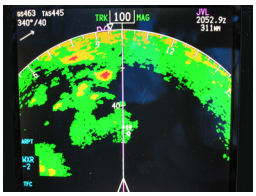
RADAR
TRAINING INTERNATIONAL

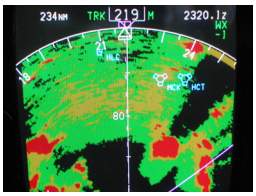
PROGRAM CATALOG

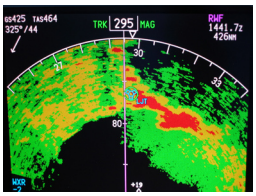
Customized Airborne Weather Radar Seminars

Cover image by Josep Altarriba.

Contents







Overview

Radar Training International, Inc. (RTI) specializes in customized airborne weather radar training for flight professionals and organizations worldwide. The foundation of our philosophy is to provide proactive training for those who pursue uncompromising standards of safety and excellence.

"Superb presentation with the very valuable and appreciated explanation of 'why' along with 'how.' I will recommend this program highly."

~ S.P., San Diego, CA

Our clients are career pilots and flight department personnel, highly motivated professionals who desire focused training customized for their aircraft, personnel, or mission. Our program, presented in a highly efficient and operationally practical manner, builds a foundation of fundamental knowledge necessary for advanced concepts in airborne radar proficiency.

Our commitment to clients from the beginning is for an exceptional program, but it does not end there. For over ten years, we've been building relationships with industry experts including meteorologists, severe-weather scientists, vendors of aviation weather products, and representatives of the radar and radome manufacturers. This extensive network is an important component of our service and long-term commitment to our clients.

Our Strategy

The six-hour Customized Private Program is the cornerstone of our training. We bring a comprehensive on-site seminar to your facility that covers operational tactics and techniques—as well as limitations inherent in all airborne weather radar systems. Beginning with a brief overview of radar basics, we emphasize the critical role a solid academic foundation plays in operational proficiency. Information is directly applicable to real-world operations and is presented in a compact, efficient manner. Case studies provide an opportunity for our clients to make "operational" decisions and analyses in the classroom using real-life situations, images, and scenarios.

Our Results

Enhanced aviation safety is our ultimate goal. Our clients depart with an increased understanding of the limitations and capabilities of airborne weather radar, and as a result, exhibit a higher degree of confidence in using their systems. They are also less likely to send an aircraft to the repair shop because of a bad decision associated with hazardous events, such as dry-hail encounters or a failure to consider geographic location. They also learn how modern technology, such as the newest-generation "automatic" radar systems or the display of NEXRAD weather in the cockpit, can be used to augment professional skills, but never to substitute for them.

Your Options

RTI's Customized Private Program can be adapted to meet a variety of training needs for specific client demographics. Options include:

1. Customized Private Program (p. 4)
The foundation of our training programs.

2. Individual Guest Attendee (p. 9)
Allows individuals to attend a Customized Private Program.

3. Sponsored Program (p. 10)
For safety-orientated organizations or gatherings.

4. Manufacturer Consulting (p. 11)
Tailored for manufacturer interests.

5. Public Speaking (p. 12)
Individual 50-minute presentation(s).

6. Operational Airborne Observation (p. 13)
Practical application of seminar information.

"Great display of information and super presentation. Description of tilt was the highlight. Thanks, and outstanding job."

~ J.S., Buffalo Grove, IL

OVERVIEW

Module 1.
Radar Basics, (p. 4)

Basic radar system anatomy
Beam characteristics
Stabilization basics
Gain control
Turbulence mode
Radome considerations
Displayed colors
Malfunctions
Radar horizon

Module 2.
Fundamental Concepts (p. 6)

Reflectivity
Attenuation
Tilt control

Module 3.
Operational Employment (p. 7)

Preflight weather evaluation
Non-radar clues
Preflight inspection
Ground operations/taxi
Tilt considerations on takeoff
Cruise considerations
Over-flight of thunderstorms
Geographic considerations
Cell shape and gradient
Terminal area operations
Growth rate

Option 1. Customized Private Program

Domestic and International
Duration: 6 hours
Cost: See price sheet insert, or write info@rtiradar.com.

This comprehensive, customized program is designed for professional pilots and flight departments. It is intended to provide a foundation of knowledge from which a high degree of proficiency can be achieved. As a by-product, our clients are armed with essential knowledge necessary to differentiate between features which are operationally functional and those that are mostly marketing fluff.

