



Fundamentals of

# AIR TRAFFIC CONTROL

Second Edition

Michael S. Nolan

# **FUNDAMENTALS OF AIR TRAFFIC CONTROL**

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**SECOND EDITION**

*Michael S. Nolan*  
Purdue University

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# PREFACE

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This book was written after having searched long and hard for an appropriate college-level textbook on air traffic control. Various Federal Aviation Administration publications have been available for years, as have commercial introductory texts. But most of these books either describe rules and regulations or take a simplistic approach to how the air traffic control system works. No text has described not only how the ATC system works but *why* it operates the way it does. This book remedies that situation. It describes the background and history of the development of the air traffic control system, emphasizing why things are done the way they are, instead of simply repeating rules and regulations.

Throughout the text, appropriate real-life examples are used to illustrate the reasoning behind procedures used by air traffic controllers. The liberal use of figures and example phraseology assist the student in achieving an overall understanding of the air traffic control system. It is hoped that with this knowledge, future air traffic controllers will have a far better understanding of their chosen profession and can make the appropriate decisions that will lead aviation into the next century.

There are many unique features to this textbook that are not found in any other text on air traffic control. These features include the following.

## **History and Background**

The history of the development of the air traffic control system and many of its components is included throughout the book. This history is not intended to be a dry repeat of names and dates but rather an explanation of past decisions that dramatically affected the current air traffic control system.

## **Illustrations and Photographs**

Abundant illustrations and photographs are provided in this textbook. Air traffic control is a three-dimensional, visually oriented profession that cannot be explained simply through the use of text. These illustrations were designed to supplement the text, further explaining concepts and ideas that are difficult for the inexperienced student to visualize when simply reading about them.

## **Examples and Phraseology**

One of the most important tasks facing a controller is the proper use of phraseology. The air traffic control system is based on understanding and usage of strange and sometimes hard to understand wording. Besides explaining the

proper use of terms, the text includes numerous examples of the proper usage of phraseology.

### **Real-Life Examples**

Throughout the text, examples found in real life are used to further explain the concepts introduced. In addition, one entire chapter is dedicated to the actual operation of the air traffic control system. "Behind the scenes" activities and coordination are described, using sample flights through actual airspace. Such examples reinforce the material introduced in earlier chapters, further clarifying and explaining some of the complicated procedures used to separate air traffic above the United States.

### **Chapter Material**

The first four chapters of this text prepare the student for understanding the intricate procedures used in controlling air traffic. These four chapters cover fundamental topics, such as history, navigation, and phraseology. Chapters 5 through 11 detail the separation of aircraft in the ATC system. Chapter 12 is an in-depth look at the future of air traffic control, while Chapter 13 discusses employment opportunities for air traffic controllers. At the conclusion of the text is a detailed glossary of terms introduced in the book.

### **Acknowledgments**

I would like to thank the following individuals who have made this textbook possible. Without their gracious help and assistance, it would have been impossible to complete this book: Juanita Hull, Federal Aviation Administration; James Cheesman, SRSA Corporation; Bill Goodnight, Federal Aviation Administration; and the entire staff and management of the Champaign ATCT, Lafayette ATCT, and Indianapolis ATCT and ARTCC.

The following reviewers made many helpful suggestions in development of the manuscript for this book: Peggy Baty, Embry-Riddle Aeronautical University; Terry S. Bowman, Southern Illinois University; Jeffry B. Burbridge, Catonsville Community College; Jonathan R. Burke, Metropolitan State College of Denver; Bruce D. Hoover, Palo Alto College; Patrick K. Mattson, St. Cloud State University; Martha Pearce, Arizona State University; Michael J. Polay, Embry-Riddle Aeronautical University; Robert H. Ryder, Delta State University; Thomas Teller, Daniel Webster College; and Henry Whitney, Mt. San Antonio College.

The air traffic control system in the United States is truly a system, which means that it takes the efforts of many individuals to make the whole thing work. I've found that publishing a textbook is much the same. Although my name is on the cover, only the concerted efforts of a diligent, professional, and very talented group of people made it possible for this book to be published. Everyone involved was just as important as everyone else, as is the case in any system. We should all be very thankful for their work and effort. I sure am.

The first edition was completed in 1990 through the efforts of a group of individuals at both Wadsworth and Del Mar Associates. Although many of them are no longer connected with this project, their legacy lives on, and I remember them fondly. They include Anne Scanlan-Rohrer, aviation editor at

Wadsworth, and her editorial assistants, Leslie With, Karen Moore, and Cathie Fields. Jackie Estrada, Richard Carter, Detta Penna, Robin Witkin, and Nancy Sjoberg developed the layout and most of the illustrations for the first edition. Thanks to one and all.

The second edition was coordinated by Ruth Cottrell of Ruth Cottrell Books and Jennie Burger of Wadsworth. They were assisted by Barbara Britton and Charles Cox. I can never thank them enough for their patience and guidance. They taught me how to edit and revise this book, as I'm sure they have guided many other authors. They are the book experts, responsible for the ultimate product you see before you. They were indispensable members of our system. Without them, this project could never have been accomplished. And of course I must thank my wife, Barbara, and my three children, Linda, Erin, and David, who gave up a lot of their time with Daddy so he could finish this revision on time. I am indebted to each and every one of you.

