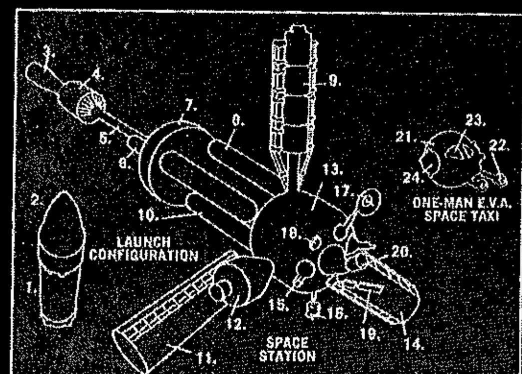
MPC GOES ONE STEP BEYOND TODAY'S SPACE LAUNCHING WITH THE

PILGRIM OBSERVER

SPACE STATION THE NEXT STEP IN SPACE TRAVEL

Here is the next step in space exploration in the Seventies . . . the result of America's space authorities' best thinking on the nation's first inter-planetary space station. The Pilgrim Observer is a complete, self-sustaining community space station, able to make deep probes to far-reaching planets, able to carry twelve crew and passengers and their supplies, able to send out and receive an E.V.A. space taxi and an Apollo module, able to maintain itself and its passengers for extended periods of time. No science-fiction here. From its inception, the Pilgrim Observer was checked and rechecked for authenticity and feasibility. These are the parts and this is the type of space craft of the future . . . a craft that lifts off the earth as a rocket, then jetisons its nose cone and opens up into a space station, swinging out its giant arms and extending its nuclear engines. And this magnificent model in 1/100 scale duplicates every part and every operation.

- There are fourteen working parts.
- It can be built and displayed in its rocket configuration. The nose cone is in clear, see-through plastic. The modified Apollo module and E.V.A. space taxi are located within the nose cone.
- It can be displayed as a space station. The three giant sections can swing out and the nuclear engines actually extend out the rear. The nose cone can be removed, exposing the communications network, the Apollo module and the E.V.A. taxi.
- One section provides living quarters for crew and passengers, the second houses the hydroponic farm for food supply, and the third contains the on-board nuclear power supply.
- The Main Control Center is at the center of the sections and behind this the fuel and life support tanks. In front are the moveable telescopes and antennae.
- Fully extended the Pilgrim Observer measures 17½" in length and 12" in diameter. Contracted, it is 12" in length and 3¼" in diameter.
- The Apollo module can be removed from its nose cone location and locked into the Main Control Center.



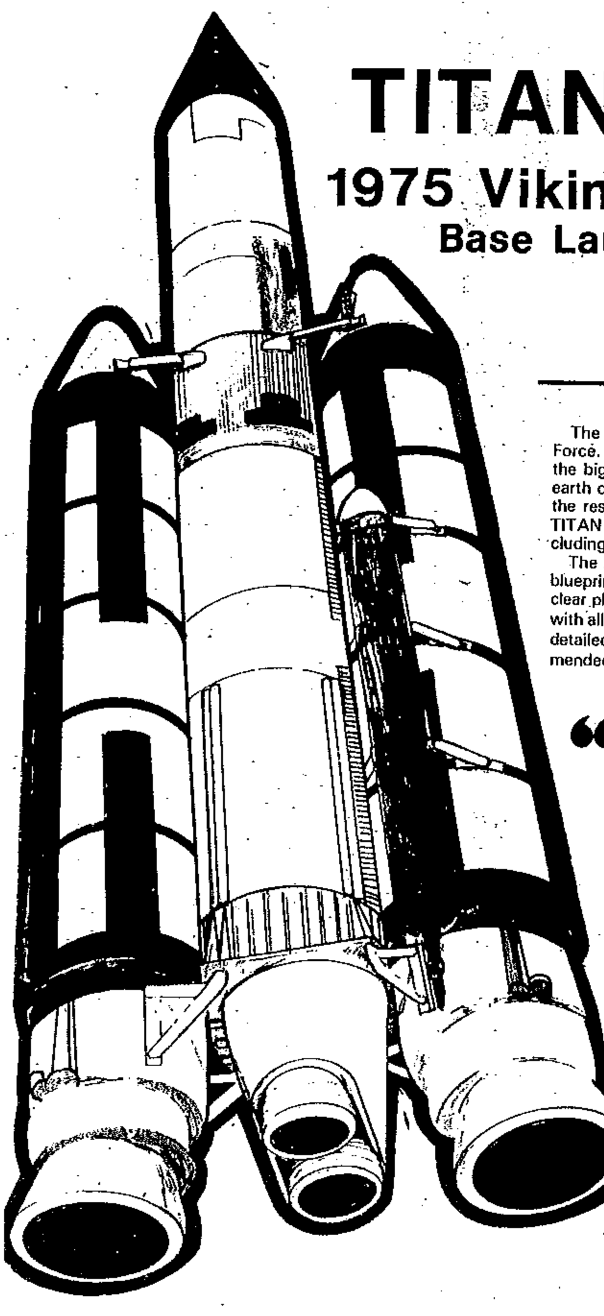
1. Launch Configuration. 2. Launch Shroud. 3. NERVA Exhaust Engines. 4. NERVA Nuclear Engine Housing. 5. NERVA Extension Arm. 6. 2nd Stage Liquid Fuel Engine. 7. Rear Protective Shroud. 8. Hydrogen and Liquid Oxygen Fuel Tanks. 9. Nuclear On-board Power Supply. 10. Fuel and Life Support Tank. 11. Hydroponic Farm. 12. Modified Apollo Command Module. 13. Main Control Center. 14. Crew Quarters. 15. Navigation Telescope. 16. High Gain Antenna. 17. Radar Antenna. 18. Observation Port. 19. Multi Channel Telemetry Antenna. 20. Large Reflecting Telescope. 21. Extra Vehicular Activity (E.V.A.) Taxi. 22. Mechanical Arms. 23. Navigation Ports. 24. R.C.S. Engines.

PQ 2
3-9001
$6.00

ALL THIS AND MORE . . .

TITAN 3

1975 Viking to Mars Base Launch Vehicle



The Titan IIIC was developed by the Martin-Marietta Corporation for the U.S. Air Force. Boasting a lift-off thrust of over 2 million pounds, it has been overshadowed by the bigger manned Saturn vehicles. Yet TITAN IIIC has been routinely placing into earth orbit large communications satellites and special USAF space payloads. It was the rescue launch vehicle in the motion picture, "Marooned." In the 1970 decade, TITAN IIIC and its derivatives are scheduled to launch a number of spacecraft, including the 1975 Voyager Mars Lander.

The AVI kit is a faithful replica developed from official USAF and Martin-Marietta blueprints. You can build it to fly with a Type B6-2 or C6-4 motor, and it comes with 4 clear plastic fins to stabilize it in flight. Or you can build it as a non-flying shelf model with all stages separable and all Aerojet-General liquid propellant rocket engines highly detailed from official drawings. No-motor weight: 4.4 oz. Length: 12.75". Recommended motors: B6-2 or C6-4.

PQ 3
"LAUNCH"
3-9002
$4.00

USAF TITAN IIIC LAUNCH VEHICLE

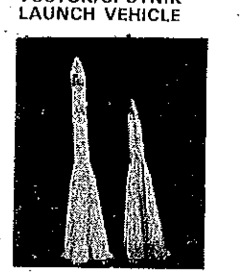
Both the prototype and the model hold a number of "firsts". The Soviet RD-107 vehicle lofted the world's first unmanned earth satellite, Sputnik-I, into orbit on October 4, 1957. With an additional upper stage, it was the launch vehicle for Yuri Gagarin's first manned earth orbital flight on April 12, 1961. The model was the first all-plastic show-or-go model rocket. You can build it to stand as an accurate shelf model or as a flying model. You can build it in two versions—the one that launched Sputnik-I or the one that lofted Gagarin. This model in 1/100 scale has been internationally acclaimed as the most accurate replica of man's first probes into space. Built-up models of this kit are at the Federation Aeronautique Internationale in Paris and at the National Air & Space Museum of the Smithsonian Institution in Washington, D.C. Model comes with all 32 rocket nozzles, clear plastic Sputnik shroud, clear plastic Vostok shroud with clear view of cosmonaut and Vostok vehicle, 4 strap-on boosters, and complete, authentic data book giving all available information on weight, thrust, dimensions. Includes drawing released by U.S.S.R. No motor weight: 4.9 ounces. Length: 15". Recommended motors: B6-2, C6-4.

FLY IT!

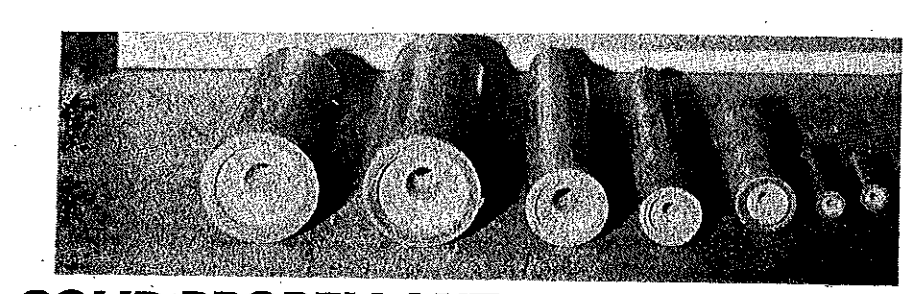
AVI astroport

PQ 3
3-9000
$4.50

USSR RD-107 VOSTOK/SPUTNIK LAUNCH VEHICLE



VOSTOK



SOLID PROPELLANT

MODEL ROCKET ENGINES

AVI Astroport produces rocket motors that are specifically intended for use in Model Rocket vehicles.

The terms 'rocket motor' and 'rocket engine' will be used interchangeably in our discussions.

To give you a better feeling for what is involved in the definition, manufacture and use of these remarkable Space Age products we suggest that you read this and the following three pages carefully.

By better understanding Model Rocket engines, the hobby should become more rewarding and fun for you. We also hope you will develop a better appreciation and increased respect for the handling, storage and operation of these power plants.

DEFINITION

"Model Rocket Engine" means a solid propellant rocket engine produced by a commercial manufacturer in which all chemical ingredients of a combustible nature are preloaded and ready for use.

Requirements

1. A model rocket engine shall be a solid propellant reaction engine produced by a commercial manufacturer. It shall have all of the propelling ingredients preloaded into the casing in such a manner that they cannot be easily removed. Delay trains and ejection charges may be included as an integral part of the engine or may be preloaded and packaged separately if (a) the auxiliary package is a single preassembled unit containing all of the remaining combustible material, and (b) the auxiliary package is so designed that an average person would have no difficulty handling or using it safely.

2. A model rocket engine casing shall be made of nonmetalic material of low thermal conductivity so that the temperature of the external surface of the model rocket engine shall not exceed 150 degrees Centigrade (302 degrees Fahrenheit) during or after operation.

3. A model rocket engine must be so constructed that, should it rupture its casing, the casing shall not fragment.

4. A model rocket engine must be so designed and constructed as to be incapable of spontaneous ignition in air, in water, as a result of physical shocks, jarring, impacts or motion under conditions that would reasonably be expected to occur during shipment, storage and use, or when subjected to a temperature of 80 degrees Centigrade (176 degrees Fahrenheit) or less.

5. A model rocket shall contain no more than 62.5 grams (2.2 ounces) of propellant material, and shall produce less than 80 Newton-seconds (17.72 pound-seconds) of total impulse with thrust duration not less than 0.050 seconds.

6. A model rocket manufacturer shall subject a random sample of one percent (1%) of each engine production lot to a static test which shall measure and record thrust, duration, thrust time profile, delay time, and strength of the ejection charge (if any). Model rocket engine lots must be corrected or destroyed by the manufacturer if:

a. The total impulse of any test item departs more than 20 percent (20%) from the established mean value for the engine type;

b. The time delay of the test item departs more than 20 percent (%) from the established mean value for the engine type but in no event shall this variation exceed 3 seconds;

c. The ejection charge of the test item does not function properly;

d. The test item malfunctions in any other manner. Static tests shall be conducted with the test item at ambient temperature.

7. A model rocket engine type, whose performance deviates from the sample test criteria detailed above within one year from the date of manufacture, shall be withdrawn from commercial sale and redesigned to provide reliable operation when ignited within a period of one year from the date of manufacture. All model rocket engines shall have imprinted upon the exterior of their casings the date of manufacture.

8. A model rocket engine shall be shipped and stored with no igniter element installed that may be actuated by open flame at a temperature of less than 150 degrees Centigrade (302 degrees Fahrenheit), or by incident radio frequency radiation normally encountered in shipping, storage and use. No manufacturer, distributor, or any other person shall sell or otherwise make available to the public any type of model rocket ignition device that is intended to be initiated by a hand-held flame.

9. A model rocket engine shall be shipped and sold with complete instructions for storage, handling and use. These instructions shall contain a warning to read and follow all instructions carefully and to use the engine only in accordance with instructions. In addition, the instructions shall contain the following information:

a. How to safely ignite the engine by electrical means;

b. Performance data on the model rocket engine type to include propellant weight, total impulse, average thrust, time delay and thrust time curve;

c. Any special First Aid data or steps to be taken in the event of burns or if the propellant is orally ingested;

d. Proper and safe disposal of the engine if it has become too old, been subjected to conditions that may impair its performance, or in the opinion of the user may have become unsafe;

e. Special action to be taken in fighting any fire in which stored rocket engines may be involved.

10. A model rocket engine containing more than 25 grams (0.88 ounces) of propellant material shall be sealed at the factory with a nonflammable, nonmetalic seal in the nozzle and in the forward end, such seals to be readily removable by the user unless the engine is designed to perform its function with the seals in place.

11. A model rocket engine in operation shall not expel from its nozzle any pieces of burning propellant, and shall be incapable of igniting a piece of dry paper or grass at a distance from its nozzle 500 times the diameter of the nozzle throat.

CLASSIFICATION

National Association of Rocketry certified model rocket engines are assigned a type classification which is based on the total amount of energy the engine can deliver, i.e. the total impulse as determined by the NAR Standards and Testing Committee.

Fractions and letters of the alphabet are used in the type designations. Each successive type has a maximum permissible energy content of twice that of the previous one. There are eight defined types with the energy ranges listed below.

Type	Total Impulse (Newton-seconds)
¼A	0.00 - 0.625
½A	0.626 - 1.25
A	1.26 - 2.50
B	2.51 - 5.00
C	5.01 - 10.00
D	10.01 - 20.00
E	20.01 - 40.00
F	40.01 - 80.00

It is easy to see that a maximum powered F engine has 128 times the energy of a maximum ¼A engine.

It is also obvious that there can be a C engine that has a total impulse of only 5.02 Newton-seconds while another certified C type might have a total impulse at the top of its class at 9.99 Newton-seconds.

Each NAR certified motor must carry the type classification code. That code must be followed by a number indicating the average thrust of the engine in Newtons to at least two significant figures, and a dash followed by a number indicating the time delay in seconds to the nearest second of the time delay charge duration.

Example:

B6-4

B; The total impulse is between 2.51 and 5.00 Newton-seconds.

6; The average thrust is 6 Newtons.

-4; The time delay is around 4 seconds.

THEORY & TERMS

Model rocket engines are true rocket engines and obey the same laws that larger motors which are used in the Space Program do.

Basically the model rocket engine contains both a fuel and oxygen in the form of a solid oxidizer which are mixed together in the right proportions so that they will conbime vigorously (burn) when ignited.

The burning producers large volumes of hot gas and some solid particles which pressurize the space remaining (the chamber) upon conversion. There is a nozzle that allows the gases to escape in a somewhat orderly fashion along a particular direction.

This high velocity incandescent gas creates a reaction in the opposite direction which we call *thrust.*

Each propellant type in combination with the physical design of the rocket engine will produce thrust that will vary with time in a fairly predictable manner.

Thrust is the amount of force that the motor will exert at a given moment and we measure it in pounds in the English system and Newtons in the Metric system.

As a motor burns we can measure the thrust as it varies with time, and we can record that variation on a chart recorder to produce a thrust-time curve. The thrust-time curve is a valuable tool in studying rocket motor performance. Not only does it give us a picture of how the force varies with time; it also enables us to measure the total energy that the rocket engine produces.

