



WHITE EAGLE  
AEROSPACE



# Basic Rocket Science

MAKE YOUR CAREER SOAR



# Course Description

**The Basic Rocket Science (BRS) short course provides a practitioner-based training experience in the key principles, disciplines, technologies, and how-to protocols of suborbital rocket flight.**

Participants learn about the various phases of rocket flight including launch, boost, coast, and recovery. The workings of the atmosphere and its influences on endoatmospheric rocket flight performance are examined. The principles of solid rocket propulsion are presented, and representative solid rocket motor propulsion characteristics reviewed.

Trajectory simulation based on the round Earth equations of motion is a significant topic of instruction. Key rocket vehicle aerodynamics data such as zero-lift drag characteristics and aerodynamic force and moment derivatives are examined as are methods for computing these parameters. Vehicle mass properties such as weight, center-of-gravity, and moments of inertia are discussed as well as methods for computing these quantities.

Course members also receive instruction on the static and dynamic stability requirements for each stage of a rocket-powered vehicle. Aerodynamic heating effects and methodologies are presented from the standpoints of vehicle thermal design, analysis, and survivability. Parachute recovery of rocket components is discussed as is the generation of debris dispersion footprints sometimes required for range safety clearance.

## Key Course Topics

- Atmospheric Properties
- Solid Rocket Motor Propulsion
- Single Stage
- Multiple Stage
- Static Stability
- Dynamic Stability
- Aerodynamic Heating
- Mass Properties
- Stabilizing Fins
- Tangent Ogive
- Zero-Lift Drag Characteristics
- Aerodynamic Derivatives
- Launch Lugs
- Altimeters
- Trajectories
- Equations of Motion
- Atmospheric Models
- Parachutes
- Dispersion Footprints
- FAA Clearance
- Flight Simulation
- Range Safety
- Data Uncertainties
- Aero Prediction
- Onboard Video





# Course Outline

**Basic Rocket Science (BRS) is a top-level treatment of the principles, disciplines, technologies and how-to protocols pertinent to designing, analyzing, and flying single stage and multi-stage rocket-powered vehicles. The knowledge provided is applicable to rocket flight at any scale including model rocketry, high-power rocketry, experimental rocketry, and commercial rocketry.**

## Basic Rocket Science Module Overview

Day	Module	Lecture Title	Key Topics
1	1	Rocket Vehicle Flight Operations	Launch, Boost, Coast, and Recovery. Range facilities and flight support personnel. Altimeters. Record keeping. Photo and video support.
	2	The Earth's Atmosphere	Atmospheric pressure, density, temperature, and wind variations with altitude. Atmospheric models.
	3	Airframe Design	Single and multiple stage configurations. Static and dynamic stability considerations. Nose external shapes. Stabilizing fin geometries and sizing.
2	4	Trajectories	Round earth equations of motion. Rocket vehicle flight simulation. Single and multiple stage flight performance.
	5	Propulsion	Solid rocket motor operation. Total impulse categories. Thrust-time curve data. Specific Impulse. Data uncertainties.
	6	Aerodynamics	Aerodynamic zero-lift drag characteristics. Aerodynamic force and moment derivatives. Data uncertainties.
3	7	Mass Properties	Stage weight, center-of-gravity, and moment of inertia characteristics. Data uncertainties.
	8	Aerodynamic Heating	Causes of aerodynamic heating. Vehicle stagnation point and acreage heating estimation. Maximum surface temperature and airframe thermal design.
	9	Debris Dispersion Footprints	Impact/landing dispersion estimation. Range safety. Flight clearance and altitude limitations. Effects of winds, thrust misalignments, and vehicle imperfections.