NONRESIDENT TRAINING COURSE

June 2001

Aerographer's Mate

Module 5—Basic Meteorology

NAVEDTRA 14312

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: In completing this nonresident training course, you will demonstrate a knowledge of the subject matter by correctly answering questions on the following subjects: Fundamentals of Meteorology, Atmospheric Physics, Atmospheric Circulation, Air Masses, Fronts, Atmospheric Phenomena, Climate and Climatology.

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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Published by
NAVAL EDUCATION AND TRAINING
PROFESSIONAL DEVELOPMENT
AND TECHNOLOGY CENTER

NAVSUP Logistics Tracking Number
0504-LP-026-4050

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."

TABLE OF CONTENTS

SUMMARY OF THE AEROGRAPHER'S MATE TRAINING SERIES

The following training manuals of the AG training series are available:

AG MODULE 1, NAVEDTRA 12881, *Surface Weather Observations*

This module covers the basic procedures that are involved with conducting surface weather observations. It begins with a discussion of surface observation elements, followed by a description of primary and backup observation equipment that is used aboard ships and at shore stations. Module 1 also includes a complete explanation of how to record and encode surface METAR observations using WMO and NAVMETOCCOM guidelines. The module concludes with a description of WMO plotting models and procedures.

AG MODULE 2, NAVEDTRA 12882, *Miscellaneous Observations and Codes*

This module concentrates on the observation procedures, equipment, and codes associated with upper-air observations and bathythermograph observations. Module 2 also discusses aviation weather codes, such as TAFs and PIREPs, and includes a chapter on surf observation procedures. Radiological fallout and chemical contamination plotting procedures are also explained.

AG MODULE 3, NAVEDTRA 12883, *Environmental Satellites and Weather Radar*

This module describes the various types of environmental satellites, satellite imagery, and associated terminology. It also discusses satellite receiving equipment. In addition, Module 3 contains information on the Weather Surveillance Radar-1988 Doppler (WSR-88D). It includes a discussion of electromagnetic energy and radar propagation theory, and explains the basic principles of Doppler radar. The module also describes the configuration and operation of the WSR-88D, as well as WSR-88D products.

AG MODULE 4, NAVEDTRA 12884, *Environmental Communications and administration*

This module covers several of the most widely used environmental communications systems within the METOC community. It also describes the software programs and products associated with these systems. The module concludes with a discussion of basic administration procedures.

AG MODULE 5, NAVEDTRA 14312, *Basic Meteorology*

This training manual introduces the Aerographer's Mate to the basic fundamentals of meteorology, atmospheric physics, atmospheric circulation, air masses, fronts, atmospheric phenomena, climate and climatology.

NOTE

Additional modules of the AG training series are in development. Check the NETPDTC website for details at http://www.cnet.navy.mil/netpdtc/nac/neas.htm. For ordering information, check NAVEDTRA 12061, *Catalog of Nonresident Training Courses*, which is also available from the NETPDTC website.

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.cnet.navy.mil/netpdtc/nac/neas.htm

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: n315.products@cnet.navy.mil
Phone: Comm: (850) 452-1001, ext. 1782
DSN: 922-1001, ext. 1782
FAX: (850) 452-1370
(Do not fax answer sheets.)
Address: COMMANDING OFFICER
NETPDTC N315
6490 SAUFLEY FIELD ROAD
PENSACOLA FL 32509-5000

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 (CODE N331)
6490 SAUFLEY FIELD ROAD
PENSACOLA FL 32559-5000

NAVAL RESERVE RETIREMENT CREDIT

If you are a member of the Naval Reserve, you will receive retirement points if you are authorized to receive them under current directives governing retirement of Naval Reserve personnel. For Naval Reserve retirement, this course is evaluated at 9 points. (Refer to *Administrative Procedures for Naval Reservists on Inactive Duty,* BUPERSINST 1001.39, for more information about retirement points.)

Student Comments

Course Title: *Aerographer's Mate, Module 5—Basic Meteorology*

NAVEDTRA: *14312* **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.

NETPDTC 1550/41 (Rev 4-00)

CHAPTER 1

FUNDAMENTALS OF METEOROLOGY

Meteorology is the study of atmospheric phenomena. This study consists of physics, chemistry, and dynamics of the atmosphere. It also includes many of the direct effects the atmosphere has upon Earth's surface, the oceans, and life in general. In this manual we will study the overall fundamentals of meteorology, a thorough description of atmospheric physics and circulation, air masses, fronts, and meteorological elements. This information supplies the necessary background for you to understand chart analysis, tropical analysis, satellite analysis, and chart interpretation.

SYSTEM OF MEASUREMENT

LEARNING OBJECTIVE: Recognize the units of measure used in the Metric System and the English System and how these systems of measurement are used in Meteorology.

To work in the field of meteorology, you must have a basic understanding of the science of measurement (metrology). When you can measure what you are talking about and express it in numerical values, you then have knowledge of your subject. To measure how far something is moved, or how heavy it is, or how fast it travels; you may use a specific measurement system. There are many such systems throughout the world today. The Metric System (CGS, centimeter-gram-second) has been recognized for use in science and research. Therefore, that system is discussed in the paragraphs that follow, with brief points of comparison to the English System (FPS, foot-pound-second). The metric units measure length, weight, and time, respectively. The derivation of those units is described briefly.

LENGTH

To familiarize you with the conventional units of metric length, start with the meter. The meter is slightly larger than the English yard (39.36 inches vs. 36 inches). Prefixes are used in conjunction with the meter to denote smaller or larger units of the meter. Each larger unit is ten times larger than the next smaller unit. (See table 1-1.).

Table 1-1.—Common Prefixes in the Metric System

Prefix[1]	Symbol	Decimal Value	Scientific Notation
Kilo	K	1000	10^3
Hecto	H	100	10^2
Deka	D	10	10^1
Deci	d	.1	10^{-1}
Centi	c	.01	10^{-2}
Milli	m	.001	10^{-3}

[1]These prefixes are used with all metric units such as meters, grams, liters, and seconds (eg., kilometers, hectometers, centiliters, milliseconds).

Since the C in CGS represents centimeters (cm) you should see from table 1-1 that the centimeter is one-hundredth of a meter, .O1M, or 10^{-2} M. Conversely, 1 M equals 100 cm. To describe a gram, the G in the CGS system, you must first have a familiarization with area and volume.

AREA AND VOLUME

A square has four equal sides and it is a one-plane figure—like a sheet of paper. To determine how much surface area is enclosed within the square you multiply the length of one side by the length of the other equal side. If the sides were 1 centimeter (cm) in length the area of the square would be 1 cm × 1 cm = 1 square cm, or 1 cm^2. If squares having an area of 1 cm^2 were stacked on top of each other until the stack was 1 cm tall, you would end up with a cube whose sides were each 1-cm in length. To determine the volume of the cube you simply multiply the length by the width and height. Because each side is 1 cm you end up with a volume of 1 cubic centimeter (cm^3) (1 cm × 1 cm × 1 cm = 1 cm^3). More simply stated, multiply the area of one side of the cube by the height of the cube. Once you understand how the volume of a cube is determined, you are now ready to review the G in the CGS system.