

# S9086-CH-STM-020/CH-074 V2

0910-LP-074-0050

FIRST REVISION

## NAVAL SHIPS' TECHNICAL MANUAL

### NAVSEA S9086-CH-STM-020 CHAPTER 074 VOLUME 2 NONDESTRUCTIVE TESTING OF METALS QUALIFICATION AND CERTIFICATION REQUIREMENTS FOR NAVAL PERSONNEL (NON-NUCLEAR)



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SUPERSEDES S9086-CH-STM-020, CHAPTER 074 V2, DATED 15 MARCH 1979.

PUBLISHED BY DIRECTION OF COMMANDER, NAVAL SEA SYSTEMS COMMAND

**1 SEPTEMBER 1989**

LIST OF EFFECTIVE PAGES

| Page<br>No.                 | Change<br>No.* |
|-----------------------------|----------------|
| Title                       | 0              |
| A                           | 0              |
| Flyleaf-1/(Flyleaf-2 blank) | 0              |
| i thru iv                   | 0              |
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\*Zero in this column indicates an original page.

NAVSEA TECHNICAL MANUAL  
CERTIFICATION SHEET

NAVSEA 9086/11 (8-88)

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|  |                        |                     |                   |                  |  |
|--|------------------------|---------------------|-------------------|------------------|--|
| TM Identification Number                               |                        |                     |                   | Publication Date |  |
| S9086-CH-STM-020 CH-074 Vol 2                          |                        |                     |                   | 1 September 1989 |  |
| Change No. <u>-</u>                                    | Revision No. <u>2</u>  | Volume No. <u>2</u> | Part No. <u>-</u> |                  |  |
| Book No. <u>-</u>                                      | Chapter No. <u>074</u> | Other No. <u>-</u>  |                   |                  |  |
| TM Specification, TMCB/TMSR No. <u>NDMS-880464-000</u> |                        |                     |                   |                  |  |

Title: Non Destructive Testing of Metals  
Qualification and Certification Requirements  
for Naval Personnel (Non-Nuclear)

FOR CHANGES AND REVISIONS: (Indicate "NA" if item not applicable)

Purpose of Change/Revision: Update

TM/Change/Revision Numbers Superseded: S9086-CH-STM-020 of 15 March 1979

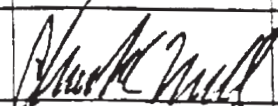
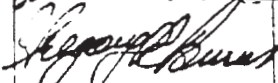
TMDER/ACN Numbers Incorporated: NA

Ship or Equipment Alteration/Field Change(FC)/Engineering Change(EC)  
 Numbers Incorporated: NA

CERTIFICATION STATEMENT

This is to certify that responsible NAVSEA activities have reviewed the basic technical manual [ ], revision [X], or change [ ] for acquisition compliance, technical coverage, and printing quality. This form is for internal NAVSEA management use only, and does not imply contractual approval or acceptance of the technical manual by the Government, nor relieve the contractor of any responsibility for delivering the technical manual in accordance with the contract requirements.

NAVSEA SIGNATURES

| Activity         | Name             | Signature   | Organization | Code | Date      |
|------------------|------------------|---|--------------|------|-----------|
| Acquisition      | D. Ball          |   | NSDSA        | 5H23 |           |
| Technical        | C. Null          |  | NAVSEA       | 05M2 | 7/7/89    |
| Printing Release | Gregory R. Burns |  |              |      | 25 Oct 89 |

NAVSEA TECHNICAL MANUAL  
CERTIFICATION SHEET

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SYNOPSIS OF CHANGE. Generally describe each significant technical addition, deletion, and change. Use additional page(s) if necessary.

General Update

RECORD OF CHANGES

ACN/Formal

CHAPTER 074 V2

| *CHANGE<br>ACN NO | DATE<br>OF<br>CHANGE | TITLE OR BRIEF DESCRIPTION ** | ENTERED<br>BY |
|-------------------|----------------------|-------------------------------|---------------|
|                   |                      |                               |               |

\* When a formal change supersedes an ACN, draw a line through the ACN number

\*\* Only message or letter reference need be cited for ACNs

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**S90-CH-STM-020/CH-074 V2**

**NAVAL SHIP'S TECHNICAL MANUAL**

**CHAPTER 074 - VOLUME 2**

**NONDESTRUCTIVE TESTING OF METALS**

**QUALIFICATION AND CERTIFICATION REQUIREMENTS**

**FOR NAVAL PERSONNEL**

**(NON-NUCLEAR)**

S9086-CH-STM-020 (15 March 1979 Edition) Chapter 074 Volume 2, Naval Ships' Technical Manual (NSTM) is superseded by Chapter 074 Volume 2, REVISION 1, as follows:

1. This revision results from the Naval Sea Systems Command's program to revise, repackage, and reissue the NSTM.
2. All holders of the NSTM shall replace Chapter 074 Volume 2 dated 15 March 1979, with new Chapter 074 Volume 2, REVISION 1, dated 1 September 1989.
3. The technical point of contact for this volume of Chapter 074 is the Naval Sea Systems Command, Code 05M2.

