

BASIC

BASIC EXAMINATION TOPICAL OUTLINES

Basic Examination Level III Topical Outline

The Basic examination will cover three main topical areas:

- 1.0 Personnel Qualification and Certification Programs
Covering Recommended Practice No. SNT-TC-1A, ANSI/
ASNT-CP-189, and the ASNT NDT Level III Program
- 2.0 General Familiarity with Other NDT Methods, Covering
the 11 NDT Test Methods Listed in this Section, and;
- 3.0 General Knowledge of Materials, Fabrication,
and Product Technology

The above topics are further subdivided into topical outlines below, followed by the reference materials used in the development of these outlines and sample questions typical of those in the examinations.

1.0 Personnel Qualification and Certification Programs

- 1.1 Recommended Practice No. SNT-TC-1A
 - 1.1.1 Scope
 - 1.1.2 Definitions
 - 1.1.3 Nondestructive testing methods
 - 1.1.4 Levels of qualification
 - 1.1.5 Written practice
 - 1.1.6 Education, training, and experience for initial qualification
 - 1.1.7 Training programs
 - 1.1.8 Examinations
 - 1.1.9 Certification
 - 1.1.10 Technical performance evaluation
 - 1.1.11 Interrupted service
 - 1.1.12 Recertification
 - 1.1.13 Termination
 - 1.1.14 Reinstatement
 - 1.1.15 Referenced publications
- 1.2 ASNT Standard ANSI/ASNT-CP-189
 - 1.2.1 Scope
 - 1.2.2 Definitions
 - 1.2.3 Levels of qualification
 - 1.2.4 Qualification requirements
 - 1.2.5 Qualification and certification
 - 1.2.6 Examinations
 - 1.2.7 Expiration, suspension, revocation, and reinstatement of employer certification
 - 1.2.8 Employer recertification
 - 1.2.9 Records
 - 1.2.10 Referenced publications

- 1.3 NDT Level III certification program
 - 1.3.1 Scope
 - 1.3.2 Definitions
 - 1.3.3 Certification outcome
 - 1.3.4 Eligibility for examination
 - 1.3.5 Qualification examinations
 - 1.3.6 Examinations results
 - 1.3.7 Certification
 - 1.3.8 Validity
 - 1.3.9 Recertification

2.0 General Familiarity with Other NDT Methods

- 2.1 Acoustic emission testing (AE)
 - 2.1.1 Fundamentals
 - 2.1.1.1 Principles/theory of AE
 - 2.1.1.2 Sources of acoustic emissions
 - 2.1.1.3 Equipment and material
 - 2.1.2 Proper selection of acoustic emission technique
 - 2.1.2.1 Instrumentation and signal processing
 - 2.1.2.2 Cables (types)
 - 2.1.2.3 Signal conditioning
 - 2.1.2.4 Signal detection
 - 2.1.2.5 Noise discrimination
 - 2.1.2.6 Electronic technique
 - 2.1.2.7 Attenuation materials
 - 2.1.2.8 Data-filtering techniques
 - 2.1.3 Interpretation and evaluation of test results
- 2.2 Electromagnetic testing (ET)
 - 2.2.1 Sensors
 - 2.2.2 Basic types of equipment, types of readout
 - 2.2.3 Reference standards
 - 2.2.4 Applications and test result interpretation
 - 2.2.4.1 Flaw detection
 - 2.2.4.2 Conductivity and permeability sorting
 - 2.2.4.3 Thickness gauging
 - 2.2.4.4 Process control
- 2.3 Leak testing (LT)
 - 2.3.1 Fundamentals
 - 2.3.1.1 Bubble leak testing
 - 2.3.1.2 Pressure leak testing
 - 2.3.1.3 Halogen detector leak testing
 - 2.3.1.4 Mass spectrometer leak testing

