WELDING INSPECTION TECHNOLOGY WORKBOOK

MODULE 1

WELDING INSPECTION AND CERTIFICATION

Q1-1 Why is there an increasing need for weld quality?
- a. safety
- b. economics
- c. less conservative design
- d. government regulations
- e. all of the above

Q1-2 What AWS document describes the rules for the CWI certification program?
- a. AWS 5.5
- b. AWS D1.1
- c. AWS QC-1
- d. AWS 5.1
- e. AWS 14.1

Q1-3 Weld quality control should begin after welding has been initiated.
- a. true
- b. false

Q1-4 What are the three welding inspector certifications covered in AWS QC-1?
- a. CAWI, CWI, BWI
- b. CWI, CAWI, SCWI
- c. SCWI, CWI, ACWI
- d. Level I, II, and III
- e. None of the above

Q1-5 What is generally considered to be the most important quality of a welding inspector?
- a. graduation from a welding vocational program
- b. an engineering degree
- c. an associate degree
- d. professional attitude
- e. hold a certified welder certificate

Q1-6 The vision requirements for a CWI are near vision acuity on:
- a. Jaeger J1 at 24 inches
- b. Jaeger J2 at 12 inches
- c. Jaeger J2 at 12 inches, with or without corrective lenses
- d. the inspector cannot wear glasses
- e. 20/20 vision

Q1-7 The acronym KASH stands for:
- a. knowledge, attitude, skills, and habits
- b. knowledge, application, skills, and habits
- c. knowledge, attitude, skills, and honesty
- d. knowledge, application, skills, and honesty
- e. knowledge, attitude, sincerity, and honesty

Q1-8 The welding inspector should have a basic understanding of:
a. welding processes
b. nondestructive testing methods
c. a and b above
d. codes and standards
e. all of the above

Q1-9 The term used to describe a delay in the production schedule to permit inspection is:
a. NDE
b. hold point
c. pre-inspection
d. reference point
e. arc strike

Q1-10 Inspection report corrections should be made by:
a. rewriting the entire report
b. reporting the correction to the welding foreman
c. telling the welder what was done
d. ignoring the original error
e. single-line out the error, correct the error, date, and initial

Q1-11 A definition of ethics is:
a. using common sense and honesty
b. living by the rules
c. being fair and impartial
d. basing decisions on facts
e. all of the above

Q1-12 For communications to be effective, it should form a "continuous loop."
a. true
b. false

Q1-13 The welding inspector must often communicate with:
a. welders
b. supervisors
c. welding engineers
d. members of management
e. all of the above

Q1-14 NDE personnel (other than CWI's) should be certified to what document?
a. QC-1
b. D1.1
c. API 1104
d. ASNT SNT-TC-1A
e. certification is not needed

Q1-15 You must have a high school diploma to become a CWI.
- a. true
- b. false

Q1-16 The CWI exam has several parts; these are:
- a. fundamentals, practical, code
- b. fundamentals, basic, code
- c. basic, vision test, fundamental
- d. code, vision test, practical
- e. none of the above

Q1-17 The CWI exam requires that the D1.1 Code be used for the open book Code test.
- a. true
- b. false

Q1-18 The CWI exam contains three parts, each two hours long.
- a. true
- b. false

Q1-19 The title of the AWS Standard, A3.0 is:
- a. Filler Metal Specifications
- b. Standard Welding Terms and Definitions
- c. Guide to CWI Certificatioin
- d. Requirements for CWI Certification
- e. none of the above

Q1-20 API Standard 1104 covers the fabrication of cross-country bridges.
- a. true
- b. false

Q1-21 Some of the approved codes/standards for the open book portion of the CWI exam are AWS D1.1, API 1104, AWS D1.5, and AWS D15.1.
- a. true
- b. false

Q1-22 Prior to starting a job assignment, the welding inspector should determine:
- a. what code, standard, or specification applies
- b. what inspections should be conducted
- c. when inspections should be conducted
- d. where records are maintained
- e. all of the above

