



WHITE EAGLE
AEROSPACE



Fundamentals of Hypersonics

MAKE YOUR CAREER SOAR

Welcome

Thank you very much for your interest in White Eagle Aerospace. Since our founding in 2006, we have become a trusted leader in professional technical training and education throughout the aerospace industry.

As a fellow aerospace professional with over 45 years of industry experience, I understand the critical need for ongoing technical training in the workplace. White Eagle Aerospace was established in order to meet this pressing need.

For many years, we have recognized a growing crisis in the aerospace workforce. Throughout the industry, there is an increasingly bimodal distribution of aerospace professionals. One end of that distribution includes young, well trained, highly motivated, but very inexperienced professionals. The other end of the distribution involves individuals who have been around the aerospace industry for a long time and have a great deal of experience, but are on their way out of their chosen profession. This leaves a broad valley of inexperience between the two.

Who is going to pass the baton to the upcoming generation of aerospace professionals? Where will they get their knowledge – knowledge that goes beyond academia and even graduate degrees? Much of what they need to know is not available in today's standard university curricula. What they need is:

- Specialized knowledge over a range of disciplines
- Knowledge provided by an experienced expert in the field
- Knowledge conveyed by a master instructor

White Eagle Aerospace recognizes these issues and provides effective solutions for your workforce. We are pleased to present you with this brochure, which outlines our Fundamentals of Hypersonics (FOH) professional short course. We are dedicated to your success. Should you have any questions about our course catalog or desire more information on how we can help MAKE YOUR CAREER SOAR, please contact us today.

Best Regards,



White Eagle Aerospace



About Our Company

Whether you are new to the aerospace industry or have years of professional experience, we are your provider-of-choice for expert technical training.

Acquiring key knowledge, critical lessons-learned and technical know-how are crucial ingredients for success in today's complex and highly competitive aerospace market. Our nationally-acclaimed short courses cover a wide range of highly relevant and useful technical subjects. Each course is delivered by a subject matter expert who is also an master technical instructor.

We offer you comprehensive technical training in essential topics, with minimal time away from work – all at a price that fits today's tight training budgets.



Target Audience

The Fundamentals of Hypersonics (FOH) short course provides a comprehensive training experience in the basic principles, technologies, and methodologies of hypersonics. Course material also explores a myriad of key aerodynamics-related topics that are intimately related to hypersonic flight test and flight research operations.

This short course is intended for anyone seeking instruction in rudimentary hypersonic aerodynamics, gas dynamics and aerothermodynamics. The course presents a thorough treatment of hypersonic flow physics, gas dynamics, aerodynamic heating, plasma effects, boundary layer transition, aeroacoustics and flight vehicle force and moment characteristics. This knowledge and its application are essential to successful aerospace vehicle design, analysis and testing.

Delivered by a master instructor and subject matter expert with over 45 years of professional aerospace experience, this 5-day intensive training course provides participants with invaluable real-world knowledge, enhanced understanding and improved competency in this key discipline.

Group Discounts

White Eagle Aerospace is dedicated to meeting your organization's professional training needs. In order to better serve you, we offer special group discounts rates and on-site training. If you have a group of 15 or more participants, we will bring our nationally acclaimed FOH short course to your location at a discounted rate. Please contact us today to learn how we can help MAKE YOUR ORGANIZATION SOAR!

Who Will Benefit

- **Aerodynamics Engineers**
- **Flight Test Engineers**
- **Airframe Designers**
- **Launch Vehicle Designers**
- **Aircraft Systems Engineers**
- **Missile Systems Engineers**
- **Aircraft Flight Crew**
- **Operations Research Analysts**
- **Flight Control Specialists**
- **Fluid Dynamics Specialists**
- **Computational Fluid Dynamics (CFD) Specialists**
- **Program Managers**
- **College Instructors**
- **College Students**





Course Description

The Fundamentals of Hypersonics (FOH) short course provides a comprehensive training experience in the basic principles, technologies and methodologies pertaining to the multi-disciplined realm of hypersonic flight.