- 2.3.2 LT procedures and techniques
 - 2.3.2.1 System factors
 - 2.3.2.2 Relative sensitivity
 - 2.3.2.3 Evacuated systems
 - 2.3.2.4 Pressurized systems – ambient fluids, tracer fluids
 - 2.3.2.5 Locating leaks
 - 2.3.2.6 Standardization
- 2.3.3 Test result interpretation
- 2.3.4 Essentials of safety
- 2.3.5 Test equipment
- 2.3.6 Applications
 - 2.3.6.1 Piping and pressure vessels
 - 2.3.6.2 Evacuated systems
 - 2.3.6.3 Low-pressure fluid containment vessels, pipes, and tubing
 - 2.3.6.4 Hermetic seals
 - 2.3.6.5 Electrical and electronic components
- 2.4 Liquid penetrant testing (PT)
 - 2.4.1 Fundamentals
 - 2.4.1.1 Interaction of penetrants and discontinuity openings
 - 2.4.1.2 Fluorescence and contrast
 - 2.4.2 PT
 - 2.4.2.1 Penetrant processes
 - 2.4.2.2 Test equipment and systems factors
 - 2.4.2.3 Test result interpretation, discontinuity indications
 - 2.4.2.4 Applications
 - 2.4.2.4.1 Castings
 - 2.4.2.4.2 Welds
 - 2.4.2.4.3 Wrought metals
 - 2.4.2.4.4 Machined parts
 - 2.4.2.4.5 Leaks
 - 2.4.2.4.6 Field inspections
- 2.5 Magnetic particle testing (MT)
 - 2.5.1 Fundamentals
 - 2.5.1.1 Magnetic field principles
 - 2.5.1.2 Magnetization by means of electric current
 - 2.5.1.3 Demagnetization
 - 2.5.2 MT
 - 2.5.2.1 Basic types of equipment and inspection materials
 - 2.5.2.2 Test results interpretation, discontinuity indications
 - 2.5.2.3 Applications
 - 2.5.2.3.1 Welds
 - 2.5.2.3.2 Castings
 - 2.5.2.3.3 Wrought metals
 - 2.5.2.3.4 Machined parts
 - 2.5.2.3.5 Field applications
- 2.6 Neutron radiographic testing (NR)
 - 2.6.1 Fundamentals
 - 2.6.1.1 Sources
 - 2.6.1.1.1 Isotopic
 - 2.6.1.1.2 Neutron generators
 - 2.6.1.2 Detectors
 - 2.6.1.2.1 Imaging
 - 2.6.1.2.2 Nonimaging
 - 2.6.1.3 Nature of penetrating radiation and interactions with matter
 - 2.6.1.4 Essentials of safety
 - 2.6.2 NR
 - 2.6.2.1 Basic imaging considerations
 - 2.6.2.2 Test result interpretation, discontinuity indications
 - 2.6.2.3 Systems factors (source/test object/detector interactions)
 - 2.6.2.4 Applications
 - 2.6.2.4.1 Explosives and pyrotechnic devices
 - 2.6.2.4.2 Assembled components
 - 2.6.2.4.3 Bonded components
 - 2.6.2.4.4 Corrosion detection
 - 2.6.2.4.5 Nonmetallic materials
- 2.7 Radiographic testing (RT)
 - 2.7.1 Fundamentals
 - 2.7.1.1 Sources
 - 2.7.1.2 Detectors
 - 2.7.1.2.1 Imaging
 - 2.7.1.2.2 Nonimaging
 - 2.7.1.3 Nature of penetrating radiation and interactions with matter
 - 2.7.1.4 Essentials of safety
 - 2.7.2 RT
 - 2.7.2.1 Basic imaging considerations
 - 2.7.2.2 Test result interpretation, discontinuity indications
 - 2.7.2.3 Systems factors (source/test object/detector interactions)
 - 2.7.2.4 Applications
 - 2.7.2.4.1 Castings
 - 2.7.2.4.2 Welds
 - 2.7.2.4.3 Assemblies
 - 2.7.2.4.4 Electronic components
 - 2.7.2.4.5 Field inspections
- 2.8 Thermal/infrared testing (IR)
 - 2.8.1 Fundamentals
 - 2.8.1.1 Principles and theory of IR
 - 2.8.1.2 Temperature measurement principles
 - 2.8.1.3 Proper selection of IR technique
 - 2.8.2 Equipment/materials
 - 2.8.2.1 Temperature measurement equipment
 - 2.8.2.2 Heat flux indicators
 - 2.8.2.3 Noncontact devices
 - 2.8.2.4 Contact temperature indicators

