



**NONRESIDENT
TRAINING
COURSE**



February 2001

**Fire Controlman,
Volume 1—Administration
and Safety**

NAVEDTRA 14098

NOTICE

Page 4-4
must be printed on a
COLOR printer

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 OBJECTIVES: After completing this course, you will have a basic knowledge of the following topics: Basic workcenter logs and reports; primary sources of FC technical and non-technical job-related information; the Maintenance Data System (MDS) and its associated forms; primary technical manuals associated with the routine duties of Fire Controlmen; electric shock and its effects on the human body; procedures for measuring voltages; electromagnetic radiation hazards; the tagout bill and its associated procedures; hazardous materials found in FC workspaces; storage requirements for hazardous materials; basic safety principles associated with ammunition handling, shipping, and stowage; the Navy's program for qualifying and certifying explosives handling personnel; and types of ammunition stowage and their safety devices.

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.

*2001 Edition Prepared by
FCC(SW) Charles F.C. Mellen*

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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 (CODE 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 (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 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 1—Administration and Safety

NAVEDTRA: 14098 **Date:** _____

We need some information about you:

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

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

Your comments, suggestions, etc.:

<p>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.</p>
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NETPDTC 1550/41 (Rev 4-00)

CHAPTER 1

GENERAL ADMINISTRATION

LEARNING OBJECTIVES

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

1. Describe the basic reports and logs used by work center supervisors.
2. Identify the primary sources of technical and non-technical job-related information.

INTRODUCTION

Throughout your career as a Fire Controlman, you will be involved with receiving and passing on job-related information. The bulk of that information will be contained in reports, logs, and formal publications. This chapter discusses the reports, logs, and publications of importance to you.

Reports and logs are bywords in general administration, without which the performance of many functions would be nearly impossible. As a Fire Controlman, you will be involved with either creating or maintaining various administrative reports and logs in such areas as supervision and assignments, space upkeep and cleanliness, supply and logistics, funding allocation, and tool, consumables, and equipment procurement.

Job-related publications are excellent for discovering new techniques in troubleshooting and testing equipment, obtaining updates on safety procedures, and increasing your knowledge of electronics. These publications are very important to every Fire Controlman technician. Therefore, they must be maintained correctly and updated promptly.

As a Fire Controlman technician or supervisor, you have the responsibility for properly applying the information contained in this chapter and for enhancing your administrative skills. As a work center supervisor, you should ensure that your technicians are aware of the procedures for maintaining and updating various information sources (publications) of importance to them.

REPORTS AND LOGS

Reports and logs, like inspections, are “necessary evils” to the technician. Without reports and an accountability system, maintenance and repair would be almost impossible. There would be no way to maintain supply support for equipment, and no way to know what equipment is on board, its quantity, or location.

This section discusses some of the more important reports and logs you will use.

GETTING UNDERWAY REPORTS

Getting underway reports are also known as “pre-underway check-off lists” or equipment status reports. The Department Head or Combat Systems/ Weapons Officer is normally responsible for turning in this report before the ship gets underway. Normally there will be a check-off list of equipment and events that need to be done 72-hours, 48-hours, 24-hours, 12-hours, etc. before your ship’s underway time. These reports are usually locally generated forms and therefore their content and format may vary among commands. You may be asked to furnish information about the equipment in your work center or about such diverse areas as major systems status, estimated time of repair, power outages, and minimum discernible signal (MDS) readings from radars. You will also be required to initial or sign your name on this check-off list to verify your equipment status. Therefore, it is important that you give timely and accurate information so that your ship can get underway without any delays.

EIGHT AND TWELVE O' CLOCK REPORTS

Eight and twelve o' clock reports are similar to "getting underway reports." These are daily reports that give the commanding officer a specific look at the daily status of all major equipment on board the ship. They provide information on major weapons systems status, estimated time of repair, part ordering status, and daily system operability test results. Twelve o' clock reports are turned in to the commanding officer (or the command duty officer if the commanding officer is absent) just before 1200 each day and are logged into the ship's Deck Log. This is normally coordinated by the Officer of the Deck and delivered by the Messenger of the Watch or Petty Officer of the Watch. Eight o' clock reports are turned in every evening at about 2000 to the command duty officer during inport duty days or to the commanding officer if the ship is underway. Eight o' clock reports have the same type of information as twelve o' clock reports. These reports are all ultimately turned into the commanding officer by duty department heads of all the major departments, not just the combat systems department. As a supervisor you will be required to give information about the status of your equipment to the duty department head. Therefore, it is important that you give accurate and up-to-date information to insure support for equipment maintenance and casualties. Look at your ship's local instructions to find out what specific reports are required for your ship for both eight o' clock and twelve o' clock reports.

CASUALTY REPORTS

Casualty reports (CASREPs) are a method your ship uses to communicate in a written message format your ship's need for outside assistance to fix a broken piece of equipment. The reason you might need to send this report can vary. However, normally it will be either because the part you need is not in your supply system or because you need greater technical expertise to fix your equipment. Your CASREP message will result in getting your equipment fixed and operating in a quick and timely manner.

The casualty report (CASREP) system contains four types of reports: initial (CASREP), update (CASREP with a serial number change), correction (CASCOR), and cancellation (CASCAN). CASREPs are not a substitute for 3-M data, but they are in addition to and complement it. Information on the

preparation and submission of casualty reports is contained in *Operational Reports*, NWP 1.03-1 (IC 1) (formerly NWP 10-1-10).

WORK-CENTER LOGS

Every work center requires many types of logs to work efficiently. The logs mentioned here do not compose a comprehensive list, nor are they all mandatory. They are included to give you an overview of what logs may be required and used on a routine basis in your work center. Always check with your ship's local instructions concerning your work-center's specific log requirements. The logs discussed here include the work-center pass down log, trouble log, supply log, PMS accountability log, tag-out log, and smooth log.

Work-Center Pass Down Log

Work-center pass-down logs are not considered formal documents. They usually contain specific information about equipment that is helpful to the technician for maintenance, trouble shooting, and ordering of parts. Most work centers use a blank book (available through supply) labeled with the work center name and kept with other important documents, such as the 3-M manual. Entries are made with pen and ink by the leading petty officer, work center supervisor, or repair parts petty officer. Each entry is dated and gives enough information to clearly communicate what the problem or sequence of events is. Information can be routine, as in regular maintenance checks, or it can be casualty related. It's up to you how you want to design your work center log so that it's useful for your work center. If you develop the habit of making daily entries, you will be able to determine how long consumable parts actually last before they need to be replaced (consumable parts are those parts you replace on a regular basis, such as filters). There is no formal requirement to keep a work-center log; however, it is highly recommended that you spend the time and energy to maintain one. A work-center log, if properly maintained, is an invaluable tool in getting to know your specific equipment. It can help you to see trends in your system's performance and track recurring casualties resulting in an informal, but accurate, history of your equipment. Not only will it help you, but it will also help future technicians in doing maintenance and trouble shooting long after you have transferred.

Trouble Log

Trouble reports and logs are usually filled out each time an equipment trouble is detected. They are generated locally and are a great help in filling out 3-M documents because they tell you what equipment is affected, the nature of the trouble, and the time of the failure. After you have corrected the trouble, you should make an entry in the report or log stating that the correction has been completed, including the date of completion and your signature.

Sometimes equipment belonging to someone else but located in your work center breaks. An example of this might be a bad phone circuit or a blown fuse. In these cases you should call the respective “trouble call” desk. This might be Damage Control Central (or equivalent) or the Combat Systems Officer of the Watch (CSOOW). The trouble call desk will give you a number that represents your call and the associated fault. Each trouble desk has its own log and will record your trouble call in it. Make sure that you put this number in your work center’s trouble log to ensure that you also have a record of the fault. You can use a blank book, binder, folder or whatever you think will get the job done in keeping accurate records of these types of faults. It’s a good idea to have the person correcting the fault sign or initial the log after the fault has been corrected. This will give you an accurate history of your work center’s non-equipment related casualties.

Other locally generated logs that may be used are test equipment checkout logs (to track test equipment on loan to other divisions), consumable usage logs (to track the use of consumable supplies), and tool accountability logs (to track tools issued to individuals).

Supply Log

Your work center uses the supply log to list and keep track of parts you have ordered in order to support equipment maintenance or repair. Normally the person assigned as Repair Parts Petty Officer (RPPO) will make entries and update the supply log as required. This log is kept in your work center with other important records. You can either use a pre-printed form that is already divided into rows and columns (ordered through your supply system) or create your own record. An important thing to remember is to be consistent in making entries when you order, receive or update parts for your equipment. This will ensure that you get parts support in a timely manner and that you don’t waste time and money because of careless supply

log maintenance. Your supply department will give you specific directions on keeping a good supply log and will direct you in complying with your ship’s instructions. There are specific personnel qualifications standards for repair parts petty officer that will guide you in preparing a supply log and in performing the duties of a good repair parts petty officer. Check with your divisional chain of command or the supply department for the latest requirements and training for repair parts petty officer.

Preventative Maintenance System (PMS) Accountability Log

The PMS accountability log is used to keep track of maintenance performed on a system or piece of equipment within the last 13 weeks. It documents the maintenance done on equipment according to the maintenance requirement card (MRC), the actual date maintenance was completed, and the signature of the person who did the actual maintenance. This is a required log in your work center and is subject to routine inspection. Inspection of the PMS accountability log is usually done on a weekly basis, but can be done at any time. For specific instructions for your work center, check your ship’s instructions and the 3-M manual.

Tag-Out Log

The tag-out log documents the issuing of safety tags (normally danger tags) required for maintenance or repair of equipment. This log is commonly referred to as a “laminated tag-out log.” This program is authorized by the commanding officer. At the discretion of the commanding officer, certain work centers are allowed to use laminated danger tags. The ship will have a local instruction that details all requirements for this program and what the commanding officer expects of work centers that are allowed the privilege of using laminated danger tags. Laminated danger tags are numerically serialized danger tags that are laminated for use in routine, periodic maintenance. They are filled out with grease pencil and subject to the same type of signature requirements and logging as any danger tag. Laminated tags can only be used for one working day and may not be used for maintenance or repair that extends beyond the normal work day. If a danger tag is needed for more than one working day, the normal tag out procedures for the department apply. Laminated tags are audited on a daily basis by the work center supervisor and on a weekly basis by the division

officer. Specific requirements for the proper method of tag out are discussed in your ship's instructions, the 3-M manual, OPNAVINST 5100.19C *Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat*, NAVSEA S0404-AD-URM-010/TUM, *Tag-Out User's Manual (TUM)*, and COMNAVSURFPACINST 5101.2H CH-1, *Equipment Tag-Out Procedures*.

Smooth Log

The smooth log contains all baseline data (information about your system when it was first installed) for all weapon systems on your specific ship. It also contains the latest data on your weapons systems, based on the most recent maintenance, overhauls, or testing completed. This data consists of information such as radiation cut-out zones for radar, radar transmitter tests, system operability tests, pre- and post-fire checks, train and elevation measurements, pre-aim calibration gun exercises, towed target exercises, and other important tests, measurements, and exercises. The smooth log is actually more than one volume and is normally kept wherever the Combat Systems Officer of the Watch (CSOOW) stands watch.

- Q1. What resources should you use to determine what reports should be turned in for your ship's eight o'clock reports?
- Q2. What are the four types of casualty reports used in the casualty reporting system?
- Q3. How often should laminated tags be audited?

INFORMATION SOURCES

Many types of information sources apply to your job. Use them. They may be periodicals (bulletins, magazines, or messages), schematics, work-center logs, instructions, or applicable modules in the *Navy Electricity and Electronic Training Series (NEETS)*. You may also use individual command logs to keep an accurate history of equipment performance and the location of test equipment. New personnel may use the various information sources to bring themselves up-to-date on new procedures and troubleshooting techniques. In addition, they may use the work center's logbooks to learn the operating history of the equipment they are assigned to maintain.

You may want to use technical periodicals to keep current of any changes or policies affecting equipment configuration and safety-related items. Periodicals

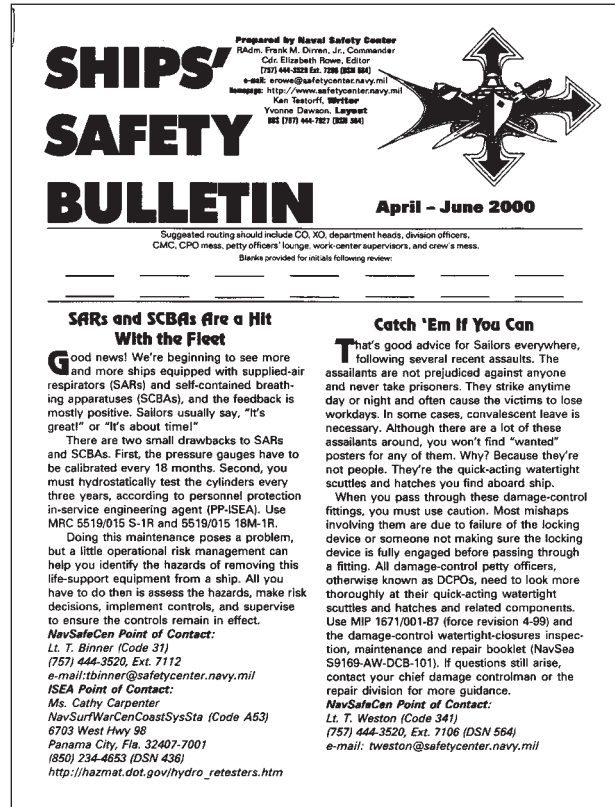
also contain important information that may affect you as a Fire Controlman. **Remember, however, that most periodicals are only for informational purposes and do not change or supersede applicable policies, directives, or instructions.**

SHIPS' SAFETY BULLETIN

The *Ships' Safety Bulletin* is published quarterly by the Naval Safety Center, Norfolk, Virginia. The bulletins cover all aspects of safety information, from electrical safety shoes to revisions of safety courses. If your work center does not maintain copies of the *Ships' Safety Bulletin*, contact your ship's Safety Officer to get a copy so you can keep current on safety-related items. These bulletins should be kept in hard binders in chronological order, as they are filled with technical and safety information that everyone in the shop should have available for use. Figure 1-1 illustrates a front cover of a *Ship's Safety Bulletin*.

AFLOAT SAFETY ADVISORIES

Afloat safety advisories are in message format and advise commands of current and emergent safety-related items. Your command may obtain them on a floppy disk from the Naval Safety Center.



FC01001

Figure 1-1.—*Ships' Safety Bulletin*.

FATHOM

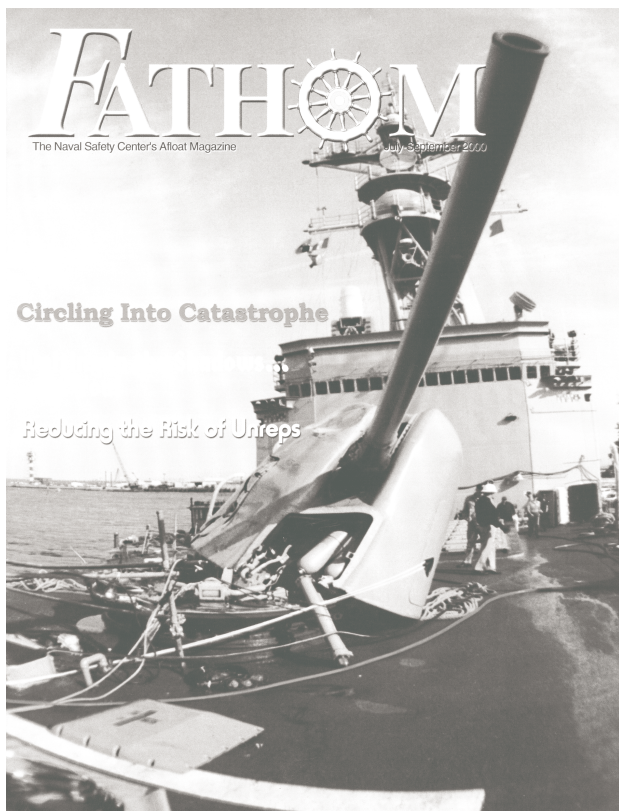
Fathom, an afloat safety review magazine, shown in figure 1-2, is published quarterly by the Naval Safety Center. Its articles pertain to safety issues concerning surface and submarine forces and it is distributed primarily to these forces.

ASHORE

Ashore, a shore safety review periodical in magazine format, is published quarterly by the Naval Safety Center. *Ashore* is an official publication, approved for distributing safety-related information to inform naval personnel on current safety concerns and emerging developments within their areas of expertise. Although the contents of this periodical are informative, they are not directive. *Ashore* presents good articles and is a beneficial addition to any shore-based Fire Controlman's reference library. Figure 1-3 illustrates a front cover of an *Ashore* magazine.

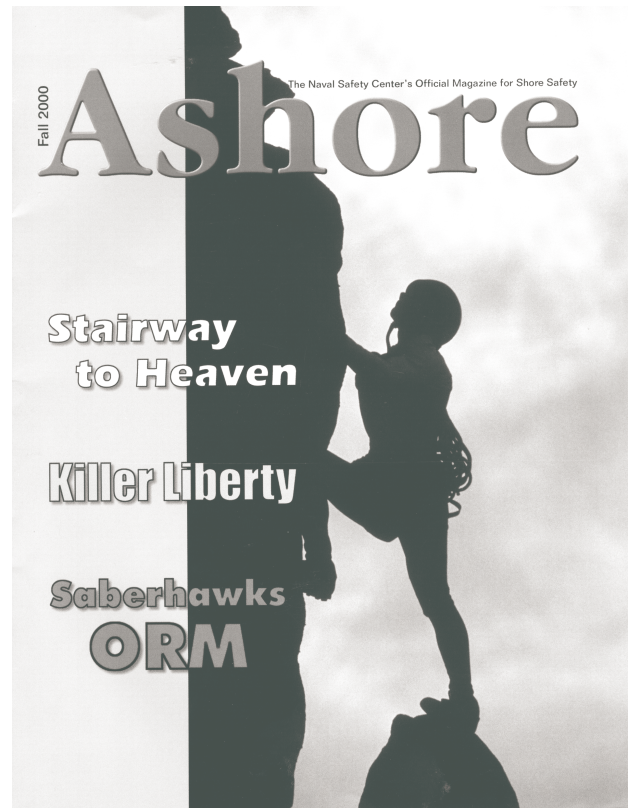
TECHNICAL MANUALS

Throughout your training you have become familiar with technical manuals. They are a key



FCf01002

Figure 1-2.—*Fathom* magazine.



FCf01003

Figure 1-3.—*Ashore* magazine.

ingredient in understanding and maintaining your equipment. Every system in the Navy has its own set of technical manuals that explain its operation in detail. The technical manuals for your equipment will include diagrams for various voltages and computer signals that are important to your system's operation. Most of these diagrams will give you enough information to follow the flow of these voltages and signals, only identifying circuit cards or assemblies that directly effect the operation of your system. They are not true schematics in that they do not identify every component in every assembly. In addition to technical manuals, each system will have some type of newsletter or bulletin published on a regular basis that gives you helpful information about your system. This newsletter may be published monthly, quarterly, or as funds allow for the publisher. It will contain technical articles and information to help you in trouble shooting and maintaining your gear. It is well worth your time to read the newsletter that applies to your equipment.

- Q4. What source should you contact first to obtain a copy of the *Ships' Safety Bulletin* that your work center does not have?
- Q5. Afloat safety advisories are published in what format?

INSTRUCTIONS

There are many instructions in the Navy, and to keep them all in your work center would be unrealistic. However, many instructions contain important information pertaining directly to your FC world, such as electronic safety and hazardous material control. When you come across this information, make a copy of it and keep it in a binder for reference in your work center. Remember to keep this binder current as you receive official changes to your instructions.

SUMMARY

This chapter has briefly discussed the various reports, logs, publications, and technical sources you will see in everyday life at your command. Some of these (such as the 3-M manual) are required reading for all FC's and some (i.e., local instructions) are only required at your specific command. It is your responsibility to find out what your local requirements are and to seek out the appropriate supporting instructions. Talk with your work center supervisor, leading petty officer, chief petty officer, and others in your chain of command to find out what your

administrative requirements will be. Although this part of your job may seem the least fulfilling, if you do it properly, you will have a good record of your equipment's operational and maintenance history that will help you get the parts you need for maintenance and repair. You will also be able to leave a good record trail for new personnel to follow. Do not overlook the importance of these administrative tasks for yourself and your fellow FC's.

ANSWERS TO CHAPTER QUESTIONS

- A1. *Your ship's local instructions.*
- A2. *Initial (CASREP), update (CASREP with a serial number change), correction (CASCOR), and cancellation (CASCAN).*
- A3. *Laminated tags are audited on a daily basis by the work center supervisor and on a weekly basis by the division officer.*
- A4. *Contact your ship's Safety Officer.*
- A5. *Afloat safety advisories are in message format and come on a floppy disk from the Naval Safety Center.*

CHAPTER 2

TECHNICAL ADMINISTRATION

LEARNING OBJECTIVES

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

1. Describe the Maintenance Data System and identify its associated forms.
2. Identify the primary technical manuals associated with the routine duties of the Fire Controlman

INTRODUCTION

“Technical administration” is a broad term that defines the methods used to document the completion of job tasks. Whether a task is part of equipment maintenance or repair, it is not fully completed until all documenting paperwork has been completed. You, as the technician, are responsible for ensuring that all paperwork is completed for each task you are assigned.

The technical administration for most of your job tasks is prescribed by the ship’s Maintenance and Material Management System (3-M) manual. The 3-M manual (OPNAVINST 4790.4 series) discusses this system in detail. Part of the Maintenance and Material Management System includes the Maintenance Data System (MDS). This chapter discusses MDS and some of the manuals in the technical library that are useful in completing Fire Controlman paperwork.

THE MAINTENANCE DATA SYSTEM

The Maintenance Data System (MDS) enables technicians and their supervisors to record maintenance actions in substantial detail. This provides a variety of retrievable reports concerning maintenance and the performance of the equipment. One of the major objectives of MDS is to provide the capability to report configuration changes. A configuration change is generally defined as “the addition, deletion, modification, or relocation of any piece of *installed* equipment aboard a ship.” From your viewpoint, the reason it is important for your command to report configuration changes is to ensure that you have the required parts support that you need to maintain and repair your equipment.

The usefulness of the MDS depends on the accuracy, thoroughness, and timeliness of the reported information. Programs for improving the reliability, maintainability, and logistic support of your equipment depend on how conscientiously you adhere to the reporting procedures.

This section briefly describes the major components of the MDS: MDS forms, the Current Ship’s Maintenance Project reports, and the Planned Maintenance System.

MAINTENANCE DATA SYSTEM FORMS

As a Fire Controlman, you may use several MDS forms each day. The *Ships’ Maintenance and Material Management (3-M) Manual*, OPNAVINST 4790.4, commonly referred to as the “3-M Manual,” provides in-depth information on how to complete these forms. For information on completing the supply forms associated with the MDS, refer to the appropriate supply manuals.

Ship’s Maintenance Action Form

The Ship’s Maintenance Action Form (OPNAV 4790/2K), shown in figure 2-1, is the primary MDS form. A multiple-copy form having six sections, the 4790/2K is used to report both deferred and completed maintenance actions (including previously deferred actions), and is commonly referred to as a “two-kilo”. Whenever you make an entry on this form, print the information in CAPITAL letters. Be sure your entries are legible and located within the tick marks. If you make an error, line it out with a single line and enter the correct information. Refer to your 3-M manual for specific guidance.

OPNAV 4790/2K (Rev. 6-76) S/N 0107-LF-047-9011												SHIP'S MAINTENANCE ACTION FORM (2-KILO)												COMP		DEFL			
SECTION I. IDENTIFICATION												JOB CONTROL NUMBER																	
1. SHIP'S UIC				2. WORK CENTER				3. JOB SEQ. NO.				4. APL/AEL																	
A. SHIP'S NAME						5. EQUIPMENT NOUN NAME						6. WND STA		7. CAB		8. DFR													
B. HULL NUMBER				13. IDENT./EQUIPMENT SERIAL NUMBER				14. EIC																					
15. SAFETY HAZARD <input type="checkbox"/>		16. LOCATION (Compartment/Deck/Frame/Side)								17. WHEN DISCOVERED DATE				YR.		DAY													
CONFIGURATION CHANGE												FOR INSURY USE																	
18. ALTERATIONS (SHIPALT, ORDALT, Fld. Chg, etc.)												19. */**		20. INSURV. NUMBER				21. SUFFIX		22. U		23. S		24. P/F					
SECTION II. DEFERRAL ACTION												25. S/F MHRS. EXP.		26. DEFER. DATE		27. S/F MHRS. REM.		28. DEADLINE DATE											
SECTION III. COMPLETED ACTION												29. ACT. TXN.		30. S/F MHRS.		31. COMPLETION DATE		32. ACT. MAINT. TIME		33. TI		34. METER READING							
SECTION IV. REMARKS / DESCRIPTION																													
35. REMARKS / DESCRIPTION																													
37. CSMP SUMMARY																										36. CONT. SHEET			
38. FIRST CONTACT / MAINT. MAN (Print)				39. RATE				40. SECOND CONTACT / SUPERVISOR (Print)				41. PRI		42. T/A		43. INTEGRATED PRIORITY													
C. DIV. INIT.		D. DEPT. INIT.		E. COMMANDING OFFICER'S SIGNATURE						F. TYCOM AUTHORIZATION						44. IUC		45. TYCOM											
46. SPECIAL PURPOSE		A.		B.		C.		D.		E.		F.		G.		H.		I.		J.		K.		L.					
SECTION V. SUPPLEMENTARY INFORMATION																													
47. BLUEPRINTS, TECH. MANUALS, PLANS, ETC.												AVAILABLE ON BOARD		48. PREARRIVAL / ARRIVAL CONFERENCE ACTION / REMARKS															
												YES																	
												NO																	
SECTION VI. REPAIR ACTIVITY PLANNING / ACTION																													
49. REPAIR W/C			50. EST. MHRS.			51. ASST. REPAIR W/C			52. ASST. EST. MHRS.			53. SCHED. START DATE			54. SCHED. COMP. DATE														
YR.			DAY			YR.			DAY			YR.			DAY														
55. REPAIR ACTIVITY UIC				54. WORK REQ. ROUTINE				57. EST. MANDAYS				58. EST. MANDAY COST \$				59. EST. MATERIAL COSTS \$													
60. EST. TOTAL COST \$				61. JOB ORDER NUMBER				62. LEAD P&E CODE				63. DATE OF EST.																	
YR.				YR.				YR.				YR.																	
64. FINAL ACT.		65. MHRS. EXPENDED		66. DATE COMPLETED		G. COMPLETED BY (Signature-Rate)						H. ACCEPTED BY (Signature-Rate/Rank)																	
YR.		YR.		DAY																									

FCf02001

Figure 2-1.—Ship's Maintenance Action Form (OPNAV 4790/2K).