Key technical topics covered in this course include: hypersonic aerodynamics, hypersonic flow physics, high temperature gas dynamics, aerodynamic heating, plasma effects, boundary layer transition, aeroacoustics and flight vehicle force and moment characteristics. However, course material extends beyond basic hypersonics, covering a myriad of other multi-disciplinary topics that are intimately related to hypersonic flight, including: airbreathing propulsion systems, thermal protection systems, planetary entry, stage separation, and atmospheric models.

Participants will acquire a sound understanding of hypersonic aerophysics and the effects of the hypersonic flight environment on vehicle loads and performance, including a consideration of both continuum flow and rarefied flow aerodynamic effects. They will also acquire an understanding of the basics of hypersonic air breathing propulsion and the importance of having an accurate aero-propulsion force accounting system. Finally, participants will come to appreciate the extensive and impressive history of hypersonic flight and its influence on both current day and projected hypersonic programs.

Key Course Topics

- Hypersonic Gas Dynamics
- Aerodynamic Heating
- Aeroacoustic Effects
- Plasma Effects
- Airbreathing Propulsion
- Continuum Flow Aerodynamics
- Transitional Flow Aerodynamics
- Rarefied Flow Aerodynamics
- Equilibrium Effects
- Non-Equilibrium Effects
- Viscous Interactions
- Thermal Protection Systems
- Hypersonic Vehicle Design
- Boundary Layer Transition
- Planetary Entry Vehicles
- Atmospheric Models
- Jet Interaction Effects
- Force Accounting Systems
- Aerothermoelasticity
- Stage Separation
- Rail Gun Technology
- Historical Flight Programs





Course Outline

The Fundamentals of Hypersonics (FOH) short course is an intensive 5-day training program that provides a maximum training experience to aerospace professionals with minimum time away from work.

Fundamentals of Hypersonics Module Overview

Day	Module	Lecture Title	Key Topics
1	1	Compressible Flow Review	Conservation laws, perfect gas law, normal shocks, oblique shocks, Prandtl-Meyer flow, conical flow.
	2	Hypersonic Gas Dynamics	Gas models, temperature effects, chemical reactions, continuum flow, free molecule flow.
2	3	Hypersonic Aerodynamics	Newtonian theory, pressure methods, skin friction methods, lift and drag, rarefied flows.
	4	Hypersonic Aerothermodynamics	Stagnation heating, heat transfer modes, body shape effects, thermal protection, plasma sheath.
3	5	Boundary Layer Transition	Boundary layer transition phenomena, linear stability theory, wind tunnel noise effects, transition prediction.
	6	Aeroacoustic Phenomena	Flowfield effects, body shape effects, sound pressure level, probability density function.
4	7	Air-Breathing Propulsion	Turbojets, ramjets, scramjets, energy food chain, hypersonic cruiser, transatmospheric vehicles.
	8	Stage Separation	Staging method, staging loads, aerodynamics, stored elastic energy, nozzle side load effects.
	9	Jet Interaction Effects	Flow phenomenology, amplification factors, key parameters, similitude factors, aero modeling.
	10	Planetary Entry	Ballistic entry, lifting entry, entry corridor, entry vehicles, planetary atmospheres.
5	11	Flight Aerodynamics Extraction	6-DOF forces and moments, mass properties, accelerometers, rate gyros, atmospheric effects.
	12	Historical Vehicle Tech Briefs	X-15, X-17, X-20A, X-43A, ASSET, PRIME, FIRE, RAM C, SPRINT, Reentry-F, Shuttle Orbiter, Galileo Entry Probe.



Aerospace History

Much has transpired during the 100-plus years of powered flight. We are both the beneficiaries and stewards of the technological progress that previous generations have bequeathed to us.

However, many professionals in today's aerospace workforce have scant knowledge of the key people, events and innovations that comprise the history of their own profession. While we cannot live in the past, we must learn from it if we are to be successful now and in the future. Further, like our predecessors, we must protect and preserve this legacy knowledge for the benefit of succeeding generations.