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# CHAPTER 074 – VOLUME 2

## NONDESTRUCTIVE TESTING OF METALS – QUALIFICATION AND CERTIFICATION REQUIREMENTS FOR NAVAL PERSONNEL (NON-NUCLEAR)

### SECTION 11. INTRODUCTION

#### 074-11.1 GENERAL

**074-11.1.1** The various nondestructive testing methods are effective tools for detection of flaws and defects in metals. The degree of flaws and defects in metals. The degree of effectiveness of a Nondestructive Test (NDT) depends primarily on the use of proper testing techniques which can be performed only by qualified personnel.

**074-11.1.2** To ensure achievement of uniform and reliable nondestructive tests on naval materials and components, implementation of the training, qualification, and certification programs described in this chapter should be followed precisely.

#### NOTE

This chapter furnishes both the minimum mandatory requirements (indicated by the word shall) and guidance information (indicated by the words should or may) necessary for nondestructive inspection and safety when used for ships maintenance, repair, and alterations.

#### 074-11.2 REFERENCE DOCUMENTS

##### CAUTION

All nondestructive testing performed aboard or on naval ships shall be done in accordance with the applicable mandatory documents.

**074-11.2.1 MANDATORY DOCUMENTS.** Mandatory basic reference documents, such as fabrication and repair documents, used for all nondestructive testing requirements are listed in Table 074-11.

#### NOTE

Information in the latest edition of the documents is reflected in the requirements in this chapter. The requirements may be superseded by changes or revisions to these documents or to changes in NAVSEA instructions.

**074-11.2.2 GUIDANCE DOCUMENTS.** In addition to the mandatory reference documents listed in Table 074-11, certain documents provide valuable guidance for NDT Operators, Inspectors, and Examiners. They are listed in Table 074-12.

**074-11.2.2.1** Except as specified in paragraph 11.2.2.2, all naval personnel performing nondestructive testing shall be qualified and certified in accordance with procedures detailed in this chapter.

**074-11.2.2.2** All nondestructive testing required by the **Welding Standard**, NAVSEA 250-1500-1, shall be performed by personnel qualified to the requirements of NAVSEA 250-1500-1.

**Table 074-11. MANDATORY REFERENCE DOCUMENTS**

| <b>Identification</b>   | <b>Title</b>   |
|-------------------------|--|
| MIL-STD-1688            | Fabrication, Welding, & Inspection of HY-80/100 Submarine Applications   |
| MIL-STD-1689            | Fabrication, Welding, & Inspection of Noncombatant Ship Structures   |
| NAVSEA 0900-LP-003-9000 | Radiography Standard for Production & Repair Welds   |
| NAVSEA 0900-LP-003-8000 | Surface Inspection Acceptance Standards for Metals (NOTE: Includes MT, PT & Visual Inspection)                                       |
| NAVSEA 0900-LP-001-7000 | Fabrication & Inspection of Brazed Piping Joints   |
| MIL-STD-278             | Standard for Welding & Allied Processes on Piping and Machinery  |
| MIL-STD-271             | Requirements for Nondestructive Testing Methods  |
| AWS A2.4                | American Welding Society: Symbols for Welding and Nondestructive Testing   |
| NAVSEA 0900-LP-999-9000 | Acceptance Standards for Surface Finish of Flame or Arc-Cut Material   |
| MIL-STD-248             | Welding and Brazing Procedure and Performance Qualification  |
| NAVPERS 15105           | Manual of Navy Enlisted Classification   |
| ASTM-E-446              | Reference Radiographs for Steel Castings Up to 2 Inches in Thickness   |
| ASTM-E-155              | Reference Radiographs for Aluminum and Magnesium Castings  |
| ASTM-E-186              | Reference Radiographs for Heavy Walled (2 to 4-1/2 in.) Steel Castings   |
| ASTM-E-272              | Reference Radiographs for High Strength Copper Base and Nickel Copper Alloy Castings   |
| ASTM-E-310              | Radiographs Acceptance Criteria for Tin Bronze Castings  |
| MIL-STD-2195(SH)        | Inspection Procedures for Detection and Measurement of Dealloying Corrosion on Aluminum Bronze and Nickel Aluminum Bronze Components |