Supplemental Form

The Supplemental Form (OPNAV 4790/2L), shown in figure 2-2, is used to provide amplifying information from drawings, listings, associated parts

placement, part labels, etc., for use by a repair activity. When you need to use an OPNAV 4790/2L with an OPNAV 4790/2K, enter the notation "2L USED" in block 35 of the OPNAV 4790/2K.

OPNAV 4790/2L (Rev by 73) S/N 0107-LF-77003060		SUPPLEMENTAL FORM (2-LIMA)		
SECTION I. IDENTIFICATION				
A. SHIPS NAME	B. HULL NUMBER	JOB CONTROL NUMBER		
		C. SHIPS UIC	D. WORK CENTER	E. JOB SEQ NO.
		F. CONTINUATION FOR <input type="checkbox"/> 2K <input type="checkbox"/> 2L <input type="checkbox"/> 2P		
SECTION II. REMARKS/SKETCHES				
G.				
SECTION III. AUTHENTICATION				
H. FIRST CONTACT/MAINTENANCE MAN (<i>Print</i>)	I. DATE YR DAY	J. SECOND CONTACT SUPERVISOR (<i>Print</i>)	K. DATE YR DAY	
FCf02002				

Figure 2-2.—Supplemental form (OPNAV 4790/2L).

Maintenance Planning & Estimating Form

The Maintenance Planning & Estimating Form (OPNAV 4790/2P) is used with an OPNAV 4790/2K that defers maintenance to be done by an intermediate maintenance activity (IMA) under the Intermediate

Maintenance Management System (IMMS). When the form is completed, it provides information required for detailed screening and planning. Figure 2-3 shows this form as it may appear when a repair activity has completed planning and scheduling for the maintenance requirement.

MAINTENANCE PLANNING & ESTIMATING FORM (P & E)

SECTION I - PLANNING

JOB CONTROL NUMBER	
A. SHIP'S NAME USS UNDERWAY	B. HULL NUMBER AS-48
1. SHIP'S UIC 20888	2. WORK CENTER EA05
3. JOB SEQ NO 2858	
4. PERIODIC MAINTENANCE REQUIREMENT	
5. PERIODICITY	6. YMM ISSUED
7. SPECIAL DATA	

<p>8. SCREENING ACTION</p> <p>IUC TVCOM</p> <p>a <input type="checkbox"/> h <input type="checkbox"/> DEPOT ACCOMPLISH</p> <p>b <input checked="" type="checkbox"/> i <input type="checkbox"/> IMA ACCOMPLISH</p> <p>c <input type="checkbox"/> j <input type="checkbox"/> TSU/NAVSEC/NOSSO/ETC.</p> <p>d <input type="checkbox"/> k <input type="checkbox"/> SHIP'S FORCE (IMA) (DEPOT) ASSIST</p> <p>e <input type="checkbox"/> l <input type="checkbox"/> SHIP TO SHOP</p> <p>f <input type="checkbox"/> m <input type="checkbox"/> ACCOMPLISH WITH MODIFICATIONS</p> <p>g <input type="checkbox"/> n <input type="checkbox"/> DISAPPROVE</p>	<p>9. QUALITY ASSURANCE REQUIREMENT</p> <p>a <input type="checkbox"/> SUBSAFE</p> <p>b <input type="checkbox"/> LEVEL 1</p> <p>c <input type="checkbox"/> NUCLEAR LEVEL 1</p> <p>d <input type="checkbox"/> NON-DESTRUCTIVE TEST</p> <p>e <input type="checkbox"/> NUCLEAR WORK PROCEDURES</p> <p>f <input type="checkbox"/> SUBMARINE ANTENNA ENGINEERING DIVISION</p> <p>g <input checked="" type="checkbox"/> SPECIAL CLEANING</p> <p>h <input checked="" type="checkbox"/> SPECIAL TESTING</p> <p>i <input type="checkbox"/> SPECIAL IDENTIFICATION</p> <p>j <input type="checkbox"/> NOISE CONTROL</p> <p>k <input type="checkbox"/> RADIOLOGICAL CONTROL</p> <p>l <input checked="" type="checkbox"/> OTHER CONTROLS HAZMAT</p>	<p>10. SPECIAL REQUIREMENTS</p> <p>a <input type="checkbox"/> <input type="checkbox"/> KEY EVENT</p> <p>b <input type="checkbox"/> SPECIAL INTEREST</p> <p>c <input type="checkbox"/> DRY DOCK REQUIRED</p> <p>d <input type="checkbox"/> PRE OVERHAUL TEST REQUIRED</p> <p>e <input type="checkbox"/> POST OVERHAUL TEST REQUIRED</p> <p>f <input checked="" type="checkbox"/> DEPARTURE TEST REQUIRED</p>
---	--	---

C. IUC SIGNATURE <i>WIEAOSJ</i>	D. TVCOM SIGNATURE	11. NORMALLY DONE BY a <input type="checkbox"/> S/F b <input checked="" type="checkbox"/> IMA c <input type="checkbox"/> DEPOT
------------------------------------	--------------------	---

SECTION II - SCHEDULING

12. LEAD WORK CENTER 25A	13. SCHED START DATE YR DA 4053	14. SCHED COMP DATE YR DA 4068	15. EST MHRS 0083	16. KEY OP 02	17. TASK EVAC & RECHG
18. ASST WORK CENTER 03T	19. SCHED START DATE YR DA 4054	20. SCHED COMP DATE YR DA 4067	21. EST MHRS 0004	22. KEY OP 03	23. TASK UNSHIP & CLAD
24. ASST WORK CENTER 03A	26. SCHED START DATE YR DA 4051	26. SCHED COMP DATE YR DA 4069	27. EST MHRS 0049	28. KEY OP 01	29. TASK MONITOR FREON
30. ASST WORK CENTER 26A	31. SCHED START DATE YR DA 4056	32. SCHED COMP DATE YR DA 4057	33. EST MHRS 0006	34. KEY OP 04	35. TASK BRAZE/WELD
36. ASST WORK CENTER 51A	37. SCHED START DATE YR DA 4053	38. SCHED COMP DATE YR DA 4058	39. EST MHRS 0021	40. KEY OP 05	41. TASK REWIND & BAKE
42. ASST WORK CENTER	43. SCHED START DATE YR DA	44. SCHED COMP DATE YR DA	45. EST MHRS	46. KEY OP	47. TASK

SECTION III - TECHNICAL DOCUMENTATION

48. NAVSHIPS TECH MAN 351-0665	ON BOARD YES NO X

SECTION IV - IUC/REPAIR ACTIVITY/TYCOM REMARKS

49. COMPRESSOR MOTOR SHORTS

SECTION V - SUPPLEMENTAL PLANNING

50. EST MANDAYS	51. EST MANDAYS COST \$	52. EST MATERIAL COST \$	53. EST TOTAL COST \$	54.
-----------------	-------------------------	--------------------------	-----------------------	-----

Figure 2-3.—Maintenance Planning & Estimating Form (OPNAV 4790/2P).

Ship's Configuration Change Form

The Ship's Configuration Change Form (OPNAV 4790/CK), shown in figure 2-4, is used to report configuration changes at the individual equipment level. (The associated maintenance action on an

OPNAV 4790/CK does not need to be documented on an OPNAV 4790/2K.) This form is used to report the completion of (1) a previously deferred maintenance action that results in a configuration change, and (2) a maintenance action (with no prior deferral) that results in a configuration change.

SHIP'S CONFIGURATION CHANGE FORM OPNAV 4790/CK (5-84) (REV 5-84) S/N 0107 LF 047-9010										CONFIG FILE CORR	COMP M/A NO DEFL	COMP DEFL	
SECTION I - JOB IDENTIFICATION													
JOB CONTROL NUMBER						ALTERATION IDENTIFICATION							
1. SHIP'S UIC		2. WORK CENTER		3. JOB SEQ. NR		4. ALTERATIONS (SHIP ALT, FLD, CHG., ETC)							
A. SHIP'S NAME				B. HULL NUMBER				5. EIC		6. ACT Tm			
7. EQUIPMENT NOUN NAME						8. S/F MHRS. EXP		9. ACT MAINT TIME	10. COMP DATE				
SECTION II - JOB DESCRIPTION/REMARKS													
12. JOB DESCRIPTION /REMARKS													
SECTION III - COMPONENT CONFIGURATION CHANGE IDENTIFICATION													
11. COMPONENT NOUN NAME										14. QUANTITY		16. CA	
16. COMPONENT IDENTIFICATION						12. COMPONENT SERIAL NUMBER							
18. COMPONENT APLAEL				19. LOCATION (DECK FRAME/SIDE)				20. EIC					
21. NEXT HIGHER ASSEMBLY						22. SAC		23. WORK CENTER					
24. NAME PLATE DATA													
25. MIF						26. EOSS							
27. TM													
SECTION IV - SPECIAL PURPOSE													
28. RIN				29. AILSIN				30. SECAS OFFICE USE					
- INSTRUCTIONS -													
ITEM NUMBER	SECTION I & II DESCRIPTION	SECTION I & II			LEGEND								
		PAGE 1	CONT	PAGE									
1-3	JOB CONTROL NUMBER	M		M	SECTION I BLOCK 8 ACTION TAKEN 5A - PARTIALLY COMPLETED ALTERATION 5B - FULLY COMPLETED ALTERATION 5C - FULLY COMPLETED EQUIVALENT TO ALTERATIONS 5D - ALTERATION DIRECTIVE NOT APPLICABLE 1 - MAINTENANCE ACTION COMPLETED PARTS DRAWN FOR SUPPLY 2 - MAINTENANCE ACTION COMPLETED, REQUIRED PARTS NOT DRAWN FROM SUPPLY (LOCAL MANUFACTURE PRE-EXPENDED BINS) 3 - MAINTENANCE ACTION COMPLETED, NO PARTS REQUIRED SECTION I BLOCK 16 COMPONENT ACTION MAINTENANCE ACTIONS R - REMOVED EQUIPMENT I - INSTALLED EQUIPMENT M - MODIFIED EQUIPMENT CONFIG FILE CORR NO MAINTENANCE ACTION A - ADDITION OF RECORD D - DELETION OF RECORD C - CORRECT/CHANGE EXISTING RECORD								
4	ALTERATION IDENTIFICATION	IP		IP									
5	EQUIPMENT IDENTIFICATION CODE	M		NR									
6	ACTION TAKEN	M		NR									
7	EQUIPMENT NOUN NAME	M		NR									
8	SHIP'S FORCE MANHOURS EXPENDED	M		NR									
9	ACTIVE MAINTENANCE TIME	M		NR									
10	COMPLETION DATE	M		NR									
11	METER READING	IP		NR									
12	JOB DESCRIPTION (REMARKS)	O		NR									
ITEM NUMBER	SECTION III DESCRIPTION	REMOVE (R/D)	INSTALL (I/A)	MODIFY (M/C)									
13	COMPONENT NOUN NAME	M	M	M									
14	QUANTITY	M	M	M									
15	COMPONENT ACTION	M	M	M									
16	COMPONENT IDENTIFICATION	IP	IP	IP									
17	COMPONENT SERIAL NUMBER	IA	IA	IA									
18	COMPONENT APLAEL	M	IA	IA									
19	LOCATION	M	M	M									
20	EQUIPMENT IDENTIFICATION CODE	NR	IA	NR									
21	NEXT HIGHER ASSEMBLY	IP	IP	IP									
22	SERVICE APPLICATION CODE	IA	IA	IA									
23	WORK CENTER	NR	M	NR									
24	NAME PLATE DATA	NR	M	NR									
25	MAINTENANCE INDEX PAGE	IA	IA	IA									
26	EOSS	IP	IP	IP									
27	TECH MANUAL NUMBER	IA	IA	IA									
WORK CENTER SUPERVISOR		DIVISION OFF		SUPPLY DEPT		3M COORDINATOR		SHIP SEQUENCE NUMBER		PAGE _____ OF _____			

FC02004

Figure 2-4.—Ship's Configuration Change Form (OPNAV 4790/CK).

**Ship's Configuration Change Form
Continuation Page**

The Ship's Configuration Change Form Continuation Page (OPNAV 4790/CK(C)), shown in figure 2-5, is simply a continuation page for the OPNAV 4790/CK. The *COSAL Use and Maintenance Manual*, SPCCINST 4441.170, in addition to

OPNAVINST 4790.4, provides block-by-block instructions for completing these forms.

**CURRENT SHIP'S MAINTENANCE
PROJECT SYSTEM**

The Current Ship's Maintenance Project (CSMP) System provides the command and the work center

SHIP'S CONFIGURATION CHANGE FORM CONTINUATION PAGE										OPNAV 4790/CK(C)	
(REV 5-84) S/N 0107 LF 047-9010											
JOB CONTROL NUMBER		ALTERATION IDENTIFICATION		SAME AS P1-S111 EXCEPT		PAGE		OF			
1. SHIP'S UIC	2. WORK CENTER	3. JOB SEQ NO	4. ALTERATIONS (SHIP ALT., FLD., CHG., ETC.)							14. QUANTITY	15. CA
11. COMPONENT NOUN NAME											
16. COMPONENT IDENTIFICATION					12. COMPONENT SERIAL NUMBER						
18. COMPONENT APLJLAE				19. LOCATION (DECK FRAME/SIDE)				20. EIC			
21. NEXT HIGHER ASSEMBLY						22. SAC		23. WORK CENTER			
24. NAME PLATE DATA											
25. MIF						26. EOSS					
27. TM											
28. RIN			29. AILSIN			30. SECAS OFFICE USE					
JOB CONTROL NUMBER		ALTERATION IDENTIFICATION		SAME AS P1-S111 EXCEPT		PAGE		OF			
1. SHIP'S UIC	2. WORK CENTER	3. JOB SEQ NO	4. ALTERATIONS (SHIP ALT., FLD., CHG., ETC.)							14. QUANTITY	15. CA
11. COMPONENT NOUN NAME											
16. COMPONENT IDENTIFICATION					12. COMPONENT SERIAL NUMBER						
18. COMPONENT APLJLAE				19. LOCATION (DECK FRAME/SIDE)				20. EIC			
21. NEXT HIGHER ASSEMBLY						22. SAC		23. WORK CENTER			
24. NAME PLATE DATA											
25. MIF						26. EOSS					
27. TM											
28. RIN			29. AILSIN			30. SECAS OFFICE USE					
JOB CONTROL NUMBER		ALTERATION IDENTIFICATION		SAME AS P1-S111 EXCEPT		PAGE		OF			
1. SHIP'S UIC	2. WORK CENTER	3. JOB SEQ NO	4. ALTERATIONS (SHIP ALT., FLD., CHG., ETC.)							14. QUANTITY	15. CA
11. COMPONENT NOUN NAME											
16. COMPONENT IDENTIFICATION					12. COMPONENT SERIAL NUMBER						
18. COMPONENT APLJLAE				19. LOCATION (DECK FRAME/SIDE)				20. EIC			
21. NEXT HIGHER ASSEMBLY						22. SAC		23. WORK CENTER			
24. NAME PLATE DATA											
25. MIF						26. EOSS					
27. TM											
28. RIN			29. AILSIN			30. SECAS OFFICE USE					
JOB CONTROL NUMBER		ALTERATION IDENTIFICATION		SAME AS P1-S111 EXCEPT		PAGE		OF			
1. SHIP'S UIC	2. WORK CENTER	3. JOB SEQ NO	4. ALTERATIONS (SHIP ALT., FLD., CHG., ETC.)							14. QUANTITY	15. CA
11. COMPONENT NOUN NAME											
16. COMPONENT IDENTIFICATION					12. COMPONENT SERIAL NUMBER						
18. COMPONENT APLJLAE				19. LOCATION (DECK FRAME/SIDE)				20. EIC			
21. NEXT HIGHER ASSEMBLY						22. SAC		23. WORK CENTER			
24. NAME PLATE DATA											
25. MIF						26. EOSS					
27. TM											
28. RIN			29. AILSIN			30. SECAS OFFICE USE					

FCf02005

Figure 2-5.—Ship's Configuration Change form Continuation page (OPNAV 4790/CK(C)).

with the administrative management data they need to systematically repair or alter the ship's hull, installed equipment, or material. It identifies the backlog of deferred maintenance for each work center on computer printouts generated by the ship's MDS. Your ship's 3-M Coordinator will deliver a CSMP report to each work center on a regular basis. You, or someone in your work center, will be required to verify that your work center's CSMP is accurate and to update it if it isn't.

The MDS provides the means for gathering the information used in the CSMP. The success or failure of the CSMP system depends entirely on how accurate the information is and how supervisors and technicians use that information.

PLANNED MAINTENANCE SYSTEM

The Planned Maintenance System (PMS) provides each command with a simple, standard means for planning, scheduling, controlling, and performing planned equipment maintenance. PMS actions are the minimum actions necessary to maintain equipment in a fully operational condition.

In the following paragraphs, we describe the primary forms used in the PMS. These forms are available through the Naval Supply System.

Maintenance Requirement Card

Maintenance procedures are contained on a Maintenance Requirement Card (OPNAV 4790), shown in figure 2-6. Every preventive maintenance action has an associated MRC that describes, in detail, "who (rate)" should do "what," "when," "how," and "with what resources" for the maintenance requirement.

Equipment Guide List

A maintenance requirement card may have an associated Equipment Guide List (OPNAV 4790/81), shown in figure 2-7, that identifies the location of all identical equipment covered by the MRC. Guide lists are filled out by technicians, since they know where their equipment is located. The Maintenance Requirement Card may also have an associated Tag Guide List (OPNAV 4790/107) that describes what equipment must be tagged out while the maintenance is being performed (see your 3-M manual for a sample).

Maintenance Index Page

A Maintenance Index Page (OPNAV 4790/85) contains a brief description of the maintenance requirements on all the maintenance requirement cards for each item of equipment. Included are the periodicity codes, the man-hours involved, the minimum required skill level, and, if applicable, the related maintenance requirements.

List of Effective Pages

The List of Effective Pages (Report No. PMS 5) provides a listing of all Maintenance Index Pages assigned to your work center. It includes a report date, a force revision number, your type commander (TYCOM), ship's hull number and unit identification code, your work center, maintenance index page numbers, and a brief description of equipment for each maintenance index page listed.

Weekly PMS Schedule

A Weekly PMS Schedule (OPNAV 4790/15) is a visual display posted in each work center's working area that shows who has been assigned to perform required maintenance on specific components or equipment.

Quarterly PMS Schedule

A Quarterly PMS Schedule (OPNAV 4790/14) is a visual display that shows a quarter's worth of specific maintenance requirements, divided into weeks.

Planned Maintenance System Feedback Report

The Planned Maintenance System Feedback Report (OPNAV 4790/7B), shown in figure 2-8, provides the command with an easy method for recommending changes to maintenance requirement cards, ordering replacements for cards that have been lost or mutilated, and notifying the system's command of any discrepancies in coverage.

This form has an original and four copies. Instructions for preparing and submitting it are printed on the back of the form. See figure 2-9.

SHIP SYSTEM Miscellaneous Shipboard Electrical Equip and Installed Receptacles 3000		SUBSYSTEM Miscellaneous Shipboard Electrical Equip and Installed Receptacles 3000		MRC CODE 3000 M-4/ Q-2R	
SYSTEM Miscellaneous Shipboard Electrical Equip and Installed Receptacles 3000		EQUIPMENT Miscellaneous Shipboard Electrical Equip and Installed Receptacles 300XY		RATES EM2 EMFN	M/H 0.1 0.1
MAINTENANCE REQUIREMENT DESCRIPTION 1. Inspect portable electrical tool/device equipped with two-prong plug. 2. Measure insulation resistance.				TOTAL M/H 0.2 ELAPSED TIME 0.1	
SAFETY PRECAUTIONS 1. Forces afloat comply with Navy Safety Precautions for Forces Afloat, OPNAVINST 5100 series 2. Ensure all tag-out procedures are in accordance with current shipboard instruction. 3. Tool test set (SCAT 4547) can produce voltages dangerous to life. Wear rubber gloves.					
TOOLS, PARTS, MATERIALS, TEST EQUIPMENT					
TEST EQUIPMENT			MISCELLANEOUS		
1. (0399) Electrical tool testers, SCAT-4547, 07239-235000 2. (0883) Megger, 500V, 100MOhm, SCAT-4452 3. (0901) Multimeter, AC/DC, SCAT-4245			1. (0526) Gloves, electrical workers, 7500 volt maximum safeuse, size 9, rubber		
MATERIALS 1. (0098) Pen, ball-point 2. (1144) Tag, safety 3. (1857) Tag, safety check 4. (2277) Pad, writing paper					
NOTE: Numbers in brackets can be referenced to Standard PMS Materials Identification Guide (SPMIG) for stock number identification.					
PROCEDURE NOTE 1: For equipment issued on permanent or semi-permanent loan to work centers, accomplish monthly, all others accomplish quarterly or before each issue. For repair locker equipment, accomplish quarterly or after each use, whichever occurs first.					
DISTRIBUTION STATEMENT D Distribution authorized to DOD components and DOD contractors only; critical technology; February 1994. Other requests for this document shall be referred to Naval Sea Systems Command (SEA 04TD). Destroy any method that will prevent disclosure of contents or reconstruction of the document.					
LOCATION Equipment Guide List Recommended				DATE February 1994	
					PAGE 1 OF 3
					24
					4ABG
					N

MAINTENANCE REQUIREMENT CARD (MRC)
OPNAV 4790 (REV. 2-82)

FC02006

Figure 2-6.—Maintenance Requirement Card (OPNAV 4790).

EQUIPMENT GUIDE LIST OPNAV 4790/81 (2-76) S/N 0107- LF- 047- 9405				PAGE OF <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr></table>									
MIP NO. (Less last 2 characters) _____			MRC PERIODCITY _____										
EQUIPMENT NAME NOMENCLATURE	SERIAL NO. QUANTITY	LOCATION	APPLICABLE DATA AS REQUIRED BY MRC										
						FCf02007							

Figure 2-7.—Equipment Guide List (OPNAV 4790/81).

SHIP’S NON-TACTICAL AUTOMATED DATA PROCESSING PROGRAM (SNAP)

The Ship’s Non-tactical Automated Data Processing Program (SNAP) system is used to process and track maintenance actions for your ship. SNAP is a computer-based system that includes the previously mentioned MDS forms in its data banks. Instead of filling out a hard copy form, you can access the SNAP computer and do the same thing on a computer screen. Consult your chain of command to find out what version of computer software your ship uses and what training is available to you.

- Q1. What is a configuration change?*
- Q2. What manual discusses the MDS in detail?*
- Q3. What is the primary MDS form?*
- Q4. What basic information is contained in a maintenance requirement card?*

THE TECHNICAL LIBRARY

To do your job properly, you must know how to use technical manuals effectively and efficiently. In addition to the technical manuals for your equipment, dozens of other technical manuals are available to help you do your job. Many of these technical manuals are now produced on compact discs (CDs) as well as in

hard copy (printed) format. Some of these manuals are even accessible on the Internet. Check with your supply department and chain of command to see what format is available for your ship.

This section briefly describes some of the various manuals and publications that you should expect to find in your ship’s technical library.

PUBLICATION APPLICABILITY LISTING

The *Publication Applicability Listing* (PAL) (a publication that is unique to each ship) lists technical manuals, operating instruction charts, performance standards sheets, maintenance standards books, and technical manual changes for operating and maintaining onboard systems and equipment under the technical cognizance of the Commander, Naval Sea Systems Command (COMNAVSEASYSCOM).

The PAL is produced from the Ships’ Technical Publications System, NAVSEASYSCOM’s technical manual information system, and is maintained by the Naval Ship’s Data Support System (NSDSS), Port Hueneme, California. Although the PAL provides assistance in determining the publication needs of a ship or shore station, it does not specify required publications.

SEE INSTRUCTIONS ON BACK OF GREEN PAGE

FROM (SHIP NAME AND HULL NUMBER) USS NEVERWAS FFG 999	SERIAL # 1074 - 94
	DATE 09 MAR 94

TO

NAVAL SEA SUPPORT CENTER PACIFIC (Category A)

TYPE COMMANDER (Category B)

SUBJECT: PLANNED MAINTENANCE SYSTEM FEEDBACK REPORT

SYSTEM, SUB-SYSTEM, OR COMPONENT SONAR RECEIVING SET	APL/CID/AN NO./MK. MOD AN/SQR - 18A (V)1
SYSCOM MIP CONTROL NUMBER 4621/23 - 23	SYSCOM MRC CONTROL NUMBER VARIOUS

DESCRIPTION OF PROBLEM

CATEGORY A	CATEGORY B
<input checked="" type="checkbox"/> MIP/MRC REPLACEMENT	<input type="checkbox"/> TECHNICAL <input type="checkbox"/> TYCOM ASSISTANCE <input type="checkbox"/> OTHER (Specify)

REMARKS

REQUEST TWO COPIES EACH OF FOLLOWING CLASSIFIED MRCs:

72 EZV9 N

12 EZV0 N

20 EZW5 N

TOTAL OF 6 MRCs REQUESTED. ADEQUATE SECURE STORAGE PER OPNAVINST 5110.1H IS AVAILABLE.

ORIGINATOR & WORK CENTER CODE ET (SW) Frost EE01	DIV. OFFICER LT A. B. Smith
DEPT. HEAD I. M. Daboss, CDR, USN	3-M COORDINATOR GMC (SW) J. R. DOE

Originator do not write below. For TYCOM use only.

TYCOM <input type="checkbox"/> CONCUR	<input type="checkbox"/> DO NOT CONCUR	<input type="checkbox"/> TAKES ACTION	PASSES FOR ACTION
TYCOM REP SIGNATURE			DATE

Figure 2-8.—Planned Maintenance System Feedback Report (OPNAV 4790/7B).

1. ORIGINATOR

- a. Typewritten copies are preferred, however, handprinted copies are acceptable. Use ballpoint pen and ensure all copies are legible.
- b. EQUIPMENT IDENTIFICATION: Fill in titled blocks that apply. Gives as much information that can be determined. Ensure that correct APL number is used for hull, mechanical or electrical equipment or electronic/weapons equipment which does not have an Army-Navy number or mark/mod designation.
- c. DESCRIPTION OF PROBLEM: Check the appropriate box.

Category A

- (1) MIP/MRC REPLACEMENT: Ensure that PMS documentation request is current in accordance with latest SFR. For missing MIPs/MRCs, give SYSCOM control numbers when they can be determined. If SYSCOM control numbers cannot be determined, provide as much nameplate data as can be obtained. When ordering a variety of missing/worn MIPs/MRCs, the subject section shall be left blank.

Category B

(2) TECHNICAL:

- (a) Identify specific discrepancy discovered in PMS by MRC control number, step number, etc.
- (b) For publication discrepancies identify publication by number, volume, revision date/number, change number, page, paragraph and/or figure as appropriate.