It is for these reasons that White Eagle Aerospace strongly emphasizes aerospace history in its technical short courses. This is done through the mediums of special presentations, videos and field trips. The Fundamentals of Hypersonics (FOH) short course features a number of key historical programs.

Featured Tech Briefs

- X-17
- X-15A-2
- X-20A
- X-43A
- SPRINT Missile
- Space Shuttle Orbiter
- Galileo Entry Probe
- Project PRIME
- Reentry F
- ASSET
- RAM-C
- FIRE





Information at a Glance

The Fundamentals of Hypersonics (FOH) short course provides a comprehensive training experience in the basic principles, technologies, and methodologies of hypersonics.

The course presents a thorough treatment of hypersonic flow physics, gas dynamics, aerodynamic heating, plasma effects, boundary layer transition, aeroacoustics, and a myriad of multi-disciplinary topics that are intimately related to hypersonic flight. This technical knowledge and its application are essential to successful aerospace vehicle design, analysis and testing.

Delivered by a master instructor and subject matter expert with over 45 years of professional aerospace experience, this 5-day intensive training course provides participants with invaluable real-world knowledge, enhanced understanding and improved competency in this key discipline.

Contact White Eagle Aerospace

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520-219-0526

Key Course Information

- **Instructor:** J. Terry White
- **Duration:** 5 instructional days; 36 instructional hours.
- **Materials:** 1) Course lecture and tech brief volumes in bound form and 2) course DVD containing all lecture slides, images, videos, reference documents, and homework solutions.
- **Cost:** \$2,000 for single seat.
- **Registration:** Please visit our website to view the most current Course Calendar. To register for a scheduled course, simply complete and submit the online registration form.
- **Group Discounts:** In order to better serve your organization, we offer special group discount rates and on-site training. For information, please contact Phyllis White at pjwhite@whiteeagleaerospace.com.





J. Terry White

Aerosciences Instructor

John Terry White is president and CEO of White Eagle Aerospace. With headquarters in Oro Valley, Arizona, White Eagle Aerospace is a leading provider of engineering consulting, professional training, and history of flight presentation services to the aerospace community.

White's over 45 years of professional aerospace experience includes the NASA Space Shuttle Program, NASA X-43A Flight Project, and United States Navy STANDARD Missile Program. During his extensive career, he has served on the engineering technical staff of Rockwell International, General Dynamics Corporation, Hughes Missile Systems Company, NASA Dryden Flight Research Center and Raytheon Missile Systems.

In 2009, White completed a 2-year assignment as manager of the Aerodynamics Department in the Guidance, Navigation, and Control Center at Raytheon Missile Systems in Tucson, Arizona. In this capacity, he was responsible for all aerodynamics work performed at the world's largest tactical missile producer. White resigned from Raytheon in 2010 as an Engineering Senior Fellow in Aerodynamics.

White has authored more than 180 technical papers on a wide variety of aerospace and aerospace subjects. His teaching credentials include 15 years as an instructor in the Aerospace Engineering Department of the California State Polytechnic University, Pomona, 10 years as an instructor in the professional development program at Raytheon and 6 years developing and teaching courses at White Eagle Aerospace. Those who have taken his courses say that White brings an uncommon passion and extensive technical knowledge to the training environment.

White is particularly well known for his inspiring aerospace history lectures and presentations. These "techno-histories" are intense, fast-paced reviews of historically-significant events in United States aerospace history. He has lectured extensively on aerospace history topics at the USAF Test Pilot School, the Society of Experimental Test Pilots, the National Aeronautics and Space Administration, the American Institute of Aeronautics and Astronautics, academia, and industry. White also serves as a motivational keynote speaker for aerospace conferences, business functions, commemorative events, public service organizations, special interest groups, and private business.

Courses Offered

- **Aerodynamics for Engineers**
- **Aerospace Lessons-Learned**
- **Advanced Missile Aerodynamics**
- **Aerospace Vehicle Performance**
- **Basic Missile Aerodynamics**
- **Fundamentals of Earth Reentry**
- **Fundamentals of Gas Dynamics**
- **Fundamentals of Hypersonics**

Contact Information

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