This presentation lasts approximately six hours with brief breaks each hour. The order and content of each presentation vary slightly according to specific customer equipment and needs. Due to the significant number of variations available from manufacturers for displays and control panel configurations, specific configurations are not normally discussed.

Information is presented in three major modules: Radar Basics, Fundamental Concepts, and Operational Employment. We conclude with an operational summary of the most important points.

Module 1. Radar Basics

The capability of airborne weather radar is typically guided by a combination of physics, technology, and proficiency. Available features commonly come at the expense of compromise. Radar Basics is designed to introduce the basic physics and design limitations inherent in all X-band systems, regardless of the manufacturer or their marketing claims. It also provides the foundation for more advanced topics and concepts discussed throughout the day.

Basic radar system anatomy – An overview of system components and operating characteristics provides a foundation of knowledge, a prerequisite for advanced study. This is necessary information for all operators, including those considering the purchase of a new system. For example, the power output of some existing systems is 35 Watts while for others it is 10,000 Watts. We demonstrate the significance this and other design considerations have when making operational decisions—knowledge professional pilots must possess.

Beam characteristics – Radar energy behaves predictably in most cases. However, since system capability and performance are tied directly to beam characteristics, displayed information can be misleading and confusing. Understanding these characteristics allows users to more effectively

employ airborne weather radar in the tactical (short-range) versus the strategic (long-range) environment.

Stabilization basics – An overview of stabilization systems is given. Understanding what these systems are designed to do will assist in recognizing when they are not functioning properly.

Gain control – Manually adjusting gain can provide details not otherwise obvious. Manipulating the gain may also be hazardous (grossly understating the threat) when used incorrectly. We discuss the effects of manipulating gain control and educate our clients on some of the variations used by the manufacturers.

Turbulence mode – This mode can detect turbulence under certain conditions but is also plagued with serious limitations. Armed with knowledge, pilots can use turbulence mode to their advantage while avoiding the biggest operational problem—over-reliance. How turbulence is displayed varies by design, which is an invitation to confusion.

Radome considerations – The radome is an integral part of every airborne radar system. Normal operational flying can expose the radome to environmental elements that should be considered and factored into all radar-related decisions. Additionally, after-market modifications to a high-quality radome, including painting, striping, or the improper installation of a protective boot, can inhibit optimum performance. An improperly maintained or repaired radome poses a serious risk.

"To this day, our guys still talk about your seminar. Your techniques have been useful and effective."

~ S. W., Olathe, KS

Displayed colors – Modern systems are designed to convert radar data into a pilot-friendly language, i.e., colors on the display. However, operational decisions based solely on colors are a recipe for trouble. Furthermore, black on the display is commonly interpreted as an area of no hazard when in fact some of the most serious hazards are cloaked in areas of black. We provide information to be considered when interpreting displayed images.

Malfunctions – Malfunctions will manifest themselves differently depending on which component fails; some are obvious, some not. Internal system monitoring will annunciate certain modes of failure but cannot provide a warning for all malfunctions. We offer techniques that minimize the risk of catastrophic failures and malfunctions going unnoticed.

Radar horizon – The "weather avoidance range" published by manufactures implies that radar can be used effectively at very long distances. The "radar horizon" is a limitation common to all airborne radar systems, including the newest systems. However, with knowledge of the prerequisites—and for traditional systems, an expanded discussion of beam anatomy—some radar systems may be used effectively beyond the radar horizon to the weather avoidance range, for strategic weather planning.

pro•fi•cient
adjective competent, skilled.
ORIGIN from Latin *proficere* 'to advance' (Oxford)

Proficiency, the most fundamental principal of radar operation, is not automatic with the selection of the WX mode. Skillfully operating the radar, and interpreting the images — like a doctor interpreting an x-ray — requires both academic knowledge and practice in the real world. Only then, with a high degree of proficiency, can the risks of flying in a hazardous convective weather environment be mitigated to an acceptable level.

Module 2. Fundamental Concepts

The second part of our program is broken down into three submodules: Reflectivity, Attenuation, and Tilt Control. Lack of knowledge and understanding in these areas has been causal in many accidents and incidents involving professional pilots and, as such, warrants in-depth discussion.

