #16 tube size and designed for unibody staging can be flown to 550 feet with a C6-5 engine. With no modification to the rocket a booster engine can be coupled to the sustainer with a simple sleeve unit and the rocket's altitude can be doubled. There is no booster airframe with its set of fins; unibody is simpler than any staging system now is use in terms of both operation and construction. It is not a replacement for the staging systems used in smaller diameter rockets or for clustering. It is a new option to be considered as an addition to existing systems and opens another dimension of possibilities for new designs and improved performances. Figure #1 shows a typical unibody two-stage rocket.

As you will note, the booster engine projects from the tail of the rocket. This poses some potential stability problems. Before we continue, a review of the fundamentals of stability for model rockets in flight might be in order.

STABILITY

It is generally desirable that a model rocket fly in the direction it is aimed. A rocket which flies straight can be said to be stable in flight. The rockets flown at Cape Kennedy have guidance systems that steer them in flight; model rockets, on the other hand, must be built to stabilize themselves without a guidance system – like an arrow stabilizes itself.

To understand the principles of stability we must introduce the terms.

CENTER OF GRAVITY – Take a model rocket and make it balance on your fingertips. You will find a point at which the model balances perfectly. This is the model's center of gravity. Now place a penny on the rocket just behind the nose. The rocket's nose pitches down. You will have to find a new balancing point. When you find it you will observe that the center of gravity was moved forward by adding weight forward. Find the center of gravity of a rocket with its engine installed and ready to fly. The rocket will turn around the center of gravity in flight.

CENTER OF PRESSURE – Just as the center of gravity was the balancing point for the weight of the model, the center of pressure can be thought of as the balancing point for the air pressure forces acting on the model. An object moving through still air encounters a resistance which is called drag. Take a model rocket outdoors when a wind is blowing and hold it lightly between your fingers so that the wind blows against its full length. You will find a point at which the model "balances" with the pressure of the moving air equal on both ends of the rocket. This is the center of pressure. On a stable rocket, the center of gravity is located ahead of the center of pressure. In flight, the concentration of weight tends to "lead" and the concentration of resistance tends to "follow". On a stable rocket, where the center of gravity is located ahead of the center of pressure, the nose "leads" and the fins correct for any deflection from the intended trajectory by providing lift in a direction opposite from the turning force.

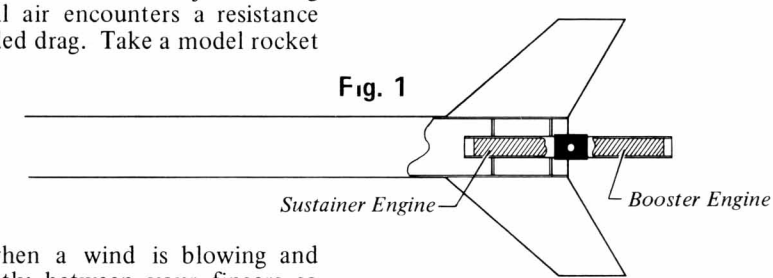
What can disturb a stable rocket? We could add fins at the nose until the center of pressure is moved ahead of the center of gravity. Or we can add weight at the tail until the center of gravity is moved back behind the center of pressure. Whenever the center of gravity is behind the center of pressure, the rocket will be unstable.

A good rule of thumb is that for stable flight the center of gravity must be at least one body diameter ahead of the center of pressure.

For more information on stability consult Centuri's Technical Information Report (TIR) 30 and 33.

Now we are in a position to assess the effects of placing a booster engine in the rear of a model rocket without adding a set of fins. The center of gravity has been moved toward the tail; the center of pressure has not been changed. Any rocket designed for unibody staging must be designed in such a way that it is stable in flight with a finless frameless booster stage. Such a rocket must incorporate a number of design features.

Fig. 1



UNIBODY DESIGN FEATURES

A BODY TUBE 1.0 INCHES IN DIAMETER OR GREATER! It is on a rocket of this size that the weight and drag penalty of a conventional booster is highest. On larger and heavier models the weight of a booster engine has less effect on the center of gravity than on smaller rockets on which the engines often out-weigh the airframe.

A LONG BODY TUBE. Any rocket designed for unibody staging should be long and sleek. The length of the body tube should generally be 12-20 times the diameter.

SWEPT BACK FINS. The combination of a long airframe and swept fins guarantee that the center of gravity will be well ahead of the center of pressure.