ANSWER KEY—MODULE 1

Q1-1	e	(pg. 1-1)
Q1-2	c	(pg. 1-9)
Q1-3	b	(pg. 1-1)
Q1-4	b	(pg. 1-9)
Q1-5	d	(pg. 1-3)
Q1-6	c	(pg. 1-3)
Q1-7	a	(pg. 1-4)
Q1-8	e	(pg. 1-5)
Q1-9	b	(pg. 1-5)
Q1-10	e	(pg. 1-6)
Q1-11	e	(pg. 1-6)
Q1-12	a	(pg. 1-7)
Q1-13	e	(pg. 1-8)
Q1-14	d	(pg. 1-9)
Q1-15	b	(pg. 1-11)
Q1-16	a	(pg. 1-11)
Q1-17	b	(pg. 1-11, 12)
Q1-18	a	(pg. 1-12)
Q1-19	b	(pg. 1-12)
Q1-20	b	(pg. 1-11)
Q1-21	a	(pg. 1-11, 12)
Q1-22	e	(pg. 1-1)

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MODULE 2

SAFE PRACTICES FOR WELDING INSPECTORS

Q2-1 The welding inspector is exposed to which of the following safety hazards:
a. radiation
b. falling objects
c. electrical shock
d. eye hazards
e. all of the above

Q2-2 A document which covers safety in welding and cutting is:
a. AWS D1.1
b. API 1104
c. ANSI/ASC Z49.1
d. ASME Section VIII
e. ASME B31.3

Q2-3 The most important component of an effective safety and health program is:
a. safety rules
b. safety procedures
c. protective equipment
d. welding helmet
e. management support

Q2-4 Safety training is mandated under provisions of:
a. AWS "Safe Practices"
b. OSHA
c. ASME Code
d. Welding Handbook, Volume 2
e. none of the above

Q2-5 The abbreviation 'MSDS' means:
a. Management Support and Daily Safety
b. Material Strength and Discontinuity Sheet
c. Material Safety Data Sheet
d. Material Strength and Data Sheet
e. none of the above

Q2-6 The abbreviation 'TLV' means:
a. Total Linear volume
b. Threshold Limit Value
c. Tack Length Value
d. Threshold Limiting Valve
e. none of the above

Q2-7 Employers must make all applicable MSDS data available to their employees.
a. true
b. false

Q2-8 Personnel must be trained to recognize safety hazards.
a. true
b. false

Q2-9 A 'Hot Work Permit' is required for:
a. all welding operations
b. all cutting operations
c. all preheating operations
d. areas where a fire hazard may occur during a welding, cutting, or preheating operation
e. all of the above

Q2-10 Eye hazards found in welding operations include:
a. flying particles
b. radiation
c. smoke and fumes
d. all of the above

Q2-11 Protective equipment not suitable for eye protection from welding radiation includes:
a. welding helmets with filter plates
b. clear safety goggles
c. safety goggles with filter plates
d. protective screens
e. properly positioned barricades

Q2-12 Suitable clothing materials for welding and cutting are:
a. 65% cotton, 35% polyester
b. wool
c. chemically treated cotton
d. b and c above
e. none of the above

Q2-13 Before working on equipment where machinery guards have been removed, a 'Lock, Tag, and Try' procedure should be completed.
a. true
b. false

Q2-14 In avoiding fumes during welding, the most important factor is:
a. the type of base metal
b. the type of filler metal
c. the type of welding process
d. the position of the welding machine
e. the position of the welder's head

Q2-15 It is not important to consider ventilation during welding and cutting operations.
- a. true
- b. false

Q2-16 When entering confined spaces, a 'standby' is not required.
- a. true
- b. false

Q2-17 Some of the toxic materials the welder may be exposed to are:
- a. cadmium
- b. chromium
- c. nickel
- d. lead
- e. all of the above

Q2-18 Proper usage and handling of compressed gas cylinders include:
- a. not welding on cylinders
- b. not including the cylinders in the ground or electrical circuit
- c. securing them properly
- d. identifying the gas prior to use
- e. all of the above