Reflectivity – Radar returns are predicated on the reflective qualities of a target. Not all threats meet the minimum thresholds of reflectivity and thus may go undetected by the radar. Dry hail is a classic example. We discuss the reflectivity characteristics of various hydrometeors that will provide insight as to why some potentially hazardous threats might not be detected or displayed by the radar. Pilots who attempt to employ airborne weather radar without a fundamental understanding of reflectivity are easily confused by what is or is not being displayed. Occasionally, this also results in extraneous write-ups resulting in costly down time and a waste of valuable maintenance resources.

For organizations utilizing NEXRAD products during either preflight planning or for augmenting radar in-flight, we provide an overview of NEXRAD system basics and philosophy. We highlight key differences from airborne radar, including the color-coding of the products, and critical limitations of the technology.

Attenuation – Different phenomena weaken radar energy—a limitation imposed by simple physics. However, when total attenuation occurs as a result of heavy precipitation, a serious threat exists. Depending on the synopsis, attenuation will manifest itself differently—not necessarily in an intuitive manner. We explain attenuation and discuss operational techniques pilots may employ to assist in recognizing it during different weather synopses and phases of flight.

Tilt Control – Given the information provided in the Radar Basics, Reflectivity, and Attenuation modules, tilt control becomes straightforward and logical. We start by discussing the airborne integrity check, a technique used to check basic operating parameters and performance of the radar. Three basic tilt positions are then presented which clients can modify to fit their particular equipment and style of flying, guided by the concept of "calculated-and-methodical." If applicable, we discuss the auto-tilt and vertical profile modes found on some modern-day systems. We also provide a brief overview of the latest generation "multi-scan" and "volume-scan" radar systems being marketed by the manufacturers. The tilt control on these systems has either been completely removed or provided as a backup reversionary mode if the AUTO mode should fail.

Module 3. Operational Employment

The third part of our program introduces advanced concepts using the knowledge and information presented earlier. Arranged in a logical manner—preflight through approach and landing—Operational Employment provides an opportunity to demonstrate how the techniques and limitations of airborne weather radar fit into operational flying. Several real-life case studies and scenarios are presented for group discussion and evaluation—a powerful tactic for professional pilots.

Preflight weather evaluation – Airborne weather radar systems give pilots a snapshot of activity in real time. They cannot forecast or predict how weather may change. Given the explosive growth rate potential of convective weather, it is necessary to thoroughly evaluate atmospheric potential during preflight. The Terminal Aerodrome Forecast (TAF) is a good place to start, but it has many limitations, including its small valid geographic area. Weather products, such as Convective Outlook or Collaborative Convective Forecast Product, encompass a much larger geographic area and should be consulted during preflight. We discuss how this information can be used to augment weather radar analysis during flight.

"Excellent! I like the level of detail provided."

~ S.V., Hillsboro, OR

Non-radar clues – Operators who have a thorough knowledge of radar systems understand that they should not be used as "go/no-go" devices; there are simply too many limitations. Non-radar clues, often giving insight into atmospheric potential, must be factored into operational decisions. We provide ten "red flags," adapted from the Radar Training Systems "Objective Storm Hazards Indexing Test," as a starting point for this evaluation.

Preflight inspection – Several things can inhibit the efficiency of airborne weather radar. Damaged, improperly repaired, or contaminated radomes will all affect the efficiency of the radar. All preflight walk-arounds should include a visual inspection of the radome.

Ground operations/taxi – Commonly, pilots delay turning the weather radar on until the aircraft is lined up on the departure runway. This may deny the pilot the opportunity to make a critical evaluation prior to departure. We offer operational considerations for utilizing the radar (when safe to do so) during ground operations. Radar systems with a narrow or reduced horizontal sweep warrant special consideration and are discussed.

Tilt considerations on takeoff – Radar systems have physical limits that restrict the pilot's ability to thoroughly evaluate departure corridor weather. Additionally, attenuation during this phase may manifest itself differently than in other phases of flight. Techniques and considerations addressing this phase of flight are discussed.

Cruise considerations – Using weather radar at cruise altitude presents unique challenges, especially for operators cruising at high altitude with small antennas. We present case studies involving inadvertent thunderstorm penetrations by professional flight crews resulting in injuries, and focus on how to employ airborne weather radar to avoid similar mishaps. Additionally, considerations for employment—long range versus short range—are discussed.

Over-flight of thunderstorms – Many of the hazards associated with thunderstorms have been defined, however the triggering mechanisms, or predicting when and where they will occur, still eludes the capability of modern technology. The decision to over-fly convective weather, therefore, is never risk free. Flying at night or in IMC offers a unique challenge, in that the only information available upon which to base a fly-over decision may come from the radar. We highlight some of the limitations and considerations necessary when employing the radar when in this capacity.