**Table 074-12. GUIDANCE REFERENCE DOCUMENTS**

| <b>Identification</b>                                     | <b>Title</b>   | <b>Publisher</b>   |
|---|--|--|
| ASTM-E-125  | Standard Reference Photo-<br>graphs for Magnetic<br>Particle Indications on<br>Ferrous Castings  | American Society for Testing<br>and Materials  |
| VOLUMES I and II  | Nondestructive Testing<br>Handbook   | American Society for Non-<br>destructive Testing   |
| VOLUMES I thru %<br><br>2nd edition                       | Programmed Instruction<br>Handbooks<br><br>Radiography in Modern<br>Industry   | American Society for Non-<br>destructive Testing<br><br>Eastman Kodak Company                                |
| ASTM Std.   | Methods of Testing Metals<br>Part 3  | American Society for Testing<br>and Materials  |
| Section 1<br><br>No. 1<br><br>H-55                        | Welding Handbook<br><br>Living with Radiation<br><br>Quality and Reliability<br>Assurance Handbook Non-<br>destructive Testing Series<br>Radiography | American Welding Society<br><br>U.S. Atomic Energy<br>Commission<br><br>Government Printing Office           |
| Recommended<br>Practice<br>SNT-TC-LA<br>June 1980 Edition | American Society for Non-<br>destructive Testing<br>Recommended Practice<br>SNT-TC-LA  | American Society for Non-<br>destructive Testing Inc.,<br>4153 Arlingate Plaza<br>Columbus, OH<br>43228-0518 |

## SECTION 12. NOMENCLATURE

### 074-12.1 DEFINITIONS

**074-12.1.1** Definitions and terminology used in nondestructive testing are given in paragraphs 074-12.1.2 through 074-12.1.17.

**074-12.1.2 APPROVAL.** The term approval (or approved) means that the item under consideration requires formal acceptance by the Naval Sea Systems Command (NAVSEA) or authorized representative(s).

**074-12.1.3 AUTHORIZED REPRESENTATIVE.** An authorized representative is any government representative specifically authorized by NAVSEA to approve equipment, material, or procedures within the scope of the applicable NAVSEA document.

**074-12.1.4 CERTIFICATION.** Certification is a written, recorded verification of qualification.

**074-12.1.5 FACILITY.** Facility is the term used to refer to the physical naval facility performing nondestructive testing.

**074-12.1.6 INSPECTOR.** The inspector is the individual certified as specified in this chapter to evaluate, and accept or reject, materials or workmanship based on invoked acceptance specifications.

**074-12.1.7 NDT.** NDT is the abbreviation used for nondestructive testing.

**074-12.1.8 NDT CERTIFICATION AGENCY.** NDT certification agency is the term used to designate a Navsea approved representative(s) for certification of NDT examiners. Fleet Analysis Center, Code 865, is the approved NAVSEA certification agency for NDT examiners.

**074-12.1.9 QUALIFICATION ACTIVITIES.** Qualification Activities for NDT examiners are Mare Island and- Portsmouth Naval Shipyards.

**074-12.1.10 NONDESTRUCTIVE TESTING LEVELS.** An NDT level indicates a level of qualification and certification within a specific NDT method.

**074-12.1.11 NDT SCHOOL.** The designated school for the training and certification (except examiners) of NDT personnel is the Service School Command, NDT School, Naval Station, Box 6, San Diego, CA 92136.

**074-12.1.12 NONDESTRUCTIVE TESTING EXAMINER.** An NDT examiner is an individual examined and certified by an NDT Agency and delegated by the facility to conduct, on an individual basis, written and operational examinations to certify and re-certify personnel to the level of operator/inspector, as applicable. The NDT examiner also approves NDT procedures in accordance with MIL-STD-271.

**074-12.1.13 NONDESTRUCTIVE TESTING METHODS.** Six methods currently are in use for nondestructive testing. They are:

- a. Radiography (RT)
- b. Ultrasonics (UT)
- c. Magnetic particle (MT)
- d. Liquid penetrant (PT)
- e. Visual inspection (VT)
- f. Eddy current (ET)

**074-12.1.14 NONDESTRUCTIVE TESTING INSPECTOR.** The individual who accepts or rejects the inspected part or item in accordance with the provisions of the applicable fabrication document and

pertinent acceptance standard. For radiography, the film interpreter is the nondestructive testing inspector. For MT, PT, and UT, it is preferred that the inspector also conduct the test; however, if the task requires a minimum of two persons, an operator or another inspector may be assigned to assist the inspector.

**074-12.1.15 NONDESTRUCTIVE TESTING OPERATOR.** An NDT operator performs or applies one of the test methods listed in paragraph 074-12.1.13. For radiography, the radiographer is the operator and, as stated in paragraph

074-12.1.14, the film is interpreted by the inspector.

**074-12.1.15.1** The operator assists the inspector because the ET, MT, PT, and UT methods require that operation and inspection be performed simultaneously.

**074-12.1.16 NDT PERSONNEL.** NDT personnel are the individuals performing or evaluating any of the test methods.

**074-12.1.17 QUALIFICATION.** Qualification is the term applied to compliance with examinations and certification requirements as defined in this chapter.