THIS FORM WILL NOT BE USED TO ORDER PUBLICATIONS.

- (3) TYCOM ASSISTANCE: Includes clarification of 3-M instructions and other matters related to PMS administration.
 - (4) OTHER: Identify in detail any problem not covered by (1) through (3) above. Shifts of maintenance responsibility will be reported under this item. Ensure that all work centers involved in the change are identified by work center code. Approval by the Executive Officer will be shown in the "Remarks".
- d. REMARKS: Provide brief, but complete, description of problem or requirements. Executive Officer indicate approval of maintenance responsibility shift by endorsement. Use additional forms if more space is required. Mark addition forms, "page 2 of 2", "page 2 of 3", etc. Staple additional forms behind basic form.
 - e. ORIGINATOR IDENTIFICATION: Sign and insert work center code in appropriate space.

2. DIVISION OFFICER: Review for accuracy and completeness and sign in the space provided.

3. DEPARTMENT HEAD: Review for accuracy and completeness and sign in the space provided.

4. 3-M COORDINATOR:

- a. Serialize, date and sign in the appropriate space.
- b. ROUTING INSTRUCTIONS: For Category "A" FBRs, forward the white and yellow copies to the appropriate NAVSEACEN and the pink copy to the TYCOM. For Category "B" FBRs, forward the white, yellow and pink copies to the TYCOM. Retain blue copy in suspense file. Return green copy to the originator.

Figure 2-9.—Instructions for completing OPNAV 4790/7B.

The PAL consists of four separately bound volumes, each having two parts. Volume 1 lists only general and ship-applicable publications that do not relate to equipment or systems. It does not include any of the publications that appear in volumes 2, 3, and 4.

- Volume 1—*General Publications*
 - Part 1—Electronics, Hull, Maintenance & Electrical (HM&E), and Miscellaneous
 - Part 2—Weapons
- Volume 2—*Electronics*
 - Part 1—Equipment sequence
 - Part 2—Publication sequence
- Volume 3—*HM&E*
 - Part 1—Equipment sequence
 - Part 2—Publication sequence
- Volume 4—*Weapons*
 - Part 1—Equipment sequence
 - Part 2—Publication sequence

NAVAL SHIPS' TECHNICAL MANUAL

The *Naval Ships' Technical Manual* (NSTM) is a set of books (called chapters) that contain general information on a variety of topics. You can find a complete listing of the NSTM chapters in chapter 001, *General NSTM Publications Index and User Guide*, NAVSEA S9086-AA-STM-010.

The chapters listed in the following paragraphs are related to your job as a Fire Controlman, both as a technician and as a member of a ship or station organization.

- **NSTM Chapter 079—*Damage Control-Practical Damage Control*, NAVSEA S9086-CN-STM-020.** Provides broad guidance for establishing a damage control organization. It is designed to help organizations plan before damage occurs, spend a minimal amount of time localizing damage that does occur, and make emergency repairs or restoration as quickly as possible after damage occurs.
- **NSTM Chapter 300—*Electric Plan-General*, NAVSEA S9086-KC-STM-010.** Provides information and instructions on electrical equipment, electrical safety precautions,

electrical insulation and insulation resistance, and maintenance reconditioning of electrical equipment. It also provides the requirements that Fire Controlmen must meet in a shipboard safety program, including the use and maintenance of both organizational and personal electrical and electronic equipment.

- **NSTM Chapter 400—*Electronics*, NAVSEA S9086-ND-STM-000.** Provides major policies and instructions pertaining to the maintenance of electronic equipment and safety information on board both active and reserve ships.
- **NSTM Chapter 631—*Preservation of Ships in Service-Surface Preparation and Painting*, NAVSEA S9086-VD-STM-020.** Provides instructions, requirements, and information for the prevention of corrosion of ships, boats, and small craft. Its topics include surface preparation, painting, and application of other preventive measures.
- **NSTM Chapter 634—*Deck Coverings*, NAVSEA S9086-VG-STM-010.** Provides information concerning materials, installation procedures, maintenance and repair of deck coverings, gratings, sealing methods, and caulking compounds used for sealing deck seams.

ELECTRONICS INSTALLATION AND MAINTENANCE BOOK

The *Electronics Installation and Maintenance Book* (EIMB) contains, in one convenient source, safety information, maintenance policies and philosophies, installation standards and practices, and overall electronic equipment and materials-handling procedures required by Chapter 400 of the *Naval Ships' Technical Manual*.

The EIMB, a 13-volume series of individual books, is an excellent source of basic information that can be used as a training tool for your work center. If space is available, you will benefit from having a complete set for your technical library. These books are periodically updated by incorporating the Engineering Information Bulletin (EIB) articles. EIMB/EIB's are also available on compact disc. Check with your supply department for details on ordering the latest compact disc version.

COMBAT SYSTEM OPERATIONAL SEQUENCING SYSTEM (CSOSS)

The Combat System Operational Sequencing System (CSOSS) is a collection of manuals specifically designed for each class of ship. The manuals include step-by-step procedures and supporting material for combat system personnel to use in supporting the operation and maintenance of combat system equipment. Combat system readiness fundamentals are provided in the Combat System Technical Operations Manual (CSTOM). The CSOSS and CSTOM manuals cover a wide spectrum of readiness fundamentals for each class of ship. Joint instruction COMNAVSURFLANTINST 4790.20/COMNAVSURFPACINST 4790.9 (series) provides directions to commanding officers for use of CSOSS. CSOSS is a readiness tool that provides the means to manage combat systems readiness around-the-clock, at-sea and in-port, in peacetime and in wartime.

Consult your specific CSOSS User's Guide for detailed instructions and explanations concerning the requirements of your ship class and related equipment. Your ship's Combat Systems Officer of the Watch (CSOOW) and chain-of-command will help you find specific information about these manuals and CSOSS instructions.

OTHER PUBLICATIONS

Many other useful publications are available throughout the fleet. However, because of their vast number, we can describe only a few of them. You can identify many of these additional publications by checking the bibliographies of your primary publications.

Electromagnetic Radiation Hazards

Electromagnetic Radiation Hazards, NAVSEA OP 3565, is a two-volume manual that prescribes operating procedures and precautions to prevent injury to personnel, ignition of volatile vapors, and premature initiation of electroexplosive devices in ordnance in electromagnetic environments.

Volume I is *Hazards to Personnel, Fuel, and Other Flammable Material*. Volume II is divided into two parts: Part I-*Hazards to Unclassified Ordnance Systems*, and Part II-*Hazards to Classified Ordnance Systems*. Volume I and Volume II, Part I are unclassified. All classified data is contained in Volume II, Part II.

Procedures for Conducting a Shipboard Electromagnetic Interference Survey (Surface Ships)

The *Procedures for Conducting a Shipboard Electromagnetic Interference (EMI) Survey (Surface Ships)*, MILSTD 1605 (SHIPS), provides detailed procedures for conducting an electromagnetic interference survey aboard surface ships.

Navy Electricity and Electronics Training Series

The *Navy Electricity and Electronics Training Series* (NEETS) is a multi-modular set of manuals that contain a vast amount of information. The current modules are shown in table 2-1. The NEETS modules are high-quality training aids and are excellent review publications on basic electronics for all Fire Controlmen. ALL Fire Controlmen should be thoroughly familiar with the NEETS modules.

Equipment Identification Code Master Index

The *Equipment Identification Code Master Index*, NAMSO 4790.E2579, provides a listing of equipment identification codes (EICs) in two sections. Section I lists EIC numbers in numerical sequence and identifies the equipment nomenclature assigned to each EIC number. Section II lists nomenclature in alphanumeric sequence and identifies the EIC numbers assigned to the equipment.

Guide for User Maintenance of NAVSEA Technical Manuals

The *Guide for User Maintenance of NAVSEA Technical Manuals*, NAVSEA S0005-AA-GYD- 030, is an important part of the technical library, because keeping the technical manuals aboard your ship up to date is essential to the operational readiness of your command's systems and equipment.

Electrostatic Discharge Control Handbook for Protection of Electrical and Electronic Parts, Assemblies, and Equipment

The *Electrostatic Discharge Control Handbook for Protection of Electrical and Electronic Parts, Assemblies, and Equipment (Excluding Electrically Initiated Explosive Devices)* (Metric), MIL-HDBK 263, provides guidance, not requirements, for establishing and implementing an electrostatic

Table 2-1.—NEETS Modules

MODULE	TITLE OF MODULE	NAVEDTRA NUMBER
1	<i>Introduction to Matter, Energy, and Direct Current</i>	B72-01-00-92
2	<i>Introduction to Alternating Current and Transformers</i>	172-02-00-91
3	<i>Introduction to Circuit Protection, Control, and Measurement</i>	B72-03-00-93
4	<i>Introduction to Electrical Conductors, Wiring Techniques, and Schematic Reading</i>	B72-04-00-92
5	<i>Introduction to Generators and Motors</i>	B72-05-00-94
6	<i>Introduction to Electronic Emission, Tubes, and Power Supplies</i>	B72-06-00-92
7	<i>Introduction to Solid-State Devices and Power Supplies</i>	B72-07-00-92
8	<i>Introduction to Amplifiers</i>	172-08-00-82
9	<i>Introduction to Wave-Generation and Wave-Shaping Circuits</i>	172-09-00-83
10	<i>Introduction to Wave Propagation, Transmission Lines, and Antennas</i>	B72-10-00-93
11	<i>Microwave Principles</i>	172-11-00-87
12	<i>Modulation Principles</i>	172-12-00-83
13	<i>Introduction to Number Systems and Logic Circuits</i>	B72-13-00-94
14	<i>Introduction to Microelectronics</i>	172-14-00-84
15	<i>Principles of Synchros, Servos, and Gyros</i>	B72-15-00-93
16	<i>Introduction to Test Equipment</i>	B72-16-00-95
17	<i>Radio-Frequency Communications Principles</i>	172-17-00-84
18	<i>Radar Principles</i>	172-18-00-84
19	<i>The Technician's Handbook</i>	B72-19-00-92
20	<i>Master Glossary and Index</i>	172-20-00-85
21	<i>Test Methods and practices</i>	B72-21-00-87
22	<i>Introduction to Digital Computers</i>	B72-22-00-88
23	<i>Magnetic Recording</i>	B72-23-00-91
24	<i>Introduction to Fiber Optics</i>	B72-24-00-92

discharge (ESD) control program. This follows the requirements of *Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment (Excluding Electrically Initiated Explosive Devices (Metric)*,

MIL-STD-1686. While this publication does not provide information on protecting electrically initiated explosive devices, it does apply to protecting electrical and electronic parts, assemblies, and equipment from damage due to ESD.

- Q5. *What is the Publication Applicability Listing (PAL)?*
- Q6. *What joint instruction gives guidance for use of the CSOSS?*
- Q7. *Which section of the Equipment Identification Code Master Index, NAMS0 4790.E2579, lists EIC numbers in numerical sequence and identifies the equipment nonmenclature assigned to each EIC number?*

SUMMARY

The Maintenance Data System (MDS) and its many components are an extremely important tool in tracking your equipment's performance. The accurate and timely reporting of deferred maintenance or configuration changes will result in better parts support and equipment readiness. The Planned Maintenance System (PMS) works with the MDS to ensure that your equipment is fully operational. The MDS forms are processed and maintenance actions tracked through the Ship's Non-tactical Automated Data Processing program (SNAP). This computer-based system enables ship's personnel to order parts or fill out MDS forms on a computer screen. Check with your command to find out what version you are using and where you can get training for SNAP.

Your ship's technical library is an important resource for you as an FC. Many technical publications are no longer distributed in a printed format but are distributed on compact disks. Check with your supply department and chain of command to find out how to order these publications, whether in a paper or compact disk format.

One of the more important resources to become familiar with as an FC is the Combat System Operational Sequencing System (CSOSS). Each class

of ship has its own collection of manuals specifically configured to the CSOSS. You need to become familiar with your command's CSOSS publications and the training offered for your CSOSS program.

The *Navy Electricity and Electronics Training Series (NEETS)* is still an excellent resource for reviewing your basic electronics. It is being updated to a compact disk format and is also available on an Internet web site. There are many other good technical resources for FC's that are not mentioned here. Make it a habit to look for other resources that can help you perform your job better.

ANSWERS TO CHAPTER QUESTIONS

- A1. *An addition, deletion, modification, or relocation of any piece of **installed** equipment aboard a ship."*
- A2. *The 3-M manual (OPNAVINST 4790.4 series).*
- A3. *The Ship's Maintenance Action Form (OPNAV 4790/2K).*
- A4. *"Who (rate)" should do "what," "when," "how," and "with what resources" for the maintenance requirement.*
- A5. *A publication, unique to each ship, that lists technical manuals, operating instruction charts, performance standards sheets, maintenance standards books, and technical manual changes for operating and maintaining onboard systems and equipment under the technical cognizance of the Commander, Naval Sea Systems Command (COMNAVSEASYSKOM).*
- A6. *COMNAVSURFLAMTINST 4790.20/
COMNAVSURFPACINST 4790.9.*
- A7. *Section I.*

CHAPTER 3

ELECTRONICS SAFETY

LEARNING OBJECTIVES

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

1. Describe electric shock and its effects on the human body.
2. Describe the procedures to follow for measuring voltages.
3. Describe electromagnetic radiation hazards.
4. Describe the tag-out bill and its responsibilities and procedures.

INTRODUCTION

Electronics safety is essential for the well-being of every Fire Controlman. If you, as a technician, are not thoroughly familiar with electronics safety, you may become the next casualty.

To be an effective Fire Controlman, you must be thoroughly familiar with all aspects of electronic safety. Statistics show that a high percentage of accidents and casualties could have been prevented if some specific precautionary measures had been taken. Common sense, good indoctrination, and training are required of all personnel maintaining and operating electronic equipment.

When working with electronic equipment, you should remember this rule: **SAFETY FIRST**. Dangerous voltages energize much of the equipment you work with.

Use the safety precautions outlined in this chapter to complement information given in your electronic equipment instructions. These instructions (applicable directives and equipment technical manuals) provide specific safety instructions. Before you perform maintenance on any equipment, be sure to observe all required safety precautions.

This topic discusses electric shock, voltage measurement, electromagnetic radiation hazards, tagout bills, and protective equipment.

ELECTRIC SHOCK

Electric shock is the sensation and muscular spasm caused when electric current passes through the body. The word *current* is underlined in the last sentence to emphasize that it is the *current* and NOT the voltage that causes electric shock. No matter how much voltage is present, you will be shocked only if you provide a ground path for the electric current.

The following excerpt from a mishap report shows just one result of not following proper safety procedures:

“While trying to adjust the alignment between coarse and fine synchros in the gun drive drawer, a Fire Controlman received a shock from a 115-volt source. While performing preventive maintenance, he discovered that the alignment did not meet the performance specifications required by the maintenance requirement card (MRC). After trying to align the synchros, he discovered that the fine synchro was faulty. To get into the synchro control box, he removed the insulation cover. While adjusting the synchro, the technician touched the exposed wiring on the synchro with his thumb, allowing 115 volts of alternating current to enter his thumb and forearm. He went to medical, after which the corpsman sent him to the naval hospital for evaluation and observation. He was released the next day, slightly damaged, but very much aware of the value of following safety procedures.”

Ninety-nine percent of what you do in your job as a Fire Controlman, you will do around electricity. Since that makes you extremely susceptible to electric shock, it's very important for you to know the basics of electric shock, how to avoid being shocked, and how to treat victims of electric shock. The following section discusses those factors.

This section discusses the severity, avoidance, and victims of electric shock.

BASICS OF ELECTRIC SHOCK

The following factors determine the severity of the effect electric shock has on your body:

- The amount of body resistance you have to the current flow.
- The path the current takes through your body.
- The length of time the current flows through your body.

Body Resistance

Resistance varies greatly in different parts of your body. A value of 1,500 ohms is commonly used as the resistance between major extremities of an average human body: hand to hand, or hand to foot.

For example, suppose you accidentally grabbed a wire carrying 120 volts alternating current (V ac). We can use Ohm's law, $I = E/R$, to figure how much current would flow through your body:

$$E = 120 \text{ V ac (the voltage you grabbed)}$$

$$R = 1,500 \text{ ohms (your average body resistance)}$$

Therefore:

$$I = 120/1,500 \text{ amp}$$

$$I = .080 \text{ amp}$$

$$I = 80 \text{ milliamperes}$$

Therefore, if you grabbed a 120-V-ac wire, 80 milliamperes of current would flow through your body!

Table 3-1 shows the effects of varying amounts of electric shock on a normal person. In our example, you grabbed 80 milliamperes of current! That is 15 milliamperes beyond what could be fatal. It is also 70 milliamperes beyond the "can't-let-go" threshold for a 120-pound person and 62 milliamperes beyond what is needed to cause you to stop breathing.

Table 3-1.—Effects of Electric Shock

CURRENT (milliamperes)	HUMAN REACTION (at 60 Hertz)
1.1	PERCEPTION: A slight tingling sensation.
10.0 16.0	CAN'T LET GO: Arm and hand muscles close involuntarily: A 120-pound person. A 175-pound person.
18.0	CAN'T BREATHE: PARALYSIS OF THE CHEST MUSCLES.
65.0	HEART FIBRILLATION: Rapid, irregular contractions of the heart muscles. Could be fatal.

Remember, the 1,500 ohms is just an average value. Body resistance varies from person to person and may often be less than 1,500 ohms. When your skin is moist, your body resistance could be as low as 300 ohms! Also, breaks in your skin at the point of contact could reduce your skin resistance to nearly zero!

Skin resistance is only important when you are handling voltages of less than 240 volts. If you get shocked by more than 240 volts, the voltage arc will burn through your skin and leave deep, third-degree burns where it enters your body.

Current Flow Path

The two most dangerous paths that current can take through your body are (1) from hand to hand and (2) from left hand to either foot. The second path is the MOST dangerous since the current will flow through both your heart and other vital organs.

Current Flow Duration

Fibrillation is the shocking of your heart into a useless flutter. The longer you are shocked, the more chance there is for your heart to begin fibrillating. Most people who die from electric shock die from fibrillation. Fibrillation in a normal adult is unlikely if the current in milliamperes is less than $116/t$, where "t" is the shock duration in seconds. The longer you are shocked, the less current is needed to cause heart fibrillation.

Some examples of shock current levels and durations that could cause fibrillation are:

- 21 milliamperes for 30 seconds,
- 44 milliamperes for 7 seconds, or
- 67 milliamperes for 3 seconds.

HOW TO AVOID BEING SHOCKED

Preventing yourself from receiving an electric shock can be summed up in three words: isolate, insulate, and ground.

1. **Isolate:** Isolate yourself from the source of electric shock. Secure the power to equipment before you attempt to work on it. Be sure to keep all electrical equipment covers, doors, and enclosures in place when you are not actually working on the equipment. If you must leave circuitry exposed, rope off the area, post appropriate signs, and warn your fellow workers of the danger.
2. **Insulate:** Make sure that the electrical tools and equipment you use are properly insulated. Use only approved insulated hand and portable electric power tools. Check power and extension cords frequently for deterioration, cracks, or breaks. Breaks in the insulation cause many electrical mishaps.
3. **Ground:** Electric current always follows the path of least resistance. To prevent yourself from being the unintentional path to ground, make sure that your equipment is well grounded. Well-grounded equipment will direct any stray electric current to ground, thereby protecting you from electric shock. A good ground can also help protect your equipment from excessive voltage spikes or lightning. For further information on equipment grounding, see *Shipboard Bonding, Grounding, and Other Techniques for Electromagnetic Compatibility and Safety*, MIL-STD 1310 (NAVY).

HOW TO TREAT VICTIMS OF ELECTRIC SHOCK

The rescue of electric shock victims depends on prompt action. However, to avoid becoming a victim yourself, you must observe the following safety precautions:

1. Shut off the voltage at once.

2. If you cannot shut off the voltage immediately, try to free the victim from the live conductor by using a dry board, belt, or clothing, or other nonconducting material. **Do not make direct contact with any part of the victim's body with any part of your body!** If you do, you will become part of the same circuit and may become an electric shock victim yourself!
3. After you remove the victim from the power source, determine if he or she is breathing. If the victim is not breathing, apply cardiopulmonary resuscitation (CPR) without delay. Loosen the clothing about the victim's neck, chest, and abdomen so that breathing is easier. Once the victim is breathing, protect him or her from exposure to cold, with a warm cover, if possible.
4. Keep the victim from moving. After a strong shock, the heart is very weak. Any sudden effort or activity may result in heart failure.
5. Send for a doctor or a corpsman, and stay with the victim until medical help has arrived. Do not give the victim stimulants.

To be able to successfully rescue a shock victim, it is extremely important that you and your shipmates be qualified in CPR. The effects of electric shock can range from mild surprise to death. It depends on the amount of current, the voltage, and the duration of the electric shock. Since people have varying resistance levels, it is hard to know exactly how a shock victim will be affected. More than likely, the victim will be very pale or bluish in color and may be unconscious. Therefore, immediate action is of the utmost importance.

Q1. What three key factors will determine the severity of electric shock on your body?

Q2. What three one-word commands should you follow to prevent shocking yourself?

VOLTAGE MEASUREMENT

You will be required to work on energized equipment during many of your job assignments. For example, as you troubleshoot a piece of electronic equipment, the technical manual may instruct you to measure voltages or to check signal waveforms while the equipment is energized. If so, before you connect the multimeter or the oscilloscope, there are certain safety precautions and procedures you **MUST** follow that are designed to protect you from electric shock. These precautions and procedures are divided into two

Table 3-2.—Procedures to Follow When Measuring Voltages Below 300 Volts

Step	Procedure
1	ALWAYS notify and obtain permission from your commanding officer (afloat) or your supervisor (ashore) to work on energized equipment. (Some commands require you to complete a checklist before doing this.)
2	ALWAYS study the schematic and wiring diagrams of the equipment on which you will be working. Note the location of the test points and the location of any other high-voltage points that you should be careful not to touch.
3	ALWAYS remove all metal items, such as, watches, belt buckles, rings (even wedding bands), and other items that have exposed metal. If you are wearing a security badge, put it in your pocket.
4	ALWAYS ensure that you are wearing electrical safety shoes, if they were issued, and that you are standing on insulating rubber matting. If you must insert your hand into the enclosure of the energized equipment, wear electrical safety rubber gloves rated for the appropriate voltage. See table 3-3.
5	NEVER work alone. Have a co-worker stand by. Make sure that your co-worker knows where to secure the power in case of emergency.

basic voltage categories: (1) voltage measurements below 300 volts, and (2) voltage measurements above 300 volts.

VOLTAGES BELOW 300 VOLTS

Most of the voltage measurements that you will make will be below 300 volts. Almost all the newer electronic systems operate at less than 28 volts, except for the main input ac power. Table 3-2 lists the safety procedures for measuring voltages below 300 volts. Follow them!

In addition to the procedures in table 3-2, you must obey the four safety precautions in table 3-4 when you take measurements on energized equipment.

The following excerpt from a mishap report shows the importance of following these precautions:

Table 3-3.—Rubber Glove Ratings

Class	Maximum Safe Voltage
0	750 volts
I	3,000 volts
II	4,000 volts
III	5,000 volts

“A technician could not get the alligator clip on the test lead to stay on the probe, so he held the clip to the probe with his right hand. He violated safety precautions by continuing to hold the clip and the probe while he was energizing the test lead with 1,200 volts. Soon

Table 3-4.—Safety Precautions For Measuring Voltages Below 300 Volts

No.	Safety Precaution
1	ALWAYS use test probes with safety guards or barriers on the probe tips to prevent your hand from inadvertently touching the probe tip.
2	ALWAYS use insulated alligator clips.
3	ALWAYS keep your body clear of any metal parts of the equipment on which you are working.
4	ALWAYS try to keep one hand in your pocket or behind your back when you are taking a measurement to avoid creating a ground path for electric current flow through your body from hand to hand.

thereafter, he touched the ground lead and received a serious shock. He was treated for minor burns on the palm.”

VOLTAGES ABOVE 300 VOLTS

All the safety procedures for measuring voltages below 300 volts also apply when you are measuring voltages above 300 volts. However, the big difference when measuring voltages above 300 volts is that you must NOT hold the test probe while the equipment is energized. Instead, you must attach the test probes while the equipment is de-energized. (Refer to table 3-5).

ELECTROSTATIC DISCHARGE PRECAUTIONS

Electrostatic discharge (ESD) can destroy or damage many electronic components, including integrated circuits (ICs) and discrete semiconductor devices. Since certain devices are more susceptible to ESD damage than others, warning symbols, shown in figure 3-1, are now used to identify ESD-sensitive (ESDS) items. The widespread use of integrated circuits led to the development of special training courses in miniature/microminiature (2M) circuit repair.

Certified 2M technicians are trained in procedures for reducing the causes of ESD damage. The

procedures are similar for all levels of maintenance. If you are certified in 2M repair, you should follow the protective measures in table 3-6 to help prevent ESD damage. Remember, although many sources of electrostatic charge are of little consequence during most daily activities, they become extremely important when you work with ESD material. If you are not certified in 2M repair, do not attempt to repair any of these circuits.

For further information on handling ESD materials, refer to *Introduction to Microelectronics, Navy Electricity and Electronic Training Series (NEETS)*, Module 14, NAVEDTRA 172-14-00-84.

- Q3. What is the FIRST step in taking voltage measurements below 300 volts?
- Q4. What is the major difference between using a test probe to measure a voltage above 300 volts and using it to measure a voltage of 300 volts or less?
- Q5. What dangerous effect to electronic components are ESD precautions designed to reduce or eliminate?

ELECTROMAGNETIC RADIATION HAZARDS

The electromagnetic spectrum encompasses everyday uses from commercial power to medical

Table 3-5.—Safety Precautions For Measuring Voltages Above 300 Volts

No.	Safety Precaution
1	ALWAYS follow all preliminary safety procedures for measuring voltages below 300 volts before beginning your measurement.
2	ALWAYS make sure that the equipment you are working on is de-energized.
3	ALWAYS follow the tag-out procedures.
4	ALWAYS discharge all high-voltage capacitors with a shorting probe.
5	ALWAYS attach the ground probe of the measuring device <u>first</u> .
6	ALWAYS secure the other probe of the measuring device to the test point to be measured.
7	ALWAYS make sure that the measuring device is set up for the voltage level and polarity to be measured.
8	ALWAYS energize the equipment under test, make the measurement, and then de-energize the equipment.

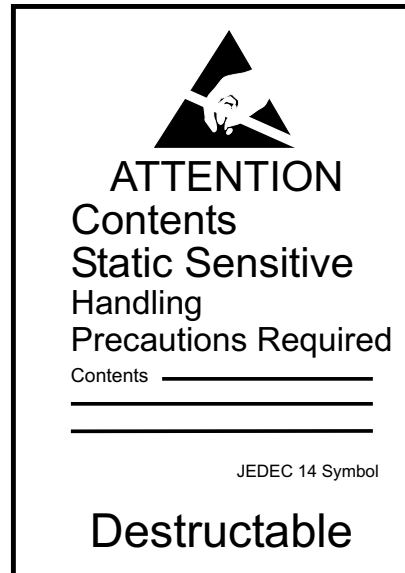


Figure 3-1.—ESD warning symbols.

x-rays as shown in figure 3-2. You will be concerned primarily with radio frequency (RF) and laser hazards.