"... after listening today, I can't believe I'm still alive with the minuscule amount of knowledge I had before. This is life-saving information."

~ J.W., Lebanon, IN

Geographic considerations – Red on a radar display may represent different threats depending on the geographic location and the weather synopsis. A thunderstorm in Florida and a thunderstorm in Colorado are both very hazardous, however they warrant different considerations and margins of safety. Operators who disregard geographic location often suffer from a loss of confidence in their systems. For example, radar Red one day results in a wet ride but the next day, while skirting Green or Yellow, severe turbulence is encountered. Geographic considerations must be factored into operational decisions.

Cell shape and gradient – There is no such thing as a benign or harmless convective cell. They all present varying degrees of hazards. Some cells, however, warrant a wider margin of safety than others. Cell shapes and gradients may provide a clue. We discuss telltale characteristics that should be considered when analyzing a weather target.

Terminal area operations – Operations in the vicinity of some airports are time-compressed and high-workload, even on clear days. Add hazardous weather to the equation and the complexity of the situation increases exponentially. The majority of major air-carrier-class convective weather accidents have occurred in the terminal area, indicating this phase of flight is both high risk and unforgiving, even to the most experienced professional pilot. Properly armed with knowledge, radar-proficient pilots can approach this regime of flight with confidence.

Growth rate – Because the growth rate of convective weather can exceed several thousand feet per minute, any analysis made, with either airborne weather radar or in-flight NEXRAD, can rapidly become "old news." Professional pilots must evaluate hazardous weather not only with respect to what it is, but what it may become. This is an absolute must. A case study is presented demonstrating the violent growth-rate potential of severe weather in a seemingly benign environment.

Option 2. Individual Guest Attendee

Duration: 6 hours

For some professional pilots and organizations, a dedicated training program may not be practical. RTI, on a case-by-case basis, will attempt to coordinate with clients hosting a Customized Private Program to allow outside guests into their program.

What you must understand: Hosting clients can and occasionally do reschedule or cancel their programs, sometimes on short notice. Individuals considering this option must be willing to accept this risk and must agree to not hold liable either the hosting client or Radar Training International for any costs associated with rescheduling or canceling. Further, hosting clients reserve the right to close their program to guests at any time.

Our program is focused primarily on the needs and equipment of the hosting clients. We will address guest attendee equipment on a time-permitting basis only.

Important: This option requires *$250 non-refundable payment in advance*, due upon approval by the hosting client to accept a guest.

What you must provide: Your own transportation to and from the hosting client facility, meals, lodging, and any other expenses associated with attending. Typically, the seminar fee is paid directly to RTI.

"Your class was excellent, very operational. Nicely done."
~ M.V., Windsor, CT

What you should do next: Review the topics in the Customized Private Program and decide if this information, combined with the additional stipulations above, is appropriate for you. If it is, please contact us at info@rtiradar.com for details.

NOTE: You must be willing to accept all restrictions and conditions without exception. Your *request for attendance* under this option is considered a binding agreement to these restrictions.

Option 3. Sponsored Program

Duration: 6 hours

This seminar is similar to the Customized Private Program, except it assumes a wide variety of radar systems equipment is used among the listening audience, and therefore is not tailored to any specific radar manufacturer or system. This option is best suited for safety-oriented gatherings

such as flying associations, safety standdowns, or businesses (e.g., FBOs), who wish to offer their members or clients a high-quality safety-oriented program.

What you need to know: Sponsors are responsible for coordinating all logistics including mailing lists and collection of individual fees.

What you must provide: Clients choosing this option must provide the facility and a projection screen and, for large groups, the projector and a lapel microphone. Additionally, refreshments and/or meals are at the discretion and expense of the hosting organization.

What you should do next: Review the Customized Private Program course content and contact us at info@rtiradar.com to discuss details.

Option 4. Manufacturer Consulting

Duration: 6 hours minimum

Improved radar design requires manufacturers to understand the design strengths and weaknesses of their systems. To accomplish this, the Manufacturer Consulting program expands on the Customized Private Program to include more than fifteen areas of specific interest to manufacturers.