## SECTION 13. PERSONNEL RADIATION SAFETY

### 074-13.1 GENERAL

**074-13.1.1 PERSONNEL PROTECTION.** Personnel must be protected from radiation hazards when performing the radiography test and when using X-Ray machines. Established standards for protection against radiation hazards are in the federal regulations of the Nuclear Regulatory Commission (NRC), OPNAVINST 5100.19A and NAVFACINST 5100.15. The use of x-ray machines as energy sources for radiography is subject to NAVFACINST 5100.15. The standards for radiation protection prescribed by NAVFACINST 5100.15 shall be adhered to precisely.

**074-13.1.2 NRC SAFETY PROVISIONS.** Some of the safety provisions to protect personnel from radiation hazards are:

- a. Procure an NRC license through the Radiological Affairs Support Office, Naval Nuclear Power Unit, Yorktown, VA 23691.
- b. Apply NRC regulations and the conditions of the NRC license for all work performed in the non-destructive testing area.
- c. Post a copy of the regulations, license, and operating procedures which apply to the work.
- d. Assign only qualified personnel to supervise, operate, and perform work with radiation equipment.
- e. Provide security measures for a radiation area and periodic inspection of the radiographic operations.

## SECTION 14. NAVY ENLISTED CLASSIFICATION

### 074-14.1 GENERAL

**074-14.1.1** Certification of nondestructive testing personnel shall be based on the appropriate Navy Enlisted Classification (NEC) rating system. Requirements for certification, re-certification, and maintenance of certification of the NECs are described in this section.

**074-14.1.2** The Service School Command, San Diego, provides training courses for achievement of various levels of competence in the six NDT inspection methods listed in NO TAG.

### 074-14.2 CERTIFICATION

**074-14.2.1** To receive a course completion certificate, a trainee must pass examinations covering all course material and, in the case of radiography, is also required to demonstrate the ability to safely handle radioactive isotopes, in accordance with the rules and regulations of the NRC.

**074-14.2.2** Upon review of the applicant's performance and skill demonstrated in the course examination, the certification agency may conduct the qualification tests provided that the applicant has met the experience requirements in SNT-TC-1A, June 1980 edition, or may require the applicant to repeat any or all phases of qualification.

**074-14.2.3** Inspection personnel attaining an NDT course completion certificate are given opportunity to be certified as operator or inspector, and are recommended for appropriate NEC assignment by the Service School Command. An NEC will not be issued until the individual has been certified in accordance with the requirements of this procedure.

## NOTE

Personnel failing any or all of the examination(s) at the Service School may, after further training, be re-examined by the examiner attached to this facility. Upon successfully passing these examinations, the examiner shall recommend the certified operators and inspectors for the appropriate NEC assignments.

### 074-14.3 RE-CERTIFICATION

**074-14.3.1** All NDT personnel shall be re-certified every 3 years in order to retain certification and NEC assignments. Re-certification is required when respective NEC skills are not used for a period of 6 months or as required by the governing document (with the exception of an examiner who has a 3-year limitation). Personnel unable to meet recertification requirements shall be recommended by their commanding officers for removal of their NDT NECs.

**074-14.3.2** The NECs for nondestructive testing, as assigned by the Bureau of Naval Personnel, are listed in the Manual of Navy Enlisted Classification, NAVPERS 15105.

### 074-14.4 CERTIFICATION, EXAMINERS

**074-14.4.1** Examiners are certified by the NAVSEA Certification Agency upon satisfactory examination at one of the NAVSEA qualification activities in accordance with Section 15.

### 074-14.5 RE-CERTIFICATION, EXAMINERS

**074-14.5.1** Examiners shall be recertified every 3 years by repeating the requirements for original certification.



Table 074–12A. NDT TRAINING COURSES

| NDT Inspection         | Level of Competence     | Course Number          |
|------------------------|-------------------------|------------------------|
| Visual (VT)            | Inspector               | A701–0033              |
| Magnetic Particle (MT) | Operator, Inspector     | A701–0033              |
| Liquid Penetrant (PT)  | Operator, Inspector     | A701–0033              |
| Eddy Current (ET)      | Operator, Inspector     | A701–0050              |
| Ultrasonic (UT)        | Operator, Inspector     | A701–0034<br>0046 0047 |
| Radiography (RT)       | Radiographer, Inspector | A701–0032<br>0035      |

#### 074–14.6 CERTIFICATION BY IMAS AND FORCES AFLOAT

**074–14.6.1** Operators and inspectors may be qualified, certified, and recertified by test examiners at the facility. The test examiner shall forward records of qualification to COMNAVMILPERCOM, Code 402E, Washington D.C. 20370.