RADIO-FREQUENCY RADIATION HAZARDS

Radiation from antennas fed by high-powered, radio-frequency (RF) transmitters has the potential to directly injure the soft tissue of personnel who are near the radiating antennas. These injuries result from the tissue being “cooked” in a manner similar to the way food is cooked in a microwave oven. Transmitters aboard ships, on aircraft, and at shore stations are potential sources of harmful radiation.

The sensations caused by exposure to excessive RF radiation vary. You should remain alert in any area in which you may be exposed to RF radiation because, at some frequencies, exposure to excessive levels of RF radiation will not produce a noticeable sensation of

pain or discomfort to give warning that injury may be occurring.

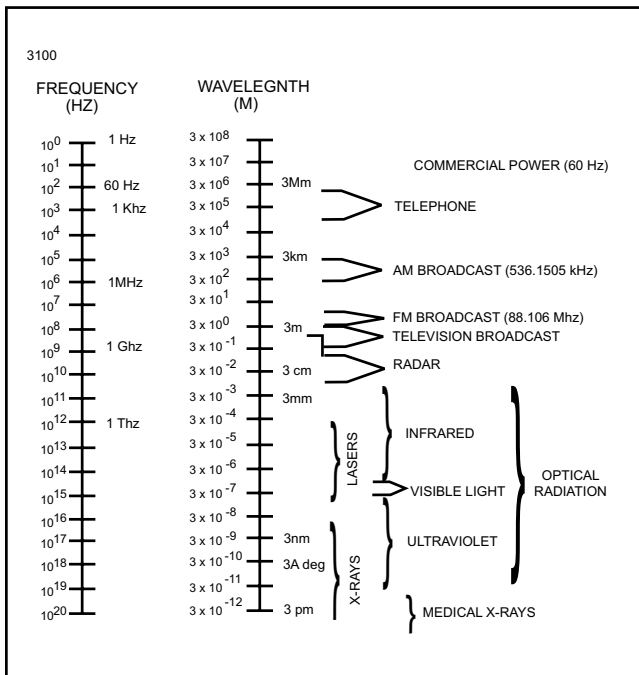
Radiated RF energy can also cause indirect injury to personnel by inducing high RF voltage levels in metal objects. If you touch such an object while it contains a high RF voltage, you will likely receive an RF burn. The current will produce heat as it overcomes the resistance of your skin. The effect of the heat may range from warmth to a painful burn.

LASER RADIATION HAZARDS

The word *laser* is the acronym for light amplification by stimulated emission of radiation. A laser is a concentrated beam of optical radiation. As a technology has increased, the use of lasers has increased from industrial and medical purposes to both offensive and defensive military purposes.

Table 3-6.—Electrostatic Discharge Precautions

No.	EDS Precautions
1	ALWAYS ground the workbenches where you will handle ESDS devices.
2	ALWAYS be sure that you are grounded.
3	ALWAYS check packaging and equipment technical manuals for ESD warnings and instructions.
4	ALWAYS ground the electrostatic unit package of an ESDS device or assembly before you open it.
5	ALWAYS minimize the handling of ESDS devices or assemblies.
6	ALWAYS avoid unnecessary physical movement.
7	ALWAYS hold the ESDS device or assembly through its electrostatic-free wrap, if possible, when you remove or replace it in the equipment.
8	ALWAYS touch, with your bare skin, the surface on which an ESDS device or assembly rests for at least 1 second before you pick it up.
9	ALWAYS avoid repairs that require soldering at the equipment level, if possible.
10	ALWAYS ground the leads of test equipment before you energize it and before you probe ESDS items.
11	NEVER permit ESDS devices or assemblies to come in contact with ungrounded materials.
12	Whenever you service ESDS devices, NEVER touch or handle materials that create static charges without repeating the grounding action.



FCf03002

Figure 3-2.—The electromagnetic spectrum.

Lasers can have varying effects on a person. Effects on the eyes can range from inflammation of the cornea to corneal burn. Effects on the skin can range from accelerated skin aging to skin burn. If you use lasers at your command, be sure to follow all safety precautions for the class of laser in use and all directions given to you by your command's laser safety officer.

For more information on the use of lasers, refer to the *Navy Occupational Safety and Health (NAVOSH) Program Manual, OPNAVINST 5100.23*, for shore operations; and the *NAVOSH Program Manual for Forces Afloat, OPNAVINST 5100.19*, for shipboard operations.

Q6. What common household appliance is typically used to illustrate the tissue damage that can be done by harmful RF exposure?

TAG-OUT BILL

The tag-out bill is a system of documents used to save lives and to prevent unnecessary damage to equipment. It uses caution tags, danger tags,

out-of-calibration labels, and out-of-commission labels to let you know when a specific switch, circuit breaker, piece of equipment, electronic system, or plumbing valve should be either operated with extra care or left alone.

It is impossible in this section to identify all situations requiring tag-out procedures. However, we can mention a few situations that require you to tag out certain equipment:

- Working Aloft or Over the Side: When you are working aloft or over the side, be sure that any equipment that could give you radiation burns or that could asphyxiate you is turned off and tagged out.
- Corrective Maintenance: When you are working on equipment that must have its power secured and there is a chance that someone else could inadvertently reapply power while you are still working on the equipment, the equipment should be tagged out.
- Preventive Maintenance: When the PMS MRCs or equipment technical manuals direct you to secure electrical power, those power switches should be tagged out.

TAG-OUT RESPONSIBILITIES

Commanding officers are responsible for the safety of their personnel and the operational readiness of their ship. They are ultimately responsible for ensuring that their personnel follow appropriate tag-out procedures. To help do this, they assign authorizing officers who have the authority to sign, issue, and clear tags and labels. There is usually one authorizing officer for each department, who may be a commissioned officer, a chief petty officer, or a petty officer.

Your department's authorizing officer normally has the following responsibilities:

- Ensure that personnel are qualified to do the work they are about to do,
- Maintain tag-out logs,
- Sign and issue tags and tag-out record sheets, and
- Clear the record sheets from the tag-out logs and destroy the tags when the work is completed.

TAG-OUT DOCUMENTS

There are five tag-out documents that you may use in your job as a Fire Controlman:

- Tag-out logs
- CAUTION Tags (NAVSHIPS 9890/5)
- DANGER Tags (NAVSHIPS 9890/8)
- OUT-OF-CALIBRATION Labels (NAVSEA 9210/6)
- OUT-OF-COMMISSION Labels (NAVSHIPS 9890/7)

This subsection discusses the first three documents in depth. The last two documents are labels that are only used to identify test equipment that is either out of calibration or out of commission, and, therefore, need no further explanation.

Tag-Out Log

A tag-out log is a permanent log of the authorizations given for all tag-out actions. Preferably kept in a three-ring binder, it has the following five sections:

SECTION 1. Section 1 contains a copy of the *Equipment Tag-Out Bill*, found in *Standard Organization and Regulations of the U.S. Navy*, OPNAVINST 3120.32; and a copy of the command's amplifying instruction on equipment tag-out procedures.

SECTION 2. Section 2 contains the DANGER/CAUTION Tag-Out Index and Record of Audits (OPNAV 3120/4). The authorizing officer uses this form to assign and track all of the issued DANGER/CAUTION tags. Table 3-7 describes blocks 1 through 5 on figure 3-3.

SECTION 3. Section 3 contains the DANGER/CAUTION Tag-Out Record Sheets (NAVSEA 9210/9) that are still in effect. Figures 3-4 and 3-5 show the front and back sides of this form.

SECTION 4. Section 4 contains the Instrument Log (NAVSHIPS 9890/10). Keep a record of all the OUT-OF-COMMISSION and OUT-OF-CALIBRATION labels issued in this log.

SECTION 5. Section 5 contains the DANGER/CAUTION Tag-Out Record Sheet (NAVSEA 9210/9). Keep the record sheets that have been cleared and are no longer in effect in this section.

Table 3-7.—DANGER/CAUTION Tag-Out Index and Record of Audits Description

Block	TITLE	Description
1	Log Serial	The sequential log serial number issued for tag-out actions.
2	Date Issued	The date the log serial number was issued.
3	Type	The type of tags used, either CAUTION or DANGER.
4	Description	The description of the system or component that will be tagged out and any amplifying information.
5	Date Issued/Cleared	The date that ALL the tags were cleared.

damaged when normal operating procedures are used. In that case, use a DANGER tag.

DANGER Tag

A DANGER Tag (9890/8) is a RED tag, shown in figure 3-7. It is used to prohibit operation of equipment that, if operated, could jeopardize the safety of personnel or damage the equipment. Under NO circumstances may equipment be operated or removed when it is tagged with a DANGER tag.

TAG-OUT PROCEDURES

Before you tag out a piece of equipment, be sure that you have your supervisor’s permission. If the equipment is mission-critical, you may also need permission from your division officer or department head.

For further information on equipment tag-out procedures, refer to the *Tag-out User’s Manual*, NAVSEA S0400-AD-URM-010/TUM.

- Q7. What three situations discussed in the text require you to tag out equipment?*
- Q8. Name two tagout responsibilities of your department authorizing officer for tag out procedures.*
- Q9. What are the five tag-out documents that you may use in your job as a Fire Controlman?*

PROTECTIVE EQUIPMENT

The wearing of the correct protective equipment is essential to all naval personnel. It is especially important for the safety of electronics personnel. This section discusses basic electrical equipment: safety

shoes; rubber gloves; safety shorting probes; eye, hearing, and respiratory protection; and deck-insulating material.

ELECTRICAL SAFETY SHOES

You will normally be issued a pair of electrical safety shoes when you report to your first duty station. You must wear them whenever you work on or around energized equipment. Take care of them. You can clean and shine them just like regular safety shoes. When they become worn out or damaged, turn them in to your supply division for a new pair. Electrical safety shoes do not have any exposed metal parts like you might find on regular safety shoes. They have special non-conducting soles designed to protect you from a maximum of 600 volts.

RUBBER GLOVES

Rubber gloves are designed to keep you from being injured when you must or may accidentally touch an electrically “live” component. There are four classes of rubber insulating gloves. The primary features of the gloves are their wall thickness and their maximum safe voltage rating. Refer back to table 3-3 for glove classes and the maximum safe voltage for which they may be used.

SAFETY SHORTING PROBE

Some of the electronic equipment you may work on will use large capacitors to filter the electrical power. You must discharge these capacitors before working on the equipment by using a safety shorting probe. The procedure for using a shorting probe is provided in table 3-8.

DANGER/CAUTION TAG-OUT RECORD SHEET				DATE/TIME TAG-OUT ISSUED		
SYSTEM OR COMPONENT			LOG SERIAL No.			
REASON FOR TAG-OUT						
PERSONNEL / EQUIPMENT HAZARDS INVOLVED (MANDATORY FOR DANGER TAGS)						
AMPLIFYING INSTRUCTIONS (MANDATORY FOR CAUTION TAGS)						
WORK NECESSARY TO CLEAR TAG(S) INCLUDING TESTS						
OPERATIONS/WORK ITEMS INCLUDED IN TAG-OUT						
APPLICABLE DOCUMENTATION (I.E., JOB ORDER, RIP-OUT, S/P, ETC) NUMBER & TITLE	TAG NUMBERS USED	DATE/ TIME ISSUED OR ADDED	PETTY OFFICER IN CHARGE	AUTHORIZING OFFICER	WORK COMPLETE	
			SECOND PERSON (SIGNATURE)	REPAIR ACTIVITY REP. (WHEN APPROP)	REPAIR ACTIVITY REP. (WHEN APPROP)	DATE
NAVSEA 9210/9 (FRONT)		0116 - LF - 092 - 1047		<input type="checkbox"/> CHECK BOX IF CONTINUED ON ADDITIONAL SHEET		

FC03004

Figure 3-4.—DANGER/CAUTION Tag-Out Record Sheet (NAVSEA 9210/9)(front).

EYE PROTECTION

No matter what job you are performing, you depend heavily on your sense of sight. To help protect your eyesight, you should know when to wear eye protection and what eye protection to wear. The *Navy Occupational Safety and Health (NAVOSH) Program Manual*, OPNAVINST 5100.23, states that you must

wear appropriate eye protective equipment whenever you perform eye-hazardous operations. In other words, whenever you are doing something that could damage your eyes, wear eye protection.

Some of the things you may do that fall into the eye-hazardous category are:

- soldering,

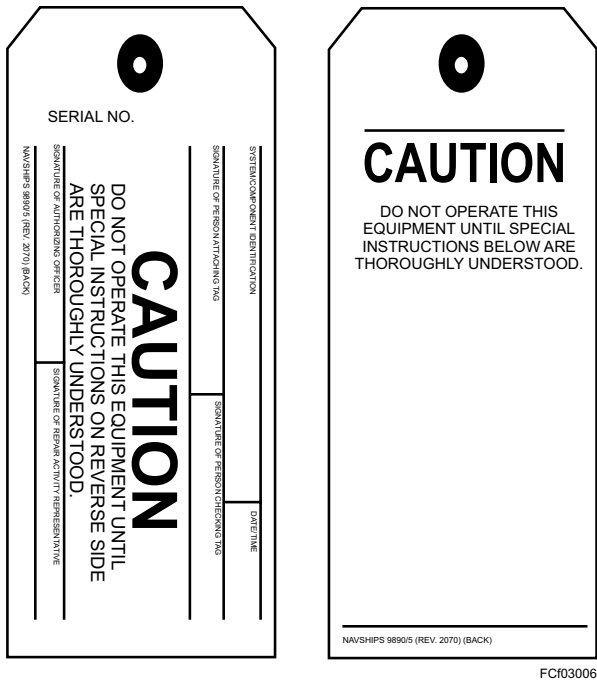


Figure 3-6.—CAUTION Tag (NAVSHIPS 9890/5).

- Clean and store eye-protection equipment properly after you are through using it.

HEARING PROTECTION

Although you may not think of hearing protection as being associated with electrical and electronic repair, it is. Consider the area in which you will be working. Hearing loss is a problem in the Navy. Every day, you may be working with and around noisy equipment and machinery that could damage your hearing. In most cases, the damage will not happen overnight; it will happen slowly.

Your hearing may degrade until you will not be able to hear the softer sounds as well as you could have

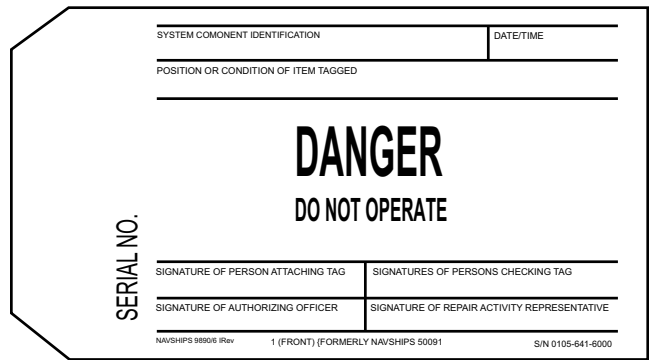
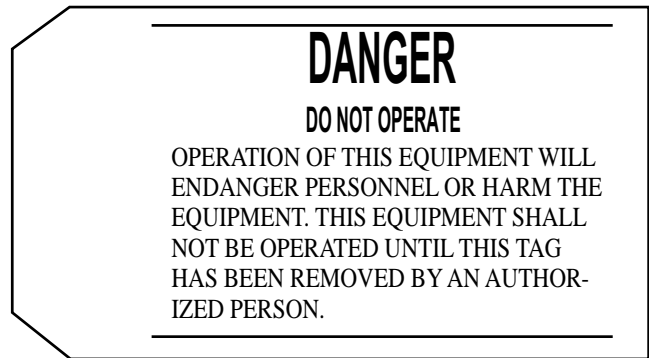


Figure 3-7.—DANGER Tag (NAVSHIPS 9890/8).



if you had worn hearing protection. This is commonly called a *hearing threshold shift*. It simply means that the more you are exposed to damaging levels of noise, the louder normal sounds must be for you to hear them.

You must start now to protect yourself from hearing loss. OPNAVINST 5100.23 states that all personnel must wear hearing protective devices when they enter or work in an area where the operations generate noise levels of greater than 84 decibels. If you are in doubt about whether a noise level is high enough

Table 3-8.—Safety Shorting Probe Procedure

Step	Action(s)
1	Secure the input power to the equipment. Use appropriate tag-out procedures, if necessary.
2	Open the equipment to gain access to the capacitors that need to be discharged. Do NOT touch any exposed terminals, as large filter capacitors can store a lot of energy.
3	Connect the flexible ground strap of the safety shorting probe to the metal chassis of the equipment, ensuring a good metal-to-metal connection.
4	Hold the safety shorting probe by its plastic handle and touch the metal probe tip to the appropriate terminals to be grounded. Do NOT touch the metal probe tip or the flexible ground strap while the probe is in contact with the capacitor's terminals. Repeat this step two or three times to ensure that the capacitor is completely discharged.

to require hearing protection, err toward the side of safety. Protect your hearing!

RESPIRATORY PROTECTION

It is very important to use the proper respiratory protection when you use hazardous paints, solvents, and other materials associated with cleaning and maintaining electronic equipment and antennas. Be sure to ask your supervisor about the need for respiratory protection whenever you

- chip lead- or chromate-based paints while removing corrosion,
- prime or paint the bases of antennas, or
- clean circuits with spray solvents or alcohol.

Whenever you perform these operations, be sure that the work area has good ventilation. This will help prevent you from over-inhaling hazardous vapors and dusts.

DECK-INSULATING MATERIAL

Your working environment should have deck-insulating material (more commonly called rubber matting) to protect you and your shipmates from electric shock. It must be installed wherever work is done on energized electrical and electronic equipment. This includes electronic repair shops that have workbenches for working on electronic equipment.

The rubber matting should be rated for use in areas where the maximum voltage will not exceed 3,000 volts. It must be installed in one continuous run, at least 36 inches wide, and must extend at least 24 inches past each end of the workbench.

If you must work on energized equipment in an area where rubber matting is not installed, protect yourself from electric shock by using a 6-foot piece of rubber matting as a portable safety deck. When you are done, roll it up and store it for the next job.

Rubber matting does a great job of protecting you from electric shock, but it will not protect you for long if you do not take care of it.

The following tips will help keep the insulating properties of rubber matting intact:

- Keep rubber matting clean and free of any excess dirt, oil, or oil-based products. When you clean it, do NOT use abrasive cleaners or electric buffers; they will ruin its insulating effectiveness.
- Inspect the rubber matting for cuts, cracks, or excessive wear periodically. If you notice any of these conditions, replace it entirely.

Q10. Name four types of personal protective equipment associated with working with electricity.

SUMMARY

Throughout your training you have been taught about electrical and electronic safety. This chapter has attempted to give you an overview of this area of safety. However, one of the greatest dangers in this area is not your lack of knowledge but the complacency you may develop from hearing the same message over and over. You know these safety standards; they have been drilled into your thinking. You may have even taught this material to someone at some time in your career. **DO NOT ALLOW A COMPLACENT ATTITUDE TO KILL YOU!** Although voltage is normally mentioned in talks about electrical shock, you must remember that current is what will kill you. As little as one-tenth of one ampere (0.1 ampere) of current can be fatal. The majority of shock fatalities are related to voltages less than 120 volts. Even lesser voltages can be fatal because of the relative current flow. Treat all voltages as life threatening.

In view of the potential harm of electrical shock, the tag-out system was implemented for your safety. Do not take anything for granted when tagging out equipment. Make sure everything is done by the book and that you and your fellow FC's are safe. Do not be in such a hurry that you use short cuts in tagging equipment out or in using protective equipment. Do not adopt the attitude that it's "the other guy" who gets killed or injured when using "short cuts." **Read, study, and know** what your command requirements are for tagging out equipment and checking out protective gear.

Take the knowledge offered in this chapter and apply it to your everyday job.

Remember, SAFETY FIRST!

ANSWERS TO CHAPTER QUESTIONS

- A1. *The amount of body resistance you have to the current flow, the path the current takes through your body, and the length of time the current flows through your body.*
- A2. *Isolate, insulate, and ground.*
- A3. *ALWAYS notify and obtain permission from your commanding officer (afloat) or your supervisor (ashore) to work on energized equipment. (Some commands require you to complete a checklist before doing this.)*
- A4. *When your measuring a voltage above 300 volts, you must NOT hold the test probe while the equipment is energized. Instead, you must attach the test probes while the equipment is de-energized.*
- A5. *Electrostatic discharge (ESD).*
- A6. *A microwave oven. RF injuries result from the tissue being “cooked” in a manner similar to the way food is cooked in a microwave oven.*
- A7. *Working aloft or over the side, doing corrective or preventive maintenance.*
- A8. *Ensure that personnel are qualified to do the work they are about to do, maintain tag-out logs, signing and issuing tags and tag-out record sheets, clear the record sheets from the tag-out logs, and destroying the tags when the work is completed.*
- A9. *Tag-out logs, CAUTION Tags (NAVSHIPS 9890/5), DANGER Tags (NAVSHIPS 9890/8), OUT-OF-CALIBRATION Labels (NAVSEA 9210/6), and OUT-OF-COMMISSION Labels (NAVSHIPS 9890/7).*
- A10. *Safety shoes, rubber gloves, safety shorting probes, eye protection, hearing protection, respiratory protection, and deck-insulating material.*

CHAPTER 4

HAZARDOUS MATERIALS

LEARNING OBJECTIVES

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

1. Identify the hazardous materials found in Fire Controlman workspaces and the safety precautions associated with each material.
2. Identify the storage requirements for hazardous materials.

INTRODUCTION

What are hazardous materials (HM)? A hazardous material is any material that, because of its quantity, concentration, or physical or chemical properties, may pose a substantial hazard to human health or the environment when used incorrectly, spilled accidentally, or released purposefully. Subcategories of HM include: combustible materials; toxic materials; corrosive materials (including acids and bases); and oxidizer, aerosol, or compressed gases. Cleaning solvents, paints, batteries, and floor wax are specific examples of hazardous materials.

Part of doing our job and maintaining our equipment and workspaces involves using hazardous materials. Whether we use hazardous materials daily or infrequently, we need to know how to identify them and understand their use, storage, and disposal procedures.

Many hazardous materials, if not used properly, can be hazardous to your health. For example, they can burn or irritate your skin, cause internal damage if you inhale them, or poison you if you ingest them. You must, therefore, be aware of and follow safe handling, storage, and disposal procedures for all hazardous materials that you may have to use or work around.

You can find additional safety information on hazardous materials in the following publications:

- *Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat*, OPNAVINST 5100.19 (Series), Chapters B3, C23, and D15.
- *Navy Occupational Safety and Health (NAVOSH) Program Manual*, OPNAVINST 5100.23 (Series), Chapters 6, 7, 9, 11, and 20.

- *Natural and Environmental Resources Manual*, OPNAVINST 5090.1 (Series), Chapters 1, 3, 10, 12, 15, 19, 20, and 21; and Appendices A, C, G, H, I, K, and L.

This chapter discusses how to identify hazardous materials and the safety precautions related to these materials.

IDENTIFICATION OF HAZARDOUS MATERIALS

All hazardous material containers must be labeled. Manufacturers of hazardous materials must follow strict Occupational Safety and Health Administration (OSHA) regulations on labeling. As a minimum, each label must clearly identify (1) the name of the material, (2) the name and address of the manufacturer, and (3) the nature of the hazard, including the target organ(s) affected by the material.

Hazardous materials provided through the stock system, including open-purchase materials, must meet these requirements. You are not authorized to relabel properly labeled hazardous materials.

The Navy places great importance on handling hazardous materials properly. To help you understand that importance, the following section describes the Material Safety Data Sheet required by OSHA, the Hazardous Material User's Guide (HMUG), and the labeling procedures required by the Department of Defense (DOD), the Chief of Naval Operations (CNO), and the Navy.

MATERIAL SAFETY DATA SHEET

OSHA regulations require employers to provide employees with safety information on the hazardous

materials with which they work. This law also pertains to Federal civilian and military personnel. Manufacturers must provide hazardous material information for all hazardous materials they produce and must make a Material Safety Data Sheet (MSDS) available to the users of each hazardous material.

In the Navy, MSDSs are provided in a computer database on compact disk read-only memory (CD-ROM) entitled “Hazardous Material Control and Management (HMC&M) System.” The CD-ROM contains the *Hazardous Material User’s Guide (HMUG)*, *Ships’ Hazardous Material List (SHML)*, *Shipboard Safety Equipment Shopping Guide*, and the *Hazardous Material Information System (HMIS)*, which provides over 70,000 MSDSs for materials used within the DOD.

The MSDS must be available to all users of hazardous materials and their supervisors; therefore, the CD-ROM containing the HMC&M database is provided on board every ship and shore station. The MSDS is used to train hazardous material users on the dangers and precautions of that material. Each MSDS contains the following information:

- General information, including an emergency phone number for the material’s manufacturer.
- Ingredients and identity information.
- Physical and chemical characteristics.
- Fire and explosion hazard data.
- Health and hazard data, including first aid.
- Precautions for safe handling and use.
- Control measures, including protective equipment.
- Transportation data.
- Disposal data.
- Label data.

Your hazardous material control supervisor or hazardous material/hazardous waste coordinator can provide you with an MSDS upon request. Ashore, the MSDSs for each work center are located within the work area. Aboard ship, MSDSs for every item of HM aboard are available either through the HMIS or by hard copy for open purchased items. Supervisors must provide instruction in MSDS understanding and use, and personnel using HM must be trained on the

dangers and precautions contained within the MSDS before they actually use those materials.

HAZARDOUS MATERIALS USER’S GUIDE (HMUG)

The *Hazardous Materials User’s Guide (HMUG)* provides safety data for hazardous materials commonly used on ships. The HMUG supplements the information contained in the Material Safety Data Sheets (MSDSs). Always refer to the MSDS first. Then use the HMUG to clarify any MSDS information you do not understand.

The HMUG provides compatibility information, control measures, safety precautions, health hazards, spill control, and disposal guidelines for 22 hazardous material groups (for instance, adhesives, cleaners, degreasers, paints, solvents, etc.).

- The Compatibility Information section lists example material classes that are not compatible with the hazardous material group and the types of reactions that could occur if incompatible materials should mix.
- The Control Measures section identifies and prescribes personal protective equipment (PPE) for the chemical hazards in the group.
- The Safety Precautions section provides safety guidance for using and storing hazardous materials in the group.
- The Health Hazards section points out common signs and effects of overexposure to the hazardous material and provides “What to do” instructions for the hazardous material user.
- The Spill Control section provides information for responding to a spill.
- The Disposal Guidelines section provides acceptable methods for disposing of materials within the group.