- 2.8.2.5 Noncontact pyrometers
- 2.8.2.6 Line scanners
- 2.8.2.7 Thermal imaging
- 2.8.3 Applications
 - 2.8.3.1 Exothermic or endothermic investigations
 - 2.8.3.2 Friction investigations
 - 2.8.3.3 Fluid flow investigations
 - 2.8.3.4 Thermal resistance investigations
 - 2.8.3.5 Thermal capacitance investigations
- 2.8.4 Interpretation and evaluation
- 2.9 Ultrasonic testing (UT)
 - 2.9.1 Fundamentals
 - 2.9.1.1 Wave propagation
 - 2.9.1.1.1 Sound fields
 - 2.9.1.1.2 Wave travel modes
 - 2.9.1.1.3 Refraction, reflection, scattering, and attenuation
 - 2.9.1.2 Transducers and sound beam coupling
 - 2.9.2 UT
 - 2.9.2.1 Basic types of equipment
 - 2.9.2.2 Reference standards
 - 2.9.2.3 Test result interpretation, discontinuity indications
 - 2.9.2.4 System factors
 - 2.9.2.5 Applications
 - 2.9.2.5.1 Flaw detection and evaluation
 - 2.9.2.5.2 Thickness measurement
 - 2.9.2.5.3 Bond evaluation
 - 2.9.2.5.4 Process control
 - 2.9.2.5.5 Castings
 - 2.9.2.5.6 Weldments
- 2.10 Visual testing (VT)
 - 2.10.1 Fundamentals
 - 2.10.1.1 Principles and theory of VT
 - 2.10.1.2 Selection of correct visual technique
 - 2.10.1.3 Equipment and materials
 - 2.10.2 Specific applications
 - 2.10.2.1 Metal joining processes
 - 2.10.2.2 Pressure vessels
 - 2.10.2.3 Pumps
 - 2.10.2.4 Valves
 - 2.10.2.5 Bolting
 - 2.10.2.6 Castings
 - 2.10.2.7 Forgings
 - 2.10.2.8 Extrusions
 - 2.10.2.9 Microcircuits
 - 2.10.3 Interpretation and evaluation
 - 2.10.3.1 Codes and standards
 - 2.10.3.2 Environmental factors
- 2.11 Magnetic flux leakage testing (MFL)
 - 2.11.1 Fundamentals
 - 2.11.1.1 Magnetic field principles
 - 2.11.1.2 Magnetization by means of electric current
 - 2.11.1.3 Flux leakage
 - 2.11.2 MFL
 - 2.11.2.1 Basic types of equipment and inspection materials
 - 2.11.2.2 Types of discontinuities found by MFL
 - 2.11.2.3 Sensors used in MFL
 - 2.11.3 Applications
 - 2.11.3.1 Wire rope inspection
 - 2.11.3.2 Pipe body inspection
 - 2.11.3.3 Tank floor/steel plate inspection
- 3.0 **Basic Materials, Fabrication, and Product Technology**
 - 3.1 Fundamentals of material technology
 - 3.1.1 Properties of materials
 - 3.1.1.1 Strength and elastic properties
 - 3.1.1.2 Physical properties
 - 3.1.1.3 Material properties testing
 - 3.1.2 Origin of discontinuities and failure modes
 - 3.1.2.1 Inherent discontinuities
 - 3.1.2.2 Process-induced discontinuities
 - 3.1.2.3 Service-induced discontinuities
 - 3.1.2.4 Failures in metallic materials
 - 3.1.2.5 Failures in nonmetallic materials
 - 3.1.3 Statistical nature of detecting and characterizing discontinuities
 - 3.2 Fundamentals of fabrication and product technology
 - 3.2.1 Raw materials processing
 - 3.2.2 Metals processing
 - 3.2.2.1 Primary metals
 - 3.2.2.1.1 Metal ingot production
 - 3.2.2.1.2 Wrought primary metals
 - 3.2.2.2 Castings
 - 3.2.2.2.1 Green sand molded
 - 3.2.2.2.2 Metal molded
 - 3.2.2.2.3 Investment molded
 - 3.2.2.3 Welding
 - 3.2.2.3.1 Common processes
 - 3.2.2.3.2 Hard-surfacing
 - 3.2.2.3.3 Solid-state
 - 3.2.2.4 Brazing
 - 3.2.2.5 Soldering
 - 3.2.2.6 Machining and material removal
 - 3.2.2.6.1 Turning, boring, and drilling
 - 3.2.2.6.2 Milling
 - 3.2.2.6.3 Grinding
 - 3.2.2.6.4 Electrochemical
 - 3.2.2.6.5 Chemical
 - 3.2.2.7 Forming
 - 3.2.2.7.1 Cold-working processes
 - 3.2.2.7.2 Hot-working processes