APPLICATIONS OF THE UNIBODY STAGING SYSTEM

The effect of watching a large model rocket take off under B14-0 power and continue climbing under the long burn of a C6-7 engine leads one to think of the rocket going through two "phases" of powered flight rather than separate stages and such is the case. The airframe is being powered by an engine "stack". One has a choice of flying the rocket in a single engine mode or in a two phase mode. Using a B14-0 booster engine one can lift off quite a load.

Of the rockets in the Centuri fleet the following can be flown using unibody staging:

1. Orion
2. Centurion
3. Long Tom (can be made 3 stage, or a unibody booster can be substituted for the finned unit).
4. Payloader (weight should be added to the payload section until the CG returns to the same point as with a single engine in place).
5. Taurus

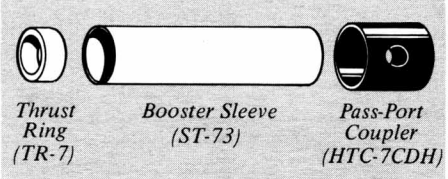
CLUSTER STACKS – Unlike conventional staging systems, unibody stacks can be clustered. Imagine an attempted conventional staged cluster of three engines. In the booster airframe are three B14-0 engines. In the second stage, there are three C6-7 engines. The rocket is fired . . . liftoff . . . the three booster engines burn . . . one of the three engines ignites the engine above it slightly before the other two have burned out. As a result, the blast of the one second stage engine forces the two stages apart before the other two engines can ignite and we now have a large, heavy rocket very unstable and potentially dangerous. With unibody staging, however, each stack functions independently of the others and small errors in timing cancel each other out. If stability is important in single stack unibody staged rockets it becomes crucial with clustered stacks. Generally speaking, stacks should not be clustered unless one wishes to loft a heavy payload. For example, a 1.6 inch diameter rocket has lofted a payload of almost a quarter pound to 1,370 feet using a cluster of two stacks of B14-0 to C6-7's. A payload will offset the weight of the clustered stacks.

An egg lofting rocket can be flown with two clustered stacks if the payload capsule is loaded; you can haul an egg over 1,000 feet! Simply prepare each stack as you would a single stack rocket and then prepare the igniters as you would a regular cluster.

With some imagination you can find many uses for the unibody staging system. Do not attempt to unibody stage any other Centuri kits than the ones mentioned in this report. We have already made these tests at Centuri and any rockets not mentioned will not work.

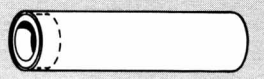
The unibody booster is simply a featherweight sleeve coupler that slips over a booster engine and holds it to the sustainer engine during booster firing. For specially designed rockets, this booster coupler can be used in place of the usual booster requiring an airframe and fins. Performance is improved with the resulting reduction in weight and drag and the unibody sleeve coupler is a cinch to put together.

Parts needed: Thrust ring, booster sleeve, pass-port coupler.



Thrust Ring (TR-7) *Booster Sleeve (ST-73)* *Pass-Port Coupler (HTC-7CDH)*

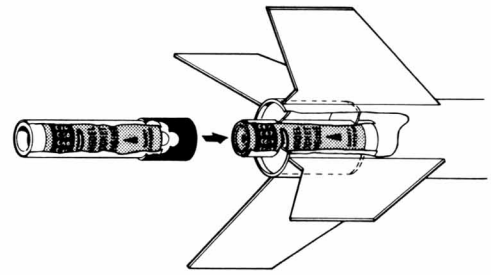
Run a bead of glue around the inside edge of the booster sleeve and push the thrust ring into place flush with the end of the sleeve.



Cement the HTC-7CDH coupler onto the top end of the sleeve tube as shown. Set the completed unit aside to dry.

The sleeve coupler should be painted a bright color such as fluorescent orange to facilitate its recovery.

The unibody system allows you to stage a rocket with the minimum of complications. The sustainer engine is placed in the rocket as in single stage operation, a booster engine is inserted in the sleeve coupler and the booster unit is slid into place against the sustainer engine. If the sustainer unit has an engine hook, lift the hook clear of the coupler as it slides over the sustainer and take care that the hook does not drop into one of the two venting ports or the booster unit will be unable to drop away and the model will be damaged. When the booster engine drops away the engine hook should snap down to hold the sustainer in place. To be on the safe side it is advisable to wrap the sustainer with masking tape for a snug fit. If the booster engine seems loose in the sleeve coupler, wrap it with masking tape, also.