**074–14.6.2** The facility's test examiner may qualify and certify operators and inspectors from other IMAs and forces afloat provided that the request for

certification is formally initiated by the candidate's command and the candidate provides the examiner with copies of the NDT procedures in use at his/her command. The examiner will review the procedures to assure that the examinations to be administered cover all relevant requirements in the procedures. The examiner shall notify the candidate's command and COMNAVMILPERCOM, Code 402E, Washington D.C. 20370, of the results of the qualification and certification per paragraph 074–15.5.4 herein.

## SECTION 15. QUALIFICATION REQUIREMENTS

### 074-15.1 GENERAL

**074-15.1.1** To obtain examiner qualification services, each facility shall apply in writing to either:

Mare Island Naval Shipyard,  
Code 135, Vallejo, CA 94529

Portsmouth Naval Shipyard, Code 135,  
Portsmouth, NH 03801

The NDT Certification Agency will inform the facility of the time and location of examination should the candidate meet the minimum prerequisite requirements defined in this section.

### 074-15.2 APPLICATION INFORMATION

**074-15.2.1** The letter of application shall include the names of the individuals to be examined and the assigned facility.

**074-15.2.2** In addition, the application shall specify the NDT method(s) for which the candidate is applying. These could include radiography, magnetic particle, liquid penetrant, eddy current, and ultrasonics. The latter course is specified in MIL-STD-271, in **Fabrication and Inspection of Brazed Piping Joints**, NAVSEA 0900-LP-001-7000, and in **Inspection Procedures for Detection and Measurement of Dealloying Corrosion on Aluminum Bronze and Nickel Aluminum Bronze Components**, MIL-STD-2195(SH).

**074-15.2.3** The examiner candidate's formal, classroom, and on-the-job training shall be listed along

with information on currently held NEC and experience.

### 074-15.3 MINIMUM REQUIREMENTS FOR EXAMINER CERTIFICATION

**074-15.3.1** The examiner candidate's minimum prerequisites are defined in paragraphs 074-15.3.2 through 074-15.3.5.

#### NOTE

These prerequisites may be waived for Certified Inspector personnel who are not graduates of the Nondestructive Testing of Metals course, provided verification of formal training is enclosed with letter of application.

**074-15.3.2 RADIOGRAPHY.** Prerequisites for application for certification in radiography testing include satisfactory completion of the Nondestructive Testing of Metals course, A701-0035. The candidate also must have the NEC code number 4938 or 4933. In addition, the candidate must have a minimum of 1 year of experience as an inspector and a minimum of 1 year of obligated military service.

**074-15.3.3 MAGNETIC PARTICLE OR LIQUID PENETRANT.** Prerequisites for application for certification in magnetic particle or liquid penetrant testing include satisfactory completion of the Nondestructive Testing of Metals course, A701-0031. The candidate also must have the NEC code number 4931 and be certified as an inspector. In addition, the candidate must have a minimum of 1 year of experience as an inspector and a minimum of 1 year of obligated military service.

**074-15.3.4 ULTRASONICS.** Prerequisites for certification in ultrasonic testing include satisfactory completion of the following Nondestructive Testing courses; A701-0046, A701-0034, and A701-0047. The candidate also must be qualified for NEC code number 4934 and have 1 year of experience in the area for which certification is desired (SIL-BRAZE thickness or shear wave). In addition, 1 year of obligated military service is required.

**074-15.3.5 EDDY CURRENT.** Prerequisites for certification in eddy current testing include satisfactory completion of the Nondestructive Testing of Metals course, A701-0050. In addition, the applicant must have a minimum of 1 year of experience as an inspector and a minimum of 1 year of obligated military service.

#### **074-15.4 QUALIFICATION LEVELS**

**074-15.4.1 NONDESTRUCTIVE TESTING EXAMINER.** The certified NDT Examiner shall be responsible for the qualification of NDT operator(s) or inspector(s) in the method(s) for which certified. The examiner shall qualify only those individuals who have successfully completed the Nondestructive Testing of metals course of instruction as listed in NO TAG, or the equivalent, and up-grade or re-certify those individuals who have a valid NDT (NEC). In addition, the nondestructive testing examiner shall be responsible for closely supervising the certified nondestructive testing inspector for a period of 1 year from the date of initial certification.

**074-15.4.1.1** The certified examiner shall be responsible for approval of NDT procedures used by personnel under his/her supervision.

**074-15.4.1.2** Examiner candidates shall be tested on all areas required in the inspection method for which

he is a candidate. An examiner will be required to satisfactorily complete a three-phase examination in accordance with Section 16. The NDT background requirements for an examiner candidate shall be in accordance with paragraphs 074-15.3.2 through 074-15.3.5.

#### **NOTE**

For exceptions to these requirements, see paragraphs 074-11.2.2.1 and 074-15.3.5.

**074-15.4.2 NONDESTRUCTIVE TESTING INSPECTOR.** NDT inspectors shall be qualified to perform inspection(s), and accept or reject, in accordance with the requirements of the applicable specification(s) and acceptance standard(s) in the NDT method(s) in which they are certified.