The energy is simply represented by the area under the curve and is measured in pound-seconds (English) or Newton-seconds (Metric), in rocketry we give it another name, *Total Impulse.*

Each design of rocket engine burns for a specific time, *Time of Burn.* If we take the Total Impulse and divide it by the value of the Time of Burn in seconds then we obtain another useful quantity, the *Average Thrust.*

Thrust is an indication of the relative lifting capability of a given engine. Total Impulse is a measure of the potential of doing work. With a given rocket design a rocket engine with twice the total impulse of another engine will lift that rocket to twice the altitude of the latter in a rough approximation.

At the end of the propellant burn a rocket suited for the engine type will be traveling upward at several hundred feet per second. To allow drag and gravity forces to slow down the rocket as it reaches for peak altitude a burning delay train that produces no thrust is built into the engine. Typically this takes a second to ten or more seconds, and is called the *Delay Time.* We measure it in seconds.

Now the rocket is near peak altitude, the delay time element is almost through burning . . . it burns through into another composition that produces a quick-burst-of-gas that activates the recovery device. The gases may be used to force a nosecone out of the head of the rocket vehicle and deploy a parachute.

The rocket motor has completed its job and the vehicle floats back to earth for recovery and another flight.

To obtain full enjoyment out of your hobby *Model Rocketry* we hope you will become fully familiar with the terms simply defined above.

Thrust	*Total Impulse*
Time of Burn	*Average Thrust*
	Delay Time

DESIGN

AVI Astroport has designed its solid propellant rocket motors to provide safe, reliable performance that is closely reproducible from one motor of a type to the next.

Basic motor design is completely consistant with the above definition.

A typical motor consists of a fiber casing with a formed ceramic nozzle in one end; the propellant grain measured and formed for a particular total energy class; a column of time delay composition and a small amount of material to provide for ejection of the recovery device at the end of the delay burn; and finally a cap to retain the ejection charge until use.

SPORT or PRECISION

We produce two series of motors, *Sport* and *Gold.* The Sport motors are the standard run produced to high standards but less precise than the Gold series. Both the Sport and the Gold series have both the Safety and Contest Certification from the National Association of Rocketry.

Sport motors are produced for general flying. Gold series motors are for use in research and contest flying.

Two variations exist in the above configuration. Both of them have no time delay element or ejection charge.

The first variation is the *Booster Engine* which as zero time delay. It is used in lower stages in multi-stage rockets. The booster engine provides thrust until the layer of propellant at the head end becomes too thin to support the chamber pressure. At this point the layer bursts through shooting burning propellant into the nozzle of the engine above igniting it, shoving the booster engine out of the way.

The second variation is the *Special Purpose, SP,* engine. There is a permanent plug at the end of the propellant column so that there can be no burn through. It is available only in the Gold Series and will be explained further there.

OPERATION

Refer to the cutaway drawing that shows a typical AVI model rocket motor with the various parts labelled.

The motor is started by an electrical igniter consisting of a short piece of nichrome wire. This is inserted into the nozzle by the modeller before launch. It must make contact with the propellant. When an electric current of 2 amperes at 6 volts is passed through the igniter wire, its temperature rises above the 550 degree F. needed to ignite the propellant.

the solid propellant grain is used up, the time delay grain is automatically activated. It produces very little thrust and allows the model rocket to coast upward to apogee. It contains a special chemical which produces a white smoke trail to permit you to see the model at very high altitudes.

When the time delay grain is exhausted, the ejection charge is automatically activated to produce a quick puff of gas which pressurizes the inside of the model rocket tube and expells the recovery device.

When the recovery device brings the model rocket back to a gentle landing, the expended motor can be removed and discarded. The model rocket is then ready for another flight with a fresh model rocket motor installed. All AVI model rocket motors are intended for only a single use and *must* be discarded after they are used. The fine safety record of model rocketry hinges upon the use of factory-loaded motors; so you should *never* attempt to make your own model rocket motor and *never* attempt to re-load a used model rocket motor casing. You cannot possibly make a model rocket motor as reliable and inexpensive as the one that you can buy from AVI.

CERTIFICATION

From the very beginning, model rocketry has been a self-policing activity with standards of safety and performance. These have been further developed and refined over the years as model rocket technology has advanced. Several national and international organizations have helped develop these standards for such items as motors, model design, construction, launch equipment, flying, etc. Thanks to them, model rocket equipment has a very high level of reliability. Thanks also to them and to the model rocket industry, there are interchangeable items such as motors, launch rails, electrical systems and igniters.

These organizations include the National Association of Rocketry (NAR) which is America's organization of model rocketeers; the 62-nation Federation Aeronautique Internationale (FAI) in Paris, France; the Hobby Industry Association of America (HIAA); and the National Fire Protection Association (NFPA) made up of people concerned with the safe design and use of products.

AVI Astroport (Aerospace Vehicles, Inc.) subscribes to, supports, and follows the standards established by these organizations.

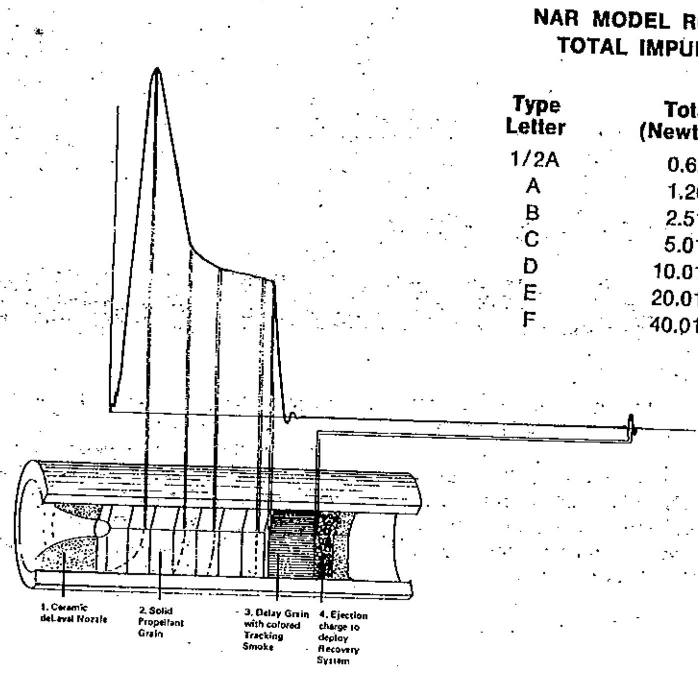
All AVI model rocket motors carry both the Safety Certificate and the Contest Certificate of the Natinal Association of Rocketry. This means that they conform to the rigid performance and safety standards of the NAR and of NFPA's Code 41 L for Model Rocketry. All AVI model rocket motors may be used in national and international competition as well as for the purpose of establishing or surpassing model rocket performance records in the USA and the FAI.

Our motors are classed "ICC Class C Toy Propellant Devices" under the provisions of paragraph 173.100(u) of ICC Tariff No. 27 by test of the Association of American Railroads, and they hold State of California certification No. M2-82, Model Rocket Engine.

AUTOMATED PRODUCTION SPORT SERIES ENGINES

The real workhorse motors of model rocketry are produced on specially designed fully automated pieces of equipment that sense the successful completion of each operation before going on to the next. Sport series motors are massed produced to keep the price to the consumer as low as possible while keeping the quality and performance within acceptable limits. After the motors are produced they are randomly checked to make sure that they conform to the legal requirements imposed on them as well as the criteria set forth by the National Association of Rocketry for both Safety and Contest Certification.

Sport Series motors are the best choice when looking to economy coupled with consistant performance and reasonable degree of reliability. Additional offerings of sport motors are included on pages 33 and 37.



NAR MODEL ROCKET MOTOR TOTAL IMPULSE RANGES

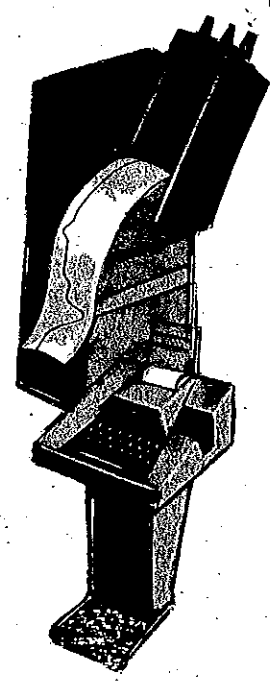
Type Letter	Total Impulse (Newton-seconds)
1/2A	0.626 - 1.25
A	1.26 - 2.50
B	2.51 - 5.00
C	5.01 - 10.00
D	10.01 - 20.00
E	20.01 - 40.00
F	40.01 - 80.00

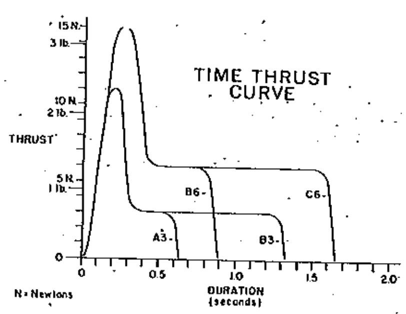
STANDARD 18 x 70

AVI THRUSTER-18® MOTOR SPECIFICATIONS
SIZE: 18 x 70mm (0.690 x 2.75 in.)

Nar Type	Total Impulse (N-sec)	Maximum Thrust (Newtons)	Average Thrust (Newtons)	Duration (Seconds)	Total Weight (Grams)	Propellant Weight (Grams)	Time Delay (Seconds)	Price *
A3-2	2.40	11	3.4	0.63	18.0	3.2	2	$1.10
A3-4	2.40	11	3.4	0.63	18.5	3.2	4	$1.10
B3-3	4.80	11	3.4	1.32	20.4	5.5	3	$1.20
B6-0	4.80	15	6.0	0.90	16.9	6.0	0	$1.20
B6-2	4.80	15	6.0	0.90	18.5	6.0	2	$1.20
B6-4	4.80	15	6.0	0.90	19.6	6.0	4	$1.20
B6-6	4.80	15	6.0	0.90	19.9	6.0	6	$1.20
C6-0	9.60	15	6.1	1.64	19.9	11.0	0	$1.50
C6-2	9.60	15	6.1	1.64	21.7	11.0	2	$1.50
C6-4	9.60	15	6.1	1.64	22.6	11.0	4	$1.50
C6-6	9.60	15	6.1	1.64	23.5	11.0	6	$1.50

*Standard pack of 3 motors, 4 ignitors, & recovery wadding



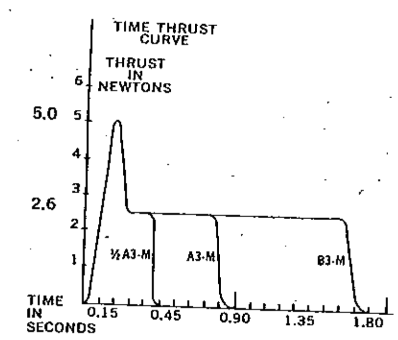


MINIJET 13 x 57

AVI MINIJET® MOTOR SPECIFICATIONS
SIZE: 13 x 57mm (0.50 x 2.25 in.)

Nar Type	Total Impulse (N-sec)	Max. Thrust (Newtons)	Average Thrust (Newtons)	Duration (sec.)	Total Weight (Grams)	Propellant Weight (Grams)	Time Delay (Seconds)	Price *
½ A3-3m	1.20	5.0	3.0	0.43	6.0	2.2	3	$1.20
½ A3-5m	1.20	5.0	3.0	0.43	6.5	2.2	5	$1.20
A3-0m	2.40	5.0	2.9	0.91	7.0	3.0	0	$1.30
A3-4m	2.40	5.0	2.9	0.91	8.0	3.0	4	$1.30
A3-6m	2.40	5.0	2.9	0.91	8.5	3.0	6	$1.30
B3-0m	4.80	5.0	2.8	1.86	9.0	6.0	0	$1.50
B3-3m	4.80	5.0	2.8	1.86	9.5	6.0	3	$1.50
B3-5m	4.80	5.0	2.8	1.86	10.0	6.0	5	$1.50
B3-7m	4.80	5.0	2.8	1.80	10.5	6.0	7	$1.50

*Standard pack of 4 motors, 5 ignitors & wadding



Method of Production

AVI Astroport Sport Series Engines are produced on an advanced technology version of the machine illustrated to the right.

The various components of the engines are fed into the machine at fixed positions. Operations are conducted on each engine 'building' it as it goes around the table, until a 'finished' engine is extracted at the end of the process.

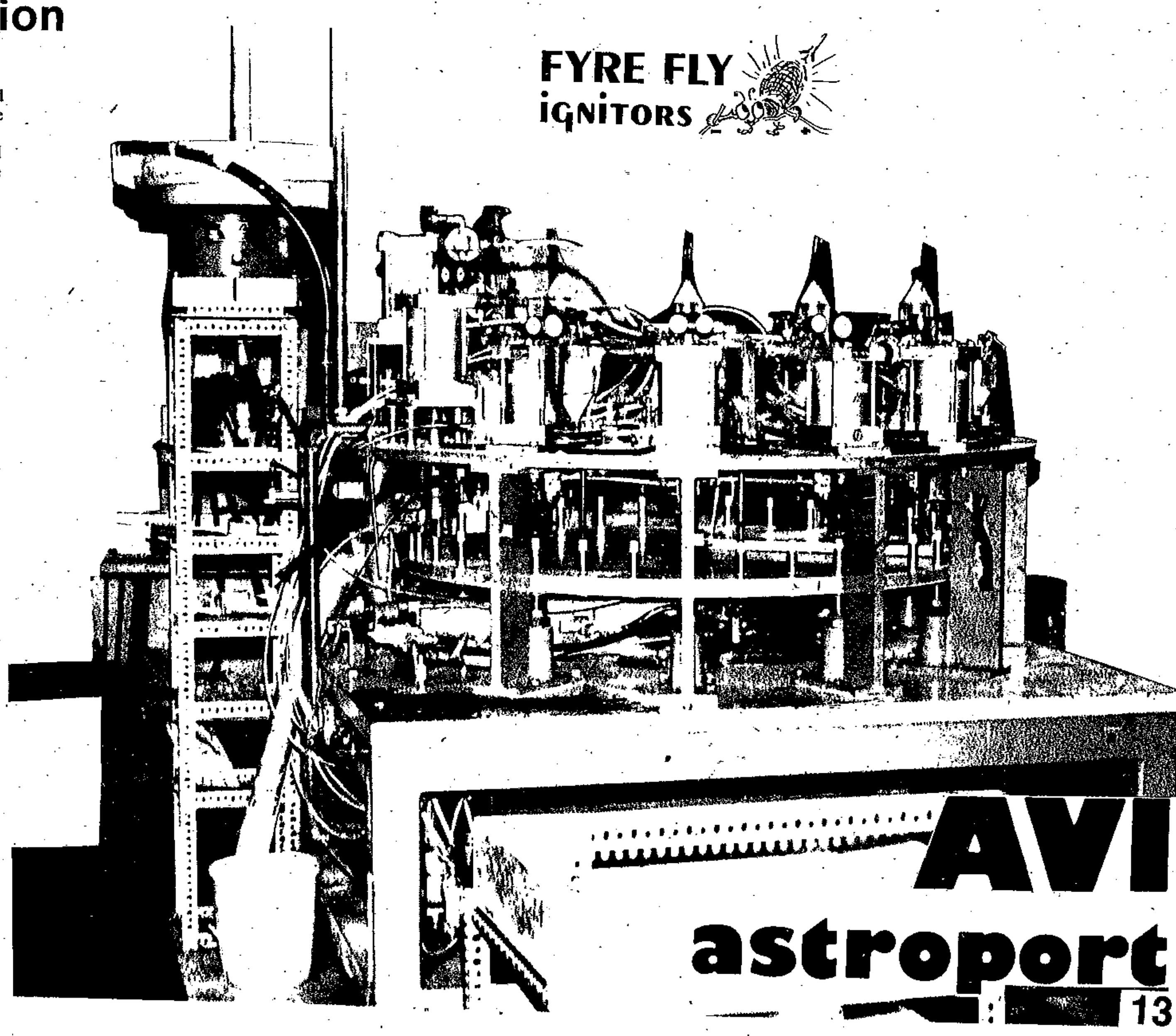
All the components that go into the engines must be carefully checked before they are fed into the machine. Casings must be checked for flaws, dimensions and other criteria. Ceramic materials that will ultimately form the nozzle and clay cap must be processed and refined. Chemicals and mixtures that form the propellant must be checked for impurities, processed and mixed to meet specifications. The components that make up the delay element must be mixed and combined in proper proportions, processed and sized for introduction into the machine.