NOTE: In a pinch, rocketeers have simply taped booster and sustainer engines together. However, engine separations are much smoother when a sleeve coupler is used.

In the unibody configuration the recommended engine combinations for the Centurion and Orion are:

CENTURION

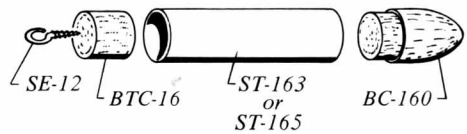
B6-0 to B6-4 or B4-4 or C6-5
B14-0 to B6-6 or B4-4 or C6-7
C6-0 to B6-6 or B4-6 or C6-7

ORION

B14-0 to C6-3 or B4-2
C6-0 to B4-4 or B6-4 or C6-5

With a B14-0 booster, the Centurion makes a ideal payload rocket for bulky payloads up to 3oz. The parts needed for a payload capsule are:

BC-160 BTC-16 ST-163 or St-165
screw eye (SE-12)



SE-12 *BTC-16* *ST-163 or ST-165* *BC-160*

With a payload the rocket is heavier and will require a shorter delay time.

With a 2 oz. payload, upper stage engines should be B4-4, B6-4, C6-5.

CHECK YOUR STABILITY WITH SWING TESTING BEFORE YOU FLY. A MODEL CAN GO "APE" AND THEN STABILIZE WHEN THE BOOSTER ENGINE FALLS AWAY!

You have no idea where or at whom the rocket is aimed when this occurs. If in doubt, fly the rocket first with a single engine. If it is stable, locate the center of gravity with one engine. Add your booster engine. Now add weight to the nose until the rocket's center of gravity returns to its original single engine location. Now you are certain to have a stable flight.

DO NOT JUST TAKE ONE OF YOUR LITTLE MODEL ROCKETS AND SLAP A FINLESS BOOSTER STAGE ON IT! IT WILL NOT WORK AND YOU COULD HURT SOMEONE.

Model rocketry has kept its enviable safety record because participants in it have used their heads. Your country is going to need your brains. Protect them!

NEWS FROM R&D

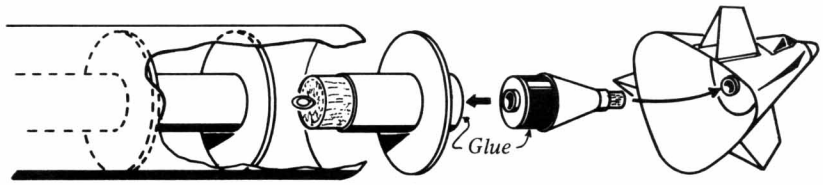
Editor letter cont.

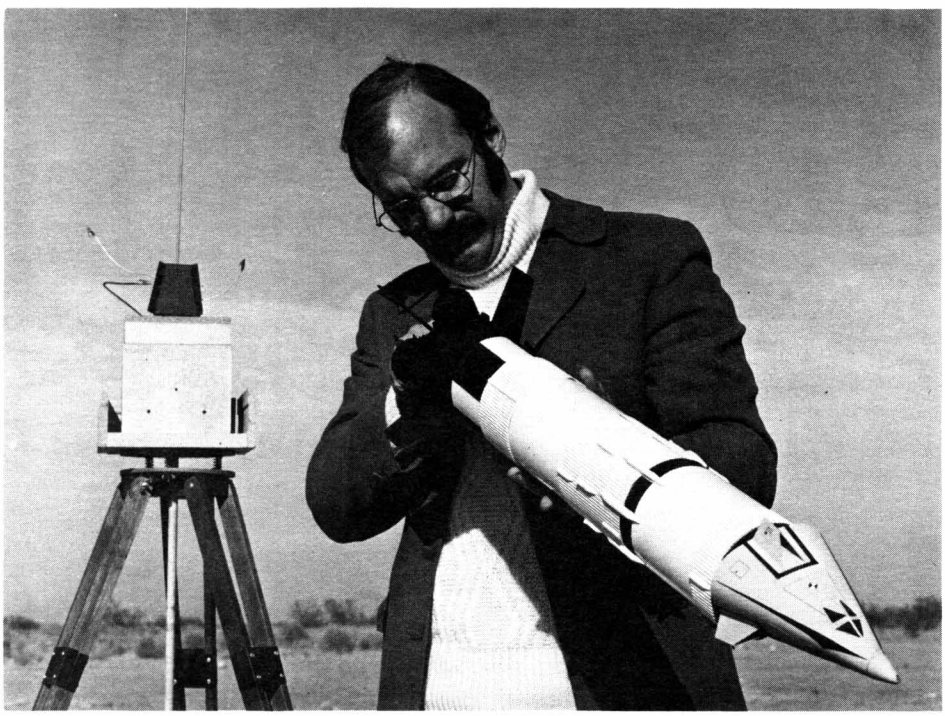
We hope to make the "News" an interesting publication. We want to hear from you, too. Tell us what you're up to, what your needs are, what you think about things. We'll publish a good letter once in a while. If you have a story you think would be suitable for the "News", send it in. Let's keep in touch. That is what the Enerjet News is really about.