**074-15.4.2.1** A candidate, to be certified as an NDT inspector, shall be thoroughly familiar with the appropriate inspection method and shall be capable of inspection results in accordance with the applicable specification(s) and acceptance standard(s). In addition, to be certified or re-certified, he/she must have course completion as listed in NO TAG.

**074-15.4.2.2** In addition, the candidate shall be familiar with the type and location of expected defects for the fabrication process, material, or stage of manufacture involved.

**074-15.4.2.3** The candidate shall be required to complete satisfactorily a three-phase examination in accordance Section 16. The phase H examination shall be comprehensive, but shall be limited to that segment of requirements, specifications, and acceptance standards of the applicable NDT method.

**074-15.4.2.4** The candidate shall have a thorough understanding of the theory and principles of the NDT method.

#### NOTE

In addition, as part of phase In, a candidate for radiography shall be required to interpret a selected film group satisfactorily to check for proper technique processing, defect identification, and evaluation.

**074-15.4.3 NONDESTRUCTIVE TESTING OPERATOR.** Personnel qualified as NDT Operators shall perform inspection(s) and report the results to the inspector. They shall perform only the inspection method for which qualified. An operator shall be permitted to accept or reject any part or item inspected, except where the operator has been certified as an inspector.

**074-15.4.3.1** A candidate to be certified as an operator shall have sufficient formal training to apply the NDT method in which certification is sought and shall be a graduate of the applicable course in Table 074-12A. The candidate shall not be required to accept or reject items tested, but shall be capable of conducting the applicable inspection method in accordance with written procedures and the appropriate specifications. The candidate shall be required to complete satisfactorily a three-phase (phases I, III, and M) examination in accordance with Section 16, with the exception that phase III shall not contain questions on acceptance/rejection.

#### **074-15.5 CONTROL OF CERTIFIED NDT PERSONNEL**

**074-15.5.1 GENERAL.** Certification of an individual in a specific method automatically certifies him/her for all levels up to and including the level for

which he/she is certified. Certified personnel shall not be permitted to perform nondestructive tests in a capacity at a higher level than that in which certified. All NDT personnel shall produce a current certification card as proof of certification upon request.

**074-15.5.2 TRANSFER OF CERTIFIED NDT PERSONNEL.** A certified NDT examiner may be transferred from one naval facility to another without recertification; however, the NDT Certification Agency must be informed of this transfer by the examiner's new activity. NDT inspectors and operators transferred from one naval facility to another must be evaluated to the satisfaction of the NDT examiner of the new facility.

**074-15.5.3 TERMINATION OF NAVAL SERVICE.** The NDT Certification Agency shall be informed by the facility when a certified NDT examiner is released from naval service.

**074-15.5.4 PERSONNEL RECORDS.** Personnel records shall be maintained for NAVSEA review by COMNAVMILPERCOM, Code 402E, indicating the extent of certification held by personnel qualified as NDT examiners. All facilities shall also notify the NDT school, within 10 days, of certification or recertification conducted by the facility NDT examiner. Notification shall include:

- a. Facility
- b. Name and rate of certified individual
- c. NDT method
- d. Qualification level
- e. Specifications and standards to which certified
- f. Date of certification or recertification
- g. Name and number of examiner

**074-15.6 REQUALIFICATION**

**074-15.6.1** Requalification of all NDT personnel shall be accomplished under the following conditions:

- a. At 3-year intervals from the date of all of the individual's initial qualifications.
- b. When a certified individual has not actively engaged in nondestructive testing for more than 6 months, or as specified in the governing document.
- c. When the facility test examiner has verification that an individual is unable to perform competently at the NDT level to which he/she is qualified.
- d. When the NDT Certification Agency has verification that the facility test examiner is unable to perform his/her duties competently.

**NOTE**

Competency may be determined by scheduled or unscheduled, formal or informal, audit by the NAVSEA or NDT Certification Agency representative.

**074-15.6.2 RETESTS.** If an individual fails the first certification examination, the organization may request a reexamination. Any request for reexamination of an individual after a second failure shall describe the additional training provided in the interim. Requests for reexamination of an individual after a third failure will not be approved unless the individu-

al has obtained additional experience in the specific nondestructive test discipline which was failed.

**074-15.6.2.1** NDT inspector and operator candidates who fail any phase of the qualification test must be given additional classroom or on-the-job training prior to retesting in the phase failed.

**074-15.6.3 VISION TEST.** All NDT candidates must show proof of a current satisfactory vision test. NDT personnel not having a current vision test shall not perform NDT functions until the prescribed vision test has been passed satisfactorily.

**074-15.6.3.1** The vision test shall be repeated annually and shall be conducted by a trained technician using standard test methods for determining visual acuity. The standard for acceptance for vision tests shall be:

- a. Natural or corrected near distance acuity to prove the applicant is capable of reading J1 letters on the standard Jaegar type chart for near vision.
- b. Ability to distinguish between colors when required by the NDT test method being applied.
- c. For radiographic inspectors, ability to pass brightness discrimination test as required by MIL-STD-271.