*Mike Nolan*

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## CHAPTER 1 FWA

# HISTORY OF AIR TRAFFIC CONTROL

### OBJECTIVES

After studying this chapter, you should be able to:

1. Discuss the significance of the Airmail Act of 1925.
2. Describe how the federal government became involved in air traffic control.
3. Discuss the history of the various federal agencies involved in air traffic control.
4. Discuss the formation of organized labor unions as they pertain to air traffic control.
5. Identify the organizations currently involved in the air traffic control system.
6. Identify the various organizations that have represented air traffic controllers.
7. Identify some of the methods air traffic controllers used in the past to separate aircraft.

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## **1903–1925: Early Aviation Developments**

When the Wright brothers' experiment in flight succeeded on December 17, 1903, the world took little notice. Newspapers of that era either did not believe or belittled the accomplishments of the two brothers on that cold, blustery morning. At the start of the century, most people regarded aviation as a pastime for experimenters and daredevils. It was hard to believe that the tiny, underpowered aircraft of that era would ever evolve into a useful form of transportation. In this early period of experimentation, anyone with a mechanical aptitude could design, build, and fly an aircraft without passing any type of test or possessing any type of license. Without regulation or certification, people began to build and quite regularly crash these early flying machines. The general public was frightened by the machines and believed that only fools would fly in them. Potential investors in this new industry were fearful of risking their capital to finance an unproven and apparently dangerous industry.

In spite of this climate of fear and distrust, aviation pioneers began to demonstrate the usefulness of their primitive flying machines. As early as 1911, the first mail was carried by air. By the time the United States became involved in World War I, the airplane had demonstrated its usefulness as an observation platform and as a crude weapons delivery system.

After the war, numerous additional uses were found for the airplane. The Post Office Department began to offer routine airmail service in 1918, using U.S. Army pilots and aircraft. In 1919 the U.S. Department of Agriculture initiated experiments that would lead to the commercial use of aircraft for application of pesticides. The first transatlantic crossing was made that year, which also saw the first experimental use of radio as a navigation aid.

### **Development of Airmail Service**

Between 1918 and 1925, airmail service was expanded by the Post Office Department until full transcontinental service was finally achieved. Until 1923 most of the mail was flown during daylight hours, since a safe, reliable form of nighttime navigation had not been developed. In 1921 the first experimental night flight was conducted, using bonfires located along the navigation route. These bonfires were replaced in 1923, when a 72-mile stretch of airway between Dayton and Columbus, Ohio was experimentally lit with electric and gas arc lighting. The experiment proved successful, and airway lighting was soon introduced across the country. By 1924 the portion of the transcontinental airway between Cheyenne, Wyoming and Chicago, Illinois was lit, and routine night flights were being conducted along this section of the airway.

By 1925 the commercial potential for aviation had been established, and the Post Office Department found itself under pressure to expand airmail service at a faster rate than was possible for a government agency. Since aviation appeared to be a commercially viable industry, it was felt that airmail service could now be handled by private airline companies. A resolution to permit private contracting, introduced by Congressman Clyde Kelly of Pennsylvania, was



signed into law on February 2, 1925 and became known as the **Airmail Act of 1925**. The Airmail Act authorized the postmaster general to contract with private individuals and corporations for the purpose of transporting airmail. Between 1925 and 1927, airmail contracts were bid to private corporations, and commercial aviation became a reality.

After this act was signed into law, many companies that had been sitting on the sidelines earnestly jumped into the aviation field. Boeing, Douglas, and Pratt and Whitney were just a few of the companies that bid to supply aircraft and engines to the budding airmail industry. Even the great Henry Ford entered the picture, producing the famous Ford Trimotor and operating an air cargo airline between Detroit and Chicago.

### **The Morrow Report**

With this increase in air activity came an increased desire for some type of national regulation of the industry. Prior to this time, individual states had reserved the right to test and certify pilots, but many were hesitant to exercise this authority. The aviation industry was still fragile, and public sentiment favored federal government regulation to unify the industry through a common set of rules, procedures, and certification. It was felt that government regulations were needed if the aviation industry were to grow and prosper. Without this regulation, the public's trust could not be gained.

A joint congressional committee recommended the formation of an advisory board composed of prominent businessmen to recommend the possible extent of federal involvement in the aviation industry. In 1924 President Calvin Coolidge appointed Dwight Morrow to head this board and make recommendations as to future government policy. The Morrow board presented its final report to the president on December 2, 1925. The **Morrow Report** recommended that military and civilian aviation operate separately, with the Department of Commerce to be given the responsibility for the promotion and the regulation of the civilian aviation industry.

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## **1925-1935**

### **Air Commerce Act**

President Coolidge endorsed the findings of the Morrow Report and passed it along to Congress. He requested that the board's recommendations be implemented as soon as possible. After the inevitable discussion and negotiations, Congress approved, and President Coolidge signed the **Air Commerce Act** into law on May 20, 1926.

As Senator Hiram Bingham, who introduced the Air Commerce Act into the Senate, explained, the purpose of the act was "not so much to regulate as to promote civilian aviation." The Air Commerce Act made it the duty of the secretary of commerce (at that time Herbert Hoover) to encourage the growth of the aviation industry through the establishment of airways and navigation aids. In addition, the secretary was authorized to regulate the industry as necessary to elevate the public's perception of aviation as a safe mode of transport-