



**NONRESIDENT
TRAINING
COURSE**

October 2000



Fire Controlman, Volume 2—Fire-Control Radar Fundamentals

NAVEDTRA 14099

Although the words “he,” “him,” and “his” are used sparingly in this course to enhance communication, they are not intended to be gender driven or to affront or discriminate against anyone.

PREFACE

By enrolling in this self-study course, you have demonstrated a desire to improve yourself and the Navy. Remember, however, this self-study course is only one part of the total Navy training program. Practical experience, schools, selected reading, and your desire to succeed are also necessary to successfully round out a fully meaningful training program.

COURSE OVERVIEW: After completing this course, you will have a basic knowledge of the following topics:

- basic radar concepts,
- equipment requirements for basic radar systems,
- types of energy transmission used in radar systems,
- scanning techniques used in radar systems,
- major components in today's radar transmitters,
- design requirements of an effective radar receiver,
- radiation and other types of hazards associated with maintaining and operating radars, and
- safety precautions associated with radar

THE COURSE: This self-study course is organized into subject matter areas, each containing learning objectives to help you determine what you should learn along with text and illustrations to help you understand the information. The subject matter reflects day-to-day requirements and experiences of personnel in the rating or skill area. It also reflects guidance provided by Enlisted Community Managers (ECMs) and other senior personnel, technical references, instructions, etc., and either the occupational or naval standards, which are listed in the *Manual of Navy Enlisted Manpower Personnel Classifications and Occupational Standards*, NAVPERS 18068.

THE QUESTIONS: The questions that appear in this course are designed to help you understand the material in the text.

VALUE: In completing this course, you will improve your military and professional knowledge. Importantly, it can also help you study for the Navy-wide advancement in rate examination. If you are studying and discover a reference in the text to another publication for further information, look it up.

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Sailor's Creed

"I am a United States Sailor.

I will support and defend the Constitution of the United States of America and I will obey the orders of those appointed over me.

I represent the fighting spirit of the Navy and those who have gone before me to defend freedom and democracy around the world.

I proudly serve my country's Navy combat team with honor, courage and commitment.

I am committed to excellence and the fair treatment of all."

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Course Assignments follow the index.

INSTRUCTIONS FOR TAKING THE COURSE

ASSIGNMENTS

The text pages that you are to study are listed at the beginning of each assignment. Study these pages carefully before attempting to answer the questions. Pay close attention to tables and illustrations and read the learning objectives. The learning objectives state what you should be able to do after studying the material. Answering the questions correctly helps you accomplish the objectives.

SELECTING YOUR ANSWERS

Read each question carefully, then select the BEST answer. You may refer freely to the text. The answers must be the result of your own work and decisions. You are prohibited from referring to or copying the answers of others and from giving answers to anyone else taking the course.

SUBMITTING YOUR ASSIGNMENTS

To have your assignments graded, you must be enrolled in the course with the Nonresident Training Course Administration Branch at the Naval Education and Training Professional Development and Technology Center (NETPDTC). Following enrollment, there are two ways of having your assignments graded: (1) use the Internet to submit your assignments as you complete them, or (2) send all the assignments at one time by mail to NETPDTC.

Grading on the Internet: Advantages to Internet grading are:

- you may submit your answers as soon as you complete an assignment, and
- you get your results faster; usually by the next working day (approximately 24 hours).

In addition to receiving grade results for each assignment, you will receive course completion confirmation once you have completed all the

assignments. To submit your assignment answers via the Internet, go to:

<http://courses.cnet.navy.mil>

Grading by Mail: When you submit answer sheets by mail, send all of your assignments at one time. Do NOT submit individual answer sheets for grading. Mail all of your assignments in an envelope, which you either provide yourself or obtain from your nearest Educational Services Officer (ESO). Submit answer sheets to:

COMMANDING OFFICER
NETPDTC N331
6490 SAUFLEY FIELD ROAD
PENSACOLA FL 32559-5000

Answer Sheets: All courses include one “scannable” answer sheet for each assignment. These answer sheets are preprinted with your SSN, name, assignment number, and course number. Explanations for completing the answer sheets are on the answer sheet.

Do not use answer sheet reproductions: Use only the original answer sheets that we provide—reproductions will not work with our scanning equipment and cannot be processed.

Follow the instructions for marking your answers on the answer sheet. Be sure that blocks 1, 2, and 3 are filled in correctly. This information is necessary for your course to be properly processed and for you to receive credit for your work.

COMPLETION TIME

Courses must be completed within 12 months from the date of enrollment. This includes time required to resubmit failed assignments.

