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THE BEST OF CALIFORNIA ROCKETRY

APRIL 1981

CALIFORNIA ROCKETRY

QUARTERLY

POWER FREAKS ARISE

COMPETITION CORNER

BIG LAUNCH COMING

SPOC-5 RESULTS

AIR-1 REPRINT

Dedicated to the advancement of model rocket technology.

Letters to and from the editor

In our "Letters To And From The Editor" section we will include the most interesting and probing letters we recieve each issue and will respond to many of them in print. Feel free to criticize (or complement) our publication or any other in your letters.

We hope that publication of the views of the average modeller will stimulate education and further communication in the model rocket community. We will also use this section to answer any technical questions the readers may have about model rocketry or hobbies in general.

We will publish CALIFORNIA ROCKETRY magazine quarterly until further notice. We hope to continually increase the volume of information as well as increase the use of photos. A carefully selected photo will appear on the cover of each issue and a photo page will highlight the inside. Please send photos. Of special interest is the possible use of color printing! "You can look for this."

Of special interest to us is information on the activities of clubs across the nation and around the world! Thanks for reading!

Cover Photo

Photo by Tom Kolis

The subject of our first cover photo is Jerry Irvine's Mongrel model. This four foot tall rocket is constructed entirely from paper, wood, and plastic, and is fully recoverable. This particular flight was marked by an extremely fast liftoff, a sucessful recovery on a six foot parachute, and a track to 0.98 miles.

This photo shows the Mongrel on its second flight with four F7-6's and a G62-15. The flight was flawless and the model was caught by the owner on recovery. Photo by Tom Kolis.

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CALIFORNIA ROCKETRY magazine will provide information and analysis on various aspects of professional, amateur, and model rocketry. Additionally, any activity that might occur at a gathering is subject to print.

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- ACE Information Report - 2
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- PHOTO PAGE !
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- 20 FULL PAGES !!

Gary Rosenfield, famous rocket motor designer and founder of Composite Dynamics, and his lovely wife Melody, apprentice rocket engineer.

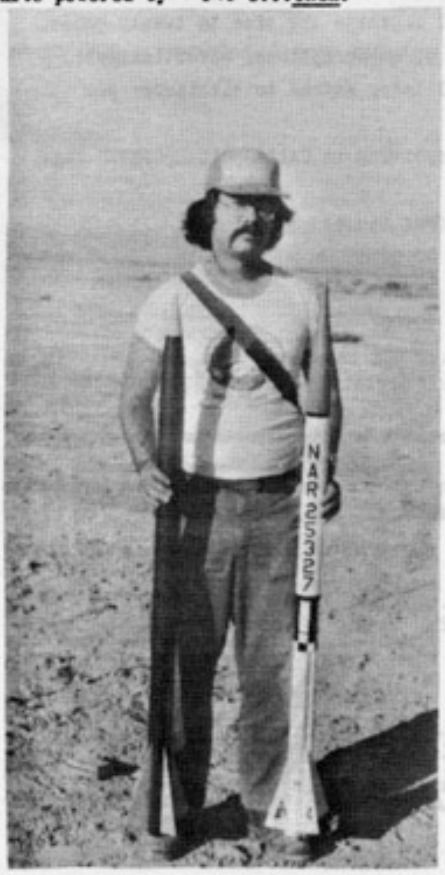
The super launch at El Dorado dry lake. Left to Right, Jerry Irvine with Mongrel, Chuck Rogers with Pegasus, and Korey Kline with two stage Chromatic Fugue and Chromatic Fantasy.

The Mongrel was flown with 4 G's and an F and with 4 F's and a G, the Pegasus was flown with a G and 12 F's, the two stage was flown with 3 G's to a G, and the Chromatic Fantasy was flown with the ultimate, 7 G's!!

The ACE of advertising space

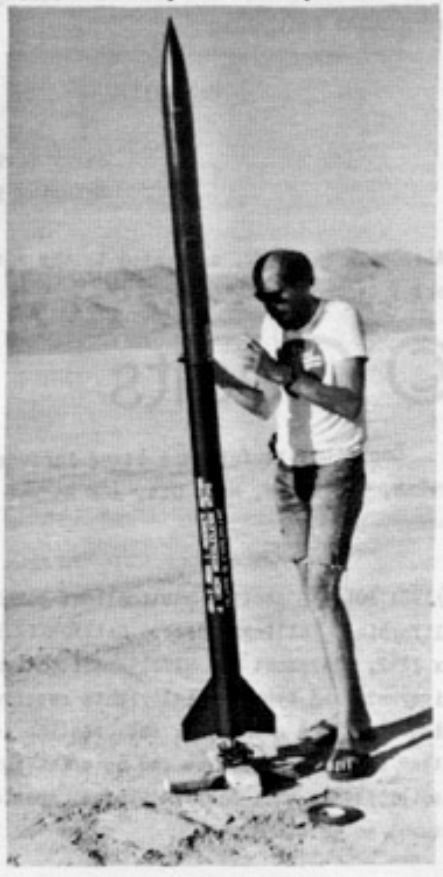
PRESENTS: glimpses from the past

Matt Ota is a former Texas rocketeer who recently caught California MRT-fever fever. He is holding two ACE Allegro kits powered by 4 F40's...each!