The HMUG does not include items such as ammunition, explosives, propellants, medical/pharmaceutical supplies, and radioactive materials.

LABELING REQUIREMENTS

The Department of Defense (DOD) and the Navy both have standard label requirements for marking hazardous materials. Every Navy command must have a system to ensure that hazardous materials are

properly marked. Within that system, all HM must be labeled in one of the following ways:

- The original manufacturer’s label or an exact copy of the manufacturer’s label, or
- For National Stock Number material, the original stock system container label *or* an exact copy of the stock system label, or
- Standard DOD Hazardous Chemical Warning Label DD 2521 (figure 4-1) or DD 2522 (figure 4-2), or
- A label developed by the facility that contains the manufacturer’s name, the product name, and either all hazard warnings provided by the original stock system/manufacturer’s label, or a locally developed hazard warning based on the physical and health hazards listed on the stock system/manufacturer’s label.

Some hazardous material containers may also display one of the Department of Transportation (DOT) shipping symbols shown in figure 4-3. These symbols depict the hazard category of the material and are used on outer packaging and on trucks and railway cars that transport those materials.

HAZARDOUS CHEMICAL WARNING LABEL					
1. CHEMICAL/COMMON NAME			2. HAZARD CODE		
3. NSN/LSN		4. PART NUMBER			
5. ITEM NAME					
6. HAZARDS <i>(X all that apply)</i>	(1) ACUTE <i>(Immediate)</i>				(2) CHRONIC <i>(Delayed)</i>
	NONE	SLIGHT	MODERATE	SEVERE	
	a. HEALTH				
	b. CONTACT				
	c. FIRE				
d. REACTIVITY					
7. SPECIFIC HAZARDS AND PRECAUTIONS <i>(Including target organ effects) (See MSDS for further information.)</i>					
8. PROTECT <i>(X all that apply)</i>					
	EYES	SKIN	RESPIRATORY		
9. CONTACT					
a. COMPANY NAME					
b. ADDRESS <i>(Street, P.O. Box, City, State, ZIP Code, Country)</i>					
c. EMERGENCY TELEPHONE NUMBER <i>(Include Area Code)</i>					
10. PROCUREMENT YEAR FOR HAZARDOUS CHEMICAL					

DD FORM 2521, OCT 2000 PREVIOUS EDITION MAY BE USED. Fc04001

Figure 4-1.—Large Department of Defense Hazardous Chemical Warning Label (DD Form 2521).

HAZARDOUS CHEMICAL WARNING LABEL					
1. CHEMICAL/COMMON NAME					
2. HAZARD CODE			3. NSN/LSN		
4. PART NUMBER					
5. ITEM NAME					
6. HAZARDS <i>(X all that apply)</i>	(1) ACUTE <i>(Immediate)</i>				(2) CHRONIC <i>(Delayed)</i>
	NONE	SLIGHT	MODERATE	SEVERE	
	a. HEALTH				
	b. CONTACT				
	c. FIRE				
d. REACTIVITY					
7. SPECIFIC HAZARDS AND PRECAUTIONS <i>(Including target organ effects) (See MSDS for further information.)</i>					
8. PROTECT <i>(X all that apply)</i>					
	EYES	SKIN	RESPIRATORY		
9. CONTACT					
a. COMPANY NAME					
b. ADDRESS <i>(Street, P.O. Box, City, State, ZIP Code, Country)</i>					
c. EMERGENCY TELEPHONE NUMBER <i>(Include Area Code)</i>					
10. PROCUREMENT YEAR FOR HAZARDOUS CHEMICAL					

DD FORM 2522, OCT 2000 PREVIOUS EDITION MAY BE USED. Fc04002

Figure 4-2.—Small Department of Defense Hazardous Chemical Warning Label (DD Form 2522).

Note: National Fire Protection Association (NFPA) labels do not comply with the requirements of the Occupational Safety and Health Administration (OSHA) Hazard Communication (HAZCOM) Standard. They may only be used to supplement a HAZCOM compliant label.

Q1. What is the minimum information that OSHA regulations require for labeling of hazardous materials?

Q2. What information can you find in the HMUG?

SAFETY PRECAUTIONS FOR HAZARDOUS MATERIALS

As we mentioned above, you must follow the prescribed safety precautions for the hazardous materials you use or handle in your workplace. These precautions are supported by requirements for



Figure 4-3.—Department of Transportation hazardous material shipping symbols.

personal protective equipment, spill response, and disposal of waste.

The following section briefly covers safety precautions for the materials commonly used or handled by Fire Controlmen: solvents, aerosol containers, polychlorinated biphenyls, batteries, and vacuum tubes.

SOLVENTS

Varnishes, lacquers, cleaning fluids, and some paints contain solvents that can ignite at relatively low temperatures. Obviously, such materials pose serious fire hazards. Some solvents emit toxic vapors; others can burn or irritate your skin and eyes.

Many solvents are used in the daily maintenance of electronic equipment. The safest solvents are those that dissolve in water (water-based). If water-based solvents are not effective, you may use trichloroethane or methyl alcohol, two of the most popular

nonwater-based solvents. However, since trichloroethane and methyl alcohol are extremely flammable, use them only when you have adequate ventilation.

When you use hazardous paints or solvents, always follow these safety precautions:

- Wipe up all spills immediately.
- Place rags or other items you use to clean up spills in a separate, covered container.
- Use protective clothing, goggles, gloves, or other appropriate safeguards to prevent paints or solvents from getting on your skin or in your eyes.
- Have accessible fire-fighting equipment nearby.
- Have adequate ventilation.
- Dispose of paints and solvents properly when you no longer need them. If you are unsure of the

disposal procedures, check with your safety officer.

- Store flammable solvents only in approved flammable storage lockers. Be sure to store flammable and corrosive materials separately.
- NEVER use carbon tetrachloride. Carbon tetrachloride is a highly toxic compound and is banned from use. Use trichloroethane instead.
- NEVER smoke or use an open flame or allow anyone else to do so in areas where paint, varnishes, lacquers, or solvents are being used.
- NEVER breathe the vapors of any cleaning solvent for prolonged periods. If you don't have proper ventilation, use proper PPE.
- NEVER discard aerosol containers in wastebaskets that will be emptied into an incinerator.
- NEVER spray cleaning solvents onto electrical windings or insulation.
- NEVER apply cleaning solvents to heated equipment. Doing so could cause a fire.

AEROSOL CONTAINERS

Aerosol containers are everywhere. When used properly, aerosol containers dispense their chemicals quickly and effectively. But if you misuse them, they can hurt you and cause damage to your surroundings. To prevent this, you must be aware of the dangers associated with aerosol containers and how to protect yourself from those dangers.

Before you use any aerosol container, read its label. The label usually has instructions on how to use, store, and dispose of the container safely. Do **not** ignore these instructions. If you do, you may become ill from the toxic effects of the chemicals in the container. Even worse, you may be seriously injured if the container explodes.

Here are some basic rules to follow when using aerosol containers:

Ventilation: Ensure that you have plenty of ventilation when you use aerosols that contain dangerous or toxic gases. If you *must* use such aerosols when ventilation is not adequate, wear the appropriate PPE.

Heat Sources: Keep all aerosol containers away from open flames, sunlight, heaters, and other possible

sources of heat. Do not smoke in areas where aerosols are being used.

Disposition: NEVER discard aerosol containers in wastebaskets that will be emptied into an incinerator, as they could explode. Dispose of the containers according to the MSDS's instructions. Some aerosol containers are considered hazardous waste.

Paint: NEVER spray paint or other protective coatings onto warm or energized equipment, as you may cause a fire.

Skin: NEVER spray paints or solvents onto your skin. Some liquids in aerosol containers may burn you; others may cause a skin rash.

Dents/Punctures: NEVER dent or puncture aerosol containers. Since they are pressurized, they may explode if they become dented or punctured.

Temperature: NEVER store aerosol containers in heated areas where temperatures can exceed the recommended storage temperature on their labels. Aboard ship, all aerosols are considered flammables and must be stored in a flammable liquid storage compartment or cabinet.

POLYCHLORINATED BIPHENYLS

Polychlorinated biphenyls (PCBs) are toxic chemicals of the chlorinated hydrocarbon group. They range in form and appearance from oily liquids, to crystalline solids, to hard transparent resins. These chemicals exhibit many favorable physical and chemical properties, including high heat capacity, chemical stability, noncorrosivity to metals, low flammability, low vapor pressure, and low electrical conductivity. Therefore, they are used extensively as insulators and coolants in electrical equipment.

PCBs in use aboard ship typically function as insulating fluids or coolants in electrical equipment. (The chemicals might occasionally be found in totally enclosed hydraulic and heat transfer systems.)

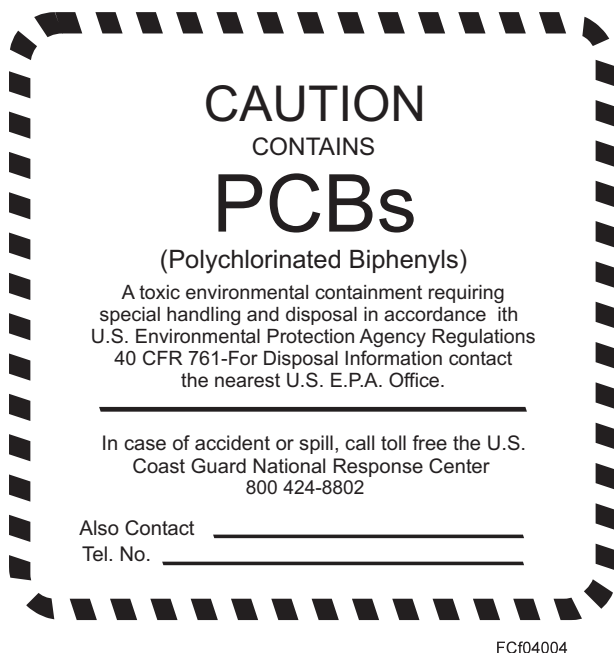
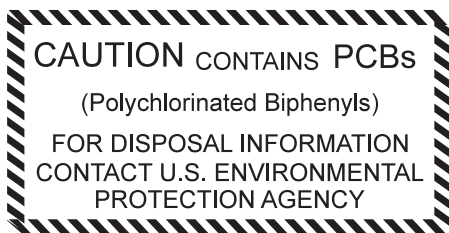
Remember, these chemicals are **toxic**. That means they can be harmful to your health (perhaps deadly.) Their adverse effects can result from either brief or repeated exposure. The effects from short-term contact with high concentrations of PCB vapors or liquids include eye, nose, and throat irritation; headaches; and the skin rash chloracne. Repeated exposure can result in severe skin irritation, respiratory irritation, digestive tract damage, and liver damage. Systemic intoxication

(an adverse effect to your entire bodily system) can result from severe overexposure. It is indicated by nausea, vomiting, weight loss, jaundice, and abdominal pain. It can be fatal.

To protect personnel, use the label shown in figure 4-4 to mark all equipment and cabinets containing in-service small and large PCB capacitors. You can find additional information on PCBs in the *Shipboard Management Guide for Polychlorinated Biphenyls (PCBs)*, NAVSEA S9593-A1-MAN-010. We highly recommended that you study this publication.

BATTERIES

A battery is a group of cells that provide direct-current (dc) electrical power. Batteries are used in automobiles, boats, aircraft, ships, submarines, lighting equipment, and portable and stationary electrical and electronic equipment. They can be used as main power sources or as secondary or backup power sources. Some batteries are rechargeable.



FC04004

Figure 4-4.—EPA-require labels for PCB hazards.

Batteries can be dangerous. If used or handled improperly, they can explode, release toxic gases, or leak hazardous chemicals.

The following section will give you the safety precautions for some of the more common types, such as carbon-zinc dry cell batteries, manganese-dioxide alkaline-zinc cell batteries, lithium cell batteries, and nickel-cadmium cell batteries.

Carbon-Zinc Dry Cell Battery

The carbon-zinc dry cell battery is a very common battery in the Navy. It has a zinc outer container, a carbon center electrode, and a chemical paste for the electrolyte. It is usually sealed in a cardboard or plastic casing.

When you use, store, or dispose of carbon-zinc batteries, always observe the following safety precautions:

- NEVER store carbon-zinc batteries in electronic equipment for extended periods. The corrosive electrolyte could leak out of the battery and damage the equipment.
- NEVER throw carbon-zinc batteries into a fire or an incinerator. They could explode.
- NEVER throw carbon-zinc batteries overboard while at sea; they contain metal pollutants. Store them on board (in a plastic-lined metal container) until you can properly dispose of them ashore. See the *Environmental and Natural Resources Program Manual*, OPNAVINST 5090.1 (Series) Appendix L.

Manganese-Dioxide Alkaline-Zinc Cell Battery

Commonly called an *alkaline* battery, the manganese-dioxide alkaline-zinc cell battery is similar to the carbon-zinc battery. The only difference is the type of electrolyte used. These batteries are used in portable electronic equipment. The safety precautions for alkaline batteries are identical to those for carbon-zinc batteries.

Lithium Cell Battery

The lithium cell battery is a high-energy, long lasting battery with a longer shelf life than most other batteries. It is often used in electronic equipment, such as computers, communications and cryptographic equipment, torpedoes, and missiles. Unfortunately, lithium batteries can be very dangerous. They can

release toxic gases or explode. If you handle lithium batteries, observe the following safety precautions to prevent injuring yourself and damaging your equipment:

- Use only lithium batteries that are approved for use in your equipment.
- Store lithium batteries in cool, well-ventilated areas away from flammable items.
- Always observe polarity when you install lithium batteries.
- NEVER pierce, short-circuit, recharge, crush, cut, burn, drop, dismantle, modify, or otherwise carelessly handle lithium batteries.
- NEVER leave lithium batteries in equipment that will not be used for long periods of time.
- NEVER throw lithium batteries in daily trash. Dispose of them properly. See the *Environmental and Natural Resources Program Manual*, OPNAVINST 5090.1, for more disposal information on lithium batteries.

Nickel-Cadmium Cell Battery

Commonly known as a NICAD, the nickel-cadmium battery is used in most cordless, rechargeable equipment, such as flashlights, cordless drills, soldering irons, and portable stereos.

The following safety precautions for NICADs are relatively simple:

- Charge NICADs in series, never in parallel.
- Follow the manufacturer's instructions for charging NICADs.
- NEVER expose NICADs to temperatures over 113 degrees Fahrenheit (45 degrees Celsius).
- NEVER short-circuit NICADs.
- NEVER store NICADs and lead-acid batteries in the same container or in the same area.
- NEVER dispose of by throwing them overboard. Store exhausted cells temporarily in a plastic-lined steel container until you can dispose of them properly ashore. See the *Environmental and Natural Resources Program Manual*, OPNAVINST 5090.1 (Series) Appendix L.

VACUUM TUBES

There are two basic categories of vacuum tubes: (1) electron tubes, and (2) cathode-ray tubes. As for other hazardous materials, you must follow certain safety precautions when you work with or handle vacuum tubes.

Electron Tubes

Electron tubes are fairly rugged devices. Most of them can handle the shocks and knocks of everyday use. However, they are not indestructible. Most electron tubes contain a near vacuum enclosed by glass.

Any excessive stress, like dropping the tube, may cause the glass to shatter, causing an implosion (burst inward). An implosion is the opposite of an explosion. When the glass shatters, the outside air rushes into the tube to fill the vacuum. As the air rushes into the tube, it carries the glass fragments with it, right on through the center of the tube and out the other side. If you are in the path of these flying fragments, you may be injured seriously. So, handle all electron tubes with care.

Some electron tubes contain radioactive material to aid ionization. These must be handled with extra care. Unbroken, the radioactive tubes are as safe as other electron tubes because the radioactive material in the tube emits slow-moving particles that are contained within the tube's thick glass envelope. However, breaking the tube will expose the hazardous radioactive material.

To avoid injuring yourself or others, observe the following safety precautions when you handle either regular or radioactive tubes:

- Handle all electron tubes, whether radioactive or not, with extreme care.
- Immediately place any electron tube that you remove, whether radioactive or not, into a protective container, such as its shipping container.
- Inform your supervisor immediately if you break a radioactive electron tube.
- Seal off a radioactive-contaminated area immediately to avoid exposing other personnel to the radioactive material.
- Treat all bad or damaged radioactive electron tubes as radioactive waste and dispose of them accordingly.

- NEVER remove a radioactive tube from its shipping container until you are ready to install it.
- NEVER touch any radioactive fragments. If you do, wash yourself thoroughly with soap and water and get medical attention.

Cathode-Ray Tubes

Cathode-ray tubes (CRTs) are everywhere: in televisions, desktop computers, radars, and electronic warfare systems. As a Fire Controlman, you will probably maintain electronic systems that use CRTs. Therefore, you must know about their hazards, handling, and disposition.

CRT HAZARDS. Working with CRTs can be extremely hazardous. A CRT consists of a large glass envelope that maintains a high internal vacuum. It also has a toxic phosphor coating on its face. CRTs are under great pressure; for example, a 10-inch CRT is subject to nearly 2,000 pounds of force. Of that, 1,000 pounds is impressed on the face of the tube alone. Therefore, breaking the glass envelope will cause a violent implosion. During the implosion, all the glass fragments, metal parts, and toxic phosphor will be expelled violently. Because a CRT carries a very high voltage and emits x-rays, it can also be hazardous when it's energized.

CRT HANDLING. To protect yourself from serious injury when you handle CRTs, follow these precautions:

- Follow the manufacturer's handling instructions.
- Keep a new CRT in its shipping carton until you are ready to use it.
- Place a defective CRT in its shipping carton immediately after you remove it from the equipment.
- Wear gloves and goggles.
- NEVER remove a CRT until you have discharged its high-voltage anode.
- NEVER strike or scratch the surface of a CRT's glass envelope.
- NEVER stand in front of a CRT when you install it. If the CRT should implode, the electron gun in its neck could be propelled at a very high

velocity through the face of the tube and into your body.

- NEVER carry a CRT by its neck.
- NEVER touch a CRT's phosphor coating; it is extremely toxic. If you break a CRT, clean up the glass fragments very carefully. If you touch the phosphor, seek medical attention *immediately*.

CRT DISPOSAL. CRTs are disposed of either by shipping them back to the manufacturer or by discarding them locally. If you ship a CRT back to the manufacturer, put it in the shipping container intact. If you dispose of a CRT locally, follow the procedure prescribed by your safety officer.

Q3. What are PCBs normally used for on board a ship?

Q4. What are two hazards associated with an energized CRT?

GENERAL STOWAGE REQUIREMENTS OF HAZARDOUS MATERIALS

Proper stowage of hazardous materials is essential to ship and personnel safety. Supply department and individual work-center personnel are responsible for the proper stowage of hazardous materials in areas under their control. For answers to your questions concerning hazardous material stowage, consult your supervisor, supply officer, or hazardous material/hazardous waste coordinator.

Hazardous materials aboard ship are typically packaged in cases or allotments of individual containers. Do not store hazardous materials in heat-producing areas or near heat-producing items. Shield hazardous materials stored on a weather deck or in exposed areas from direct sunlight.

Temporary storage of hazardous material in workspaces is limited to the amount necessary for the operation and maintenance of assigned equipment. If a HAZMINCEN is in operation, no more than a 7-day supply of common-use HM may be kept in workcenter spaces.

Study the *Naval Ships' Technical Manual*, Chapter 670, *Stowage, Handling, and Disposal of General Use Consumables*, NAVSEA S9086-WK-STM-010, and become familiar with its contents. You can find additional information in the *NAVOSH Program*

Manual for Forces Afloat, OPNAVINST 5100.19 (Series), *NAVOSH Program Manual*, OPNAVINST 5100.23 (Series), and the *Environmental and Natural Resources Program Manual*, OPNAVINST 5090.1 (Series).

SUMMARY

In your normal working environment you will be surrounded by hazardous materials. Whether that means greases, oils, paints, primers, or cleaners and detergents, you will be in daily contact with materials that are hazardous to you. Material Safety Data Sheets (MSDSs) give safety information for materials you use in doing preventive maintenance. The Hazardous Material User's Guide (HMUG) gives general guidelines for all types of hazardous materials. Many of these materials have long-lasting consequences that can effect your health even after many years. The Navy is making great strides in using less toxic materials for doing routine maintenance, but there are some

materials in use that will always be hazardous to humans. Because of this, you should learn all you can about all of the materials you use. Educate yourself and your fellow FCs concerning the specific hazardous materials you use and know the safety precautions, first-aid procedures, and stowage requirements that are associated with each type of material.

ANSWERS TO CHAPTER QUESTIONS

- A1. *(1) the name of the material, (2) the name and address of the manufacturer, and (3) the nature of the hazard, including the target organ affected by the material.*
- A2. *Compatibility information, control measures, safety precautions, health hazards, spill control, and disposal guidelines for 22 hazardous material groups.*
- A3. *Insulators and coolants in electrical equipment.*
- A4. *A very high voltage and x-ray emissions.*

CHAPTER 5

AMMUNITION SAFETY, HANDLING, SHIPPING, AND STOWING

LEARNING OBJECTIVES

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

1. Describe the basic safety principles associated with ammunition handling, shipping and stowage.
2. Describe the explosive handling personnel qualification and certification program.
3. Describe the different types of ammunition stowage and their associated safety devices.

INTRODUCTION

The application of basic safety principles to life's activities is an old precept, practiced from the dawn of time. It was an intuitive, basic survival instinct. However, as society evolved, it became evident that instinct alone wasn't sufficient. The movement toward a technical world required that cohesive thought be applied to matters of safety where dangerous and involved activities were concerned. One such activity is the procuring, stowing, and use of ammunition by the military.

The U.S. Navy has many types of ammunition that must be maintained in a state of readiness at all times. Your life, the lives of your shipmates, and the accomplishment of your mission depend on the quality and condition of this ammunition. To ensure that ammunition will perform as expected, it is prepared, overhauled, and assembled according to exacting specifications. It must also be handled, shipped, and stowed carefully, to prevent mishaps that may result in loss of life and material.

Since you will be near some type of ammunition on almost a daily basis, you will share the responsibility for ensuring that mishaps don't occur. This chapter contains information that will help you understand how to handle, ship, and stow ammunition safely. But before we discuss handling, we must reinforce your awareness of safety.

SAFETY

Your major concern during weapons handling and stowage evolutions must be safety. Safe handling and stowage operations are a team effort. All personnel involved in handling weapons must be trained and qualified to perform their job expeditiously and safely, as prescribed by *Ammunition and Explosives Ashore, Volume 1*, NAVSEA OP 5, *Ammunition Afloat*, NAVSEA OP 4, and NAVSEA OP 3347, *Ordnance Safety Precautions*.

SAFETY PHILOSOPHY

Safety is a state of mind, engendered from the top echelons of command down to the lowest working level through positive action and good leadership. Most accidents result from not applying proper safety principles. These accidents can be prevented, but only with the full cooperation of every person concerned. This means that **safety is a function of all hands**, not just the safety observers. Where explosive munitions are concerned, safety is a way of life and the means of survival for everyone in the general area. To help emphasize the critical nature of safety, we will expand the basic elements of safety in the following paragraphs.

Only by the continuous and vigorous application of these basic elements of safety can the level of ordnance accidents/incidents be reduced and, hopefully, eliminated.

Throughout the remainder of this chapter, keep the following factors in mind:

- Your knowledge of safety principles should be sound and based on thorough training.
- Your application of safety principles should be under close and constant, qualified supervision.

SUPERVISORY DUTIES

Anyone who supervises the inspection, care, preparation, handling, use, or routine disposal (excluding EOD operations) of ammunition or explosives must satisfy the following requirements:

1. Be qualified and certified as required by OPNAVINST 8023.2, *U.S. Navy Explosives Safety Policies, Requirements, and Procedures (Department of the Navy Explosives Safety Policy Manual)* and supplemental regulations.
2. Remain vigilant throughout the operation, and ensure that all regulations and instructions are observed.
3. Carefully instruct and frequently warn those under them of the need for care and constant vigilance.
4. Before beginning an operation, ensure that all subordinates are familiar with:
 - a. the characteristics of the explosive materials involved,
 - b. the equipment used, safety regulations to be observed, and
 - c. the hazards of fire, explosion, and other catastrophes that the safety regulations are intended to prevent.
5. Be alert to detect any hazardous procedures or practices, or symptoms of a deteriorating mental attitude of certified personnel, and take immediate corrective action when necessary.
6. Limit the number of personnel working with explosives or ammunition to the minimum required to perform the operation properly. Unauthorized personnel must not be permitted in magazines or in the immediate vicinity of handling or loading operations involving explosives or ammunition. Authorized visitors must be properly escorted.
7. Be alert for any hazardous procedures or practices arising from carelessness or attempts

to expedite ammunition or explosives handling operations.

8. Consult pertinent ordnance publications (OPs) to ensure that all personnel comply with specific safety precautions concerning the handling, stowage, and transportation of the ammunition involved.
9. Report accidents. When a supervisor is aware of an accident in his or her area of responsibility, he or she must immediately stop the ammunition operations. In addition to performing required on-scene duties, the supervisor must determine the circumstances and personnel involved in the accident in order to prepare an accident report.

SAFETY PRECAUTIONS

Safety precautions state clearly, concisely, and in the simplest language what may or may not be done. They should be easy to understand and not subject to misinterpretation. They should be explicit and allow no recourse, but should be general enough that they can be applied to similar situations that may arise in the future.

Safety precautions are a serious matter. They are designed to protect the well being of everyone on board and, in some cases, the ship itself. Safety precautions that use terms such as “shall,” “will,” and “must,” have the force of an order and must be obeyed. Safety precautions using the terms “should” or “may” are to be followed as a matter of policy. Deviation from safety precautions is permitted only where it is fully justified by the urgency of the situation.

Certain safety precautions are presented as visual signs or written captions embedded in the text of technical manuals to notify you of a possible danger to personnel or damage to equipment. In such cases, each precaution is mentioned as a WARNING or CAUTION immediately before the procedural directions to which it pertains.

WARNINGS. Hazards that can cause personnel injury are indicated in notes headed by the word “WARNING.” These warnings generally fall into three categories.

- Warning against poisonous fumes or harmful fluids.
- Warning against explosive or flammable components.

- Warning against mechanical hazards. These warnings are normally brief, such as calling attention to the danger involved in standing under a suspended weapon. Operating personnel reading such warnings are expected to use common sense in avoiding the hazard.

CAUTIONS. These are captions that draw attention to situations that may be potentially damaging to equipment. They are mentioned in notes headed by the word “CAUTION.” A typical caution might be written for improper lifting, pushing, or pulling on control surfaces during the handling of projectiles.

A related type of caption, NOTE, follows applicable steps that direct action and amplify the action to be performed. Notes that precede a procedural guide (PG), operation procedure (OP), or check list (CL) amplify the entire procedure.

In summary:

WARNING—Warns of danger to personnel.