The machine itself must be set-up for production of each type of motor it is capable of making. This can involve well over one hundred settings for the change-over from one motor type to another. Tooling changes, pressure and sensor changes, adjustment of detectors, adjustment of metering devices, timing changes, changes in sequence of operations and the like.

Subsequent to production the motors are cured for a period of time. They are tested fresh from the machine, at a time just before printing and once again just before final packaging. Each test has a different set of criteria to determine if the motors will perform properly in the field.

The machinery, support equipment, facilities and site represent an investment of well over $300,000 and an additional investment of equal amount in research and development.

FYRE FLY IGNITORS



ENGINEERING SPECIFICATIONS and PERFORMANCE CHARACTERISTICS

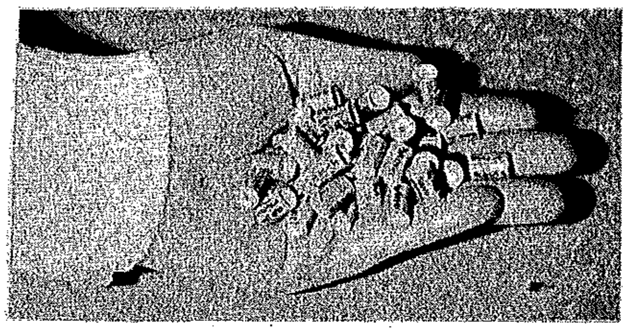


TABLE ON ACTUAL DATA ACCUMULATED

Engine Type	Parameter	Sample Size	Mean	Standard Deviation	Specification	Delta'
1/8A1.9-0	Total Mass	43	1.023 gm	0.37%	1.020 gm	+0.003 gm
¼A1.7-4.00	Delay Time	19	4.04 sec	0.69%	4.00 sec	+0.04 sec
½A1.5-5.00	Total Impulse	32	1.221 N-s	0.30%	1.23 N-s	-0.009 N-s
D6.1-6.75	Propellant Weight	34	22.08 gm	0.21%	22.16 gm	-0.08 gm
D6.1-6.75	Propellant Weight	27	22.18 gm	0.18%	22.16 gm	+0.02 gm
D6.1-6.75	Propellant Weight	31*	22.14 gm	0.11%	22.16 gm	-0.02 gm
* D6.1-6.75	Total Impulse	31*	19.71 N-s	0.16%	19.74 N-s	-0.03 N-s
D6.1-6.75	Delay Time	31*	6.81 sec	0.58%	6.75 sec	+0.06 sec
D6.1-6.75	Final Weight	31*	15.82 gm	0.71%	15.67 gm	+0.15 gm
E11.8-0	Propellant Weight	50	40.28 gm	0.09%	40.23 gm	-0.05 gm
E24.0-6.00	Total Impulse	14	38.94 N-s	0.36%	39.08 gm	-0.14 N-s
F23.8-6.50	Delay Time	7	(6.47 sec)	(0.64%)	6.50 sec	(-0.03 sec)

Calibrated instrumentation employed in the above measurements. Daytronic signal conditioner, coupled with BLH strain gauge and secondary Daytronic Differential Transformer. Technirite chart recorders, Vidar voltage to frequency converter, matrix analog to digital converter, NOVA 1200 Data General Computer, Beckman multi-event timer, Ainsworth Microbalance, ASR 35 Teletype IO, and other instrumentation used to accomplish QC and QA functions.

* The 31 sample motors were tested on 16 parameters each quantity checked against its assumed relationship to others individually and the whole. We have developed a set of formulas to define a quantity we call Fidelity and we will discuss it in a later issue of the catalog. Fidelity is a measure of how close a selection of test motors comes to meeting the inter-related specifications. We use the number 1000 to represent complete agreement with specifications (all motors on spec. on every parameter=identical). The 31 D6.1-6.75 had a Fidelity of 937.

AVI ASTROPORT "GOLD" SERIES ENGINE CHARACTERISTICS

Catalog Number and Type	Each	Price Pack of 3	Diameter MM	Main Tube Length MM	Propellant Mass GM	Total Mass GM	Total Impulse Newton-Sec	Maximum Thrust N	Burn Time Seconds	Final Mass GM	Max Lift Off Mass Rocket + Motor(s) GM
AVI-1/8A1.9-0	$0.65	$1.50	8.75	12	0.37	1.02	0.29	2.70	0.151	0.69	NA
AVI-1/8A1.9-SP	0.65	1.50	8.75	12	0.37	1.12	0.30	2.70	0.156	0.80	NA
AVI-¼A1.7-0	$1.00	$2.50	8.75	19	0.70	1.56	0.59	2.68	0.345	0.89	25
AVI-¼A1.7-SP	1.00	2.50	8.75	25	0.70	1.88	0.61	2.68	0.356	1.23	NA
AVI-¼A1.7-2.50	1.00	2.50	8.75	25	0.70	2.38	0.61	2.69	0.355	1.28	20
AVI-¼A1.7-4.00	1.00	2.50	8.75	25	0.70	2.41	0.61	2.68	0.356	1.32	18
AVI-½A1.5-0	$1.25	$3.00	8.75	38	1.42	2.70	1.21	2.69	0.814	1.31	30
AVI-½A1.5-SP	1.25	3.00	8.75	38	1.42	2.88	1.23	2.69	0.831	1.44	NA
AVI-½A1.5-3.00	1.25	3.00	8.75	38	1.42	3.13	1.23	2.69	0.830	1.42	27
AVI-½A1.5-5.00	1.25	3.00	8.75	38	1.42	3.23	1.23	2.70	0.830	1.41	23
AVI-D6.1-0	$2.25	$5.25	18.	100	22.16	34.04	19.23	11.46	3.15	13.89	165
AVI-D6.1-SP	2.25	5.25	18.	100	22.16	35.11	19.75	11.48	3.24	14.55	NA
AVI-D6.1-3.25	2.25	5.25	18.	100	22.16	37.23	19.72	11.44	3.23	15.63	120
AVI-D6.1-6.75	2.25	5.25	18.	100	22.16	38.18	19.74	11.50	3.22	15.67	105
AVI-E11.8-0	$3.50	$9.00	23.5	100	40.23	61.21	36.20	21.74	3.05	21.23	400
AVI-E11.8-SP	3.50	9.00	23.5	100	40.23	64.58	36.54	21.79	3.09	24.88	NA
AVI-E11.8-4.25	3.50	9.00	23.5	100	40.23	68.23	36.51	21.82	3.08	25.95	350
AVI-E11.8-6.00	3.50	9.00	23.5	100	40.23	69.69	36.50	21.78	3.09	27.11	300
AVI-E24.0-0	$4.00	$10.50	33.	80	46.73	88.47	38.56	41.43	1.61	44.46	453
AVI-E24.0-SP	4.00	10.50	33.	80	46.73	91.98	39.07	41.32	1.63	47.91	NA
AVI-E24.0-3.75	4.00	10.50	33.	80	46.73	95.94	39.02	41.27	1.62	49.99	453
AVI-E24.0-6.00	4.00	10.50	33.	80	46.73	98.07	39.08	41.33	1.63	50.26	400
AVI-F23.8-0	$4.50	$12.00	33.	100	62.48	114.30	55.72	41.21	2.36	50.68	453
AVI-F23.8-SP	4.50	12.00	33.	100	62.48	121.81	56.10	41.41	2.38	57.93	NA
AVI-F23.8-4.25	4.50	12.00	33.	100	62.48	121.45	56.02	41.60	2.37	54.86	453
AVI-F23.8-6.50	4.50	12.00	33.	100	62.48	123.77	56.04	41.38	2.36	54.97	420

APPLICATION, INTEGRATION and OPERATION

The AVI Astroport Gold Series Engines were designed specifically for use as Model Rocket Engines. They were designed for application in contest flying and research rockets where reliability, reproducibility and performance are prime considerations.

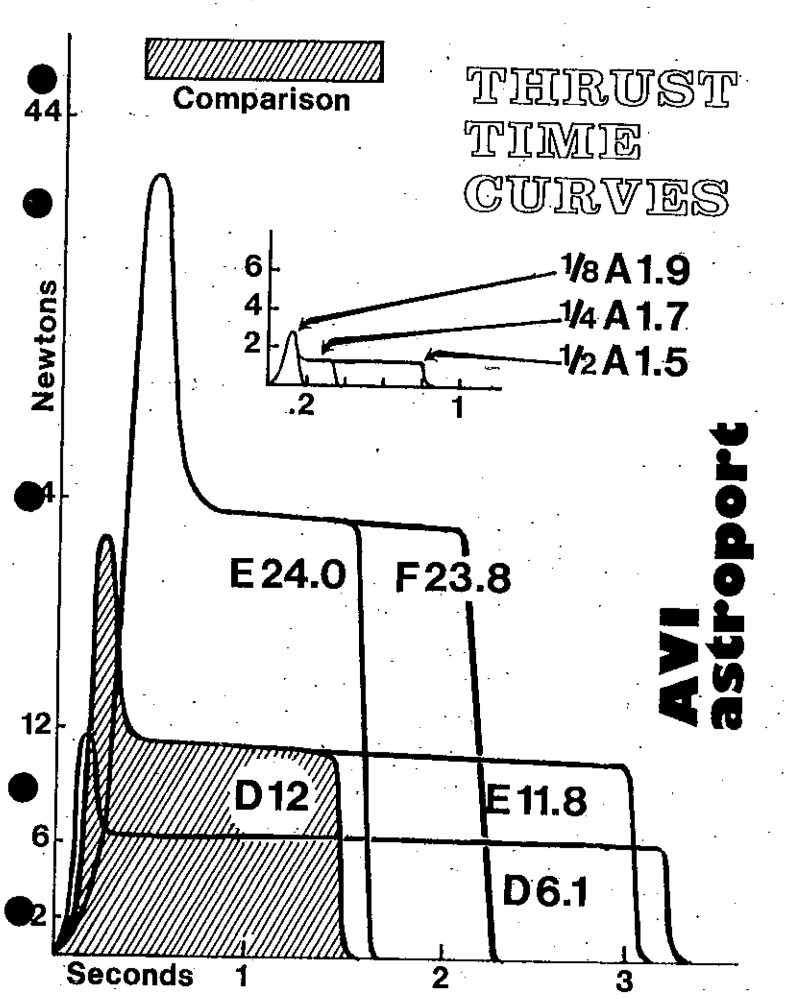
The original purchasers of the series received exact data from destructive test of samples as well as propellant weights and initial weights of the motors they received. We have discontinued supplying the specific information because the variations were so slight that we felt they were of little value to the purchaser.

Typical ranges in weights and performance data are given on the table.

APPLICATION

The AVI Astroport Gold are not sport engines: they are precision rocket motors and their prices reflect the fact. Use them wisely and they should impart an extra measure of pride to your contest and research flying.

The SP varieties are suited for use in test stand and wind tunnel investigations. Consult NFPA code 41L when conducting experiments with rocket motors in a captured vertical or horizontal attitude. There should always be competent adult supervision of rocket engine testing activities as prescribed.



INTEGRATION

This series of motors can be integrated into flying model rockets using many of the standard parts available. AVI Astroport has not created the engine mounts that fit the engines at this time.

We trust that you are well aware of the nature of the requirements to firmly mount the engines in the rocket with a suitable bulkhead or structure for the engine to react against. The motors should not be ejected from the system at time of initiation of the ejection charge unless they are provided with a recovery device and the rocket vehicle is designed to function in this manner.

We emphasize again that you must check the CG/CP relationship before flight and a knowledgable adult should act as Range Safety Officer passing on any rocket before flight to verify it air-worthiness and capable of executing a stable flight.

OPERATION

Ignitors are included with each motor or pack of motors. Full instructions on operations, a safety code and countdown cards are also included. Remember only electrical ignition is possible.

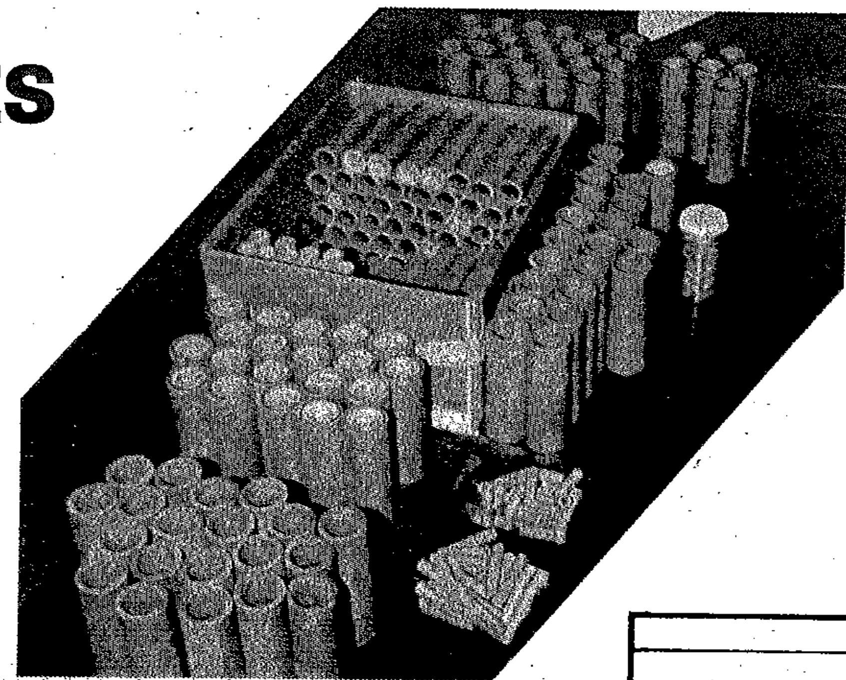
The microjet powered rockets should be flown from tower launchers or piston launchers.

The E and F Class motors come with flame proof materials in both the nozzle and head end, as required by regulations. Carefully remove the material before inserting in rocket vehicle or placing ignitor in nozzle.

When flying the larger motors the distance from the launch pad should be increased to 25 feet (8 meters). The feet of the pad should be weighted and a 3/16 inch diameter launch rod should be used. An alternate is to use a suitable tower launcher.

Remember that the altitudes that these high performance engines can fly your rockets to make it imperative that you have a large launch and recovery area.

PRECISION
GOLD SERIES
ROCKET MOTORS



DEFINITION OF OBJECTIVES

The AVI Astroport Gold Series Rocket Motors (engines) were designed with the following framework and general set of objectives.

1. Reliability 10 to 25 times greater than any other engine series available at the time.
2. Motors must comply with all International, National, US Federal, State and local laws and statutes regarding model rocketry. They must meet and surpass all requirements for FAI and NAR Safety and Contest Certification.
3. Reproducibility and consistancy within a motor type is a prime consideration.
4. Performance characteristics must make each motor type attractive to competition oriented rocketeers and those interested in using them for research.
5. Instead of rough approximations on performance data AVI Astroport will provide actual details and statistics on characteristics and performance to date.
6. Prices shall be as low as possible as dictated by costs involved with meeting other objectives and AVI Astroport pricing policies.
7. Modifications and innovations will be applied to each engine type to improve performance, reliability and consistancy as experience dictates.

DESIGN OF A SERIES

We are looking to design a series of superior rocket motors with a family resemblance. There are many variables that we can consider but let us look at the ones that we have settled on.

A. All motor types shall use basically the same propellant and it will be at most a variant of our standard propellant.
B. All engines shall be 'end burners'.
C. Basic materials shall be chosen from those which have shown best performance in the past. No radical changes.
D. Procedures in selection of materials, mixing of propellant and other pyrotechnical materials will be tightened.
E. The motors will tend to have 'intermediate' thrust levels tending towards longer thrust intervals than motors generally available at this time.
F. The frontal area the motors shall be in general less than motors currently marketed in the same class.
G. The motors of a type shall approach the upper limit of its class as closely as possible within our technical capabilities. This will dictate variations in motor length from type to type.
H. Motor weights (mass) shall be held as closely as possible to a lower limit.
I. Motors with delays shall have those delays accurate to 0.15 seconds, as stated. Delays will be stated to nearest 0.05 seconds.
J. Quality Control and Assurance levels will be designated for all components, procedures, operations and parameters to meet objectives

GENERAL RESULTS

AVI Astroport decided that the following motor types looked most promising and introduced them on 15 November 1975:

Microjets with a diameter of 8.75mm and in lengths suitable to the energy class. They are available in 1/8A, 1/4A and 1/2A.