**074-15.6.4 HEARING TEST.** An audiogram is required for personnel performing eddy current examinations using equipment with audio/alarm capabilities.

## SECTION 16. METHOD OF QUALIFICATION

### 074-16.1 GENERAL

**074-16.1.1** Examination material shall be oriented toward the NDT application requirements of a naval conversion or repair facility. The examination for examiners and inspectors shall consist of all three phases listed in paragraph 074-16.2. Administration of qualification tests for inspectors and operators shall be in accordance with instructions provided by the NDT Certification Agency.

### 074-16.2 THE THREE-PHASE EXAMINATION

**074-16.2.1 PHASE I – THEORY AND PRINCIPLES.** Phase I of the examination shall be written and shall cover inspection principles relative to the nondestructive testing method and level of qualification for which the candidate is applying. This phase of the examination is closed book and is applicable to all levels of certification. Recommended training references are listed in Table 074-12A.

**074-16.2.2 PHASE II – SPECIFICATIONS AND STANDARDS.** Phase II shall be written and shall test the candidate's knowledge of the requirements of the reference documents listed in Section 11. This phase of the examination is applicable to examiner and inspector candidates only. The examination will be the open book type where candidates may refer to the documents listed in Table 074-11, Table 074-12, Table 074-12A.

**074-16.2.3 PHASE III – OPERATIONAL.** Phase III shall require the candidate to demonstrate proficiently the ability to employ the necessary equipment and technique in accordance with the requirements of the applicable reference document(s).

**074-16.2.3.1** Candidates for NDT level other than operator shall also demonstrate ability to evaluate inspection results for acceptance or rejection. This portion of the examination is applicable to all levels of certification.

### 074-16.3 CANDIDATE EVALUATION

**074-16.3.1** The evaluation or grading system applies to both the written and operational portions of the examinations. The evaluation is to be applied uniformly to all individuals, for each phase. A minimum final grade of 80 with no less than 80 in any phase is required for all certification levels (examiner, inspector, and operator).

**074-16.3.2** To ensure that the results of examinations will be meaningful in determining the qualification of personnel, the examination material shall be handled so that prior knowledge of examination questions is known only to the test examiner.

### 074-16.4 RECOMMENDED TRAINING REFERENCES

**074-16.4.1** Recommended training references, giving document title and author or source, are listed in Table 074-12A.

TABLE 074—12A. RECOMMENDED TRAINING REFERENCES\*

| Title  | Author/Source   |
|--|---|
| <b>GENERAL</b>   |   |
| Metals Handbook Vol. 11<br>Nondestructive Inspection and Quality Control   | ASM   |
| <b>RADIOGRAPHY</b>   |   |
| Nondestructive Testing Handbook Vol. I<br><br>Handbook of Industrial Radiography<br><br>Radiography in Modern Industry<br><br>American Society for Testing Materials and Methods, and<br>Recommended Practices: E52, E142, E99, E94, E71, E155                                 | R.C. McMaster<br><br>J.A. Crowther<br><br>Eastman Kodak Co. |
| <b>MAGNETIC PARTICLE/LIQUID PENETRANT</b>  |   |
| Nondestructive Testing Handbook, Vol. II<br><br>Principles of Magnetic Particle Testing and Principles of<br>Liquid Penetrant Testing<br><br>Welding Handbook, Sec. I, American Welding Society<br>American Society for Testing and Materials: A275, E138,<br>E109, E125, A456 | R.C. McMaster<br><br><br>C.E. Betz                          |
| <b>EDDY CURRENT</b>  |   |
| Nondestructive Testing Handbook, Vol. II   | R.C. McMaster   |
| <b>ULTRASONIC</b>  |   |
| Nondestructive Testing Handbook, Vol. II<br><br>Nondestructive Testing<br><br>Ultrasonics<br><br>Welding Handbook, Sec. 1, American Welding Society,<br>American Society for Testing and Materials,<br>Recommended Practices: E113, E213, E127, E164, E114,<br>E214            | R.C. McMaster<br><br>W.J. McGonnagle<br><br>B. Carlin       |

\*Latest effective edition of each.



## SECTION 17. EQUIPMENT QUALIFICATION

### 074-17.1 GENERAL

**074-17.1.1** Prior to performing nondestructive testing, the equipment shall be qualified as described in paragraphs 074-17.2 through 074-17.5. Equipment calibrations, when required, shall be conducted to the requirements of MIL-STD-271.

#### NOTE

Equipment and NDT procedure qualification for inspections performed to meet the specifications of **Welding Standard Nuclear Propulsion Plant Publication**, NAVSEA 250-1500-1 shall be performed in accordance with the requirements of that document.