- 3.2.2.8 Powdered metal processes
- 3.2.2.9 Heat treatment
- 3.2.2.10 Surface finishing and corrosion protection
 - 3.2.2.10.1 Shot peening and grit blasting
 - 3.2.2.10.2 Painting
 - 3.2.2.10.3 Plating
 - 3.2.2.10.4 Chemical conversion coatings
- 3.2.2.11 Adhesive joining
- 3.2.3 Nonmetals and composite materials processing
 - 3.2.3.1 Basic materials processing and process control
 - 3.2.3.2 Nonmetals and composites fabrication
 - 3.2.3.3 Adhesive joining
- 3.2.4 Dimensional metrology
 - 3.2.4.1 Fundamental units and standards
 - 3.2.4.2 Gauging
 - 3.2.4.3 Interferometry

BASIC EXAMINATION TRAINING REFERENCES

PERSONNEL QUALIFICATION AND CERTIFICATION PROGRAMS

ASNT, latest edition, *A Guide to Personnel Qualification and Certification*, Columbus, OH: American Society for Nondestructive Testing Inc.

ASNT, latest edition, ANSI/ASNT CP-189: *ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel*, Columbus, OH: American Society for Nondestructive Testing Inc.

ASNT, latest edition, *ASNT Level III Study Guide: Basic*, Columbus, OH: American Society for Nondestructive Testing Inc.

ASNT, latest edition, ASNT Recommended Practice No. SNT-TC-1A: *Personnel Qualification and Certification in Nondestructive Testing*, Columbus, OH: American Society for Nondestructive Testing Inc.

COMMON NDT METHODS

ASNT. 2012. *Nondestructive Testing Overview. 3rd ed. vol. 10. Nondestructive Testing Handbook*. Columbus, OH: American Society for Nondestructive Testing Inc.

ASNT. 2015. *Magnetic Particle Testing Classroom Training Book (PTP Series)*. Columbus, OH: American Society for Nondestructive Testing Inc.

ASNT. 2015. *Ultrasonic Testing, Classroom Training Book (PTP Series)*. 2nd ed. Columbus, OH: American Society for Nondestructive Testing Inc.

ASNT. 2016. *Radiographic Testing Classroom Training Book (PTP Series)*. 2nd ed. Columbus, OH: American Society for Nondestructive Testing Inc.

ASNT. 2017. *Visual Testing Classroom Training Book (PTP Series)*. Columbus, OH: American Society for Nondestructive Testing Inc.

ASNT. 2018. *Electromagnetic Testing Classroom Training Book (PTP Series)*. 2nd ed. Columbus, OH: American Society for Nondestructive Testing Inc.

ASNT. 2019. *Liquid Penetrant Testing Classroom Training Book (PTP Series)*. Columbus, OH: American Society for Nondestructive Testing Inc.

Mix, P. 2005. *Introduction to Nondestructive Testing: A Training Guide*. 2nd ed. New York: John Wiley & Sons Inc.

MATERIALS, FABRICATION, AND PRODUCT TECHNOLOGY

ASNT. 2016. *Materials and Processes for NDT Technology*. 2nd ed. Columbus, OH: American Society for Nondestructive Testing Inc.

AWS. 2015. *Welding Inspection Handbook*. 4th ed. Miami, FL: American Welding Society.

Taylor, J., ed., 1996, *Basic Metallurgy for Nondestructive Testing*, revised edition, W.H. Houldershaw Ltd, British Institute for Non-Destructive Testing, Essex, England.

* Available from The American Society for Nondestructive Testing Inc., Columbus, OH.