We have skipped classes A, B and C at this time because of the large number of engine types already available there.

A full D class engine in a 18mm diameter casing.

A 36.5 Newton-second E class engine in a 23.5mm diameter casing.

A full E class engine in a 33mm casing.

An intermediate F class engine in a 33mm casing, due to propellant mass limitations.

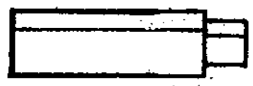
1/8 A1.9

1/8A1.9-0;SP

The 1/8A type has an average thrust of 1.9 Newtons and a Total Impulse of 0.30 N-S. The burn time is 0.15 second. Diameter is 8.75mm and length is 12mm. Original design was to produce a motor with a weight under 1 gram, present average weight of finished motors is 1.0213 grams (close).

The 1/8A is only available in zero delay, 'booster' configuration and as a Special Purpose (SP) variety with no delay and a plug in the head end so the hot gases do not blow through.

The basic reason for introduction of this 'device' is to give the rocketeer a small unit to use as separation motors for removing a pod from a boost glider, jettisoning an escape tower from a scale model; and so forth.



1/4 A1.7

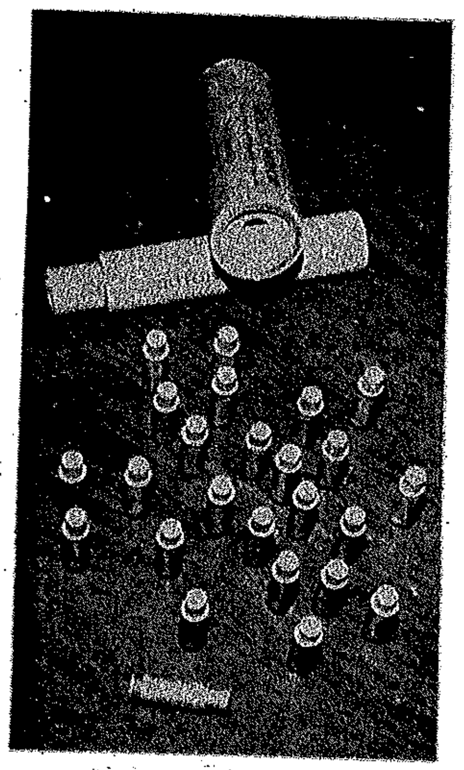
¼A1.7-0)SP;2.50;4.00

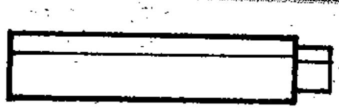
Many of the NAR contest events are geared to ¼A powered rockets. This microjet is designed to have low frontal area and weight, highest total impulse and super accurate delays (where present).

Here is a comparison with the most popular ¼A available previously (Values have been normalized to give better presentation):

	Gold Series *AVI Astroport* ¼A1.7-4.00	*Estes* ¼A3-4T
Frontal Area	1.0	2.10
Initial Weight	1.0	2.45
Burnout weight	1.0	2.82
Total Impulse Measured	1.0	0.93+
Time Delay	±3%	±15%

More information is given on the following page. We hope that this introduction of our first ¼A motor is appreciated by the Space Modeling community and we invite your comments.





1/2 A1.5

½A1.5-0;SP;3.00;5.00

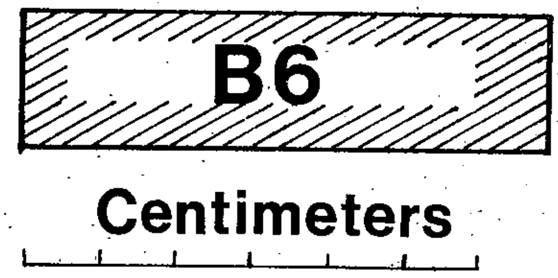
Here is a list of events where this motor should have a strong effect on National Association of Rocketry competition; Class O altitude; possibly Design Efficiency; Class O Parachute Duration; Class O Streamer Duration; Hornet Boost/Glider; Hornet Rocket/Glider; Scale; maybe Scale Altitude Class 1; Plastic Model; Class O Flexwing Duration; and Class O Helicopter Duration.

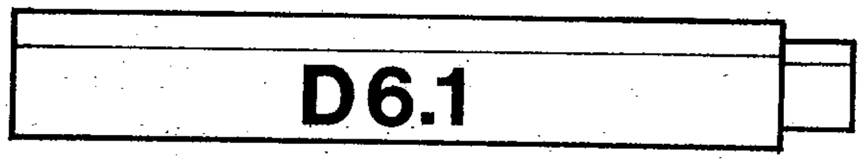
Another natural is to two stage these motors coupling the ½A1.5-0 in a lower stage to the ½A1.5-5.00 upper. Ideally there should be a longer delay available. This combination would qualify for many Class 1 events.

Not all events should necessarily be flown with something in the 9mm to 10mm diameter body tubes that microjets make possible. Use a larger diameter tube and boattail.

With the design of the microjet we are assuming that many rockets powered by them will be going off tower launchers and piston launchers.

Comparison





D6.1-0;SP;3.25;6.75

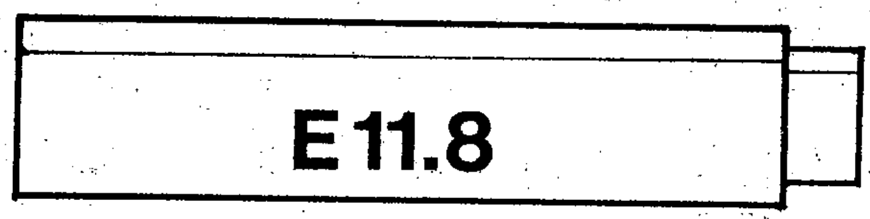
Here is a sample of performance: Don Larson of *Narhams Section* coupled the first D6.1-6.75 he ever flew with a C6-0 booster and set a new FAI class III Altitude record of 1001 meters, shattering the old record of 575 meters.

The D6.1 represents the only full D on the market. Not only that, it is built in a tube with an 18mm diameter, as opposed to the current largest selling D which is in a 23.5mm casing.

The three second burn gives a gentle lift to Eagle Class boost gliders while still giving 6.1 Newtons of lift. We know of rocketeers building two stage Eagle B/Gs for spring 76 competition and record tries.

Because of the long burn do be conscious of wind conditions when flying.

Also do not simply force the 4+ inch long D6.1 into a rocket designed to take 2.75 inch (70mm) long 18mm diameter engines. The D6.1 could shift the Center of Mass too far rearward making the rocket unstable.



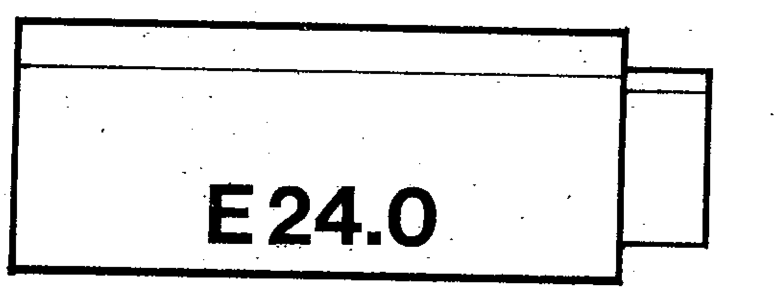
E11.8-0;SP;4.25;7.50

This engine is the same diameter as the Estes D12, 23.5mm, but it is 4+ inches (100+mm) long. Total impulse is 36.5 N-S or at 91.25% of full power for class. There has never been an engine produced with these characteristics before. It again has a long burn of 3 seconds.

You can readily modify models that were designed to take the D12 engine to E power without expensive conversion kits. Always take into consideration CG/CP relationship when modifying.

Consider this motor for your custom designs in Ostrich Egg Lofting; Mercury Dual Egg Lofting; Eagle/Boost Glider; Eagle Rocket Glider; Scale; Super Scale; Class 4 Scale Altitude; and Super Roc Competition.

Two stage the E11.8-0 and E11.8-7.50 for F class events.



E24.0-0;SP;3.75;6.00

When you need more lifting power then use the E24.0 for twice the thrust. Total impulse is 39.0 N-S (97.5% of full class) and diameter is 33mm with length 100mm+.

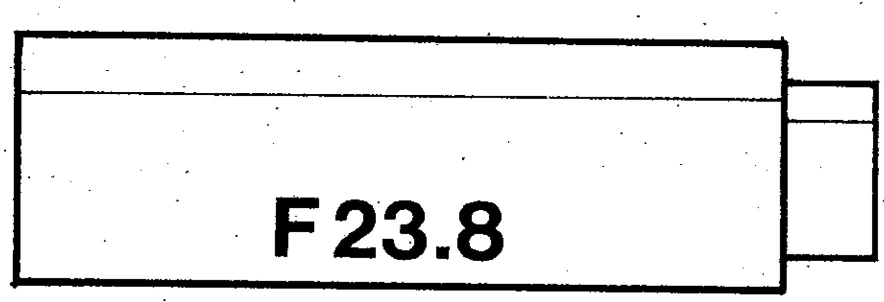
Comparison with the *Enerjet* E24 and F52 (normalized for comparison)

	AVI Astroport E24.-6.00	**Centuri** E24	F52
Frontal Area	1.00	0.75	0.75
Initial Weight	1.00	0.75	0.95
Burnout Weight	1.00	1.04	1.35
Total Impuse Measured	1.00	0.89	1.12
Maximum Thrust	1.00	0.82	1.73
Time Delay	2%	±15%	±15%

The Enerjet line has been discontinued by Centuri but a limited number of E24 types are still available.

The above table of data is informational and gives a comparison between a propellant with a I_{sp} of 90 N-S as is used in the AVI Astroport E24.0, and port burning motors using I_{sp} of 190 N-S.

A good deal of the advantage one has with the higher I_{sp} (Specific Impulse) has been lost in the design with disproportionately large configurations and weights.



F23.8-0;SP;4.25;6.50

The F23.8 again features the ultra-accurate delays that are intrinsic in the *Gold Series*. The limit of 62.5gm of propellant per engine as imposed by the NFPA makes it impossible to create a full F using the 90 N-sec I_{sp} propellant.

The F23.8 is thus a mid-range engine as far as total impulse is concerned, with a total impulse of 57 Newton-sec.

The thrust level (23+ Newtons) makes the F23.8 particularly attractive in lofting heavy scale models.

The F23.8-0 can be coupled with a D6.1-6.75 to loft small payloads to unbelievable heights. You will have to design the coupler for staging an 18mm engine off the top of a 33mm engine. The pair of motors will give you a total impulse near the top of the class and a small diameter upper stage for penetration.

Once you're into Space Modeling there develops this terrible itch to start designing your own rockets. Your imagination will run wild with dreams of fantastic ships that will rise from lift off automatically from a complex launch tower and pad that simulates most of the operations of Pad 39A at Cape Kennedy.

Your creation majestically accelerates under the power of six engines that were simultaneously ignited. At your command via a radio control system the rocket executes a sequence of operations including a roll and the firing of some vernier rockets just before the activation of thrusters that separate the escape tower from the top of the vehicle.

Now staging occurs and four engines continue to thunder as the burnt-out first stage comes parawing back to the launch site. The movie camera on board has recorded each event and the telemetry system is sending data back on all eight channels.

SECO (Sustainer Engines Cut Off), the four second stage engines have done their job. Suddenly you transmit the signal for the third stage to ignite; creating separation from the second stage and the barely visible exhaust trail signals its success at the same time you receive confirmation of the event on channel 7 of the telemetry.

Channel 6 confirms you have broken the sound barrier at 11 seconds into the flight. Channel 2 reads off altitude in thousands of feet (23, 24, 25). ***Shut down.*** The third stage motor has done its job and your rocket is on its way to coast up to well over ten miles. All systems are still go, at 110 seconds into the flight the parachute is automatically deployed and your pride and joy drifts across two states before touching down.

Two days later you receive a call from a chicken farmer over 450 miles away saying he is claiming the reward for the thing-ma-jig with your name on it that got hung up in his oak tree (the only tree on the farm).

After hanging up the phone, a smug feeling permeates your body. "Not bad for a first effort!" you muse. "Wait until they see my second one."

Editors Note: The only plausible part in the above is the rocket being found in the lonely tree.

Restrain your first impulse to attempt a project that is beyond your Proficiency Quotient.

Your first Custom Rocket should be something simple enough to construct in a few hours at most; designed to use a single mini or standard Sport Motor; use a conventional recovery system; and exhibit a high degree of stability and be executed with a reasonable degree of care. Don't just throw it together.

When flying a Custom Rocket always make sure that others in the launch area realize that it is an "experimental" design before you begin the countdown.

We can only outline a portion of the process on this and the next page . . . . .

DESIGN & ENGINEER

CUSTOM MODEL ROCKETS

BUILD & LAUNCH

ELEMENTS of the DESIGN PROCESS

Your objective is to design a custom model rocket for one reason or another. In any case we must face the constraints (limitations) that are imposed on us by the difinitions of Model Rocketry and our capabilities and resources at the time.

Be sure that you know what the definitions associated with model rocketry are. Paraphrased and condensed they go something like this:

"A model rocket is an aero vehicle powered by a reaction motor that has been commercially produced in compliance with energy class, propellant weights, performance, etc, which we call a model rocket engine.

The model rocket shall be ignited electrically and be constrained to a flight path within a cone prescribed by a 30 degree angle from the vertical immediately after ignition until such time its aerodynamic surfaces enable it to continue in a stable manner in the direction it was launched.

The weight of the rocket shall be less than one pound including the motor weight. It must be constructed of lightweight materials such as plastic, paper, wood, rubber or the like, with no structural metal parts.

The model shall contain a recovery device that will operate properly to return the rocket to the ground with little or no structural damage.

The model rocket must be capable of flight that will in no way cause danger to life or property."

Another limit is your ability. Be honest with yourself or you might bite off more than you can handle. Once you have made an initial determination of what you want to accomplish reflect on it to see how you might modify it so you can carry the job to completion.

"Time and Money" are two quantities that are often equated, but you will have to consider them separately. You're doing the design and building yourself, so the time you have available to devote to the project must be calculated (especially for a complex undertaking). Can you finish your rocket within a reasonable time . . . before you might loose interest or get stated on another project? Always remember the maxim, "Everything takes longer than your most pessimistic estimate!"

Money is the easy one! Well, in most cases it is. You can build a worthwhile Custom Model rocket for a few dollars. Even the most ambitious flyable Custom Model Rocket I can conceive that would weigh under the one pound limit, and be made with the most reasonable materials available should cost no more than a few hundred dollars even if it were loaded with lightweight telemetry, radio control and other equipment. (Please don't hit me with jewel encrusted fins or exotic payloads of radium.)

Aside: Randall Victory please return the model of mine you found with the jewelled fins.

Back to money. In any case your initial design efforts should not run more than the few dollars I have mentioned.

THE IDEA

Behind every mediocre or great Custom Model Rocket is the ***idea.*** Couple that idea with the desire to see the project through and your capability to accomplish it and you will produce a unique model.

I won't condemn an idea for a custom model rocket as long as it falls within the definition, and will not reflect poorly on the hobby itself due to the choice of subject matter, or for other reasons.

Some designs will just pop into your head and continue to grow until you sit down and put them on paper or start to glue parts together.

In many or most cases you have a particular purpose for the rocket: you want to demonstrate rocketry to a group of fire marshalls; or you want a far-out design that in your mind might be a star-ship from a small planet under the influence of a Black Hole; possibly you've advanced to the point where you are considering using telemetry to send back physical data on oscillations of a model relative to the center of mass position variable throughout the flight . . . a research vehicle; you know of the Australian sounding rocket the Kukaburra and you want to build a super detailed scale model of it; your goal is to set a world altitude mark in Federation Aeronautique International Class III category (see page 19). Obviously the choices are infinite.

You won't build every rocket that comes to mind. You won't build any of them if put off starting a project when you are sure you have a good idea. At some point you have to make a commitment to start.

