ONE STEP BEYOND

The Project of the Valkyrie Cadet Squadron, Denver, Colorado.

This 122 cadet squadron has won several Wing, Regional and National honors. Their commander is Captain Courtney Walsh, of Englewood, Colorado.

Rocket enthusiast, Preston Prunty, and cadets of the Valkyrie Cadet Squadron, built an awesome rocket that was launched on the second day of June, 2001. Prior to that, over a five-month period, Prunty and the cadets scratch-built an advanced model rocket that had the following dimensions:

- Height 12' 8 inches
- Weight 31.3 pounds (launch ready)
- Power - 24 Class C and Class G motors. This included 4 sustainer motors, 4 secondary motors, 7 main motors, and 9 outboard motors.

Initial planning began in November of 2000, and it was finally launched on the second of June, 2001. Every Tuesday evening, and most Saturday mornings, cadets worked on the basic construction at their meeting site in the Wings Over the Rockies Aerospace Museum located in Denver, Colorado. The rocket began life as two large cardboard tubes reinforced with fiberglass. The overall configuration was scaled to look like a Delta II/III rocket. All of the engine design and much of the detail work was completed by Preston while the cadets worked on the main airframe.

The Moment of Truth

It was a chilly June morning when the scheduled launch sequence began. It started with 7 main and 9 outboard motors all igniting at once. The 9 outboards burned for 7.5 seconds and the mains burned for 1.5 seconds. The sustainer motors burned for 2 seconds after liftoff. All of the 9 outboard motors separated from the rocket and were scheduled to be recovered by parachutes. Secondary sustainer motors ignited 7.5 seconds into the sequence and burned for 1.5 seconds. Four seconds after burn-out of the final thrust stage, payload separation was scheduled to occur and deployment of two parachutes were to bring the Vision safely back to the surface. On the day of the launch, not everything went as planned, but it did roar into the sky over Buckley Air Force Base and the cadets of Valkyrie Squadron all said, "…it will fly again!"

The power of aerospace education takes to the skies over Denver, Colorado.

The Valkyrie Vision is being prepared for Launch. In the background, Preston Prunty (NASA t-shirt) works with CAP Brig. General James Bobik (foreground) to get the igniter assembly ready. The awesome 12 foot tall rocket was an impressive site to nearly 100 honored guests who showed up for the launch.

GLOSSARY of MODEL ROCKETRY TERMS

Aerodynamics - The science and study of air in motion.

Acceleration - A rate of change in the speed of an object over a unit of time.

Accelerometer - An instrument that measures acceleration.

Aerospace - A compound term used to describe the atmosphere and space as one medium. The science of aeronautics and space spoken as one.

Altimeter - A device, usually an aneroid barometer, that reads in feet of altitude based on atmospheric pressure in inches of mercury.

Apogee - The highest point reached in the flight of a rocket.

Airfoil - A component of an airplane or a rocket that causes a dynamic reaction from the air through which it moves. A fin is an airfoil.

Armed - A ready-to-launch condition in which a safety key is inserted.

Ballistic - A projectile that receives an initial thrust from a power source then continues in motion due to momentum. A bullet is an example of a ballistic missile.

Ballast - Added weight, such as clay in a nose cone.

Blast - A burst of hot rocket motor exhaust.

Blast Deflector - A device that is designed to deflect the exhaust in a direction away from the source.

Boost - An additional source of power or thrust.

Boost Phase - The period in a model rocket's flight where a motor is providing thrust.

Burn - The time in which a model rocket motor is providing thrust.

Burn-out - The point where all of the fuel is expended and thrust is no longer provided.

Center of Gravity - The balancing point of all of the mass. This is also known as the Center of Mass.

Center of Pressure - The point were all of the aerodynamic forces will balance while the rocket is in motion. This is usually behind the center of gravity near the tail of the model.

Cluster - A group of rocket motors working together.

Coasting - A time in the flight of a model rocket right after the fuel is expended and the ejection charge is not yet fired.

Combustion - A chemical reaction that occurs inside the combustion chamber and provides a controlled explosion resulting in thrust.

Deceleration - Slowing down or decreasing speed.

Drag - Forces acting upon an object to slow it down.

Duration - The length of time in flight.

Ejection - To be forcefully moved.

Ejection Charge - A component of fuel in a model rocket's motor that provides enough thrust to blow the recovery system out of the body.

Elevation - An angle measured above the horizon.

FAA - Federal Aviation Administration. This is the governing body that controls all of the airspace above the USA.

Fillet - A filler added at the juncture of two components. In the case of a model rocket, a fillet is a layer of glue or putty that smooths out a right angle joint. This can add strength and improve aerodynamic flow.

Fin - An airfoil attached to the body. In the example of a model rocket, a fin is attached to aft section and adds stability in flight.

Finish - The final surface of a model rocket.

Fuel - The chemical, which reacts with oxygen to create thrust.

G - A unit of gravity.

Glide - The non-powered descent of a model with airfoils controlling part of the descent.

High-Power Rocketry - An advanced segment of the model rocketry hobby where motors larger than a "D" are used for thrust.

Igniter - An electrical device, usually nichrome wire, that provides enough heat to cause the chemical reaction between the fuel and the oxidizer.

Impulse - A motion-producing force.

Ignition - A point where fuel and oxidizer combine.

Lateral axis - The axis running through the center of gravity from side to side as viewed from the front. Movement about this axis is called "Pitch."

Launch - The takeoff.

Launch controller - An electrical system that provides a current to the igniter.

Launch lug - A tube that is attached to the body of the rocket for the purpose of guiding the model up the launch rod during liftoff.

Launch rod - A rod used to guide a model rocket in the first moments of ascent. This rod provides a path in the first seconds of launch.