Q2-19 Acetylene becomes unstable above what pressure?
- a. 5 psi
- b. 10 psi
- c. 15 psi
- d. none of the above

Q2-20 Oxygen is a flammable gas.
- a. true
- b. false

Q2-21 Electric currents above approximately 6 milliamperes are considered:
- a. not harmful
- b. primary currents
- c. harmful
- d. secondary currents
- e. b and c above

Q2-22 When operating gas cylinders, the primary valve should be opened:
- a. all the way on an acetylene cylinder
- b. one turn on an oxygen cylinder
- c. one turn or less on an acetylene cylinder
- d. all the way on an oxygen cylinder to backseat the valve
- e. c and d above

ANSWER KEY—MODULE 2

Q2-1	e	(pg. 2-1)
Q2-2	c	(pg. 2-1)
Q2-3	e	(pg. 2-1)
Q2-4	b	(pg. 2-1)
Q2-5	c	(pg. 2-2)
Q2-6	b	(pg. 2-2)
Q2-7	a	(pg. 2-2)
Q2-8	a	(pg. 2-3)
Q2-9	d	(pg. 2-5)
Q2-10	d	(pg. 2-6)
Q2-11	b	(pg. 2-6)
Q2-12	d	(pg. 2-7)
Q2-13	a	(pg. 2-8)
Q2-14	e	(pg. 2-8)
Q2-15	b	(pg. 2-8)
Q2-16	b	(pg. 2-10)
Q2-17	e	(pg. 2-12)
Q2-18	e	(pg. 2-12, 13)
Q2-19	c	(pg. 2-17)
Q2-20	b	(pg. 2-16)
Q2-21	e	(pg. 2-18)
Q2-22	e	(pg. 2-14, 17)

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MODULE 3

METAL JOINING AND CUTTING PROCESSES

Q3-1 Which of the following is a function of the flux coating of a SMAW electrode?

a. insulating
b. alloying
c. deoxidation
d. shielding
e. all of the above

Q3-2 In the AWS system of SMAW electrode designations, the next to the last digit refers to:

a. impact strength
b. electrode coating
c. welding position
d. strength
e. none of the above

Q3-3 Which of the following is an incorrect statement about a SMAW electrode designated as E7024?

a. It is a low hydrogen type.
b. The weld deposit has a minimum tensile strength of 70,000 psi.
c. It is suitable for use in the flat and horizontal fillet positions only.
d. It is an electrode for welding carbon steel.
e. none of the above

Q3-4 Of the following which is not an essential part of a typical SMAW system?

a. constant current power supply
b. wire feeder
c. covered electrode
d. electrode lead
e. work lead

Q3-5 Which of the following welding problems is the result of a distorted magnetic field that deflects the welding arc?

a. cracks
b. short circuiting
c. arc blow
d. insufficient welding current
e. all of the above

Q3-6 Which of the following is not considered a type of metal transfer for GMAW?

a. short circuiting
b. spray
c. globular
d. droplet
e. pulsed arc

Q3-7 Which of the following types of metal transfer in GMAW provides the lowest amount of heat to the workpiece, and therefore is prone to incomplete fusion?

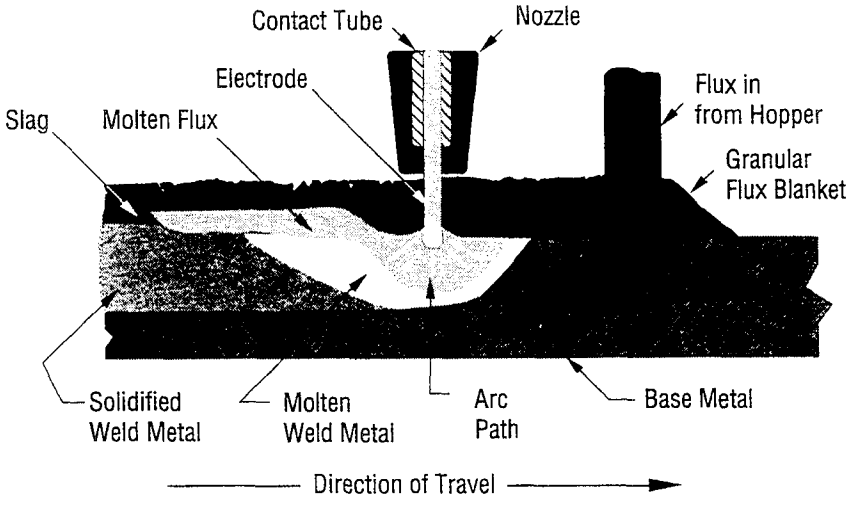
a. short circuiting
b. spray
c. globular
d. droplet
e. pulsed arc