### 074-17.2 RADIOGRAPHIC INSPECTION

**074-17.2.1** The adequacy of radiographic test equipment and materials is determined by successful completion of procedure qualification tests. Qualification tests shall be as specified in MIL-STD-271.

**074-17.2.2** The equipment and materials used shall be capable of consistently producing results of the specified quality level when used by qualified personnel.

### 074-17.3 MAGNETIC PARTICLE AND LIQUID PENETRANT INSPECTION

**074-17.3.1** The equipment and material shall meet the requirements of MIL-STD-271 prior to use.

### 074-17.4 ULTRASONIC INSPECTION

**074-17.4.1** Ultrasonic equipment shall be qualified in accordance with the specifications in the following documents:

a. For welds, bonding, soundness, thickness, and wrought material, MIL-STD-271.

b. For brazed joints, **Fabrication and Inspection of Brazed Piping Joints**, NAVSEA 0900-LP-001-7000.

### 074-17.5 EDDY CURRENT INSPECTION

**074-17.5.1** Eddy current equipment shall be qualified in accordance with the following documents:

a. For crack detection, MIL-STD-271

b. For dealloy inspection, **Inspection Procedures for Detection and Measurement of Dealloying Corrosion on Aluminum Bronze and Nickel Aluminum Bronze Components**, MIL-STD-2195(SH).

### 074-17.6 EQUIPMENT MAINTENANCE

#### CAUTION

In cleaning equipment, take care that air is not directed with any great pressure toward vital parts (such as bearings, or commutators) or cause dust-laden air to be so directed. Do not use wire brushes or other such tools for cleaning rectifiers and other electrical components.

**074-17.6.1 GENERAL.** Cleanliness is a prime factor in prolonging the life of all nondestructive testing machines and equipment. The machines should be located in a clean, dry, well-ventilated area free from acid fumes, steam, or dust.

#### NOTE

If the Planned Maintenance System (PMS) system has been installed, preventive maintenance should be conducted in accordance with Maintenance Requirement Cards (MRCs).



**074-17.6.2 CLEANING.** The machines should be cleaned once a month. Wipe off all dust, grease, and other dirt from the outside of the machine, and vacuum or blow out the interior of the machine with clean, dry, compressed air.

**074-17.6.2.1** Inspect all components and wires for deterioration of insulation.

**NOTE**

The insulation resistance should be at least 1 megohm to ground.

**074-17.6.3 EQUIPMENT TYPES.** X-ray machines, ultrasonic equipment, and eddy current testing equipment shall all be maintained in accordance with manufacturers' instructions, which will vary with the different types of machines.

**074-17.6.3.1** Magnetic particle testing equipment maintenance also shall be done in accordance with the manufacturers' instructions. This equipment, however, has the added requirement for periodic checking of ammeter calibration.

**074-17.6.4 ANNUAL OVERHAUL PROGRAMS.** Annual overhaul programs should be established, at

which time the equipments should be inspected, tested, and calibrated to ensure performance accuracy. All worn parts shall be reconditioned or replaced.

**074-17.7 INTERNAL AUDIT**

**074-17.7.1** To ensure compliance with the provisions of this chapter, the Commanding Officer should establish an internal audit team to ascertain that all critical items are fabricated or repaired. This will provide assurance of their integrity and reliability.

**NOTE**

Fabrication and repair inspection and acceptance in these areas shall be in strict compliance with all applicable NAVSEA specifications and standards to ensure the necessary quality and reliability.

**074-17.7.2** Compliance must be based on continuous and comprehensive checks of the actual work. No waivers of existing requirements for fabrication, inspection, and acceptance of critical items shall be granted unless written NAVSEA approval has been obtained.

# NAVSEA (USER) TECHNICAL MANUAL DEFICIENCY/EVALUATION REPORT (TMDER) (NAVSEA S0005-AA-GYD-030/TMMP & NAVSEAINST 4160.3A)

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1. NAVSEA TECHNICAL MANUAL NO. \*  
S9086-CH-STM-020/CH-074 V2

2. VOL.  
PART\*  
2

3. TITLE\* NONDESTRUCTIVE  
TESTING OF METALS, QUALIFICATION AND  
CERTIFICATION REQUIREMENTS FOR NAVAL  
PERSONNEL (NON-NUCLEAR)

4. REV. NO./DATE OR  
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8. GENERAL COMMENTS:

## 9. RECOMMENDED CHANGES TO PUBLICATION

| PAGE<br>NO.<br>A. | PARA-<br>GRAPH<br>B. | LINE<br>NO.<br>C. | FIG.<br>NO.<br>D. | TABLE<br>E. | F. RECOMMENDED CHANGES AND REASONS<br>TYPE OF PROBLEM [INDICATE SAFETY (S), MAJOR (M) OR MINOR (P)] |
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