Begin

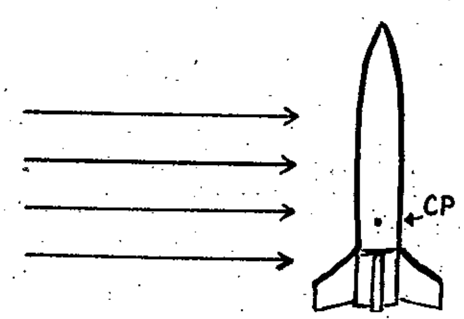
Take your idea and test it mentally to make sure that it is within your capabilities, financial means and that it fits the basic criteria of being a model rocket.

Scale the proto-design up and down to keep it within the limits imposed. Make sketches and notes about how you will accomplish certain construction features.

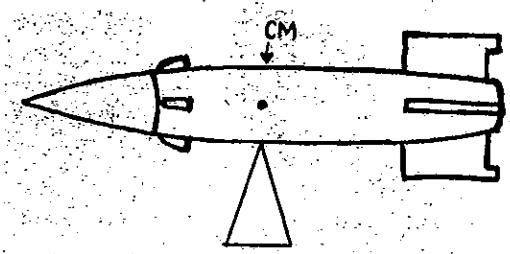
One early decision should be the type and make of motor or motors you will use to fly it. Obviously you are not going to build a model with an engine compartment 14mm in diameter and use a current type F engine in it.

Here the design process is obviously coupled with all the aspects to follow. You are doing engineering work (research and development), and you are concerned with the ease with which your model can be built and that it will fly properly.

There is not room here to cover, in the detail I would like to at this time, the full aspects of stability during flight. ***Stability in flight is of prime importance.*** A simple rule to remember is the following: "The Center of Pressure (CP) must be to the rear of the Center of Mass (CM) by an appropriate margin." The CP is the balance point where a rocket will maintain orientation perpendicular to a uniform 'wind.' Obviously it is related to the geometry of your design.



The Center of Mass is that point at which the rocket will balance on a fulcrum (straight edge), 50% of the 'weight' towards the nose and 50% towards the tail.



A rule often stated and used is that the CM should be at least one "caliber" (body tube diameter) ahead of the CP. Use it to begin with.

In your earliest attempts with simple designs always keep the fin areas well to the rear of the rocket, no fins up front. If you must move the Center of Mass forward then you can add weight to the nose of the rocket.

You can put your model through a simple test, known classically as the "Swing Test." Attach a loop of string securely to the point where the Center of Mass (with the engine in place) is and allow a six foot length to hold in your hand. Begin swinging the rocket as a lasso playing out the line. If it flys in the circle without tumbling at all or wobbling significantly then its center of pressure is to the rear of its center of mass, as it should be.

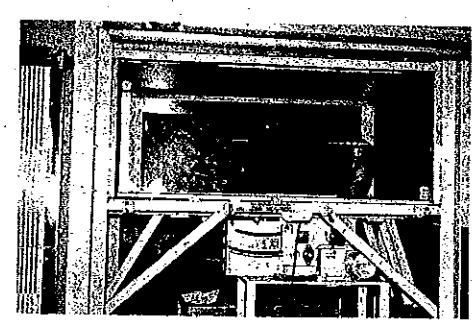
If you further modify your rocket after the test remember you must go back and retest it to check the possible change in its stability.

Modifications

Most of your rockets will vary from your first conception of them as you make changes to ensure stability, add detail, alter interior construction and so on.

There is nothing wrong with having to make such changes and usually you can rationalize that they, by and large, are improvements to the design. You are doing creative work and you're the boss.

ENGINEERING RESEARCH and DEVELOPMENT



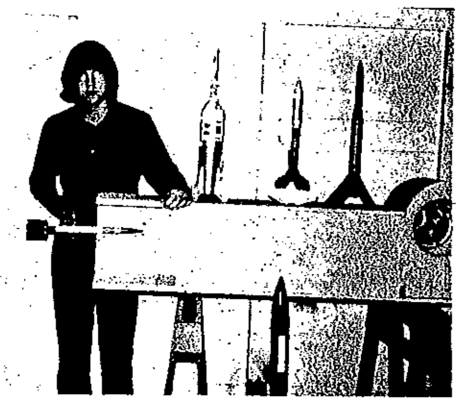
A model mounted in the Academy's low-speed wind tunnel.

PHOTO COURTESY NAR
Model Rocketry Magazine

Bob Lieber (far right) tells the one-hour scale participants how much time they have left. (Photo by Ken Paul)

PHOTO COURTESY NAR
Model Rocketry Magazine

BUILDING and TEST PROCEDURE



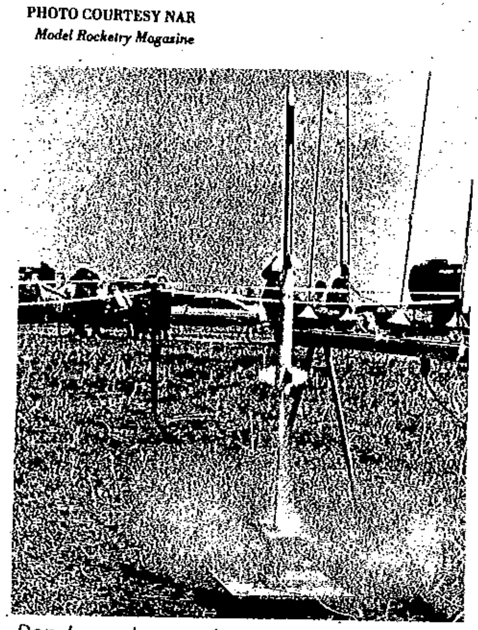
Bill Smith demonstrates his wind tunnel.

PHOTO COURTESY NAR
Model Rocketry Magazine

LAUNCH and PERFORMANCE

Shirley Lindgren loads her PeeWee Payloader on to the launcher.

PHOTO COURTESY NAR
Model Rocketry Magazine



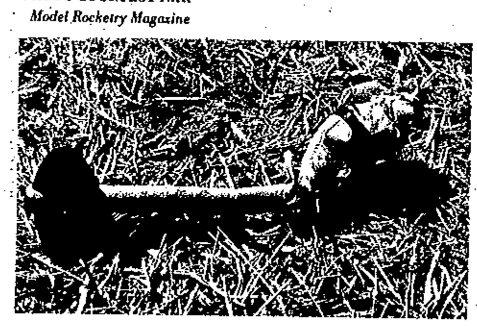
Don Larson's second-place winning scale Nike Cajun was caught by the camera at ignition. (Photo by Paul Gross)

PHOTO COURTESY NAR
Model Rocketry Magazine

EVALUATION

Dr. Gerald Gregorek explains why he designed the "Basic Boost/Glider".

PHOTO COURTESY NAR *photograph by David Klouser*
Model Rocketry Magazine



NARAM-14, like any other meet, was not without its prangs.

PHOTO COURTESY NAR
Model Rocketry Magazine

EXAMPLES

The range of designs that are possible is unlimited in number, even if there are limits to materials, weight, performance, and those limits imposed by the laws of engineering and physics.

There are some broad classes of model rockets we will cover very briefly here. A single model might fit into two or even more categories but we do want to make certain distinctions, as to types and purposes.

SIMPLE SPORT ROCKETS

Your first custom rocket should be a simple sport model. If you can successfully construct a stable model rocket with just the basic parts then you can go on to something 'fancier' and right up the ladder.

A first custom model can be constructed from the standard list of parts that are presented in this catalog. You will first have constructed enough commercial kits so you are familiar with the terminology and the method of selecting parts. *Keep the first one simple.*

DEMONSTRATION MODELS

What are you trying to demonstrate? In all cases we're sure that you are promoting our hobby and you want to emphasize the seriousness of and fun that can be had by rocketeers. Always you should be emphasizing the safety inherent in proper handling of model rocketry equipment.

If you're trying to gain new members for a club, then we suggest that you have a range of demonstration models; tiny ones with simple designs and big slow rising models that look like something from out of the future. There can be a dozen other models of varying degrees of difficulty. They should all have been previously flight tested — nothing of the experimental class. Control the quality of the demonstration by knowing how each model will perform, from experience gained in earlier flights. When you want to build a special model for demonstration then consider what you're trying to accomplish. Do you want to impress the audience with the fact you can put a model nearly out of sight and still recover it, then design a contest quality model and bring it back on a minimal streamer.

The group you are flying for may be a model airplane club where they are particularly interested in Scale R/C models. Take either direction, but probably not both. Build an R/C model Boost Glider or a super detailed model of a rocket used in the Space Program.

If you're flying in a confined space for a shopping center opening then you might build a series of large lightweight models that are flown to relatively low altitudes and recovered on large parachutes, or by helicopter or gliding techniques.

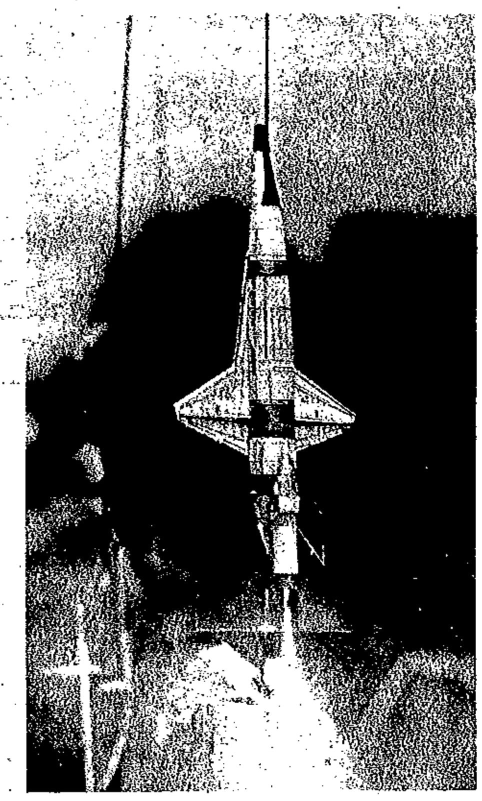
Warren Sisco and his father, John, prep a two-stage Camroc-lifting demo bird. (Photo by Dave Zuchero.)

PHOTO COURTESY NAR
Model Rocketry Magazine

EXOTIC DESIGNS

Odd-ball, Fantasy or Futuristic might all describe certain types of Exotic Designs.

There are way-out designs like: Flying Outhouses, Snoopy's Dog House, the MPC Flying Model Rocket Launch Pad, actually modified to fly, rocket powered boomerangs and the like. They all must conform to the definition of a model rocket though and display stable flights and return to ground with some sort of a recovery device.



Jim Hartman's 2001 Space Clipper had an unbelievable flight
(Photo by Alan Williams.)

PHOTO COURTESY NAR
Model Rocketry Magazine

The realm of Fantasy model rockets can be chosen from near scientific fiction to comic books or fairytail subject matter.

There have been Flying Witches on Broom Sticks, Superman, the Batmobile, Flash Gordon designs and the like. As a rough definition of this class, you might tend to group together things that might be expected to fly using rockets but do not represent a sound scientific or engineer reason for actually realizing their existance either in the past or in the future.

Terry Lee's Pilgrim Observer brought him fourth place in C Division Plastic Model. (Photo by Thomas E, Pastrick.)

PHOTO COURTESY NAR
Model Rocketry Magazine

Futuristic designs should have a fairly solid basis for their design. You should create something that in your mind could very possibly evolve out of intelligent application of scientific and engineering principles to the problem of Space Exploration.

Don't just drop parts on the model. Logically build it up to fit a particular need or purpose in the World of Tomorrow. It is similar to writing good science fiction, keep your design consistant with the message it is trying to convey.

This type of modeling can be very rewarding and stimulating.

Frank Walsh and Ed Golden display their soft landing air pollution sampling rocket at the R&D discussion group. (Photos by Jan Blickenstaff)

PHOTO COURTESY NAR
Model Rocketry Magazine

RESEARCH VEHICLES

The range in design of research vehicles likewise can be broad. The research may be in the flight characteristics of a family of rockets with variation in the position of its center of mass, or any other parameter directly related to the rocket itself.

Another class of research vehicles would be those that carry instrumented payloads to check the environment — miniature sounding rockets.

You certainly can think of a large number of investigations that can be conducted within the constraints of model rocketry.

It would be a general rule that most research rockets are cleaner in design than the Exotic class.

Often you must be clever in the design of your experiment to match the vehicle to its purpose, that is one of the challenges of research.

The National Association of Rocketry has many members that are keenly interested in a wide range of topics of research. Much of their work is published in the Model Rocketeer Magazine and/or in section publications. Membership in the NAR makes it possible to be in contact with the many interesting people that are active in model rocketry research.

SCALE MODELS

Scale models of actual rocketry hardware that are used in space exploration, atmospheric investigations or in some cases (used) as weapons; are one of the most intriguing aspects of model rocketry.

An exceedingly well done scale model is truly a work of art. It is actually one of the oldest forms of art. Scale models of many items were entombed with the ancestors of the Pharohs of Egypt. Yes, model building pre-dates the pyramids. There weren't, however, models of rockets unless the Ancient Astronaut theory holds true.

Each age has seen technical progress, and it seems that with each advancement the model builder is there beforehand building miniature hardware in anticipation of the event.

Model Steamships were in operation before Fulton launched his steamboat. But as soon as he christened it, you can be sure the modeler of the day began building tiny replicas of the first successful man-carrying vehicle.

No sooner had Daimler and Benz put their horseless carriage on the road in Germany than did someone build a scale model of it.

When the Wright Brothers made their flight, there followed commercial kits and homebuilt (custom) models of the aeroplane.

And now, you can continue the tradition. There are already hundreds of rockets that you can choose from to build a unique model rocket.

We are talking primarily about flying model rockets rather than static models. You must take the physical and legal limitations into account. Then with these in mind you have to choose a prototype to build, in order then, decide on the scale you will build it to, and the amount of detail you will provide. Obtain as much information on the prototype as possible; drawings, data, color schemes, modifications, launcher information, and the like.

Contact with other rocketeers through an NAR Section can be a valuable experience when starting or continuing in Scale Space Models.

The Biedron-Langford Team's winning Celesco Argo D-4 Javelin lifts off. (Photo by Alan Williams.)

PHOTO COURTESY NAR
Model Rocketry Magazine

COMPETITION QUALITY

NAR

Very often the quality of an endeavor is improved by competition. This is particularly true in the advancement of model rocketry. New innovations in design of the various components that make up the hobby cause actions and reactions that keep Space Modeling a living entity. Changes and evolution are necessary to keep the hobby from going stale or being outdated.

The quality of competition may vary widely on the sectional, open, regional or national level, but if you want to win then you are aware that there is a level that must be attained that is above simply going out and flying sport models on the weekend.

In their efforts to win competing model rocketeers have introduced most of the features that are a part of model rocketry today.

You will gain valuable experience that is applicable in most facets of everyday existence, for whether you know it or not you are constantly competing.

Competition in model rocketry reflects the conservative nature of the universe. The simplest, most efficient and direct approach always has the advantage. It may not always appear that way, but that is usually because you haven't fully defined the problem in the first place.

I'm not saying that the ultimate model will always win. It is obvious that one of the elements that you are always competing against is chance.

You might put together a model that all reason would say should get the job done (every expert in the country agrees its the winner), but out on the flying field an unpainted, hairy little crooked finned model edges it out by a meter or two. It will happen sometimes.

But, as you develop as a seasoned competitor people will recognize your 'style' and your expertise.

You are going to learn to choose and use the best materials for each job. You will invent and create complete new approaches to making winning designs. ***You will become a part of Model Rocket History, and a part of the adventure of the early years of the space age.***

THE NATIONAL ASSOCIATION OF ROCKETRY

Is your organization promoting the science hobby of Model Rocketry and Space Modeling throughout the United States.

All rocketeers interested in advancing beyond the basic stages should become NAR members to best take advantage of and give support to the organization.

If you have specific questions that are not answered in this presentation then we ask that you contact the NAR office directly:

NAR Headquarters, Ref: AVI
P.O. Box 725
New Providence, NJ 07974

AVI Astroport includes NAR membership forms with each order that is sent out to our mail order customers, and we will provide them to our dealers upon request.

HISTORY

The NAR was born as the Model Missile Association (MMA) in Denver, Colorado in 1958.

Formal model rocketry had developed only months before with the introduction of the concept to the public by Model Missles Incorporated, also of Denver. MMI was marketing the first commercially available model rocket kit and motors. The time was ripe for only months before the Soviet Union had launched Sputnik I, the first artificial satellite of the Earth, and youth across the country were hungry for the means of placing their own rockets into 'orbit'.

