



WHITE EAGLE
AEROSPACE



Fundamentals of Earth Reentry

MAKE YOUR CAREER SOAR



Course Description

The Fundamentals of Earth Reentry (FER) short course is designed for the aerospace professional seeking expert instruction in the basic principles, science and technology of entry into the Earth's atmosphere. Course material has direct application to the design, analysis and test of manned ballistic and lifting entry.

This intensive training program provides participants with the essential technical knowledge needed to intelligently address the critical aspects of atmospheric entry from suborbital and orbital flight. Course material provides an in-depth study of the aerophysics of Earth reentry including gas dynamics, aerodynamics, aeroacoustics and aerodynamic heating. Participants will come to understand the key characteristics of ballistic and lifting entry trajectory modes.

Technical instruction emphasizes the effects of damping of entry vehicle dynamic motion. Particularly, participants will learn how damping is affected by the structure of the Earth's atmosphere. Additional topics include: vehicle thermal protection systems, recovery systems, range safety considerations and flight crew survivability. Technical briefings are provided for a number of significant historical entry vehicles, as well as those currently under development. These case studies provide participants with valuable insights and lessons learned that are directly applicable to job performance.

Key Course Topics

- Gas Dynamics
- Aerodynamics
- Aerodynamic Heating
- Earth's Atmosphere
- Equations of Motion
- Entry Trajectories
- Flight Dynamics
- Aeroacoustics
- Entry Vehicles
- Bioastronautics
- Range Safety
- Recovery Systems
- Free Molecular Regime
- Chemically-Reacting Flows
- Heatshield Ablation
- Flight Simulation
- Ballistic Entry
- Lifting Entry
- Plasma Effects
- Human Tolerance Limits
- Pressure Suits
- Historical Flight Programs





Course Outline

Fundamentals of Earth Reentry (FER) is intended for those seeking a sound technical understanding of the critical aspects of atmospheric entry from suborbital and orbital flight.

Fundamentals of Earth Reentry Module Overview

Day	Module	Lecture Title	Key Topics
1	1	Gas Dynamics	Gas models, temperature effects, chemical reactions, continuum flow, free molecule flow.
	2	Aerodynamics	Newtonian theory, pressure methods, skin friction methods, lift and drag, rarefied flows.
2	3	Aerodynamic Heating	Stagnation heating, heat transfer modes, body shape effects, thermal protection, plasma.
	4	Earth's Atmosphere	Thermodynamic properties, winds, composition, global circulation, cloud types, turbulence, atmospheric models.
	5	Equations of Motion	Earth-centered reference frames, axis transformations, acceleration transformation equation, flight forces.
3	6	Entry Trajectories	Entry modes, ballistic entry, lifting entry, planar flight path model, altitude-velocity maps, aerodynamic heating.
	7	Flight Dynamics	Angle-of-attack oscillations, density damping, vehicle spin effects, epicyclic motion, dynamic stability, roll resonance.
	8	Apollo Entry Guidance	Lift modulation, entry corridor, guidance logic, entry targeting, backup entry control modes, historical results.
4	9	Shuttle Entry Guidance	Major guidance modes, Reference Drag Acceleration Profile, ranging logic, entry control law, lateral logic.
	10	Recovery Systems	Parachutes, ballutes, lifting bodies, gliders, parafoils, propulsive systems, rotors, hybrid systems.