CAUTION—Warns of danger to equipment.

NOTE—Amplifies information or instruction.

Since we will discuss various handling methods in this chapter, we will first list several of the GENERAL safety and maintenance rules that apply to all handling evolutions:

1. Verify that the surrounding area is clear of personnel and obstructions before you operate equipment.
2. Restrict noise and conversation to the minimum required to perform the evolution.
3. Do not stand or walk under suspended loads or weapons.
4. Do not load handling equipment above its maximum rated capacity (safe working load). Before you use handling equipment, inspect it according to the applicable Maintenance Requirement Card (MRC) and type commander’s directives.
5. Do not raise weapons higher or suspend them longer than necessary.
6. Keep weapons as level as possible when you lift them.
7. Do not allow weapons to contact any deck or equipment during lifting.

8. Verify that hooks used to handle weapons have operable safety latches or are moused.
9. Ensure that guide studs on weapons are aligned with the guide slot during loading and unloading.
10. Do not allow weapons to be unrestrained, in any direction, unless you are directed to do so in the procedure.
11. Use toxic cleaning agents sparingly and in well-ventilated areas. Vapors of most cleaning agents are toxic if inhaled in large quantities for extended periods. Be sure that cleaning agent containers are kept closed except when in use. Wash your hands thoroughly with soap and warm water after using these agents.
12. Use flammable cleaning agents and paints sparingly and only in well-ventilated areas. Be sure that no sparks, open flames, or other sources of ignition are present when you use these materials.
13. Do not strike or drop high-explosive components. Be sure that no sparks, open flames, or other sources of ignition are to be present when you work with explosives.
14. Observe all precautions for handling explosives. Do not remove an armed exploder from any weapon. Only EOD personnel may remove an armed exploder.
15. Ground yourself immediately before you touch an electrical connector or wire connected to a weapon by making bare skin-to-metal contact with the weapon.
16. Inspect all electrical connectors for bent pins and other physical damage. Always engage and disengage electrical connectors by holding the connector, never the wire.
17. Do not connect or disconnect energized electrical connectors unless you are directed to do so by authorized procedural documentation.
18. Keep the compression system free of foreign material to prevent the spontaneous combustion of oil or other carbonaceous material with hot, highly compressed air.
19. Using extreme care, shut the appropriate valves and bleed all air from lines and bodies before you disconnect fittings.

20. Exercise extreme care to prevent sharp bends or twists in air charging lines.
21. Do not tighten pipe connections or other parts while they are charged with high-pressure air.
22. Do not remove safety straps or chains from charging lines until the charging valve has been shut and the bleeder valve has been opened.

SAFETY SUMMARY

Most procedural guides (PGs), operation procedures (OPs), and checklists (CLs) have a SAFETY SUMMARY located in their front pages. The safety summary lists (one time each) all WARNINGS, CAUTIONS, and NOTES associated with the operation (weapons handling, loading, shipping, employment, emergencies, etc.) and the procedures by which the associated hazards may be reduced or eliminated.

The safety summary is divided into several parts, each consisting of the safety precautions that pertain to the various evolutions for the given weapon. All personnel must be familiar with and adhere to the applicable safety standards. Specific safety precautions are contained in the PG, OP, and CL as appropriate.

The following safety standards apply to all phases of an operation involving weapons systems:

1. Ensure that a launched weapon, either warshot or exercise, is precluded from striking the firing ship.
2. Prevent an inadvertent launching, arming, or motor start.
3. Ensure that the stowage, handling, maintenance, and testing operations of the weapon and weapon system minimize the risk of injury to personnel.
4. Strive to minimize the probability that a weapon involved in an accident or incident, or being jettisoned will explode.

Now let's begin, by discussing why you should be qualified and certified to handle conventional explosive devices.

- Q1. What is the purpose of a "WARNING"?*
- Q2. What is the purpose of a "CAUTION"?*

EXPLOSIVES HANDLING PERSONNEL QUALIFICATION AND CERTIFICATION PROGRAM

The purpose of the Explosives Handling Personnel Qualification and Certification Program is to ensure that each person is qualified and certified before performing any task involving explosives. An explosives handler must be certified by the command or organizational unit to which he or she is assigned. To be certified, the handler must demonstrate the ability to perform safely all required functions, tasks, or evolutions associated with specified explosives.

Security and aircrew personnel, ammunition working parties, and personnel on watch (who may not handle the explosives directly) may be exempt from personal or team qualification. However, each person must be carefully instructed in the safety precautions and regulations governing the function, task, or evolution to be performed.

CERTIFICATION BOARDS

The commanding officer or officer in charge of each unit or naval activity involved with handling, shipping, and stowing explosives or explosive devices must appoint a certification board for his or her organization. The board must include, as a minimum:

- The cognizant department head (or comparable supervisory representative if the organization does not have defined departments), and
- Not less than one PO1 or senior (or equivalent civilian supervisor) who is certified to perform the specified function, task, or evolution.

In large units or activities, such as aircraft carriers or weapons stations or ammunition depots, the cognizant department head may delegate the responsibility for certification to an appropriate officer or supervisor, with the concurrence of the commanding officer. A commanding officer or officer in charge may augment the certification board with additional personnel from within or outside the command. In small units or activities where a certified PO1 (or senior) is not assigned to the command, and where board augmentation from outside the command is not feasible, the type commander may authorize a waiver of the PO1 requirement.

Initial certification of personnel to perform particular explosive-related jobs may be necessary in instances where no certification board is currently

established (e.g., a newly installed weapons system, the addition of a handling and/or storage capability, or a newly commissioned ship). In most cases, experienced supervisory-level personnel will be qualified for certification. After careful review by the department head (or equivalent supervisor) of all available information relating to the individual's qualifications for the job to be performed, and a personal interview, a recommendation for certification will be made to the commanding officer or officer in charge. Final certification will then be at the discretion of the commanding officer or officer in charge. When a full qualification and certification board is formed later, certification procedures will be conducted for the remaining junior personnel.

PERSONNEL QUALIFICATION

Personnel working with explosives must be qualified as team members, as individual or team leaders, as instructors, as safety observers, or as a quality assurance inspector. Because of numerous weapons, launching devices, and weapon fuzing and loading configurations, explosive devices are segregated into representative family types. You must qualify and be certified only for applicable family types and operational situations. Table 5-1 shows the qualification levels and standards for certification.

Generally, only inert ordnance is used for drill or training purposes. If a training device is not available or if an explosive device for which training is required has no inert model, a closely related family-type inert device must be used for training. Training aids such as mockups, pictures, manuals, exploded views, and films may also be used effectively. When the use of either a family-type device or training aids is not considered to be an effective alternative for hands-on training with a non-inert device, and all safety factors have been carefully weighed, the type commander may authorize hands-on training with explosive devices, but only under qualified supervision.

To become qualified, you must demonstrate proficiency before a certified member of the certification board for each evolution you will perform. You will be required to demonstrate a competent use of applicable documentation and a knowledge of ordnance safety precautions and procedures to the extent required for ensuring that you will comply with sound handling practices and safety instructions.

You must have a working knowledge of all the types of explosive devices with which you may be required to work. Accordingly, you must become qualified and certified for each separate operation and each explosive device not in the same family type.

Another important requirement you must meet before becoming certified is to complete any appropriate Personnel Qualification Standards (PQS). For example, before you are allowed to handle projectiles aboard a frigate, you must complete the PQS for Non-Nuclear Explosive Handling. In addition to these, your command may have locally prepared qualification sheets that you must complete.

CERTIFICATION

When you are qualified and recommended for certification, you will be issued final certification by the commanding officer, the officer in charge, or the designated head of the certification board. An appropriate entry will be made in your training record and service record. Next, let's find out who must qualify and certify for what positions of responsibility.

The following personnel require individual qualification and certification:

1. Personnel whose duties require that they individually handle, inspect, package, unpack, assemble, disassemble, test, fuze, load or download, stow, arm or de-arm explosives or explosive devices must be qualified and certified for such tasks. Personnel assigned as safety observers for explosive operations, and those who inspect explosive operations for quality assurance purposes must also be qualified and certified. Supervisors of explosive operations and members of the command-appointed certification boards must also be individually certified for the evolutions that they may supervise or observe for qualification purposes. The only exception to this provision is that supervisors of explosives handling teams involved in handling explosives/hazardous materials with power-operated handling equipment need not themselves be qualified as operators. They must, however, be certified as team leaders for the explosive operations being conducted.

2. All operators of power-operated handling equipment (hoists, winches, cranes, forklifts, and so forth) used in transporting, loading, or handling ammunition, explosives, and other hazardous materials must be both certified and licensed as ground support equipment and/or materials handling equipment operators. Civilian personnel who operate these types of

Table 5-1.—Qualification Levels and Minimum Standards for Certification

CERTIFICATION LEVEL	QUALIFICATION STANDARD
IN TRAINING (IT)	<ol style="list-style-type: none"> 1. Incumbent is required, by nature of duty, to perform work tasks with explosive devices while under direct supervision of a certified team leader (TL) or individual (I). 2. Incumbent is receiving training on newly introduced explosive devices for which inert training devices are not available. 3. Incumbent shall not work with explosives unless supervised by TL or I. 4. This level of certification is temporary until such time full qualification justifies certification at a higher level, for example, TM, or I.
TEAM MEMBER (TM)	<p>BASIC QUALIFICATION. Personnel are aware of basic safety precautions relative to the work task and explosive devices concerned, have received formal and/or on-the-job training, and have been recommended by their immediate supervisor. May not work with ordnance unless supervised by TL or I.</p> <p>NOTE: TM-certified personnel will perform in team concept only under supervision of a certified TL.</p>
INDIVIDUAL (I)	<ol style="list-style-type: none"> 1. Same as for team member (TM) above. 2. Has sufficient knowledge and has demonstrated the proficiency of the work task alone, or trains others in safe and reliable operations. 3. Capable of interpreting the requirements, applicable checklists, SOP, and assembly/operating manuals.
TEAM LEADER (TL)	<ol style="list-style-type: none"> 1. Same as TM and I above. 2. Has sufficient knowledge and has demonstrated the proficiency to direct the performance or training of others, in safe and reliable operations.
QUALITY ASSURANCE (QA)	<ol style="list-style-type: none"> 1. Same as I or TL above. 2. Must have detailed knowledge and ability to train others in applicable explosive device/systems inspection criteria and be able to decide that the necessary assembly or installation procedures have been completed per applicable directives. <p>NOTE: Only TM, I, TL, and QA are interrelated. Certification at the QA level automatically assumes the individual has all knowledge and skill levels required of the TM, I, and TL member.</p>
SAFETY OBSERVER (SO)	<ol style="list-style-type: none"> 1. Must have sufficient knowledge of <u>safety procedures</u> and the <u>functioning of safety devices</u> to decide subsequent reaction when safety procedures or devices are not properly used 2. Certification at the SO level does not require prior certification at any other level. <p>NOTE: The certification level is not restricted to the most senior within a unit. A junior who possesses the foregoing standards and demonstrated maturity may likewise be certified.</p>

equipment at shore activities must also be certified and licensed.

3. Instructors of formal courses or command-approved courses in any of the functions, tasks, or evolutions involving explosives.

Team qualification and certification are required for personnel whose duties require handling, inspecting, packaging, unpacking, assembling, disassembling, testing, fuzing, loading, or downloading (aircraft, launchers, and so forth), stowing, arming, or de-arming of explosives or explosive devices while acting as members of a team or work group. Additionally, a team leader must be designated and appropriately qualified and certified. Personnel changes in certified teams must be kept to a minimum. Requalification and recertification of a team after personnel changes have occurred are at the discretion of the commanding officer or officer in charge. Shipboard gun crews are considered to be teams for the purpose of qualification and certification.

Contractor personnel who are required to perform, at a naval activity, any of the functions discussed in this chapter must provide the commanding officer or officer in charge with documentation that verifies their qualification and certification level before they perform such functions. All contracts, when issued and also when renewed, that deal with explosives and explosive operations contain a provision stating that personnel used for explosive-type operations must be qualified and certified for the type of operation to be performed.

Certification, unless revoked for cause, is valid for a maximum of 12 months. A renewal of the certification, whether issued at the time of expiration or later, should be granted only after the certification board has validated the individual's or team's qualification. Whenever possible, requalification should be completed before certification is renewed.

Revocation of Certification

Commanding officers and officers in charge may revoke individual and team certifications whenever such action is in the best interest of safety. Revoking certification for individuals or teams, including the team leader, is mandatory if an explosive mishap is caused by failure to follow authorized procedures. Flagrant disregard of safety precautions, reckless operation of equipment used to handle explosive devices, or other behavior indicating incompetence or unreliability is also cause for mandatory revocation of

certification. Personnel whose certification has been revoked must be retrained until they are requalified and recertified if the commanding officer considers such action appropriate. If, however, an individual's behavior indicates that retraining may be ineffective, he or she must be assigned other tasks not involving explosive devices. Whenever the certification of a military member is revoked, an entry must be made in the member's service record stating the specific reason for the revocation.

Transfer of Certification

When military personnel are transferred to another activity, the commanding officer or officer in charge of the receiving activity has the discretion of accepting or rejecting the certification. The transferring activity must enter in the appropriate section of the service record the individual's qualifications and dates of certification/decertification for specific evolutions involving explosive devices. Civilian employees who transfer to another activity must be recertified before being allowed to handle any explosive devices. If they are transferring to another function within the same activity, civilian employees must be certified for the new function, unless they currently hold a valid certification for that function.

The requirements for certification, revocation, and transfer of certification of nonnuclear ordnance explosives handlers are contained in OPNAVINST 8023.2C, *U.S. Navy Explosives Safety Policies, Requirements, and Procedures (Department of the Navy Explosives Safety Policy Manual)*.

To continue our discussion on the safe handling, shipping, and storing of conventional explosives, we will look first at the "handling" portion.

- Q3. What is the purpose of the Explosives Handling Personnel Qualification and Certification Program?*
- Q4. Who can authorize the use of live ordnance for training purposes?*
- Q5. Once an individual is certified to handle explosives, for how long is the certification valid?*

AMMUNITION HANDLING

Handling ammunition, in any environment, requires detailed planning, precise execution of details, and strict compliance with safety regulations. For ammunition handling aboard a ship, the

importance of these requirements cannot be over-emphasized because of the limited working space and the large number of personnel contained within the ship. All personnel (both military and civilian) involved in ammunition handling must be thoroughly trained (qualified and certified) in their areas of responsibility.

The following discussion will cover certain aspects of handling equipment and the elements of ammunition handling operations.

HANDLING EQUIPMENT

As a team member, you will use a variety of ammunition handling equipment. Examples of handling equipment include hoists and trolleys (figure 5-1), missile transfer dollies (figure 5-2), and hand lift trucks (figures 5-3 and 5-4) to name but a few. Each weapon has its own type of handling equipment. Therefore, you should consult the applicable OPs and to ensure that you have all the equipment needed to properly handle and stow the weapon(s).

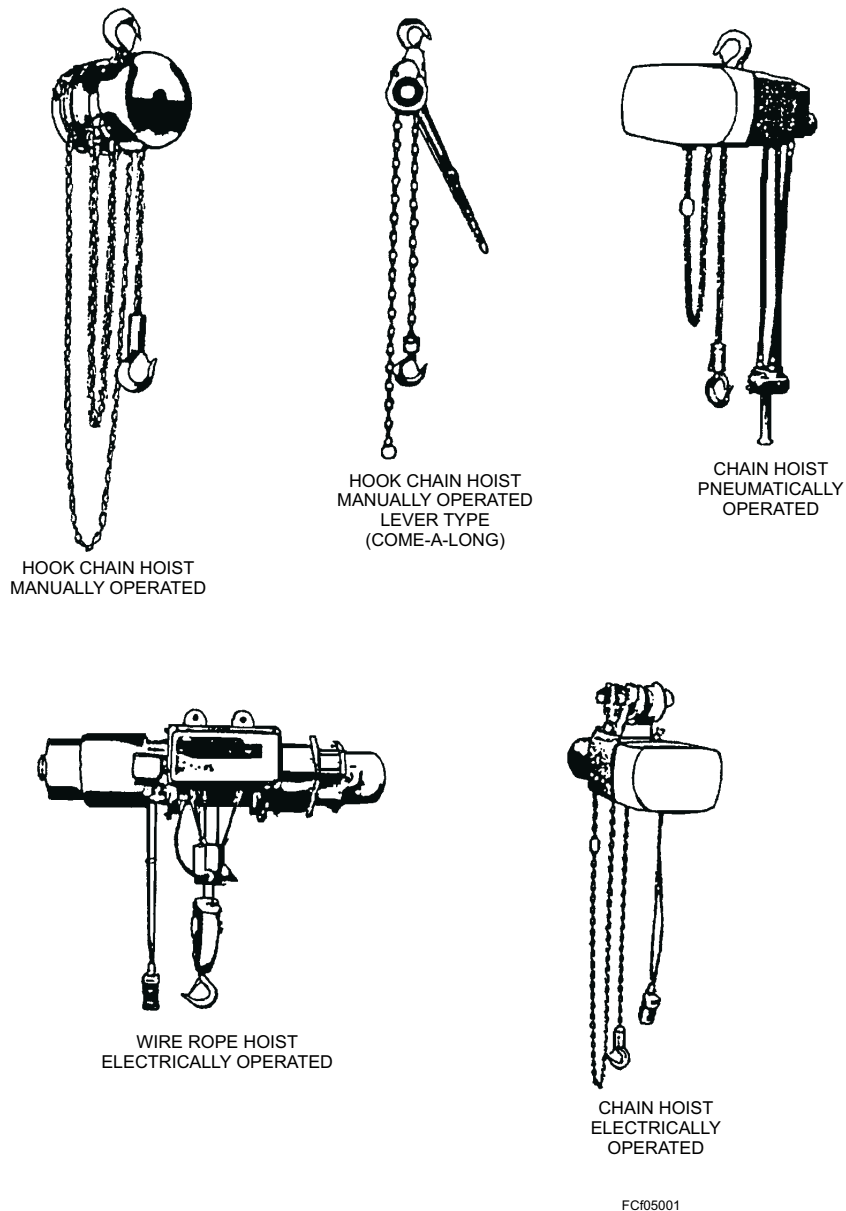


Figure 5-1.—Hoist and trolley.

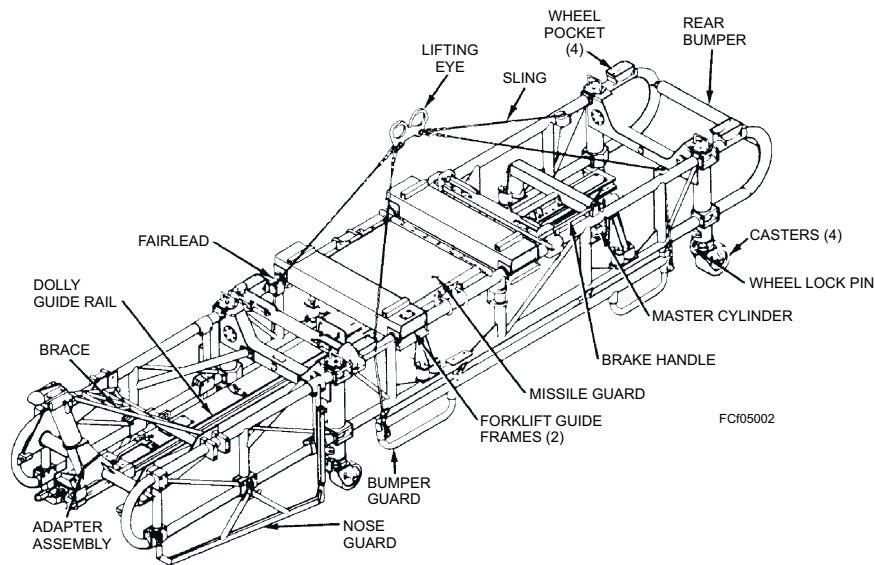


Figure 5-2.—Missile transfer dolly.

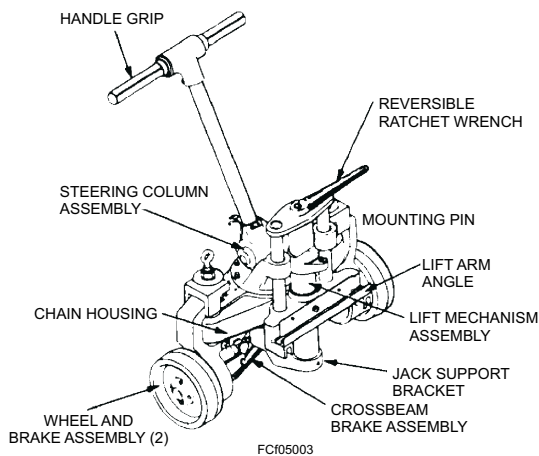


Figure 5-3.—Mk 45 hand lift truck.

In addition to gear for general use, some specialized portable gear has been developed for unique handling problems on specific ships or classes of ships. It is used for both conventional ammunition and nuclear weapons depending on design and application. You will need to refer to operating

procedures, handling and stowage manuals, or ship class drawings for identification and use of this specialized gear.

Equipment that is used frequently for lifting and transferring weapons from one location to another includes hoists, elevators, traveling cranes, floating cranes, forklifts, and hand trucks.

HANDLING OPERATIONS

The task of ammunition and explosives handling is, by nature, hazardous. Accidents occurring during these operations may kill or injure personnel, destroy essential supplies, damage valuable equipment and property, and reduce the speed and efficiency of the handling operation. Most accidents do not just happen. They are caused by carelessness or unfamiliarity with the use and limitations of handling equipment as well as laxness or failure to observe safety precautions, orders, and regulations pertaining to the handling and storage of ammunition and explosives. Accidents caused by misuse of handling equipment can be

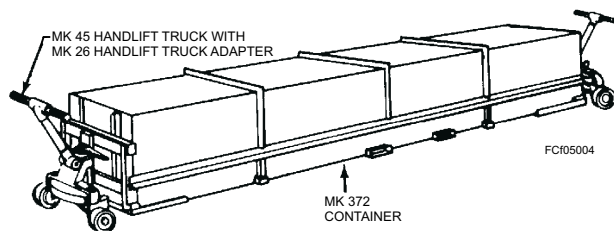


Figure 5-4.—Handling a canister with Mk 45 hand lift trucks.

prevented by a thorough understanding of its operation, use, and limitations. In all cases, the supervisor is responsible for ensuring that personnel assigned as handlers are trained in the use of the handling equipment to be used in each operation and understand the limitations of the equipment.

An ammunition (explosives or explosive material) handling operation includes one or more of the following evolutions.

- Logistics movement.— The transfer of ammunition to or from a ship at an authorized handling location. The transfer may be to or from the pier, a vehicle, a small boat, another ship, or other approved transportation.
- Strike up/strike down.— Any movement of ammunition into or out of the normal stowage locations or magazines of the ship. It may also be part of a logistics movement or part of a maintenance movement.
- Maintenance movement.— Any movement of ammunition from its normal shipboard location to another location to conduct required assembly, disassembly, maintenance or tests of a weapons system, or maintenance of a stowage area. A maintenance movement may include strike up/strike down, movement within the normal stowage area, or movement from one stowage area to another. Maintenance movements include, but are not limited to the following:
 - Removal of projectiles or missiles from tubes or launcher stowage cells for planned maintenance of the tubes or cells
 - Movement of ammunition from ready stowage locations in gun mount handling rooms while conducting maintenance in the area
 - Movement of ammunition to test or repair magazine sprinkler systems or other protective devices
 - Movement of ammunition for installation or checkout of modifications to weapons stowage areas, or to handling, launching, or direction systems
 - Movement of all-up weapons for disassembly or movement of the explosive components of weapons for combining into a higher state of assembly

- Maintenance of weapons in tenders (ADs/ASs). The assembly, disassembly, repair, maintenance, or testing of weapons or weapon components in an authorized weapons shop of a tender.

As a FireControlman you must become familiar with the handling of explosives. It will become a repetitious task, whether at a shore station or aboard ship. However, any repetitious work, no matter how dangerous, is likely to become routine and lead to carelessness. Therefore, you must be constantly vigilant to prevent mishaps in operations involving explosives. Your supervisors will be constantly vigilant and will exercise close supervision to prevent mishaps.

Now, on to the “shipping” of ammunition.

Q6. What type of handling evolution involves the transfer of ammunition from one ship to another?

AMMUNITION SHIPPING

An important aspect of ammunition handling is transporting or shipping explosive materials. We mentioned earlier in this chapter that projectiles, missiles, and some of their components are shipped in specially constructed, airtight containers. When placing weapons in these containers, you should follow the packing procedures given in the associated publications for the weapons.

General instructions for preparing and shipping naval ordnance materials are contained in NAVSEA SW020-AC-SAF-010, Volume 1 and Volume 2, *Transportation and Storage Data for Ammunition, Explosives and Related Hazardous Materials*. These publications contain information that you and your supervisors need to ship explosive materials efficiently and safely. If you are stationed at a facility where normal day-to-day operations involve receiving and shipping explosive materials, you should be familiar with the contents of NAVSEA SW020-AC-SAF-010.

EXPLOSIVES DRIVER

Sometimes Fire Controlmen are assigned the duty of driving trucks that transport explosives or of operating the forklifts and cranes that load and offload the trucks. Basically, an explosives driver is a person with an excellent safe driving record, who is fully qualified according to NAVSEA OP 2239, *Motor Vehicle Driver's Handbook Ammunition, Explosives and Related Hazardous Materials*. If you are assigned

duties as an explosives driver take a good look at the requirements you must meet to become certified to drive motor vehicles that transport ammunition, explosives, and hazardous materials.

Let's continue now with the requirements for storing these hazardous materials safely.

Q7. What NAVSEA OP should you use to find general instructions for preparation and shipping ordnance items?

AMMUNITION STOWAGE

As a Fire Controlman, you will be responsible for the care of projectiles, missiles, and associated components while they are in stowage. This is an important task because these weapons and components will spend about 99 percent of their existence in stowage. This care is even more important aboard surface ships and submarines. Why? Because at shore stations weapons are stored in their shipping containers inside magazines. Aboard surface ships these weapons are stowed in missile tubes or magazines and are exposed to salt water and humidity. A large part of your job will involve maintaining the environmental control and fire suppression systems in magazines.

MAGAZINES

A magazine is any compartment, space, or locker used, or intended to be used, for ammunition stowage. From the magazine, we can expand to the "magazine area." A magazine area includes all compartments, spaces, or passages next to or surrounding a magazine. These places are used, or intended to be used, as the area for handling and passing ammunition. The areas around loaded freighters, railroad cars, and trucks are treated as magazine areas, too. The safety and security measures that apply to shipboard magazines and magazine areas also apply to these "portable" units.

Each magazine is specifically designed for the ammunition it will contain. As a general rule, different types of ammunition will be stowed in separate magazines or lockers. The highest possible degree of safety is obtained by not mixing different explosives in the same magazines or lockers.