The stimulus of man's entry into space saw thousands of inexperienced youngsters and adults concocting their own propellants and filling them into metal casings in an effort to build a rocket that would fly. The rash of accidents and incidents that followed sent a shock-wave through governmental agencies to ban all forms of "amature rocketry". A ban is rarely a workable or effective force, there must be an alternative.

The founders of the MMA quickly proved to safety officials with influence that *Model Rocketry* was that alternative. Soon the MMA became the NAR and its ties with MMI were eliminated so that it could become an independent organization to represent the American model rocketeer.

Through the direct efforts of the NAR great advances have been made in convincing the power that is in every state, that Model Rocketry has an important place and a role to play in education the American public.

PURPOSE

The NAR exists to serve the model rocketry community of the United States of America. If need be, it is your lobby in government; national, state or local.

The NAR distributes information on the hobby in general promotion of the ideals it has set down in its charter. The NAR is structured to operate on national, regional and local levels.

It is an associate of the National Aeronautic Association which enables it to certify national model rocket performance records.

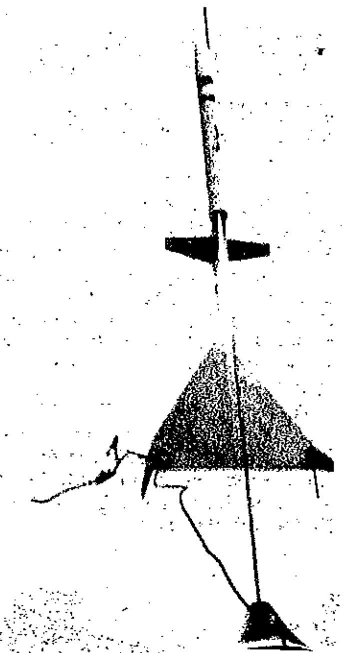
This affiliation also gives the NAR international affiliation with the Federal Aeronautique Internationale (FAI) allowing its members to file for International records.

The NAR maintains a laison with the Federal Aviation Agency; the National Fire Protection Association; the Hobby Industry Association of America; the Food and Drug Administration; and the commercial manufacturers of model rocketry equipment.

Standards have been set by the NAR for the safe operation of model rockets and they are made available as the *NAR Safety Code*.

The Standards and Testing Committee sample model rocket motors from the commercial manufacturers and either award or withhold Safety and Contest Certification, based on well defined criteria.

The NAR is devoted to the advancement of the science and technology associated with Model Rocketry.



Mike Hodapp's AVI Delta Katt takes off.

PHOTO COURTESY NAR
Model Rocketry Magazine

MEMBERSHIP

The National Association of Rocketry has members in every state of the Union, and each possession and territory of the United States. Over the years, over 25,000 have joined and supported the organization. Currently there are over 2000 active members, well under 1% of the people that will fly a model rocket this year.

Nineteen hundred and seventy six is the year that the NAR has chosen to launch a determined membership drive and AVI Astroport has dedicated these two pages to their efforts.

Membership is open to all ages, and the members are from 8 years old to 80. There are housewives, paperboys, university professors, science teachers, astronauts, and people from many other walks of life that have been or are now members.

The dues schedule appears below. . . .

JUNIOR MEMBER
(Under 16 as of January 1)
Division A **$7.00**

LEADER MEMBER
(Under 21 as of January 1)
Division B **$8.00**

SENIOR MEMBER
(21 or over as of January 1)
Division C **$10.00**

ACTIVITIES

Building and flying model rockets is a main concern for most of us rocketeers. But we do it with purpose.

This catalog should give you an indication of the broad nature of the subject, and rocketeers like to get together to build, do their design work, form teams for competition, and do research on the subject.

NAR members come together for Technical Meetings, Symposiums and innumerable bull sessions.

They hold many Sport Launches, Demonstration Launches and of course get together to compete in organized meets.

Modelers prepare their B/Gs for flight. (Photo by Peter Galindez.)

PHOTO COURTESY NAR
Model Rocketry Magazine

BENEFITS

The National Association of Rocketry provides you with a respected representative of your interests in model rocketry on a national level.

The organization acts as the authority of the subject of model rocketry and assures its preservation and development.

As a member you are covered by a $1,000,000 liability policy for protection against personal or property injury resulting from your rocketry activities.

You receive your own NAR number and your *Model Rocket Sporting License*. This license allows you to compete in sanctioned competition according to the Pink Book rules.

You receive a copy of the Pink Book (the U.S. Model Rocket Sporting Code).

NAR decals or stickers are included in your membership packet.

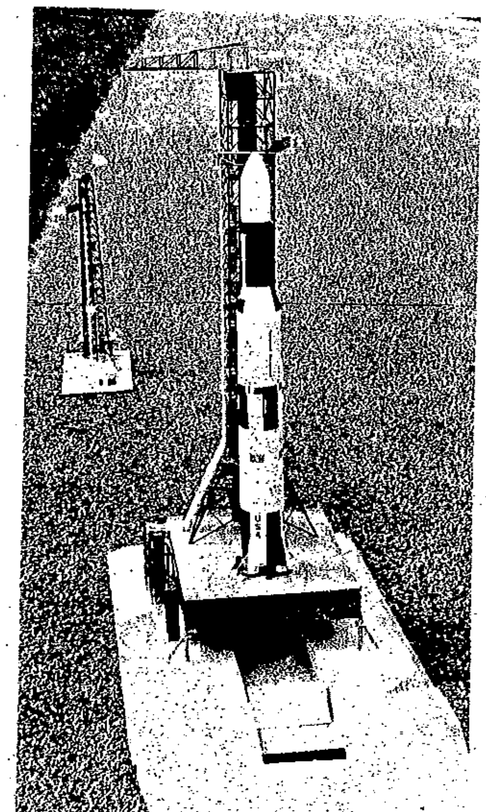
There are further material benefits that are being considered for inclusion in the packet at this time.

You also receive a one-year subscription to the monthly publication, *"The Model Rocketeer."*

There are of course many other benefits that you can receive depending on the degree of activity you are interested in.

The NAR membership sponsors many contests and sporting events each year, and a tabulation is kept of performance by each member culminating in the National Association of Rocketry Annual Meet (NARAM) where the National Champions for the year are named.

Membership in the NAR should make you a better Space Modeler.



Speaking of the Saturn V launcher, Glenn Gibson of the Point Place Model Rocket Club in Toledo, Ohio, built this one, along with a Skylab Saturn V. The model and launcher are 1/100 scale. (Photo by Glenn Gibson)

PHOTO COURTESY NAR
Model Rocketry Magazine

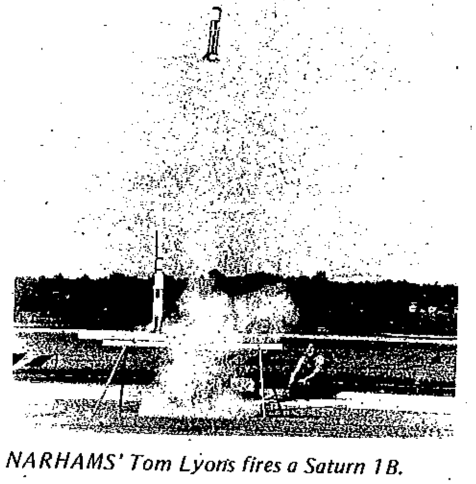
SECTIONS

If you have or can enlist ten or more NAR members then you can form a Chartered Section of the National Association of Rocketry. As a section you can compete as a unit for a national trophy.

The members of the section choose a name for their organization and meet and compete under its ensign.

Regular meetings are held and many are launch dates.

Many sections put out a periodical newsletter that they exchange with other sections on a regular basis.



NARHAMS' Tom Lyons fires a Saturn 1B.

PHOTO COURTESY NAR
Model Rocketry Magazine

Jonathan Bundick tries to put his Hawk R/G on the rail. His glider gave him a second place in A Division. (Photo by Frank Warner.)

PHOTO COURTESY NAR
Model Rocketry Magazine

Model Rocketeer Monthly Magazine

The NAR has its own journal - the Model Rocketeer. It is published monthly and the contributors to it are the membership of the association.

The magazine contains information on changes in contest rules; a calendar of coming events; many articles on technical developments within the hobby; standings of the top twenty contestants in each age division; comments and gripes by the membership; designs for rockets; building hints; news from various sections; news of new products from the manufacturers; and of course more.

NAR

AVI astroport

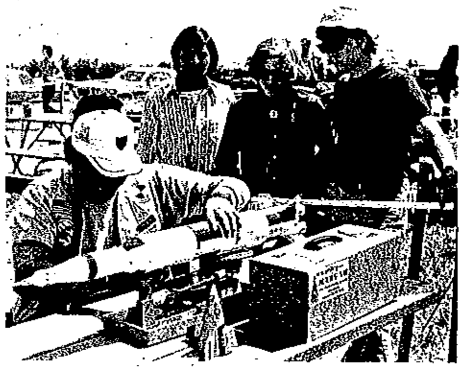
COMPETITION FLYING

Just as competition is good for any business, so is competition an asset to Space Modeling.
New technological and scientific advances arise due to the modelers attempts to excell.
The NAR oversees organized competition in the United States of America as the recognized representative of International Space Modeling.

Age Divisions

July 1 is the beginning of each new contest year and the reference date for determining the Competition Age Division that you will be a part of. (Take your age as of the previous July first.)
The divisions are as follows:

Division A	14 years old or younger
Division B	15, 16 or 17 years old
Division C	18 years old or older



A scale Saturn V passes through the safety check-in line. (Photo by Paul Gross)
PHOTO COURTESY NAR
Model Rocketry Magazine

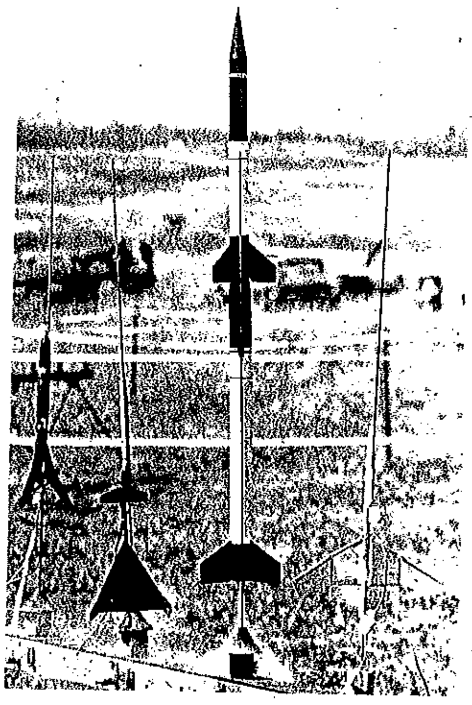
The Pink Book

The Pink Book is the standard set of rules that has been created over the years by the National Association of Rocketry, and its official title is the United States Model Rocket Sporting Code, 1973 edition.
The 'Code' is drawn up and administered by the NAR Contest and Records Committee (Contest Board).

Events

The current listing of categories of events includes the following:
Altitude . . . There are six events divided up by energy ranges allowed. The contestant wins that has flown his rocket to the highest measured altitude.
Predicted Altitude . . . A single event open to all engine types where the modeler predicts how high his model will fly (minimum of 100 meters). The modeler that closest predicts his model's performance (percentage-wise) is the winner.
Design Efficiency . . . The purpose of the event is to obtain the greatest altitude with the least amount of power (energy), or the largest value of meters per Newton-second.
Payload Competition . . . Loft a standard payload (weight) to the highest altitude within energy class and win.
Egg Lofting . . . You must loft an egg to highest altitude and return it unbroken to win in this event.
Parachute Duration . . . By energy class. This is a timed event. Keep your model aloft for the greatest time using parachute recover.
Streamer Duration . . . By energy class. Also a timed event using a single streamer.
Boost/Glider Duration . . . A timed event by energy class. Carry a glider aloft by rocket power, separate the booster pod and time until the glider touches ground.
Rocket Glider . . . Timed events by energy class. Similar to above, but now you must bring the total glider and pod-motor combination back intact (no separation).
Spot Landing . . . A point is chosen on the ground for the entriest to land near. A recovery device must be used. The model that lands closest to the predetermined point is the winner.
Scale Competition . . . Scale models of existing or historical guided missiles, rocket vehicles or space vehicles are judged for fidelity and flight performance.

Other events include Super Scale, Space Systems, Drag Racing, Plastic Model Conversion, Flexwing Duration, Helicopter Duration, Super Roc, Research and Development and more.
You can specialize or attempt to become proficient in each of the above events. You can compete on a local, regional and/or national level.



Tom Lyon's Scale entry, an Aero Hi, lifts off. (Photo by Paul Gross)
PHOTO COURTESY NAR
Model Rocketry Magazine

Sanctioned Contests

Contests are classified as follows (partial definitions):
Section Meets: This is competition among the members of chartered NAR section.
Open Meets: Two or more NAR chartered sections are competing against each other; or all NAR members in a predetermined geographical area are qualified.
Regional Meets: Competitors must come from no less than two states.
National Meet: Only one national meet shall be held each year.

Gary Bossong prepares to launch the Saturn V.
PHOTO COURTESY NAR
Model Rocketry Magazine

NARAM

The National Association of Rocketry Annual Meet is the one national meet of the year. Hundreds of rocketeers from across the country gather to ply their skill against each other.
There is always a sponsoring section or sections and the meet moves from area to area. NARAM 17 (the seventeenth held) was in Florida. The first National meet was held in Colorado, and others have been conducted in Minnesota, Texas, Maryland, Virginia, as well as other states.
The NARAM 18 will be held on the east coast in the fall of 1976.
Tradition plays a big part in the NARAMs and it is truly the high point of the year for Model Rocketeers.
AVI Astroport hopes that you're an NAR member by the time the next one rolls around so that you can take part in this part of America's Space Age Heritage.

AVI was among the manufacturers to set up displays in the CAP-supplied tents.
PHOTO COURTESY NAR
Model Rocketry Magazine

NATIONAL RECORDS

Yes, you can get your name in the record books; or at least model rocketry provides the opportunity for you to attempt to place it there.
The National Aeronautic Association records and preserves all national aerospace records in the United States. They have authorized the National Association of Rocketry to administer record filings as their affiliate concerned with model rocketry.
The procedure is not difficult and many records are far below the current level of technology. Full details are listed in the NAR 'Pink Book' and your NAR Sporting License opens the door enabling you to be listed as a National Record holder.

At the launch control are Scott Decker (standing in the back), Rick Lepski (seated and wearing a white hat) the Launch Officer, RSO Mark Fradkin (in the black hat), and, standing at the right of the photograph, Steve Noppenberger and Ron Mitnick. (Dorothy Cobb Studio)
PHOTO COURTESY NAR
Model Rocketry Magazine

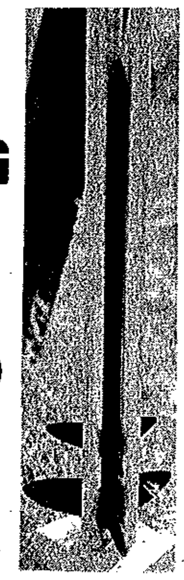
INTERNATIONAL SPACE MODELS

Model rocketry has spread around the world and is officially called Space Modeling by the Federation Aeronautique Internationale.
There have been many international Space Model competitions and the bi-annual World Space Model Championships will be held in the United States during 1976. The most probable location appears to be Ohio at this time.
In the past competitors from the United States, Great Britain, Canada, Bulgaria, Rumania, Yugoslavia, Egypt, Czechcoslovakia, Poland and other countries have joined in competition.
As an NAR member you could qualify to represent your country in an international competition.
Dozens of new countries have taken up Space Modeling since the last World Meet in 1974, and it is possible that in 1976 or certainly by the following meet in 1978 that representatives from Switzerland, Germany, France, Australia, Japan, Formosa, the Soviet Union, Denmark, Sweden, Turkey, Greece, Mexico, Brazil and Argentina may participate.
The FAI also keeps a ***Worlds' Record Book*** containing flight records for all aerospace pursuits. If you set a world record your name would go in the same book that cites the triumph of mankind with Neal Armstrong's 'small step' onto the moon.