Q3-8 Which of the following gases can be used as shielding gases for GMAW?

a. carbon dioxide
b. argon-oxygen
c. argon-carbon dioxide
d. argon
e. all of the above

Q3-9 What type of welding process is pictured below?

a. SMAW
b. GMAW
c. FCAW
d. SAW
e. ESW



Q3-10 Which of the following is not considered an arc welding process?

a. SMAW
b. GMAW
c. FCAW
d. ESW
e. none of the above

Q3-11 In the electrode designation system for FCAW, the second digit (1) in an electrode marked (E71T-5) refers to:

a. strength
b. welding position
c. chemical composition
d. usability
e. none of the above

Q3-12 Which of the following is not always an essential element of an FCAW system?

a. constant voltage power supply
b. tubular electrode
c. wire feeder
d. external shielding gas
e. work lead

Q3-13 What aspect of the GTAW and PAW processes makes them different from the other arc welding processes?

a. nonconsumable electrode
b. power supply
c. shielding
d. all of the above
e. none of the above

Q3-14 Shielding for the GTAW and PAW processes is primarily accomplished through the use of:

a. granular flux
b. slag
c. inert gas
d. oxygen
e. none of the above

Q3-15 A green stripe on a tungsten electrode designates:

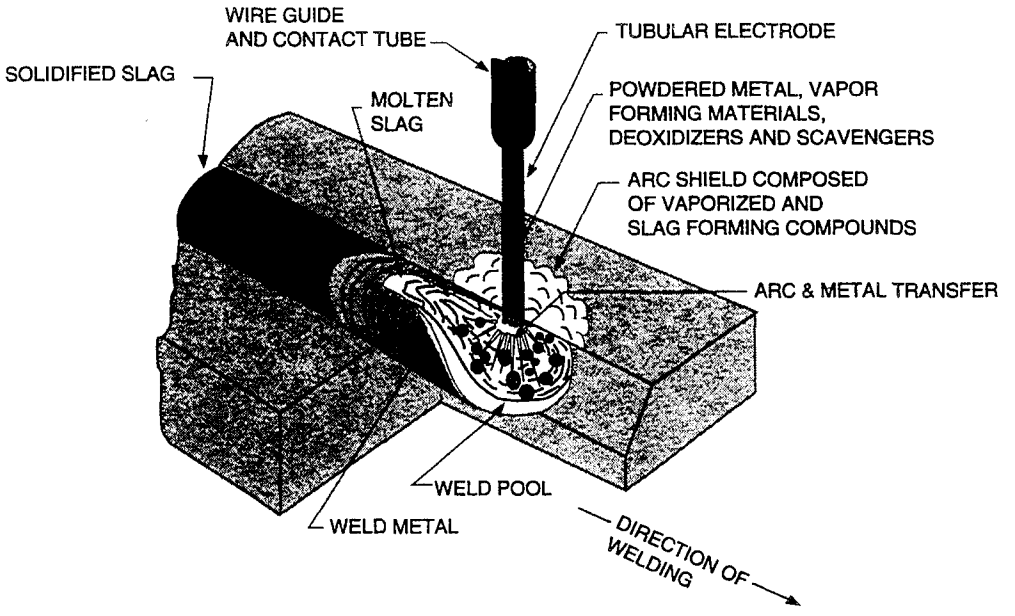
a. pure tungsten
b. 1 % thoriated tungsten
c. 2% thoriated tungsten
d. zirconiated tungsten
e. none of the above