However, there are exceptions to this rule. Some stowage areas can be designated single-purpose or multipurpose magazines. While single-purpose stowage is desirable, it is not always possible. Often a ship's mission requires it to carry a variety of

ammunition. Mixed-stowage in multipurpose and certain single-purpose magazines is acceptable. But, there are limitations and restrictions to mixed-stowage. Current safety instructions must be followed and proper authorization must be obtained for mixed-stowage. When mixed-stowage is authorized, it must conform, as close as possible, to the permissible stowage tables listed in NAVSEA OP 4, *Ammunition Afloat*.

There are five major types or classes of magazines. We will discuss the four types you will most likely encounter: primary magazines, missile magazines, ready-service magazines, and lockers. The fifth type is called a chemical magazine. Only lethal and incapacitating chemical ammunitions will be stowed in these extremely special magazines. Normally, chemical ammunition is not carried aboard ship.

A ship's primary and ready-service magazines normally stow its complete wartime allowance of ammunition.

Primary Magazines

Primary magazines are usually located below the main deck, preferably below the ship's waterline. Primary magazines must be well-insulated, ventilated, and have some means of temperature control. They must also have a sprinkler system that can be activated from both remote and local stations. Primary magazines must be closed and locked when unattended.

Missile Magazines

Due to the nature of guided missiles, a fine-line distinction exists between a missile magazine and a primary magazine. Most of the differences are minor and can be related to two factors. First, missile magazines contain various electrically- and hydraulically-powered equipment. Quite often, there is little or no physical separation between this equipment and the missiles. Therefore, the potential for fire is great. Fire detection and suppression assumes greater importance in missile magazines. Second, missile magazines are located close to their launchers. This closeness is necessary to reduce loading time and to support high rates of fire. Thus, missile magazines are generally located above the ship's waterline. For this reason, missile magazines are less protected than primary magazines and are more susceptible to battle damage and fire.

Missile magazines contain special features to combat the effects of accidentally ignited rocket motors. Restraining latches (e.g., cell latches) keep each missile from moving in the magazine. Blowout hatches, relief ports, and plenum exhaust vents pass rocket motor gases to the atmosphere. This prevents internal magazine pressures from building to dangerous levels.

Missile magazines are normally equipped with special combustion detection devices and contain automatic sprinkler systems, with remote and local activation capabilities. Missile magazines also have a water injection or booster suppression system. A carbon dioxide system may be installed in some magazines, especially in unmanned spaces. Missile magazines are insulated, have temperature control systems, and must be closed and locked when unattended.

Ready-Service Magazines

Ready-service magazines are located near the missile launcher they serve. They provide permanent stowage for part of the ship's ammunition allowance, especially gun-type ammunition. Generally, ready-service magazines have many of the same characteristics as primary magazines. They are insulated, ventilated, and have manually activated sprinkler systems.

Missile magazines, although in a class by themselves, are sometimes considered as ready-service magazines. Ready-service magazines must be closed and locked when unattended.

Lockers

A locker can be a small compartment or space. More often though, a locker is a metal box-like structure. In either case, a locker provides stowage for special types of ammunition such as detonators and pyrotechnic devices.

Lockers are frequently located on a ship's weather deck. They will be close to the weapon or area they are intended to serve. A label installed on the outside of each locker clearly identifies the type of explosives contained within the locker.

The contents of a locker must be arranged in a neat and orderly manner. When the locker's lid or door is closed, it cannot contact (or jam) any part of the ammunition. Securing and safety latches, hinges, and other hardware must be well-maintained and in good

working condition. Sometimes, lockers are equipped with a sprinkler or flooding system. If such a system is installed, clear and legible operating instructions must be prominently displayed. Lockers must be kept closed and locked when unattended.

ENVIRONMENTAL CONTROLS

Magazines are fitted with appropriate environmental control and safety features to protect their ammunition from excessive temperatures and humidity.

Most magazines are equipped with mechanical cooling or ventilation systems. However, there are a few magazines that do not have either of these features. If a magazine without controls shows a heat gain in excess of 100° F, portable ventilation systems are used to prevent overheating or condensation of moisture.

Supply and Exhaust Ventilation

Ventilation ducts and exhaust ventilation outlets to and from magazines provide forced-air ventilation. Air is forced through the ducts by electric fans installed within the ducting. Standard covers maintain water-tightness keep flames caused by hits on the ship during combat from entering the magazines. These covers must always be closed during combat (general quarters) conditions unless there are imperative reasons for doing otherwise.

Certain types of ammunition may produce fumes that, if inhaled, may have a slightly intoxicating effect. However, this should not appreciably reduce individuals' work efficiency. Generally, there is sufficient air volume in large sealed magazines and handling rooms to provide a safe working atmosphere.

Frequently, in hot climates, magazines can be maintained at a lower average temperature by closing off the supply of air during the heat of the day and running the blowers only at night when cool air can be forced in. During the day the magazine will heat slowly by conduction rather than rapidly by the introduction of heated air.

Magazine Vent Check Valves

It may be necessary to operate the sprinkler system in magazines while the ventilation valves are secured. During these times; the magazine must be vented by an air escape to ensure that the pressure within the magazine will not build up beyond the allowed pressure limits of the watertight boundaries. Magazine

check valves allow air and water to escape from the magazine into one of the ventilation ducts or through an independent air escape.

Exhaust Vents

Most magazines, particularly missile magazines, are vented to the atmosphere. When missile motors burn, they rapidly produce large volumes of smoke and gas. If a missile motor should accidentally ignite in a magazine, the smoke and gas will be vented directly to the atmosphere, rather than to other areas of the ship. The area on the weather deck in the vicinity of an exhaust vent is potentially hazardous and is marked to warn personnel not to loiter in the area.

Magazine Alarms

Magazines are equipped with various alarm and sensing devices. When activated, they provide audible and visual warnings that something is wrong. An alarm may mean that an actual problem exists or that a problem is developing. Designated personnel should investigate any activated alarm immediately. The following paragraphs discuss three common alarms.

FH ALARM CIRCUIT.—The FH alarm circuit is used with a magazine's sprinkler system to indicate two system problems: leakage and activation. Leakage indicates that a problem is developing. Actuation means that water is flowing and the ammunition is getting sprayed. Actual sprinkling can result from a real fire or a high heat buildup in the magazine. It also can result from a gross sprinkler system malfunction. In any case, appropriate action must be taken immediately.

F ALARM CIRCUIT.—The F alarm circuit is also known as the high-temperature alarm circuit. It sounds an alarm when magazine space temperature reaches a dangerous level. If the F alarm sounds, you should investigate the problem immediately! If you react quickly enough, you may be able to take measures to reduce the temperature. This may prevent the sprinkler system from activating.

COMBUSTION GAS AND SMOKE DETECTOR.—Some magazines may contain a combustion gas and smoke detector. This detector is another early warning device similar to a smoke detector in a house. It detects the presence of combustion gases and smoke particles in the air formed in all types of fires and in smoldering or overheated materials. These particles are so small that they are

invisible to the human eye; however, they are present before there is any evidence of flame.

MAGAZINE INSPECTIONS

Aboard ship, magazine inspections are mandatory and are an integral part of the ship's PMS. These inspections must be conducted by qualified personnel using a check sheet (maintenance requirement card) to ensure that a hazard or abnormal condition is not overlooked.

It is not within the scope of this manual to discuss in detail the criteria of all required magazine inspections. However, we can provide a brief description of daily magazine inspection requirements.

Daily Visual Inspections

The daily visual inspection of magazines generally consists of checking for improperly secured stowage, unsatisfactory protective packaging, unusual fumes or odors, magazine cleanliness, and any other abnormal condition.

Abnormal conditions in a ship's magazine or ammunition stowage space include evidence of tampering to gain access (broken, damaged, or missing locks), evidence of theft, and the presence of unauthorized materials. Abnormal conditions also include evidence of localized overheating from adjacent compartments on decks, bulkheads, and overheads; indications of leaks from sprinkler or flood pipes, nozzles, or control valves and regulators; and inoperable or damaged reachrods, linkages, automatic fire alarm devices, and other similar equipment.

Another important requirement of the daily inspection is to observe, record, and report maximum and minimum temperature conditions.

Magazine Temperatures

Temperature is the most important factor that affects powder and propellant stability. This is why it's important to monitor temperature conditions.

Temperature readings are normally taken once a day. The exact time may vary, but most ships take the readings in the morning (around 0800 for example), using a special maximum and minimum thermometer (sometimes called a high-low thermometer). Figure 5-5 illustrates a typical maximum and minimum thermometer.

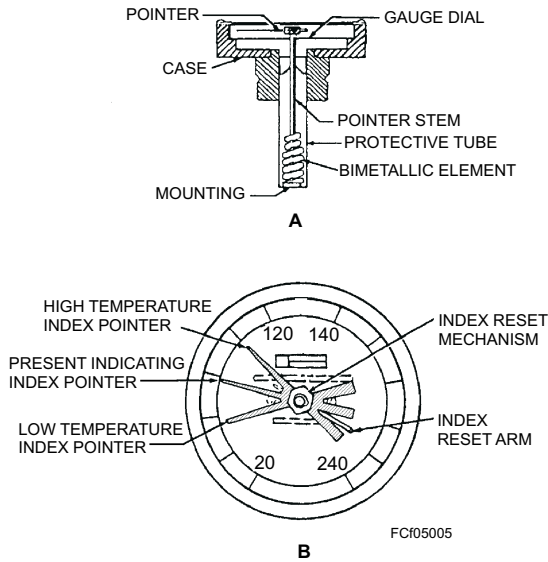


Figure 5-5.—Bimetallic maximum and minimum thermometer: A. Internal components; B. Dial face and pointers.

Every magazine or locker will have at least one direct reading thermometer. It will be located where maximum space temperature variations will normally occur. It must be installed so it is readily accessible for taking readings and resetting the index pointers. Special brackets are available to mount the thermometer where it can be protected from accidental damage.

View A of figure 5-5 shows the internal components of the device. The temperature-sensitive element is a single helix low-mass coil (bimetal element) that fits closely inside the thermometer stem. The bimetal element is carefully sized and aged for lifetime stability and is covered with a fluid to assure good heat transfer. The fluid also permits maximum speed of response and reduces pointer oscillations caused by outside vibrations. The case and stem are made from stainless steel for strength and anticorrosion protection.

View B of figure 5-5 illustrates the dial face of the thermometer. It is 3 inches in diameter. A plastic window protects the index pointers. The index reset arm is on the outside of the window and is used to reset the high-low pointers. Temperature gradations on our example are marked off in 20° increments. The approximate readings on this thermometer are 100° F, high; 78° F, present; and 55° F, low. After you record these temperatures, reset the “high” and “low” pointers in line with the “present” pointer. As temperature rises during the day, the “present” pointer pushes the “high”

pointer up the scale. As temperature falls during the night, the “present” pointer reverses direction and pushes the “low” pointer down the scale. As the sun comes up, the “present” pointer again moves up the scale. Thus, we see three different temperature readings. They reflect the temperature variations throughout a 24-hour period.

The 45° spread between the high and low pointers in our example is a bit large. However, it could happen. The reading you must be cautious about is the 100° F high. When this occurs, you should turn on the magazine cooling or ventilation system. If these systems are not working, you might have to use artificial cooling (fans, blowers). Topside lockers may require cooling with water. Remember, the optimum temperature should be around 70° F.

A magazine temperature record card (fig. 5-6) is located in each magazine and is posted near the thermometer for recording daily magazine temperatures. These cards are replaced on the first day of each month. The completed cards are removed from the magazine and the temperatures for each month are posted in a permanent log. The magazine temperature cards must be retained on file for a period of one year.

When magazine temperatures are recorded in the permanent log, temperatures in excess of 100° F must

MAGAZINE TEMPERATURE RECORD			
5ND GEN 90 (REV 11-48)			
COMPARTMENT	THERM. Number		MONTH
A 304 M	279		APRIL
DATE	MAXIMUM	MINIMUM	INITIAL
1	84	72	OP4C
2	82	70	OP4C
3			
4			
5			
6			
29			
30			
31			

P&PO N or Va 11-2-48 99014 (J c 8) 8M

Figure 5-6.—Magazine Temperature Record Card.

be recorded in a conspicuous manner (red ink). If the temperature exceeds 110°F in smokeless powder, rocket motor and JATO magazines, the temperature must be checked hourly and recorded in a separate notebook. These recorded temperatures are transferred daily to the permanent log. Any magazine in which the temperature is consistently above 100°F must be reported to the Naval Sea Systems Command (NAVSEASYS COM).

Cleanliness in Magazines

All magazines and other spaces containing explosives must be kept scrupulously clean. Combustible materials such as paper, oily rags, cotton waste, solvents, and volatile liquids are not permitted in or near a magazine except when they are being used for approved purposes. Care must be taken to ensure that no steel wool, sand, gravel, or other abrasive substances are on the decks or other working places where explosives are handled. The bulkheads, overhead, and deck should be wiped or washed down as often as necessary to keep them clean. All ammunition holding and securing devices must be kept free of oil, grease, and paint.

Work in Magazines

No work may be performed in a magazine or explosive stowage area unless it is required by ship design or as part of stowing and unstowing procedures (canning, decanning, loading, and unloading dollies, etc.) or is otherwise necessary and unavoidable. Work in a magazine normally is limited to such activities as admitting and stowing hazardous munitions, removing articles stowed in the magazine, keeping the stowage space clean, and maintaining the equipment in the magazines. Before any work that might cause abnormally high temperatures or intense local heat in a magazine or adjacent compartment used primarily as a magazine is performed, all explosives should be removed to other safe stowage. They should not be returned to the magazine until the work is completed and normal conditions are restored.

Appropriate warning, safety precautions, and instructions must be posted conspicuously in all areas where explosives, dangerous chemicals, or other hazardous materials are stowed. Training must be conducted on a regular basis to ensure that all personnel are aware of the meaning and intent of all warning signs, safety precautions, and instructions.

Food, drink, and smoking are prohibited in a magazine or magazine area. Personnel are not permitted to carry cigarette lighters or any type of open flame, or spark or flame-producing apparatus in these areas.

Electrical switches, junction boxes, and convenience outlets must be protected with watertight fittings. Be sure to keep protective caps and covers installed on these fixtures. Magazine lighting may be either fluorescent or incandescent. The light fixtures must be watertight, installed properly, and well-maintained. Be sure to use the proper size bulb where plastic protective globes are used. Never have a naked, unprotected light in a magazine.

Sound-powered telephone circuits are usually installed in magazine spaces. They should be tested routinely and maintained in good condition. Traffic and working areas of certain magazines will have a nonskid deck covering. There are different types of coverings available, so check current instructions for the approved materials.

Ammunition magazines must be identified properly and clearly. In addition to the standard compartment designators, another important sign or label must be in place. This marking is commonly called the AMMUNITION FAR SIDE sign. The sign (fig. 5-7) will be installed on all bulkheads, decks, and overheads surrounding a magazine. On vertical bulkheads, the signs should be 5 feet above the deck and spaced every 12 feet apart. On horizontal decks and overheads, the signs should be 12 feet apart and located to ensure maximum visibility. The sign should not be installed where it is visible from outside the ship. The sign is a yellow rectangle, 5 inches high by 9 inches wide. Painted on the sign are black slanted lines, 1/8-inch thick and one-inch long, on 3/4-inch centers along the top and bottom edges, with lines slanting from top right to bottom left. The letters are 1/8-inch thick and 3/4-inch high.

Magazine Security

All ammunition stowage spaces containing ammunition or explosives are required, by current directives and instructions, to be secured and locked unless work is actually being performed within the space. Properly securing an ammunition stowage space includes ensuring that all environmental controls are properly set and that all hatches, doors, or accesses are closed. It also includes ensuring that all dogs are

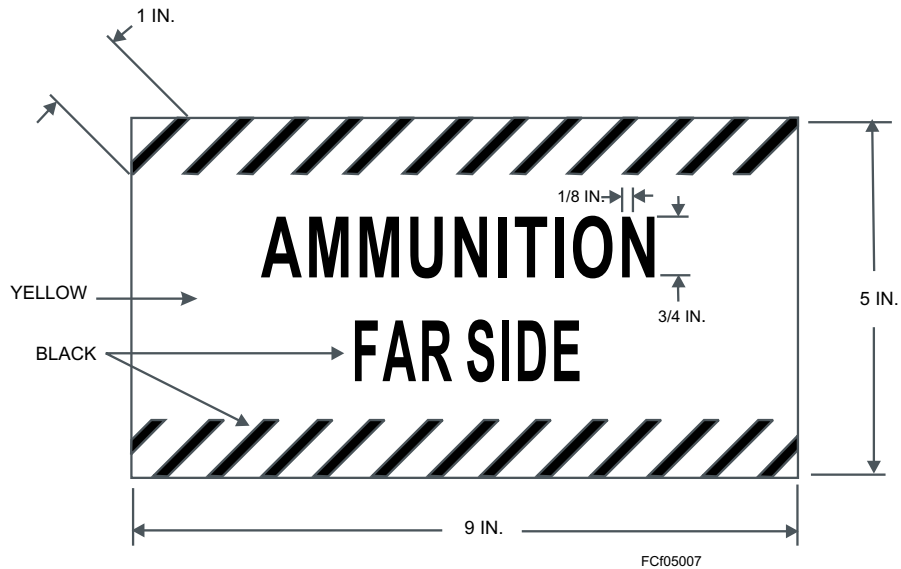


Figure 5-7.— AMMUNITION FAR SIDE, sign or label (example).

properly set on watertight closures and that the space is locked with an adequate locking device.

Only authorized personnel are permitted in a magazine and then only when they have business there. A magazine is no place in which to sit and “shoot the breeze.”

Some ammunition and explosive items such as small arms ammunition, small arms, and pyrotechnics are considered to be highly pilferable and must be stowed only in high-security stowage spaces.

Additional information on magazine security is contained in OPNAVINST 5530.13, *Physical Security Instructions for Sensitive Conventional Arms, Ammunition, and Explosives*.

There is one more aspect of ammunition stowage that we need to discuss. This is the magazine sprinkler systems used for emergency cooling and fire fighting on board ship.

SPRINKLER SYSTEMS

Sprinkler systems provide emergency cooling and fire fighting capability in magazines, ready-service rooms, and ammunition handling areas. A magazine sprinkler system consists of a network of pipes secured to the overhead and connected by a sprinkler system control valve to the ship’s saltwater fire main. The pipes are fitted with spray heads or sprinkler head valves arranged so that the water forced through them showers all parts of the magazine or ammunition handling area. Magazine sprinkler systems are capable of completely flooding their designated spaces. To

prevent unnecessary flooding of adjacent areas, all compartments equipped with sprinkler systems are watertight.

The fire main pressure on most ships is considerably higher than the pressure that magazine bulkheads can withstand; therefore, magazines are equipped with exhaust ventilators located in the bulkhead near the overhead. An exhaust ventilator is a pipe with a check valve that permits pressure release (usually to the topside). The diameter of the pipe is large enough to allow water to flow out as fast as it flows in. This prevents excess pressure from building up in the magazine compartment. On newer ships, magazines are also equipped with capped drainpipes located in the bulkhead near the deck. The caps may be removed in the adjacent compartment to drain the flooded magazine.

There are two basic types of hydraulically-controlled sprinkler systems; the dry-type and the wet-type.

Dry-Type Sprinkler System

A dry-type sprinkler system is one in which the piping from the outlet side of the main sprinkler control valve up to the sprinkler heads contains no water in a normal or ready state. This piping remains “dry” until the system is activated. The sprinkler system may be activated automatically or manually.

An automatic system is designed to actuate the magazine sprinkler in response to either a rapid rise in temperature or a slow rise to a fixed temperature.

The thermopneumatic elements, which monitor the temperature of the magazine and activate the sprinkler system, generate a pneumatic signal in response to thermal action. The pneumatic signal can be either a sudden increase or decrease in air pressure, which will actuate the sprinkler system.

The automatic control system consists of fixed-temperature units (FTUs), heat-actuated devices (HADs) heat-sensing devices (HSDs), transmission lines (Rockbestos™-covered copper tubing), circle seal check valves, and a pneumatically released pilot (PRP) valve. Manual control valves located at separate local and remote control stations are used to activate the system manually.

Wet-Type Sprinkler System

A wet-type sprinkler system is one in which the piping between the outlet side of the main sprinkler valve and the sprinkler heads is charged with fresh water. Once the system is activated, the fresh water is immediately discharged and replaced by salt water.

Although wet-type sprinkler systems do contain quite a few more components than dry-type systems, they function on similar principles. The main advantage of wet systems is a very rapid response time. Sprinkling starts approximately 1 second after activation.

For technical operating information on both types of sprinkler systems, refer to the instruction book, NAVSEA 0348-LP-078-1000, *Magazine Sprinkler System*.

- Q8. What are the five major types of shipboard magazines?*
- Q9. What type of ammunition stowage spaces are frequently located on ship's weather decks?*
- Q10. What alarm circuit is known as the "high-temperature alarm"?*
- Q11. What alarm circuit is known as the "magazine sprinkler alarm"?*
- Q12. Under normal conditions, how often should you take magazine temperature readings?*
- Q13. How should magazine temperatures that are in excess of 100 F be recorded in the permanent temperature log?*
- Q14. What does an "AMMUNITION FAR SIDE" sign look like?*

- Q15. What are the two basic types of hydraulically-controlled sprinkler systems?*
- Q16. Which type of sprinkler system uses fresh water to charge the piping between the outlet side of the main sprinkler valve and the sprinkler heads?*

SUMMARY

You have an important responsibility to handle, ship, and stow ammunition and explosives safely. Remember, the safety precautions and instructions pertaining to the safe operation and use of ammunition and explosives handling equipment must be strictly observed by all naval activities afloat and ashore. The task of ammunition and explosives handling is enormous and, by nature, inescapably hazardous. Mishaps arising in ammunition and explosives handling can kill and injure personnel, destroy essential supplies, and damage valuable equipment and property. Many of these mishaps are caused by carelessness or unfamiliarity with the use and limitations of handling equipment, as well as relaxation or failure to observe safety precautions, orders, and regulations pertaining to the handling and stowage of ammunition and explosives. You can prevent the mishaps that are caused by misuse of handling equipment if you take the time to understand the use and limitations of the handling equipment. Safety precautions and instructions are a vital element of safe ammunition and explosives handling operations. Give them careful and constant study.

ANSWERS TO CHAPTER QUESTIONS

- A1. To warn personnel of hazards that can cause personal injury.*
- A2. To draw attention to situations that may be potentially damaging to equipment.*
- A3. To ensure that each person is qualified and certified before performing any task involving explosives.*
- A4. The type commander.*
- A5. For a maximum of 12 months, unless it is revoked for cause.*
- A6. A logistics movement.*
- A7. NAVSEA SW020-AC-SAF-010, Volume 1 and Volume 2, Transportation and Storage Data for Ammunition, Explosives and Related Hazardous Materials.*

- A8. *Primary magazines, missile magazines, ready-service magazines, lockers and chemical magazines.*
- A9. *Lockers.*
- A10. *The F alarm circuit.*
- A11. *The FH alarm circuit.*
- A12. *Once a day.*
- A13. *In a conspicuous manner (red ink).*
- A14. *The sign is a yellow rectangle, 5 inches high by 9 inches wide. Painted on the sign are black slanted lines, 1/8-inch thick and one-inch long, on 3/4-inch centers along the top and bottom edges, with lines slanting from top right to bottom left. The letters are 1/8-inch thick and 3/4-inch high.*
- A15. *The dry-type and the wet-type.*
- A16. *The dry-type sprinkler system.*

APPENDIX I

REFERENCES

NOTE: Although the following references were current when this NRTC was published, their continued currency cannot be assured. Therefore, you need to be sure that you are using the latest version.

Chapter 1

Navy Occupational Safety and Health (NAVOSH) Program Manual for Forces Afloat, OPNAVINST 5100.19, Chief of Naval Operations, Washington, DC, 1984.

Operational Reports, NWP 1-03.1 (IC-1) (Formerly NWP 10-1-10), Department of the Navy, Naval Doctrine Command, Norfolk, VA, 1997.

Ships' Maintenance and Material Management (3-M) Manual, OPNAVINST 4790.4, Chief of Naval Operations, Washington, DC, 1994.

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Chapter 2

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Assignment Questions

Information: The text pages that you are to study are provided at the beginning of the assignment questions.

ASSIGNMENT 1

Textbook Assignment: "General Administration," chapter 1, pages 1-1 through 1-6; "Technical Administration," chapter 2, pages 2-1 through 2-15; and "Electronics Safety," pages 3-1 through 3-8.