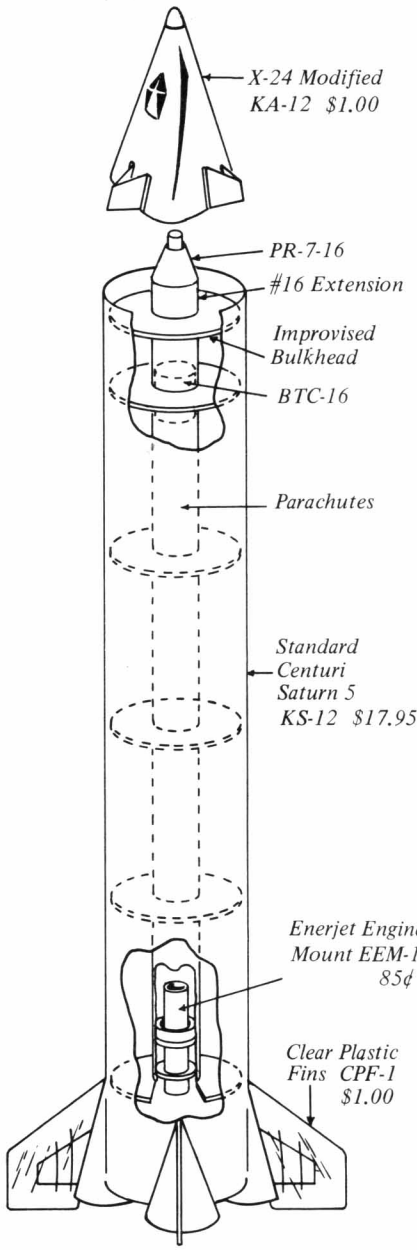
Lawrence W. Brown, Editor
Director Enerjet Programs

If you haven't already received your catalog send 25¢ in coin to Enerjet Catalog #721, 3057 W. Fairmount, Phoenix, Arizona 85017.

SATURN 5/X-24 HYBRID ENERJET POWERED







THINKING ABOUT SOMETHING BIG?

We have been experimenting with Lifting Bodies. The Centuri X-24 is a start, but we wanted to carry a modified X-24 up on a larger rocket. The Saturn 5 works fine. Shown here, a modified Saturn. An extra bulkhead was cut out of cardboard, the stuffer tube was extended to the full length of the body. A PR-7-16 reducer with a slight extension plugs into the engine socket of the X-24. The whole affair looked rather impressive. An F52-5 can boost the bird beautifully. You get that spectacular liftoff . . . then ejection separates the adapter with the X-24. When the shock chord pulls back in, the adapter pulls back leaving the X-24 hanging in the air by itself. It begins gliding at this point. A well trimmed lifting body can turn in a 60 second glide.

We're thinking about remote control... but it's expensive. So we may try a 24" long scaled up X-24 with a tiny battery powered turn-table mounted along its belly. A trim weight would be glued at a point along the rim of the turntable. As it slowly turned the CG would move, first to the right, then forward, then left, then aft. The vehicle would then execute a programmed series of turns, pitch ups, dives, etc. on the trip down. The principle of steering a Lifting Body with a variable CG would be demonstrated by such a vehicle. The X-24 employs this principle, but as the CG is fixed for each flight, the ability of the system to maneuver isn't demonstrated.

HOT FLASH! Research on an Enerjet booster is under way. We'll keep you posted.