PASS/FAIL ASSIGNMENT PROCEDURES

If your overall course score is 3.2 or higher, you will pass the course and will not be required to resubmit assignments. Once your assignments have been graded you will receive course completion confirmation.

If you receive less than a 3.2 on any assignment and your overall course score is below 3.2, you will be given the opportunity to resubmit failed assignments. **You may resubmit failed assignments only once.** Internet students will receive notification when they have failed an assignment--they may then resubmit failed assignments on the web site. Internet students may view and print results for failed assignments from the web site. Students who submit by mail will receive a failing result letter and a new answer sheet for resubmission of each failed assignment.

COMPLETION CONFIRMATION

After successfully completing this course, you will receive a letter of completion.

ERRATA

Errata are used to correct minor errors or delete obsolete information in a course. Errata may also be used to provide instructions to the student. If a course has an errata, it will be included as the first page(s) after the front cover. Errata for all courses can be accessed and viewed/downloaded at:

<http://www.advancement.cnet.navy.mil>

STUDENT FEEDBACK QUESTIONS

We value your suggestions, questions, and criticisms on our courses. If you would like to communicate with us regarding this course, we encourage you, if possible, to use e-mail. If you write or fax, please use a copy of the Student Comment form that follows this page.

For subject matter questions:

E-mail: n311.products@cnet.navy.mil
Phone: Comm: (850) 452-1355
DSN: 922-1355
FAX: (850) 452-1370
(Do not fax answer sheets.)
Address: COMMANDING OFFICER
NETPDTC N311
6490 SAUFLEY FIELD ROAD
PENSACOLA FL 32509-5237

For enrollment, shipping, grading, or completion letter questions

E-mail: fleetservices@cnet.navy.mil
Phone: Toll Free: 877-264-8583
Comm: (850) 452-1511/1181/1859
DSN: 922-1511/1181/1859
FAX: (850) 452-1370
(Do not fax answer sheets.)
Address: COMMANDING OFFICER
NETPDTC N331
6490 SAUFLEY FIELD ROAD
PENSACOLA FL 32559-5000

NAVAL RESERVE RETIREMENT CREDIT

If you are a member of the Naval Reserve, you may earn retirement points for successfully completing this course, if authorized under current directives governing retirement of Naval Reserve personnel. For Naval Reserve retirement, this course is evaluated at 3 points. (Refer to *Administrative Procedures for Naval Reservists on Inactive Duty*, BUPERSINST 1001.39, for more information about retirement points.)

Student Comments

Course Title: Fire Controlman, Volume 2—Fire-Control Radar Fundamentals

NAVEDTRA: 14099 **Date:** _____

We need some information about you:

Rate/Rank and Name: _____ SSN: _____ Command/Unit _____

Street Address: _____ City: _____ State/FPO: _____ Zip _____

Your comments, suggestions, etc.:

Privacy Act Statement: Under authority of Title 5, USC 301, information regarding your military status is requested in processing your comments and in preparing a reply. This information will not be divulged without written authorization to anyone other than those within DOD for official use in determining performance.
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NETPDTC 1550/41 (Rev 4-00)

CHAPTER 1

INTRODUCTION TO BASIC RADAR SYSTEMS

LEARNING OBJECTIVES

Upon completing this chapter, you should be able to do the following:

1. Explain the terms “range”, “bearing”, and “altitude” as they are associated with radar.
2. Explain the two basic methods for detecting objects with radar.
3. Identify and explain the use of equipment found in basic radar.
4. Identify and state the use of the four basic types of military radar systems.
5. Identify and explain the three phases of fire-control radar.
6. Identify the radar systems currently used in the U. S. Navy.