Ideally, and in the interest of safety, the goal of manufacturers is to provide customers with the highest quality and most functional radar system possible. Pilot input is essential, as there are many different considerations that, if disregarded, can render a system feature virtually worthless, or even worse, confuse and frustrate customers. Any pilot input however, must be backed by extensive academic knowledge and global operating experience. RTI presents pilots, engineers, and marketing personnel with the information they need to consider when designing a new system—information backed up by experience and input from our clients.

"Thank you again for your presentation. I got...positive feedback from everyone."

~ B.B., KBDL

Duration: Minimum of six hours. In addition to the information presented in the Customized Private Program, additional time may be necessary to expand on topics of interest and to address questions.

What you must provide: As with our Customized Private Program, the client is responsible for providing the facility and any meals or refreshments for their group.

What you should do next: Review the topics in the Customized Private Program and decide if this information, combined with the information above, would be useful and practical to your company. If so, contact us at info@rtiradar.com about pricing.

Option 5. Public Speaking

Radar Training International monitors industry trends related to airborne weather radar and aviation safety. This group-specific option can be tailored and is most popular with safety-orientated seminar programs where time is limited but a safety-related message must be communicated. As an option, it can include any portion of our Customized Private Program, such as Reflectivity, or cover more broad topics, such as common errors when using airborne weather radar, human factors, or the role that technology plays in augmenting professional skills.

What you need to know: The purpose of this option is to communicate a safety-related message or trend of interest, but does not constitute formal or comprehensive radar training. It is informational in nature and highlights topics appropriate to the client's specific needs.

Duration: Typically fifty minutes, however two or more sessions may be combined if additional information is desired.

What you must provide: Clients choosing this option must provide the facility, including the projection screen and, for large groups, the projector and a lapel microphone. Additionally, refreshments or meals are at the discretion and expense of the hosting organization.

What you should do next: Contact us at info@rtiradar.com to discuss possible topics for your group. Review the Customized Private Program course content if necessary for potential topics of interest.

Option 6. Operational Airborne Observation

This option takes information from our dedicated presentation into the operational environment. We accompany pilots, from the jumpseat, on either dedicated training or actual operational flights, and provide feedback and input based on observations. For professional pilots, this facilitates translation of academic/seminar information into the operational world in a highly efficient manner. Manufacturers find this option particularly useful because it highlights real-world problems, issues, and considerations (including human factors) in real-time—things that if addressed properly, will give them the competitive edge in the industry.

What you must know: Attendance at one of the following RTI programs is a prerequisite for this option:

- Customized Private Program

- Individual Guest Attendee

- Sponsored Program

- Manufacturer Program

Duration: Allotted time should allow for a brief preflight discussion and a climb to normal cruise altitudes.

What you must provide: Clients must provide their radar system's Pilot Operating Guide and adequate time to prebrief the flight profile.

What you should do next: Decide if it is appropriate to take your program beyond the classroom and into the operational environment. If it is, please contact us at info@rtiradar.com for details.

Erik Eliel, founder and president of Radar Training International, has been involved in aviation since 1979. His earliest years as a professional aviator were as an Air Force pilot flying the T-38, C-141, and the U-2. His interest with radar began in 1991 while flying airlift and transport missions to Europe, Africa, South America, and the Middle East. In 1997, Erik was selected to join the cadre of instructors at the Air Force Advanced Instrument School in San Antonio, Texas, teaching advanced instrument concepts to pilots representing, NASA, federal law enforcement agencies, and all branches of the DOD. It was here that Erik developed and taught the first-ever formal weather radar course for Air Force pilots.

Erik Eliel
President, RTI

Erik's early interest with weather radar and severe convective weather was inspired by the work of industry legends Bob Buck, Jim Cook, J.T. Lee, Archie Trammell, and Dr. Fred Bates. Currently, his radar seminar is offered both domestically and abroad and has been presented to professional pilots representing the flight departments of Fortune 500 companies, aviation associations, the military, a major airline, as well as dispatchers and meteorologists of aviation-related companies. He has been called on by the manufacturers of airborne weather radar systems to consult in the design, operational employment of, and evaluation of their systems. His radar- and weather-related articles have been published in the *NBAA Journal of Business Aviation* and in *Business & Commercial Aviation*. In addition, his input has been solicited for safety-orientated publications such as the Flight Safety Foundation's magazine *AeroSafety World*.

Erik has over 10,000 hours of flying time and is currently a line pilot for a major airline, logging more than 800 hours annually. His company, Radar Training International, maintains active memberships in multiple different professional flying organizations and associations, including NBAA.