Paul Shindman (left) and Ephriam Vishniac load their models for the competition.
PHOTO COURTESY NAR
Model Rocketry Magazine

JOIN TODAY

SETTING a WORLD RECORD



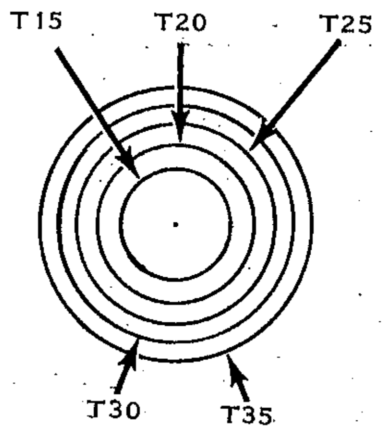
Don Larson is a draftsman and technical illustrator with a publishing firm in the Washington, D.C. area. He recently set a ***World's Record*** for Class III Altitude (at the same time setting a US Mark for Class 4 altitude).
Don used one of the new AVI Astroport D6.1-6.75 motors along with a C class booster motor to fly his rocket to 1001 meters. That is correct one thousand and one meters or a little under 3300 feet. The tracking cross-checks agreed with 4 meters. The old record was 575 meters, so you can see that he really smashed it.
The new World and National record holder is a long time rocketeer and member and advisor to the NARHAMS section. He is a seasoned judge in scale events and always on the competition scene.
Congratulations Don . . . .

Don Larson with Record Busting Rocket

EXCELL

Don't go through life trying to be just another Joe or Jane. Become involved in something of value with challenge and purpose. Whatever you do, excell at it.
AVI Astroport encourages you to choose how you spend each day carefully so that you don't become caught up in the trivial and mediocre.
Space Modeling can be a valuable addition to your list of interests. It is everchanging, challenging, and it enables you to be involved with concepts at the frontier of man's ***thrust into space.***
Space Modeling is a very special activity, and ***Model Rocketeers are very special people.***

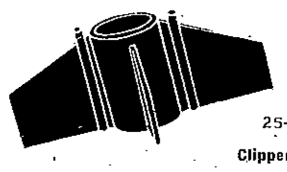
body tubing



primary series

Metrix Brand tubing has the advantages of being lightweight, durable and available in an ever increasing number of diameters and lengths. All tubing is spiral wound and is designed uniformly in even metric units. Wall thickness of 0.5 mm [0.020"].

11-15X10	T15 in 4 inch length	one for $ 0.10
11-15X20	T15 in 8 inch length	one for $ 0.15
11-20X07	T20 in 2.75 inch length	three for $ 0.25
11-20X15	T20 in 6 inch length	one for $ 0.10
11-20X22	T20 in 9 inch length	one for $ 0.15
11-20X30	T20 in 12 inch length	one for $ 0.15
11-25X07	T25 in 2.75 inch length	one for $ 0.15
11-25X15	T25 in 6 inch length	one for $ 0.20
11-25X30	T25 in 12 inch length	one for $ 0.25
11-30X15	T30 in 6 inch length	one for $ 0.25
11-30X22	T30 in 9 inch length	one for $ 0.30
11-30X30	T30 in 12 inch length	one for $ 0.40
11-35X21	T35 in 8.6 inch length	one for $ 0.35



25-P841A
Clipped-Delta Fin

secondary series

Secondary tubing is designed to fit snugly in the next larger size of primary tubing. Secondary series does not have the white overwrap which is on the primary series.

12-14X05	T14 in 2.25 inch length	one for $ 0.10
12-19X07	T19 in 2.75 inch length	one for $ 0.10
12-24X03	T24 in 1.25 inch length	one for $ 0.10
12-24X05	T24 in 2.25 inch length	one for $ 0.10
12-29X03	T29 in 1.25 inch length	one for $ 0.10

miscellaneous

99-0118	Engine Clip—Standard	3/$0.30
99-0107	Launch Lugs—Long	12/$0.40
99-0117	Shock Mounts	10/$0.50
99-0202	Lead Weights	3/$0.30
99-0311	Alligator Clips	2/$0.40
99-1010	Motor Tube Standard	3/$0.35
99-1015	Motor Tube Mini	3/$0.25
99-2010	Decal D-20-S	1/$0.15
99-2015	Decal D-20-L	1/$0.15
99-2020	Decal D-25-S	1/$0.15
99-2025	Decal D-25-L	1/$0.15
99-2030	Decal D-30-S	1/$0.15
99-2035	Decal D-30-L	1/$0.15

SPACE STICKERS

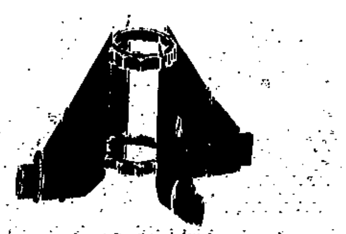
Everyone is eager to get ahold of the AVI ASTROPORT Space Stickers. We introduced the idea several years ago and now are carrying through with it on a regular basis. The stickers are only available to those who order regularly from us through the mail. Receive a selection of stickers free with every order. COLLECT THEM and USE THEM. New series will be introduced on a regular basis. 16 stickers to each set.

16 Different Space Stickers $0.50

adapters

Couplings, joiners or adapters are used for joining two pieces of tubing together. These fittings are key to producing your own designs. Available in both plastic and balsa.

22-1515B	Joining T15 to T15	1/$0.20
22-1520B	Joining T15 to T20	1/$0.25
22-2020B	T20 to T20	1/$0.25
22-2020P	T20 to T20	1/$0.25
22-2025B	T20 to T25	1/$0.25
22-2025P	T20 to T25	1/$0.25
22-2030P	T20 to T30	1/$0.25
22-2525B	T25 to T25	1/$0.25
22-2525P	T25 to T25	1/$0.25
22-2530B	T25 to T30	1/$0.30
22-2530P	T25 to T30	1/$0.25
22-2535P	T25 to T35	1/$0.35
22-3030P	T30 to T30	1/$0.35



Redstone Fin
25-P842A

fin sets

Both balsa and plastic fin units are available for replacement or construction of your own designs.

25-B211A	Zenith II No. 1	1/$0.35
25-B211B	Zenith II No. 2	1/$0.30
25-B922A	ASP	1/$0.25
25-B921A	Astrobee D	1/$0.25
25-B920A	Taurus	1/$0.25
25-B910A	Super Star	1/$0.25
25-P810A	Delta-Pioneer T20	1/$0.35
25-P841A	Clipped Delta-Moon Go T25	1/$0.40
25-P847A	Starhawk T20	1/$0.35
25-P842A	Redstone T30	1/$0.35
25-P846A	Nike T35	1/$0.50

MOTOR MOUNTS

Motor mounts center and hold the rocket engine/motor in the body tube. Note separate sizes for Standard and Mini Engines.

81-13X15	Mini Motor in T15	1/$0.20
81-18X20	Standard Motor in T20	1/$0.25
81-18X25	Standard Motor in T25	1/$0.25
81-18X30	Standard Motor in T30	1/$0.25
81-18X35	Standard Motor in T35 Nike fin	1/$0.35

launch supplies

Spare parts to keep your launch system in top condition. All items are specifically chosen or produced to meet the needs of the model rocketeer.

50-0101	Two part 36" launch rod	1/$0.35
50-0102	Blast Deflector 5" Disc	1/$0.30
50-0103	Ceramic Blast Deflector	1/$0.75
50-0201	Nichrome wire #30-15'	1/$0.45
50-0301	Safety key for controller	1/$0.15
50-0401	Micro Clips	2/$0.35
50-0501	Igniters	12/$0.35
50-0210	Lead wire—two cond. 18'	1/$0.85

RECOVERY devices

You will want to fly each rocket many times and it is essential that you bring it back safely after each flight. The items listed here are of the highest quality to enable you to have confidence in their functioning.

51-0125	10" parachute pack	1/$0.35
51-0135	14" parachute pack	1/$0.35
51-0301	18" orange streamers	4/$0.25
51-0501	Shroud line 70 yards	1/$0.45
51-0601	Elastic shock cord 3/16" in 18" lengths	3/$0.30
51-0701	Snap swivels	12/$0.75
51-0201	Recovery Wadding	1/$0.25
51-0801	Screw Eyes	6/$0.35

PARTIAL LISTING

ASTROPORT CUSTOM PARTS

"METRIX SYSTEM"

The "METRIX SYSTEM" was conceived in 1966 by M. Bergenske who is the Founder and President of AVI ASTROPORT. Through the Metrix System we obtain a standardization linking the craft of modeling to the Metric System of Measurement.

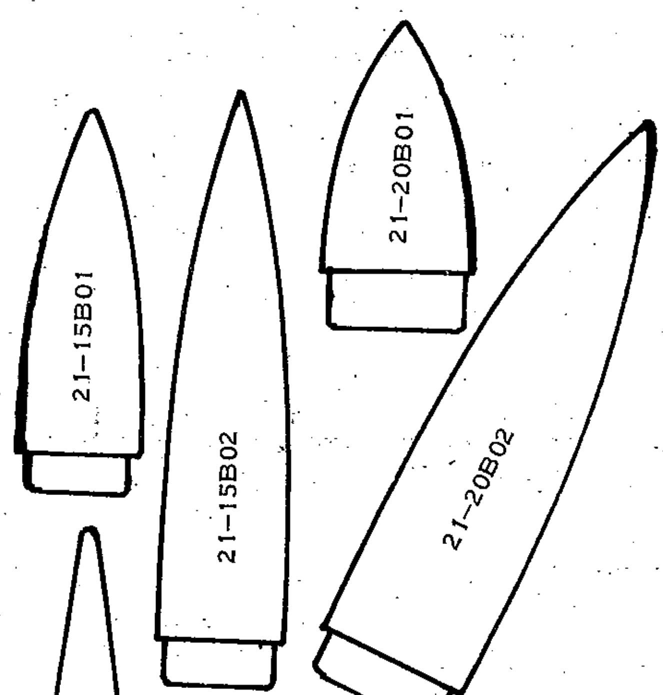
All structural components used in AVI ASTROPORT products conform with our METRIX SYSTEM. Body tubing diameters form the starting point for the development of the system. All our body tubing is designed to have outer diameters that are even multiples of Millimeters. The primary series is available in several diameters and each increase in diameter is in 5 mm increments. The secondary series of tubing is one millimeter less in diameter than the primary size, and since the wall thickness of the tubing is 0.5 mm the secondary series fits snugly into the primary. Thus a T19 [19 mm diameter] tube fits into a T20 [20 mm diameter], a T24 fits in a T25 and so on.

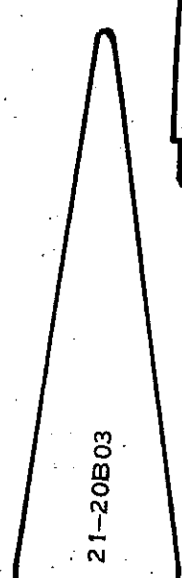
Nose Cones, Adapters and other parts where fit is keyed to the tubing diameter are sized to the primary series. Thus if you are looking for a nose cone to fit a T20 tube you must chose one that has 20 as the next two digits after the dash in the COMPUTER DESIGNATION, [21-20B01 might be your choice.]

Computer Designation [CD] will aid in the selection of parts for your models. In time the whole AVI ASTROPORT line will be keyed to the system. The CD concept will be fully explained in a later edition of the AVI ASTROPORT catalog.

Be sure and use the CD numbers and descriptions when ordering from this catalog.

21-25P02



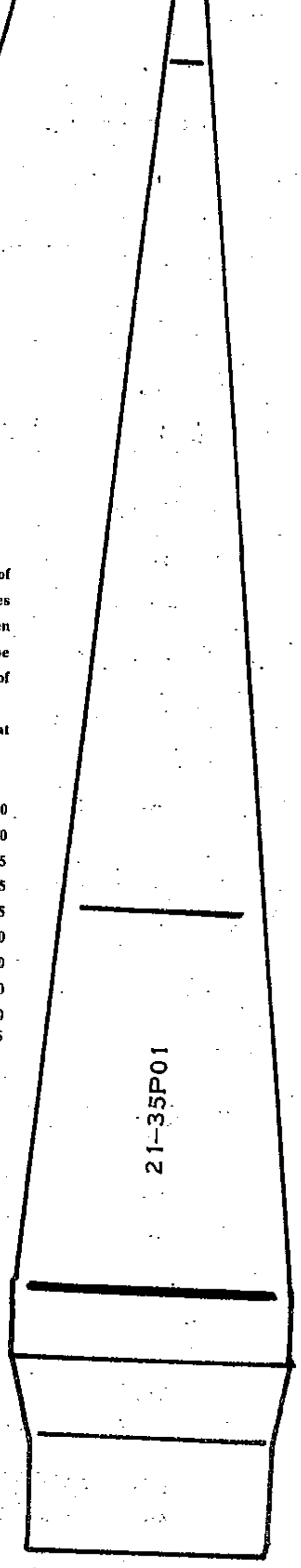


NOSE CONES

AVI ASTROPORT'S precision machining of ultra-lightweight balsa produces the finest nose cones available. Refer to the cross-sectional drawings when making your choice. All balsa nose cones can be readily customized to meet your needs with a piece of fine sand paper.

Plastic nose cones are provided with end caps that must be glued in place.

21-15B01	T15	1.75" long Balsa	one for $ 0.20
21-15B02	T15	2.90" long Balsa	one for $ 0.30
21-20B01	T20	1.25" long Balsa	one for $ 0.25
21-20B03	T20	3.10" long Balsa	one for $ 0.35
21-20P01	T20	2.50 long Plastic	one for $ 0.25
21-25B01	T25	3.20" long Balsa	one for $ 0.40
21-25P01	T25	3.20" long Plastic	one for $ 0.40
21-25P02	T25	4.0" long Plastic viper	one for $ 0.40
21-30B01	T30	3.40" long Balsa	one for $ 0.50
21-35P01	T35	8.40" long Plastic Nike	one for $ 0.65



21-20P01
PLASTIC NOSE CONE
21-25P01

The history of Model Rocketry is a fun subject in itself. There is not room here to cover the whole subject in detail but we will give you a brief outline.

The Space Age was heralded in by a pulsating tone from the first Sputnik launched by the USSR in October 1957. I was sitting in a classroom awaiting the arrival of a professor for a course in *Thermodynamics*. Suddenly Dr. Julien Mack rushed in all red faced and puffing. His portly frame was tussling with a tube radio of the day and he set it on the table in front of the class, plugged it in and tuned in a warble and peeping sound. Dr. Mack had participated in the birth of the Nuclear Age, and now as he stood before us catching his breath, we could see his deep interest and excitement in the signals coming over the radio. His composure was broken. He must have been experiencing the same thrill he felt when he witnessed the birth of the Nuclear age along with Enrico Fermi when the first "fire" was ignited in a nuclear pile under Stagg Field in Chicago near twenty years before.

His face still red, but now with sufficient wind to begin an explanation, Dr. Mack explained that the Russians had broken the fetters of Earth's gravity and the *Space Age was born*. The Sputnik (the Russian word for 'travelling companion') was circling the Earth every 90 minutes and at this time was above our horizon so we could pick up the signals. The class in thermodynamics that day was devoted to applications of that discipline to rocketry, and we strayed to orbital mechanics and subjects far afield as the "beeping" remained embedded in our minds.

That day signaled the birth of the Space Age and also the birth of *Model Rocketry*, even though those two words had not been coupled together at the time.

My mind returned to my early interest in the 'possibility' of space travel and it continued to wander throughout the day. The subject kept cropping up in every class, everyone sensed that the world would never be the same. In my Russian class we listened to the radio as the Soviet Union praised its accomplishments in both Russian and English. In Advanced Calculus we solved differential equations that we each developed independently for the effects of atmospheric drag on the new satellite based on a wide range of models for the density function of the upper reaches of the atmosphere. We were trying to determine the life expectancy of the satellite; trying to determine when it would fall back into the atmosphere and burn up. . .

That evening the newspapers were full of the news and for the next several days I collected each new political cartoon that would appear; to save for the future. I was subscribing to 'Izvestia' at the time, a Russian newspaper printed in the Soviet Union, and several days after the event itself I received the 4 October issue that announced their accomplishments in space. It became part of my collection of Space Memorabilia.