INTRODUCTION

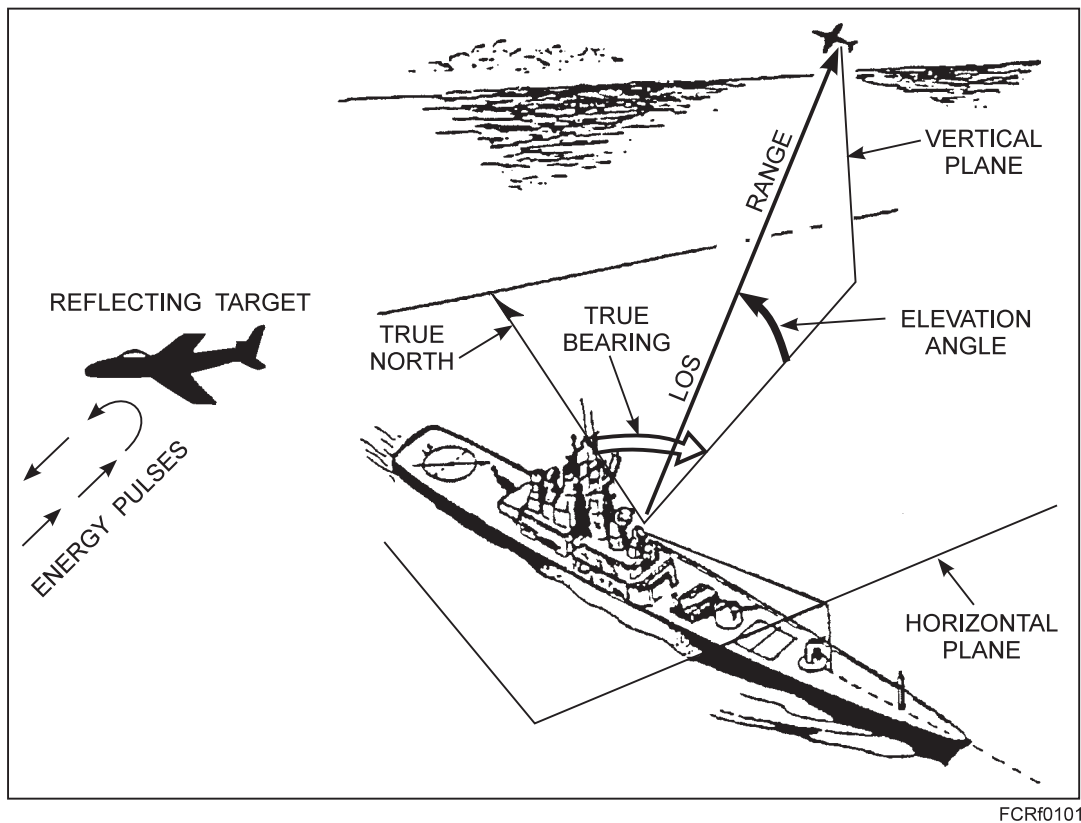
This chapter discusses radar principles and basic radar systems. As a Fire Controlman, and a possible work-center supervisor, you must understand basic radar principles and safety requirements for radar maintenance. You will find valuable supporting information in the Navy Electricity and Electronics Training Series (NEETS), especially Module 18, *Radar Principles*, NAVEDTRA 172-18-00-84, and in *Electronics Installation and Maintenance Book, Radar*, NAVSEA SE000-00-EIM-020. By referring to these publications on a regular basis, you can increase your understanding of this subject matter.

This chapter is not designed to teach you every radar system the Navy uses, but simply to familiarize you with the radars and their general characteristics. Because there are so many different models of radar equipment, we will describe only the radars and radar accessories that will be around for several years. We will not discuss older radar systems that are scheduled for replacement in the near future. Refer to your specific technical publications for detailed descriptions of the operation and maintenance of your specific radar system.

BASIC RADAR CONCEPTS

The term *radar* is an acronym made from the words **radio**, **detection**, and **ranging**. It refers to electronic equipment that uses reflected electromagnetic energy to determine the direction to, height of, and distance of detected objects. Electromagnetic energy of the frequency used for radar is unaffected by darkness. However, it can be affected by weather to some degree, depending on its frequency. It permits radar systems to determine the positions of ships, planes, and land masses that are invisible to the naked eye because of distance, darkness, or weather. Radar systems provide only a limited field of view and require reference coordinate systems to define the positions of detected objects. Radar surface angular measurements are normally made in a clockwise direction from true north, as shown in figure 1-1, or from the heading line of the ship or aircraft. The radar is located at the center of this coordinate system.

Table 1-1 defines the basic terms used in figure 1-1. You must know these terms to understand the coordinate system.



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Figure 1-1.—Radar surface angular measurements.

Table 1-1.—Radar Reference Coordinate Terms

Term	Definition
Energy pulses	The pulses that are sent out by the radar and are received back from the target.
Reflecting target	The air or surface contact that provides an echo.
True north	The direction of the north geographical pole.
True bearing/azimuth	The angle measured clockwise from true north in the horizontal plane.
Line-of-sight range	The length of the line from the radar set directly to the object.
Vertical plane	All angles in the up direction, measured in a secondary imaginary plane.
Elevation angle	The angle between the horizontal plane and the line of sight.
Horizontal plane	The surface of the Earth, represented by an imaginary flat plane which is tangent (or parallel) to the Earth's surface at that location.