- 1-1. Without the use of reports and an accountability system, maintenance and repair would be almost impossible.
1. True
 2. False
- 1-2. Which of the following reports must be completed before a ship gets underway?
1. Eight O'Clock report
 2. Twelve O'Clock report
 3. Equipment status report
 4. Casualty report
- 1-3. Which of the following conditions would require you to initiate a casualty report?
1. Your ship needs fuel.
 2. Your ship needs to do an UNREP
 3. Your ship is anchoring
 4. Your FC radar needs a part not on board
- 1-4. Which of the following reports is an initial casualty report?
1. CASREP
 2. CASCOR
 3. CASCAN
 4. CASCON
- 1-5. Which of the following publications gives guidance on the preparation and submission of a casualty report?
1. OPNAVINST 4790.4
 2. NWP 1.03.1 (IC-1)
 3. NAVSEA OP 3565
 4. SPCCINST 4441.170
- 1-6. Which of the following work-center logs is a required log?
1. Pass down log
 2. Trouble log
 3. PMS accountability log
 4. Tool check-out log
- 1-7. Who will normally update your work-center supply log?
1. Work-center supervisor
 2. Repair parts petty officer
 3. Chief petty officer
 4. Division officer
- 1-8. How frequently is your work-center PMS accountability log normally inspected?
1. Daily
 2. Weekly
 3. Monthly
 4. Quarterly
- 1-9. For which of the following purposes may the commanding officer authorize the use of laminated danger tags?
1. After-hours trouble shooting
 2. Emergency maintenance after 1600
 3. Routine maintenance during working hours
 4. Routine maintenance after working hours
- 1-10. Who is required to audit your work-center's laminated danger tags on a daily basis?
1. Work-center supervisor
 2. Leading petty officer
 3. Division officer
 4. Department head
- 1-11. Which of the following publications give(s) specific instructions for tag out requirements?
1. Your ship's instructions
 2. The 3-M manual
 3. OPNAVINST 5100.19 series
 4. All of the above
- 1-12. Which of the following logs contains your weapon system's baseline data?
1. Work-center pass down log
 2. Equipment report log
 3. Smooth log
 4. Tag-out log

- 1-13. Which of the following information is typically found in a smooth log?
1. Regular maintenance checks, casualty reports, and sequence of events
 2. Radar transmitter checks, pre-fire checks, and system operability tests
 3. Trouble calls, history of equipment, and test equipment check-out log
 4. Preventative maintenance checks, list of effective pages, tag-out guide list
- 1-14. New personnel may use information sources for which of the following purposes?
1. To bring themselves up-to-date on new procedures and troubleshooting techniques
 2. To record equipment maintenance data
 3. To obtain information on equipment no longer installed
 4. To determine who has what responsibilities on an equipment
- 1-15. Which of the following periodicals is published by the Naval Safety Center?
1. *Navy Information Bulletin*
 2. *Ships' Safety Bulletin*
 3. *Engineering Information Bulletin*
 4. *Naval Technical Bulletin*
- 1-16. Which of the following periodicals typically deals with electrical safety shoes?
1. *Deckplate*
 2. *Ashore*
 3. *Ships' Safety Bulletin*
 4. *Engineering Information Bulletin*
- 1-17. Which of the following information sources use(s) a message format?
1. *Engineering Information Bulletin*
 2. *Ashore*
 3. *Ships' Safety Bulletin*
 4. Afloat safety advisories
- 1-18. The contents of *Ashore* are of what nature?
1. Informative
 2. Required reading
 3. General directive
 4. Shipboard directive
- 1-19. Which of the following technical publications is the responsibility of the Naval Sea Systems Command?
1. *Fathom*
 2. *Deckplate*
 3. *Ships' Safety Bulletin*
 4. Afloat safety advisories
- 1-20. The magazine *Deckplate* specializes in articles on which of the following subjects?
1. Shore safety
 2. Afloat safety
 3. Shore and afloat safety
 4. Repair of naval vessels
- 1-21. The Naval Safety Center publishes which of the following three periodicals?
1. Afloat safety advisories, *Deckplate*, and *Fathom*
 2. *Ashore*, *Ships' Safety Bulletin*, and *Fathom*
 3. *Engineering Information Bulletin*, *Ashore*, and Afloat safety advisories
 4. Afloat safety advisories, *Deckplate*, and *Engineering Information Bulletin*
- 1-22. Your system's newsletter or bulletin contains which of the following types of helpful information?
1. Technical articles
 2. Troubleshooting hints
 3. Maintenance techniques
 4. All of the above
- 1-23. Which of the following is a major objective of the Maintenance Data System?
1. To report configuration changes
 2. To report field changes
 3. To maintain an equipment library
 4. To maintain logistic records
- 1-24. Which of the following definitions pertain(s) to a configuration change?
1. The addition of an equipment
 2. The deletion of an equipment
 3. The modification of an equipment
 4. All of the above
- 1-25. The Maintenance Data System's usefulness is dependent on which of the following factors?
1. Accuracy
 2. Thoroughness
 3. Timeliness in reporting information
 4. All of the above

- 1-26. What publication gives in-depth information on completing MDS forms?
1. OPNAVINST 4790.4
 2. OPNAVINST 5100.19
 3. OPNAVINST 5100.23
 4. OPNAVINST 3120.32
- 1-27. What is the primary form used to report both deferred and completed maintenance actions?
1. OPNAV 4790/2K
 2. OPNAV 4790/2L
 3. OPNAV 4790/2P
 4. OPNAV 4790/2R
- 1-28. When filling out an OPNAV 4790/2K, you must make all entries capital letters.
1. True
 2. False
- 1-29. What OPNAV form should you use to provide additional information for an action reported on an OPNAV 4790/2K?
1. 4790/2L
 2. 4790/2P
 3. 4790/2R
 4. 4790/CK
- 1-30. Under the Intermediate Maintenance Management System, what form, when completed, provides details for screening and planning?
1. OPNAV 4790/2K
 2. OPNAV 4790/2L
 3. OPNAV 4790/2P
 4. OPNAV 4790/2R
- 1-31. The associated maintenance action on an OPNAV 4790/CK must be documented on an OPNAV 4790/2K.
1. True
 2. False
- 1-32. What OPNAV form is a continuation page for the Ship's Configuration Change form?
1. 4790/2C
 2. 4790/2L
 3. 4790/CK(C)
 4. 4790/CK(L)
- 1-33. Which of the following publications provides block-by-block instruction for completing the OPNAV 4790/CK?
1. OPNAVINST 3120.32
 2. SPCCINST 4441.170
 3. OPNAVINST 4970.4
 4. OPNAVINST 5100.19
- 1-34. The Current Ship's Maintenance Project System provides which of the following activities with administrative management data?
1. TYCOM
 2. DESRON
 3. Command
 4. Shipyard
- 1-35. Planned Maintenance System (PMS) actions are the maximum actions required to maintain equipment in a fully operational condition.
1. True
 2. False
- 1-36. The Maintenance Requirement Card (OPNAV 4790) provides which of the following information concerning preventive maintenance?
1. Who does the maintenance
 2. When to do the maintenance
 3. How to do the maintenance
 4. All of the above
- 1-37. What OPNAV form identifies the location of all identical equipment covered by a Maintenance Requirement Card?
1. 4790/81
 2. 4790/85
 3. 4790/15
 4. 4790/14
- 1-38. What OPNAV form describes what equipment must be tagged out while maintenance is being performed?
1. 4790/81
 2. 4790/107
 3. 4790/14
 4. 4790/85

- 1-39. In which of the following documents can you find periodicity codes, man-hours involved, minimum required skill level, and related maintenance requirements for MRCs?
1. Equipment Guide List
 2. Maintenance Index Page
 3. Weekly PMS Schedule
 4. Quarterly PMS Schedule
- 1-40. Which of the following OPNAV forms contains names of personnel who are assigned to perform required maintenance on specific equipment?
1. Maintenance Requirement Card
 2. Maintenance Index Page
 3. Weekly PMS Schedule
 4. Quarterly PMS Schedule
- 1-41. What OPNAV form is used for recommending changes to maintenance requirement cards?
1. 4790/6A
 2. 4790/7B
 3. 4790/81
 4. 4790/15
- 1-42. Which of the following publications is unique to each ship?
1. *Naval Ship's Technical Manual*
 2. *Electronics Installation and Maintenance Book*
 3. *Engineering Information Bulletin*
 4. *Publication Applicability List*
- 1-43. Which volume of the *Publication Applicability List* contains information on weapons publication sequences?
1. I
 2. II
 3. III
 4. IV
- 1-44. In what NAVSEA publication can you find a complete listing of NSTM chapters?
1. S9086-AA-STM-010
 2. S9086-CN-STM-020
 3. S9086-VD-STM-020
 4. S9086-VG-STM-010
- 1-45. In what chapter of the NSTM can you find information on damage control?
1. 069
 2. 079
 3. 300
 4. 400
- 1-46. Chapter 400 of the NSTM provides information on which of the following subjects?
1. Weapons
 2. Electronics
 3. Engineering
 4. Combat systems
- 1-47. The *Electronics Installation and Maintenance Book* contains most of the information required by which chapter of the NSTM?
1. 079
 2. 300
 3. 400
 4. 479
- 1-48. The *Electromagnetic Radiation Hazards* manual prescribes operating procedures related to which of the following topics?
1. Igniting volatile vapors
 2. Preventing personnel injury
 3. Both 1 and 2 above
 4. Handling electronic equipment
- 1-49. In NAVSEA OP 3565, where will you find classified data?
1. Volume I, Part I
 2. Volume I, Part II
 3. Volume II, Part I
 4. Volume II, Part II
- 1-50. In which of the following publications can you find procedures for conducting electromagnetic interference surveys?
1. OPNAVINST 5100.19
 2. OPNAVINST 5100.23
 3. MIL-STD-1605
 4. MIL-STD-1606
- 1-51. What is the NAVEDTRA number of the NEETS module entitled *Microwave Principles*?
1. 172-08-00-82
 2. 172-11-00-87
 3. 172-20-00-88
 4. 172-21-00-77

- 1-52. Which NEETS module discusses the principles of radar?
1. 11
 2. 12
 3. 17
 4. 18
- 1-53. The *Electrostatic Discharge Control Handbook for Protection of Electrical and Electronic Parts, Assemblies and Equipment* (MIL-HDBK 263) provides guidance, but not requirements, for the establishment and implementation of an ESD control program.
1. True
 2. False
- 1-54. Electric shock is the sensation and muscular spasm caused when which of the following electrical elements pass(es) through your body?
1. Voltage only
 2. Current only
 3. Current and voltage
 4. High voltage and low current
- 1-55. Which of the following is the most important factor for you to know about electric shock?
1. Why it has such negative effects
 2. Where to secure power
 3. How much a person can absorb
 4. How to avoid it
- 1-56. The severity of electric shock is most affected by which of the following factors?
1. The length of time current flows through your body
 2. The amount of body resistance you provide to the flow of current
 3. The path the current flow takes through your body
 4. All of the above
- 1-57. What is the most dangerous path for current to take as it flows through your body?
1. Hand to hand
 2. Foot to foot
 3. Left hand to either foot
 4. Right hand to either foot
- 1-58. Most people who die from electric shock die from what primary cause?
1. Shock
 2. Exposure
 3. Fibrillation
 4. Injury from falling
- 1-59. What are the three basic ways you can protect yourself from electric shock?
1. Isolate, insulate, and ground
 2. Isolate, insulate, and de-magnetize
 3. Isolate, ground, and de-magnetize
 4. Isolate, insulate, and separate
- 1-60. If you are rescuing an electric shock victim, which of the following actions should you take?
1. Free the victim from the live conductor
 2. Start CPR if the victim is not breathing
 3. Send for medical help and stay with the victim until help has arrived
 4. All the above
- 1-61. The effect of electric shock depends on which of the following factors?
1. Voltage only
 2. Body resistance only
 3. Duration of electric shock only
 4. Voltage, body resistance, and duration of the electric shock
- 1-62. For which of the following voltage ranges should you observe strict safety precautions while you take voltage measurements?
1. Above 115 volts only
 2. Above 220 volts only
 3. Above 300 volts only
 4. Both below and above 300 volts
- 1-63. When you are afloat and are measuring voltages below 300 volts, you must always notify and obtain permission from which of the following personnel?
1. Commanding officer
 2. Damage control officer
 3. Officer of the deck
 4. Safety officer

- 1-64. When you are working with 4,000 volts, what class of rubber gloves should you wear?
1. I
 2. II
 3. III
 4. 0
- 1-65. What is the important additional safety requirement for measuring voltage above 300 volts on energized equipment?
1. You must wear rubber gloves
 2. You must wear safety shoes
 3. You must stand on rubber matting
 4. You must not hold the test probe
- 1-66. How should you discharge high-voltage capacitors on energized equipment?
1. With a shorting probe
 2. With a grounding clip
 3. With both a shorting probe and a grounding clip
 4. With a measuring device
- 1-67. Which of the following terms is associated with the inadvertent destruction of delicate electronic components?
1. AC
 2. IC
 3. ESD
 4. MDS
- 1-68. Although many sources of electrostatic charge are of little consequence during most daily activities, they become extremely important when you work with ESD material.
1. True
 2. False
- 1-69. What are the two electromagnetic radiation hazards with which you will be primarily concerned on the job?
1. Commercial power and television
 2. X-rays and electrical stations
 3. Radio-frequencies and lasers
 4. Voltage storage plants and commercial power
- 1-70. An RF radiation burn is a result of which of the following factors?
1. Voltage flowing through the body
 2. Current flowing through the body
 3. The body not being grounded properly
 4. A lead shield not being worn properly
- 1-71. Which of the following definitions best describes a laser?
1. A concentrated light
 2. A concentrated beam of optical radiation
 3. A high-intensity light wave
 4. A low-intensity light wave
- 1-72. Which of the following publications should you refer to for information on using lasers for shipboard operations?
1. OPNAVINST 4790.4
 2. OPNAVINST 5100.19
 3. OPNAVINST 5100.23
 4. OPNAVINST 5100.25
- 1-73. What is the purpose of the tag-out bill?
1. To identify equipment changes
 2. To report field change failures
 3. To save lives and to prevent unnecessary damage to equipment
 4. To prevent the energizing of equipment without the knowledge of damage control central
- 1-74. Which of the following situations require(s) you to tag out the equipment?
1. Working aloft or over the side
 2. Doing preventive maintenance
 3. Doing corrective maintenance
 4. All of the above
- 1-75. Which of the following officers is responsible for the safety of a ship's personnel and the operational readiness of its equipment?
1. Commanding officer
 2. Executive officer
 3. Safety officer
 4. Command duty officer

ASSIGNMENT 2

Textbook Assignment: "Electronics Safety," chapter 3, pages 3-8 through 3-15; "Hazardous Materials," chapter 4, pages 4-1 through 4-9; and "Ammunition Safety, Handling, Shipping, and Stowing," chapter 5, pages 5-1 through 5-18.

- 2-1. Which of the following is not a responsibility of an authorizing officer for tag-outs?
1. Maintaining tag-out logs
 2. Performing tag-out training
 3. Signing and issuing tags and tag-out record sheets
 4. Clearing completed tag-out sheets from the tag-out log
- 2-2. As a Fire Controlman, how many different tag-out documents are you likely to use in your routine duties?
1. One
 2. Two
 3. Three
 4. Five
- 2-3. Which of the following forms is an OUT-OF-COMMISSION label?
1. NAVSHIPS 9890/5
 2. NAVSHIPS 9890/6
 3. NAVSHIPS 9890/7
 4. NAVSHIPS 9890/8
- 2-4. Which of the following definitions best describes a tag-out log?
1. A custody log of temporary tag-out actions
 2. A temporary log of expected tag-out actions
 3. A permanent log of authorized tag-out actions
 4. A legally binding log of temporary, expected, and authorized tag-out actions
- 2-5. What section of the tag-out log contains a Record of Audits?
1. Section 1
 2. Section 2
 3. Section 3
 4. Section 4
- 2-6. Section 3 of the tag-out log contains what forms?
1. The tag-out index
 2. A record of audits
 3. DANGER/CAUTION tag-out record sheets
 4. An equipment tag-out bill
- 2-7. What tag should you use to give temporary special instructions to someone operating that tagged equipment?
1. OUT-OF-CALIBRATION
 2. OUT-OF-COMMISSION
 3. CAUTION
 4. DANGER
- 2-8. If there is a chance someone could be hurt or an equipment could be damaged under normal operations, you should tag out the equipment with what type of tag?
1. DANGER
 2. CAUTION
 3. OUT-OF-COMMISSION
 4. OUT-OF-CALIBRATION
- 2-9. An equipment may be operated when it is tagged with a DANGER tag if a co-worker says it is okay.
1. True
 2. False
- 2-10. Before you tag out equipment, which of the following individuals must sign the authorization?
1. The department head
 2. The division officer
 3. Your supervisor
 4. All of the above
- 2-11. Electrical safety shoes are designed to protect you from what maximum voltage?
1. 300 volts
 2. 440 volts
 3. 600 volts
 4. 800 volts

- 2-12. There are four classes of rubber gloves. Which class is not approved for working with 850 volts?
1. I
 2. II
 3. III
 4. 0
- 2-13. What is the recommended way to discharge a high-value capacitor?
1. Turn the equipment off
 2. Turn the equipment on
 3. Use a shorting probe
 4. Use a multimeter
- 2-14. Which of the following statements is true concerning eye protection equipment?
1. It is an option in hazardous areas
 2. It is not required when walking round eye hazardous activities
 3. It should be stored properly
 4. It is not always required in hazardous areas
- 2-15. You must use hearing protection when you enter a space where the noise exceeds what level?
1. 54 decibels
 2. 64 decibels
 3. 74 decibels
 4. 84 decibels
- 2-16. You need respiratory protection when you perform all but which of the following operations?
1. Cleaning circuit cards with spray solvents
 2. Priming or painting antenna bases
 3. Chipping chromate-based paints while removing corrosion
 4. Repainting equipment when working in the open air
- 2-17. Rubber matting should be rated for use in work areas where the voltages will NOT exceed what value?
1. 2,000 volts
 2. 3,000 volts
 3. 4,000 volts
 4. 6,000 volts
- 2-18. Hazardous materials are substances that pose a threat to human health or the environment when used incorrectly or spilled accidentally.
1. True
 2. False
- 2-19. Each hazardous material label must provide all but which of the following information?
1. Name of the material
 2. Name of the transporting agent
 3. Name and address of the manufacturer
 4. The nature of the hazard(s), including the target organ affected by the material
- 2-20. Material Safety Data Sheets (MSDSs) are provided in which of the following formats in the Navy?
1. On CD-ROM only
 2. In printed publication only
 3. On floppy diskette only
 4. On the Internet only
- 2-21. Which of the following information will you find on an MSDS?
1. Manufacturer's name
 2. Expiration date
 3. Container labeling
 4. Fire and explosion hazard data
- 2-22. What is the relationship between the *Hazardous Material User's Guide (HMUG)* and MSDSs?
1. The HMUG supercedes the MSDSs
 2. The HMUG supplements the MSDSs
 3. The HMUG replaces the MSDSs
 4. The HMUG clarifies the MSDSs
- 2-23. The *Hazardous Material User's Guide (HMUG)* includes guidance for which of the following items?
1. Ammunition
 2. Medical/pharmaceutical supplies
 3. Propellants
 4. Solvents
- 2-24. How many sizes of labeling for hazardous material does the Department of Defense use?
1. One
 2. Two
 3. Three
 4. Four

- 2-25. Which of the following solvents will NOT ignite at a relatively low temperature?
1. Varnishes
 2. Lacquers
 3. Water-based cleaning fluids
 4. Paints
- 2-26. When you are using hazardous paints or solvents, which of the following safety precautions should you follow?
1. Have a repair team standing by
 2. Have fire-fighting equipment near by
 3. Dispose of paints and solvents when you no longer need them
 4. Both 2 and 3 above
- 2-27. When you use aerosol containers, which of the following basic safety rules should you follow?
1. Keep them away from heat sources
 2. If their contents are paint or solvents, do not spray them on your skin
 3. Never dent or puncture them
 4. All of the above
- 2-28. Which of the following is a favorable property of polychlorinated biphenyls (PCBs)?
1. High heat capacity
 2. High flammability
 3. High vapor pressure
 4. High electrical conductivity
- 2-29. Polychlorinated biphenyls (PCBs) are used for which of the following purposes?
1. As insulators in electrical equipment
 2. As coolants in electrical equipment
 3. As fluid in a totally enclosed heat transfer system
 4. All of the above
- 2-30. What NAVSEA publication is a management guide for PCBs?
1. S9593-A1-MAN-010
 2. S9593-A2-MAN-010
 3. S9593-A1-MAN-020
 4. S9593-A2-MAN-020
- 2-31. A battery is a group of cells that provides which of the following types of electrical power?
1. Direct current only
 2. Alternating current only
 3. Direct and alternating current
 4. Direct or alternating current
- 2-32. What is the difference between the carbon-zinc battery and the manganese-dioxide alkaline battery?
1. The outer container
 2. The inner container
 3. The electrolyte used
 4. The carbon-centered electrode
- 2-33. Which of the following batteries can best be described as a high-energy, long-lasting battery with a longer shelf life than most other batteries?
1. Lithium
 2. Nickel-cadmium
 3. Carbon-zinc
 4. Manganese-dioxide alkaline
- 2-34. Which of the following safety precautions does NOT apply to lithium batteries?
1. Always observe polarity when you install them
 2. Always leave them in equipment for long periods to protect them
 3. Never throw them away in daily trash
 4. Use only the batteries that are approved for use in your equipment
- 2-35. Which of the following types of batteries is used mostly in cordless, rechargeable equipment?
1. Alkaline
 2. Lithium
 3. NICAD
 4. Carbon
- 2-36. Which of the following types of batteries should always be charged in series, never in parallel?
1. NICAD
 2. Lithium
 3. Carbon zinc
 4. Manganese dioxide

- 2-37. A cathode ray tube (CRT) is a type of vacuum tube.
1. True
 2. False
- 2-38. Which of the following equipment is associated with cathode ray tubes (CRTs)?
1. Electronic warfare systems
 2. Radars
 3. Computers
 4. All of the above
- 2-39. Excess stress on an electron tube's glass envelope may cause which of the following actions?
1. Explosion
 2. Implosion
 3. Ionization
 4. Neutralization
- 2-40. Which of the following hazards is/are associated with an energized cathode ray tube (CRT)?
1. Shock hazard from high voltage
 2. X-ray emissions
 3. Both 1 and 2 above
 4. Excess magnetic energy
- 2-41. Which of the following precautions applies to the handling of a CRT?
1. Be careful when touching a CRT's phosphor coating
 2. Always use gloves when lifting a CRT by its neck
 3. Follow the manufacturer's handling instructions
 4. Keep a firm grasp on the CRT when installing it from the front
- 2-42. When you dispose of a CRT locally, you should follow the procedures prescribed by which of the following persons?
1. Your supervisor
 2. The safety officer
 3. The executive officer
 4. The commanding officer
- 2-43. Which of the following chapters of the *Naval Ships' Technical Manual (NSTM)* describes procedures for the stowage, handling, and disposal of consumables?
1. 400
 2. 440
 3. 660
 4. 670
- 2-44. Most accidents result from not applying proper safety principles and can be prevented.
1. True
 2. False
- 2-45. Which of the following OPNAV instructions explains qualification and certification for supervisors of ammunition handling?
1. 8023.1
 2. 8023.2
 3. 8032.1
 4. 8032.2
- 2-46. Which of the following safety terms has the force of an order and must be obeyed?
1. Should
 2. May
 3. Shall
 4. Can
- 2-47. Hazards that can cause personal injury are indicated in notes by which of the following terms?
1. DANGER
 2. CAUTION
 3. Note
 4. WARNING
- 2-48. Situations that can cause potential damage to equipment are indicated in notes using which of the following terms?
1. DANGER
 2. CAUTION
 3. WARNING
 4. Advisory
- 2-49. Where is the safety summary located in most operation procedures (OPs)?
1. In an appendix
 2. In the front pages
 3. In an index
 4. In a glossary

- 2-50. The purpose of the Explosives Handling Personnel Qualification and Certification Program is to ensure that each person is qualified and certified before performing any task involving explosives.
1. True
 2. False
- 2-51. Which of the following personnel may be exempt from personal or team qualification for handling explosives?
1. Security personnel
 2. Personnel on watch
 3. Working parties
 4. All of the above
- 2-52. Who is responsible for appointing a certification board for the handling, shipping, and stowing of explosives for your command?
1. TYCOM
 2. Commanding officer
 3. Officer of the deck
 4. Safety officer
- 2-53. Who can authorize a waiver for the PO1 requirement on a certification board?
1. TYCOM
 2. Commanding officer
 3. Officer of the deck
 4. Safety officer
- 2-54. Which of the following circumstances will result in revocation of certification for ammunition handling?
1. Failure to follow authorized procedures
 2. Flagrant disregard of safety procedures
 3. Reckless operation of handling equipment
 4. All of the above
- 2-55. Who has the discretion for accepting a transfer of certification for ammunition handling?
1. The commanding officer of the sending command
 2. The safety officer of the sending command
 3. The commanding officer of the receiving command
 4. The safety officer of the receiving command
- 2-56. Which of the following statements concerning weapons-handling equipment is true?
1. As a team member, you will normally use only one type of handling equipment.
 2. Each weapon can be handled with a "one-size-fits-all" piece of handling equipment
 3. You should consult the applicable OP to ensure you have the right handling equipment
 4. A good forklift driver can move weapons without using handling equipment
- 2-57. The transfer of ammunition from a weapons station to your ship is considered what type of handling evolution?
1. Logistics movement
 2. Strike up
 3. Strike down
 4. Maintenance movement
- 2-58. A magazine area includes all compartments, spaces, or passages next to or surrounding a magazine.
1. True
 2. False
- 2-59. Which of the following documents gives guidance for mixed-stowage of ammunition afloat?
1. NAVSEA OP 4
 2. NAVSEA OP 5
 3. NAVSEA SW020-AC-SAF-010
 4. NAVSEA SW020-AC-SAF-020
- 2-60. How many major types of magazines are there?
1. Three
 2. Four
 3. Five
 4. Six
- 2-61. Which of the following is a characteristic of a primary magazine?
1. Located below the ship's waterline
 2. Contains various hydraulically powered equipment
 3. Located near a missile launcher
 4. Located on the ship's weather deck

- 2-62. Which of the following magazines normally stow a ship's wartime allowance of ammunition?
1. Primary and chemical
 2. Missile and ready-service
 3. Ready-service and locker
 4. Primary and ready-service
- 2-63. Missile magazines are sometimes considered what type of magazine?
1. Primary
 2. Ready-service
 3. Locker
 4. Chemical
- 2-64. Which of the following statements is true about all magazine types?
1. They are insulated
 2. They have manually activated sprinkler systems
 3. They have special combustion detection devices
 4. They must be closed and locked when unattended
- 2-65. Which of the following devices are used for environmental control of ammunition magazines?
1. Ventilation ducts
 2. Vent check valves
 3. Exhaust vents
 4. All of the above
- 2-66. FH alarms for a magazine indicate which of the following problems?
1. High temperature
 2. Gas detection
 3. Smoke detection
 4. Leakage or activation
- 2-67. Which of the following documents serves as a check sheet for inspecting a magazine?
1. The 3-M manual
 2. A maintenance requirement card
 3. The work-center supervisor's work list
 4. The magazine temperature card
- 2-68. The daily inspection of magazines generally consists of checking for which of the following conditions?
1. Improperly secured stowage
 2. Unusual fumes or odors
 3. Magazine cleanliness
 4. All of the above
- 2-69. Which of the following factors is considered most important in regard to powder stability?
1. Humidity
 2. Stowage
 3. Temperature
 4. Packaging
- 2-70. How many different temperature readings should you expect to see on a bimetallic maximum and minimum thermometer?
1. One
 2. Two
 3. Three
 4. Four
- 2-71. In which of the following locations should an AMMUNITION FAR SIDE sign be installed?
1. On the closest bulkhead to the magazine
 2. At the main entrance to the magazine
 3. Beside all escape hatches in the magazine
 4. In all areas surrounding the magazine
- 2-72. A magazine must be secured and locked at all except which of the following times?
1. During quarters
 2. When the ship is underway
 3. When someone is working in the magazine
 4. During a watch
- 2-73. Which of the following publications contains information about magazine security?
1. OPNAVINST 5530.12
 2. OPNAVINST 5530.13
 3. OPNAVINST 3120.32
 4. OPNAVINST 3120.33
- 2-74. Magazine sprinkler systems are designed to completely flood their designated space.
1. True
 2. False

2-75. Which of the following descriptions identifies a dry-type sprinkler system?

1. The piping from the outlet side of the main sprinkler control valve to the sprinkler heads contains no water in a normal state
2. The piping between the outlet side of the main sprinkler valve and the sprinkler heads is charged with fresh water
3. The piping from the outlet side of the main sprinkler control valve to the sprinkler heads contains water in a normal state
4. The piping between the outlet side of the main sprinkler valve and the sprinkler heads is charged with coolant