Launch tower - A structure that provides a path for the rocket, during launch, by exerting slight pressures upon the fins.

Leading Edge - The front edge of an airfoil. This is the edge that encounters the oncoming wind first.

Longitudinal axis - The axis going from the nose to the tail through the body of the rocket. Movement about this axis is called "Roll."

Mass Ratio - A ratio between the mass (weight) of a rocket at liftoff to its mass after the fuel has burned off.

Maximum Thrust - The greatest amount of thrust created during the combustion process.

Momentum - Mass times velocity equals momentum.

Motor - A device that converts chemical energy into thrust. The word is used interchangeably with "engine."

Multi-Stage - A rocket having two or more sections that operate one after the other.

NAR - The National Association of Rocketry. This is the official governing body of the model rocket hobby.

Newton - In scientific terms, it is method of measuring **impulse**. It is the amount of force necessary to move one kilogram of mass through a distance of one meter per second per second.

Nichrome - An alloy wire used to ignite model rocket motors when an electrical current is passed through it.

Nozzle - A small area of a rocket motor where exhaust gases pass through and are directed outward.

Oxidizer - A chemical in a rocket motor that reacts with the fuel to provide combustion.

Payload - An object (s) that is carried on board of a rocket during its flight. The payload is not normally a permanent fixture of the rocket.

Propellant - The combined mass of the fuel and the oxidizer.

Propulsion - The act of moving the rocket forward.

Range - An outdoor launch area.

Recovery System - A system built into a model rocket to bring it safely back to Earth after a flight.

Relative Wind - As a rocket moves through the air, it creates a "wind" that travels in the opposite direction. This is the relative wind.

Shock cord - An elastic cord that attaches the parts that separate when the ejection charge is ignited.

Shroud Line - The lines that make up the parachute.

Solid Propellant - When the fuel and oxidizer are dry chemicals, they make up the solid propellant.

Specific Impulse - The number of pounds of thrust delivered by consuming one pound of propellant in one second.

Stability - A measure of performance based on the ability of a rocket to maintain a desired course.

Streamer - A strip, or ribbon, of material used to slow the descent of a model rocket-other than a parachute.

Swing Test - A method of testing the basic stability of a model rocket.

Thrust - A force produced when the propellant burns.

Trajectory - The flight path of a model rocket.

Velocity - The speed per unit of time in a given direction.

Vertical Axis - The axis going through the center of gravity and 90° to the lateral and horizontal axes. Movement around this axis is known as "yaw."

Wadding - A flame resistant material (usually paper) that is packed between the motor (ejection charge) and the recovery system. This keeps the heat from damaging the parachute, payload and/or streamer.

MODEL ROCKET MANUFACTURERS, SUPPLY HOUSES and ORGANIZATIONS

Associations and Publications

National Association of Rocketry (Safety Rules featured in Text)
P.O. Box 177
Altoona, WI 54720
www.nar.org

Tripoli Rocketry Association, Inc. (High Power Rocketry)
P.O. Box 339
Kenner, LA 70063
www.tripoli.org

Sport Rocketry Magazine (The official magazine of the NAR)
P.O. Box 177
Altoona, WI 54720
www.nar.org

Academy of Model Aeronautics (An organization that welcomes free flight, radio control, control line, rockets, boats and kites)
5151 E. Memorial Dr.
Muncie, IN 47302
www.modelaircraft.org

The following businesses offer a line of products related to model rocketry. It is recommended that the cadet search the internet to see what is available.

Estes Industries (Featured in Text)
1295 H Street
Penrose, CO 81240
www.estesrockets.com

Quest Aerospace (Featured in Text)
350 E. 18th St.
Yuma, AZ 85364
www.questrockets.com

Custom Rocket Co. (Elite model featured in text)
P.O. Box 1865
Lake Havasu, AZ 86405
www.greathobbies.com

Arbor Scientific (Air Powered kits / featured in text)
P.O. Box 2750
Ann Arbor, MI 48106
www.arborsci.com

Apogee
1130 Elkton Dr., Ste A
Colorado Springs, CO 80907
www.apogeerockets.com

Air Burst Rockets (Air Powered Model Rockets/ featured in text)
MMI Mondo-tronics, Inc.
PMBN 4286 Redwood Hwy.
San Rafael, CA 94903

True Modeler's Rocket Kits
P.O. Box 186
Harbeson, DE 19951
www.truemodeler.com

Pitsco, Inc.
915 E. Jefferson
P.O. Box 1708
Pittsburg, KS 66762
This company is primarily a school supply, however, they have a huge inventory of model rockets and related components.
1-800 835-0686

Fliskits, Inc.
6 Jennifer Drive
Merrimack, N.H. 03054
www.fliskits.com

Civil Air Patrol Bookstore
30 S. Arnold St
Maxwell AFB, AL 36112
1-800-633-8768

The Leadership Development and Membership Services Directorate of the CIVIL AIR PATROL invites CADETS, AEROSPACE EDUCATION OFFICERS and PROFESSIONAL EDUCATORS to Participate in the Science, Technology, Construction and Flight of Model Rockets.

FEATURING:

- **Three Levels Of Achievement**
- **The History Of Four Rocket Pioneers**
- **The Science Of Newton's Laws Of Motion**
- **Pre-Flight Testing**
- **Model Rocket Engine Technology**
- **Altitude Tracking**
- **Rockets With Alternative Sources Of Power**
- **A Two-Stage Model Rocket**
- **An Egg-Carrying Model**
- **Construction Tips**
- **Painting And Finishing Techniques**
- **Advanced Models**
- **National Standards For Science And Technology Correlation**

This book was produced by the Civil Air Patrol, the Official Auxiliary of the Air Force