I continued to hunt out articles on the first space mission, particularly those issued by the Russians, but I best remember that issue of Izvestia with two photos of young people interested in space exploration. The first was a picture of a class of 12 to 13 year olds all wearing radio headsets listening to the Sputnik signals. The second photo was of a member of the Soviet youth group that parallels our Boy Scout organization, the Pioneers. The young man was beaming as he held a Rocket Model in his hands. The model itself was an inch in diameter and possibly a foot long with three fins swept back from the tail. The caption to the photo told of the wide spread interest in rocketry among Soviet youth and gave this boy a place in history as the proud owner of a rocket he had built and flown.

I knew the feeling that was evident in the boys expression, . . . you will know it also.

SOME HISTORY

BY M.D. BERGENSKE

In the late forties my perspective was one of a boy growing up in Madison, Wisconsin. Then it was the relatively small capital city of a mid-western farm state. Life magazine had run an article a year-or-so before proclaiming Madison as the ideal place to live. I went to a good school with a fascinating library where I could obtain books about the wide range of subjects that I enjoyed. I've found since that most of my contemporaries with an interest in the Exploration of Space covered the same interests. Paleontology (the study of dinosaurs, etc.) carried my mind back in time; Astronomy put me in my place as I realized the extent of creation; Mathematics became a friend allowing me to better understand Physics and Chemistry at a beginning level. I began to understand the difference between technology and science and how the two worked together in the development of new devices for the general benefit of mankind. Everything pieced together and I became absorbed by an interest in developing technologies. Although I'm talking of not quite thirty years ago (1947-1975), just look at the new concepts, products, and fields of endeavors that have been created. Television, transistors, and the first true computers, pocket radios, pocket calculators, commercial jet airplanes, nuclear power stations, lasers, molecular biology, electron microscopes, plasma physics, and thousands more.

Even as a boy I could predict many of the advances. I'm not setting myself apart . . . you to *today* can predict some of the wonders of tomorrow, and if you spend time applying your mind to it you will develop a sense of how our science-technological progress develops and you will become a part of it.

I couldn't be satisfied with just one field; they all interested me, but I knew that I wanted to feel a part of every important advance of my time, to in part understand how they related to each other. Each subject advances in an irregular manner pacing itself, waiting now and then for other complementary disciplines to catch-up and solidify a new base from which to surge forward. At a given moment in time one facit of science-technology has the spotlight among the 'professionals' and somewhat later it will be brought before the eye of the public, while another facit is reaching a point of break-through.

In 1947, I was convinced that Space Travel would dominate mans' attention for centuries to come; I knew it would be the greatest social as well as technical force for the rest of mankinds' existence. As I read literature by Willy Ley, marvelled at Space Art by Chestley Bonestell I couldn't believe that man hadn't nor was he then putting more effort toward the inevitable journeys into space. You must feel the same frustrations at this time if your spirit is of similar nature to mine.

I would read of every step up the ladder we made as far as going faster and higher. I knew the introduction of the transistor brought us a step closer.

Between the ages of ten and 12 I felt actual anguish at the slow pace; then in flights of fancy I would sometime actually think that maybe providence was holding everything up so I would be old and wise enough to actually participate in the first launches that would take man beyond the confines of the Earth.

Time was wasting, I had to develop my skills. I must become reasonably proficient in all areas that would qualify me for a place in the opening ceremonies for the exploration of space.

I was a model builder from the beginning . . . Hobby shops were few and far between in those days but Madison did have one only three blocks from the center of town. It became a favorite place to go on a Saturday afternoon; I would pass up a movie any day to have the time and a little extra money to spend on a delightful miniature device.

In those days there were Model Railroading and Model Airplanes and that was about it . . . for models that moved.

I was interested in both and spent a good deal of my limited resources on each in turn, but my real interest was in space and rockets. I would plan a train layout that might be a support to a space port. I always wanted to make jets or better yet rocket plane models.

By the time 1950 rolled around, I was sure we would be flying in space by 1960. I began making my own 'model rockets'. Jetex motors were available but they didn't have sufficient thrust to lift their own weight let alone a vehicle. I sent for information from the Pacific Rocket Society, and tried to contact the American Rocket Society. I read every piece of literature that I could get my hands on concerning what was coming to be known as Amature Rocketry.

"Model Rocketry" didn't exist at that time as we perceive it today. There were not ready made commercial 'model rocket' motors available anywhere at any price. In 1950, any one interest in rockets was considered off base, even in the friendly atmosphere of the hobby shop. Professional rocketeers were subject to ridicule.

If 'model rocket' engines had been available at the time I would have been in seventh heaven and I could have jumped over a technical hurdle that was set before me.

Reading the literature I could see that making rocket motors was a hazardous procedure at best. Although few people engaged in it at the time, a very high percentage were injured or maimed, both among the so-called professionals and also the amatures.

A good respect for the production of rocket motors was firmly fixed in my head but I felt I had to proceed. I convinced myself that I would have to limit the size drastically down from what amature rocketeers were working with. I also vowed to stay away from the less stable propellants they concocted. I wanted to lift my rockets off the ground a few feet, then I could think about raising the altitude barrier to a hundred feet, then break the barrier and set a new higher goal to surpass.

I developed some of the least energetic and messiest propellants the world will ever see. One that used tannic acid as the fuel, along with an oxidizer, left half the propellant as a residue in the motor casing and created a solid mass on the erector set launch tower that quickly became a gooey mass on a humid summer day.

Much of what I was doing, accompanied by at most, another young person with an interest in rockets is not worth mention.

Several years later and now close to two decades ago, I was surprised to see that the first model rocket motor produced commercially was close to my designs in many ways. Finish the story . . . I begged the cores of adding machines off of the local merchants and glued, of all things, nozzles made from wood dowel with an appropriate hole drilled up the center. My secret tannic acid base propellant was loaded into the casing and another wood plug with a hole in it in the top.

The motor was fitted into the base of the rocket airframe in a dozen different ways. The bodies of the rockets were mailing tubes and I handcarved the nosecones out of what-else — balsa wood. If I got lazy I used a rubber ball in the top of the tube, and once a carrot . . . really a carrot!

The fins were always balsa as I remember.

As I mentioned before the launch pad consisted of a tower with two rails and the rocket rested on the rails in as near a vertical position as I could set it without the rocket tumbling off. I confess I lit the motor with fuse . . . It is illegal today and more bother than it is worth.

As I mentioned before my secret propellant was not too energetic, and when the motor started the rocket would take a fraction of a second to begin moving up the rails, but by the time it left their four foot length you would swear today that it was a true and honest model rocket. There was lots of white smoke and anything it drifted onto immediately developed droplets of water on it. Back to the flight.

The rocket would go up to a couple of hundred feet and either pop the nosecone out or break a small paper strap on the side, where I had cut the tube in half leaving a small section intact to form a hinge. In either case the rocket was recovered so the engine could be replaced and the vehicle used over again.

Because of the poor performance of the propellant and the erosion of the throat of the wood nozzle and the second nozzle in the head end, the system effected the thrust phase as the nozzle diameter remained relatively small, the coast or delay phase as the nozzle eroded away, and ejection as the propellant burned through the top and shoved gases out the nozzle in place at the front end of the motor.

It took me a day to make three or four of my simple motors . . . Rarely would I fire more than one a day. In all I would guess I made and flew at most thirty.

I never did think of putting a parachute or streamer in for recovery. Maybe that's because the old V-2's they were flying at White Sands then didn't use them.

However many rockets that I flew at this time the last two were multi-stage. Number one was a failure. The first stage barely lifted the combination and the vehicle tilted over on its side about 50 feet in the air as blow-through occured and sent the second stage flying horizontally, and twirling the first stage behind it and slowly approaching the ground followed by its cork-screw shaped smoke trail.

A week later a second two stage was ready. But it rained that weekend. And the next weekend. Finally the day approached and it was clear and dry.

My improved version had a larger diameter 'booster' motor on the bottom to give more thrust and the upper wooden nozzle was left out. The upper motor nozzle sat down into the opening at the top of the lower motor. Two pieces of hair from my head were used to hold the stages together . . . no malfunction due to paper straps this time. The hairs were held in place by model airplane cement.

The small upper motor was of standard design but smaller and made out of a tube that a precision drill came in . . . it was about the diameter of a minijet today, but longer. In great expectation of it being a spectacular flight I gave the two stages a nice paint job and even painted a clever name on the upper stage . . . I've forgotten it. I should have put a payload in it or a note to be read centuries later.

Countdown and lift off . . . Mouth open I watched it climb to a hundred feet or so and ignite the second stage, the hairs held for a fraction of a second and the little motor tugged, and I imagine finally burned the hairs off for it broke free and continued upwards for *20,000 feet or so*. Well not really, but that was probably my estimate at the time. It may have gone over 500 feet, I honestly don't know.

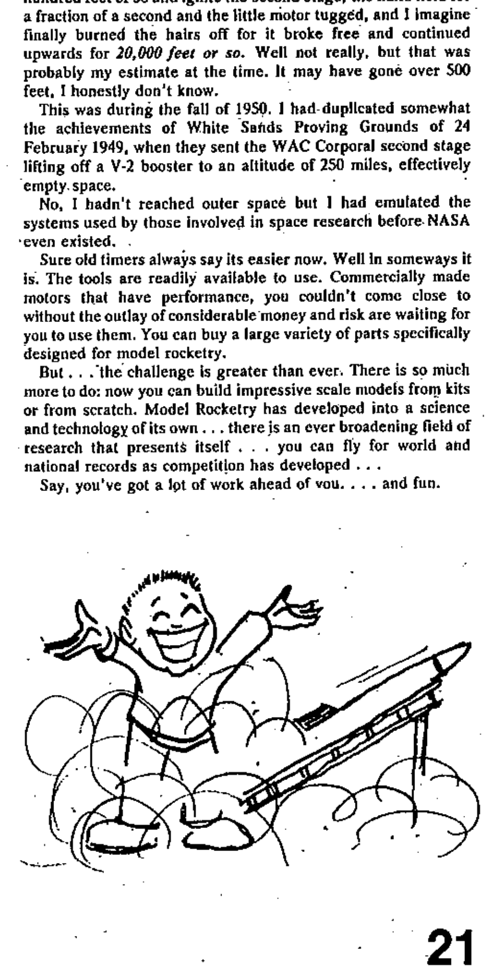
This was during the fall of 1950. I had duplicated somewhat the achievements of White Sands Proving Grounds of 24 February 1949, when they sent the WAC Corporal second stage lifting off a V-2 booster to an altitude of 250 miles, effectively empty space.

No, I hadn't reached outer space but I had emulated the systems used by those involved in space research before NASA even existed.

Sure old timers always say its easier now. Well in someways it is. The tools are readily available to use. Commercially made motors that have performance, you couldn't come close to without the outlay of considerable money and risk are waiting for you to use them. You can buy a large variety of parts specifically designed for model rocketry.

But . . . the challenge is greater than ever. There is so much more to do: now you can build impressive scale models from kits or from scratch. Model Rocketry has developed into a science and technology of its own . . . there is an ever broadening field of research that presents itself . . . you can fly for world and national records as competition has developed . . .

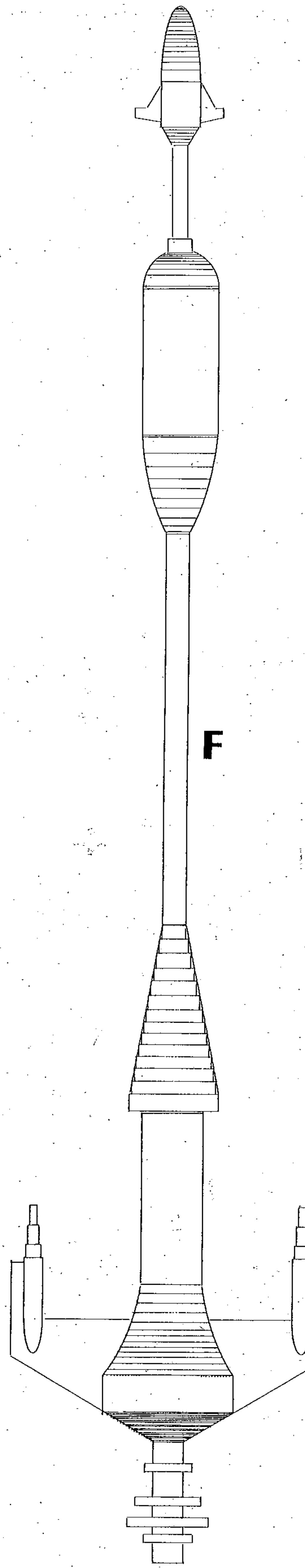
Say, you've got a lot of work ahead of you. . . . and fun.



METRIX®

SYSTEM

Patent Applied For **AVI astroport**



Flexibility in Design & Construction of CONTEST, SPORT & EXOTIC MODEL ROCKETS

Another first from AVI Astroport, and this one is really special.

Here are the tools to produce your own large diameter nosecones, couplers, adapters and other structures to enhance your creations.

You can produce components for your rocket similar to those illustrated on this page. Not only do you have greater flexibility in design at reduced labor, but you can also save money on the large diameter components as compared to fabricating them out of balsa wood.

To enable you to make use of the METRIX SYSTEM of telescoping structural elements we have also expanded our line of rocketry body tubing (Primary tubing) and also the Secondary tubing series to 60 mm diameters. At a later date we will also provide you with sizes up to 100 mm and beyond. The first set up to and including 60 mm is available and information on the second set is included in the catalog for reference. We hope to release that series in the next edition of our catalog or before. For now however DO NOT ORDER THE 100 MM SERIES.

(Please note that the lengths of the tubing is approximate as we are still working on final solidification of design)

Patent protection has been applied for on this concept that will allow both the Novice and Advance Rocketeer a much greater latitude in the Design and Construction of his own creations.

Educators will benefit also. The logical tie of the understanding of the Metric System and the construction of rockets using our Metrix System is obvious. The use of metric measure in actual design and construction is fun and pleasurable.

All our PRIMARY TUBING is designed so that the outside diameter is in even metric units. Tubing is available from 10 mm Outside Diameter (OD) up to 60 mm OD in increments of 5 mm. The tubing wall is one half mm thick so that the Inside Diameters are one mm less than the OD's.

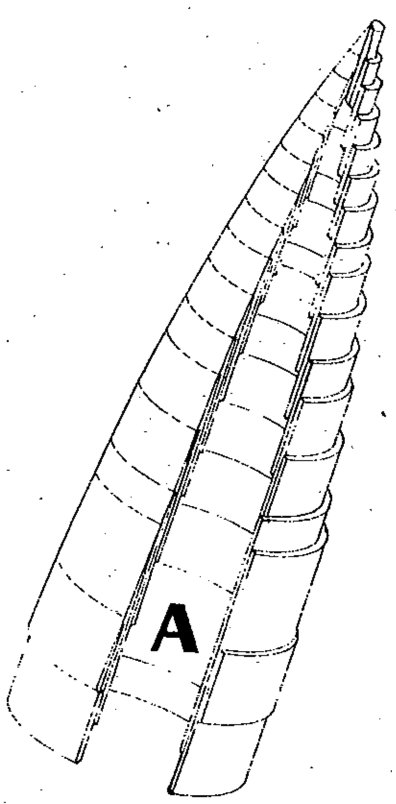
The SECONDARY TUBING is designed to fit snuggly into the primary tubing, thus the OD of the secondary tubes are 1 mm less than that of the primary series. The 19 mm secondary will fit in the 20 mm primary, the 24 mm secondary fits into the 25 mm primary and so on up to the 59 mm secondary tubing that fits into the 60 mm primary tubing.

The TELESCOPING TUBING is designed to have the same OD's as the secondary tubing. The wall thickness is 2.5 mm, however. Thus the ID's are 5 mm less than the OD. As we go up the system from the smallest 9 mm tube, you can see that each successive larger tube has an ID to match the OD of the smaller one. They telescope as their name indicates. Because of this feature you can create nosecones by extending the tubing outward to meet your desires. Then glue into position, fill and sand as explained on the next page.

Illustration A gives you an idea of the structure of a nosecone constructed using the Metrix System.

You can also easily produce adapters of your own design. Adapters are used to join together two different diameter tubes. In the illustrations we see a long coupler in B to join two tubes of greatly differing diameters. That same adapter can be shortened to configuration in C. Or instead of having a straight transition you can make a convex or positive curvature as in D or a concave or negative surface as in E.

Put together a number of your own structures and with the aid of the Structural Rings you can create something exotic as illustrated by F.



[This system is being released gradually. Products listed are not all available at this time. If you order tubing that is unavailable you will receive a credit slip for that portion of your order]