The incredable Jerry Irvine (on knees) with his fantastic 2 stage Uprated Mongrel. Power is 4 G boost and 2 G and 3 F upper. Also shown is Matt Ota.

Roger Johnson's beautiful full scale BR-7 rocket is an exact duplicate of the amateur rocket. This is the first rocket he has painted in years!



FEATURE ARTICLE

Power freaks arise

TRENDS IN HIGH POWER MODEL ROCKET MOTOR DESIGN FOR THE 80's
By Gary Rosenfield

The hobby of model rocketry had its beginnings with the development of a pre-loaded rocket motor that required no handling of chemicals by the user. Almost without exception, these motors were fueled by black powder propellant that was hydraulically rammed into a convolutely-wound paper casing.

In the late 1960's Irv Wait of Rocket Development Co. introduced the world's first model rocket motors using a modern, high-energy propellant with a plastic binder. These motors were called Enerjets. Shortly thereafter, Enerjet became a subsidiary of Centuri Engineering Co., then headed by Leroy Piester. Enerjets flourished until about 1974, when Centuri decided to shut down the Enerjet line because of various problems, probably a low profit margin due to the high manufacturing cost of Enerjets compared to conventional model rocket motors.

After a four year 'lull' in model rocket motor development, two new companies, Small Sounding Rocket Systems (now Crown Rocket Technology) in 1978 and Composite Dynamics in 1979, re-introduced the high-energy model rocket motor concept. SSRS used 1.125 inch diameter paper-phenolic casings with machined graphite nozzles. CD countered with filament-wound fiberglass cases and cast ceramic nozzles.

Both SSRS and CD used Hydroxyl-terminated polybutadiene (HTPB) fuel binder - a breakthrough in model rocket motor design technology. This is a current state-of-the-art rocket propellant ingredient in use in several military rocket systems, and soon to be in many more.

Composite Dynamics pushed model rocket technology further with its first motor, the E20 - a motor with the same physical dimensions as the Estes D12 but with 2.5 times the power (40 n/s). Since then, SSRS has introduced the E45 (.94" dia. x 3.25" long), and CD's latest is the F40, a D12 diameter motor 4.6" long (80 n/s). SSRS's E30, F50, and F67 motors are Enerjet diameter (1.125").

What about the future? Composite Dynamics has revealed plans for an 'E9' motor, an endburning design (first of its kind when introduced) with a 4.5 second burn time. Tentative dimensions are 1.125" (Enerjet diameter) and 2.5" long. ((John Davis of CL has told me that the 'E9' will be .94" x 2.75" to be compatable with Estes kits. E9's are available in certain parts of the world now! - ed.))

Rumour has it that CD is working on a C-diameter 'D'. Such a design was introduced by Enerjet in the early 70's, but was soon removed from the market. SSRS has not announced any new motors lately. Canaroc has a line of A-D motors using a composite propellant, but these are relatively low technology, with paper and plastic cases. They have no real advantage over standard black powder motors due to the low propellant delivered specific impulse (similar to gasoline octane rating).

Estes and Centuri are bound to continue producing their black powder motors, with no plans for high-performance designs.

As far as new propellants go, it will be sufficient to exceed the performance delivered by current ammonium perchlorate (AP) and HTPB formulations. This propellant will probably be an industry standard past the year 2000. At best, improved processing techniques will increase propellant density, by increasing solids loading, allowing greater amounts of propellant to be stored in smaller motor cases. This increase is not large, from about .059 to .062 lb/in^3 (5%), and will result in minor design improvements.

It is difficult to exceed specific impulses of 210 sec., partly because the small size of model rocket motors means that more of the propellant energy (as a percentage of the total) is lost to non-adiabatic conditions. These conditions include the "cold" nozzle and casing walls and also due to low combustion efficiency in the small motors because of inadequate residence (reaction) time of the combustion components in the motor chamber.

Aluminum can be used to increase propellant density to about .065 lb/in^3, but the internal losses in this system are even greater than a non-aluminized propellant. This is because aluminum combustion in a rocket motor is a relatively slow process involving predominately liquid-state combustion rather than gaseous. This means that a large portion of the aluminum in a model rocket motor is expelled from the nozzle, failing to transfer its combustion energy to the lighter molecular weight exhaust products such as Hydrogen (which by the way is the source of the increased specific impulse of these propellants in the larger motors).

Higher pressures in a motor will increase specific impulse due to the higher pressure ratio in the nozzle which "extracts" more energy from the exhaust gases, and somewhat higher combustion efficiency. Disadvantages include the requirement of increased casing thickness (and weight) and possible increases in outside dimensions.

It is doubtful that high strength materials such as Kevlar and graphite fibers will be used in model rocket motors in the near future, mainly because of the high cost of these items.

In short, the propellant for high performance model rocket motors in the 80's will probably be a non-aluminized (or low aluminum) AP-HTPB formulation with a density of about .060 lb/in^3 and a delivered ISP (specific impulse) of about 210 sec. Chamber pressures will range from 200-600 psi on the average in most designs.

CRm

Gary Rosenfield is currently a development engineer for the Bermite division of the Whittaker Corp. He does testing of new and exotic propellants for professional applications. He is well known for his work with Composite Dynamics, a model rocket motor manufacturer, from 1972 till 1980. During that time Gary was primarily responsible for product design and packaging.