Q3-16 When welding aluminum with the GTAW process, what type of welding current is most commonly used?

a. DCEP
b. DCEN
c. AC
d. a and b above
e. b and c above

Q3-17 SAW and ESW processes are similar in that:
- a. both are an arc welding process
- b. both use shielding gases
- c. both use a granular flux, which becomes molten
- d. a and b above
- e. a and c above

Q3-18 The diagram below depicts what welding process?
- a. SMAW
- b. ESW
- c. FCAW
- d. SAW
- e. GMAW



Q3-19 Solidification cracking due to improper width-to-depth ratio of the weld bead is a serious problem primarily with which welding process?
- a. SMAW
- b. OFC
- c. SAW
- d. all of the above
- e. none of the above

Q3-20 Which one of the following processes is typically used in the flat position unless special apparatus is employed?

a. GMAW
b. SAW
c. FCAW
d. SMAW
e. GTAW

Q3-21 Which of the following are not common to both GTAW and PAW?

a. nonconsumable tungsten electrode
b. constricting orifice
c. shielding gas nozzle
d. externally applied filler metal
e. none of the above

Q3-22 What technique is employed with PAW to produce full penetration welds without edge preparation?

a. stringer beads
b. weave beads
c. keyhole
d. backstep
e. none of the above

Q3-23 What welding process produces welds in a single pass, with the progression uphill along the joint?

a. SAW
b. ESW
c. FCAW
d. a and b above
e. b and c above

Q3-24 Which of the following is not an advantage of the ESW process?

a. high deposition rate
b. ease of setup
c. capable of joining thick sections
d. no tendency for angular distortion
e. none of the above

Q3-25 Which welding process is considered to be a chemical welding process?

a. SMAW
b. ESW
c. SAW
d. OAW
e. none of the above

Q3-26 Which arc welding process provides a very efficient means of joining attachments to some planar surfaces?

a. OAW
b. SW
c. GMAW
d. GTAW
e. SMAW

Q3-27 Brazing differs from welding in that:

a. no filler metal is used
b. an oxyfuel flame is used
c. the base metal is not melted
d. all of the above
e. none of the above

Q3-28 For satisfactory results, a braze joint should have:

a. clean joint surfaces
b. a small clearance between pieces to be joined
c. a large surface area for the joint area
d. heat source
e. all of the above

Q3-29 Which of the following is an advantage of brazing?

a. ease of joining thick sections
b. ability to join dissimilar metals
c. ability to join thin sections
d. a and b above
e. b and c above

Q3-30 Of the following metals, which cannot be efficiently cut using OFC?

a. high-carbon steel
b. low-carbon steel
c. medium-carbon steel
d. austenitic stainless steel
e. none of the above

Q3-31 Which of the following gases can be used to perform OFC?

a. methylacetylene - propadiene (MPS)
b. propane
c. acetylene
d. methane (natural gas)
e. all of the above

Q3-32 Which of the following cutting processes can cut any metal?

a. OFC
b. CAC-A
c. PAC
d. a and b above
e. b and c above

Q3-33 The width of a cut is referred to as the:

a. gap
b. dross
c. kerf
d. drag
e. none of the above

Q3-34 The SMAW power source can be:

a. DCEN
b. AC
c. DCEP
d. all of the above
e. a and c above

Q3-35 Of the following, which is a noncontact welding process, requires no electrodes, and is not influenced by the presence of magnetic fields?

a. ESW
b. PAW
c. LBW
d. a and b above
e. none of the above

Q3-36 Which of the following uses a focused beam of electrons as a heat source for fusion welding?

a. EBW
b. ESW
c. EGW
d. a and c above
e. none of the above

ANSWER KEY—MODULE 3

Q3-1	e	(pg. 3-4)
Q3-2	c	(pg. 3-4, 5)
Q3-3	a	(pg. 3-5)
Q3-4	b	(pg. 3-6)
Q3-5	c	(pg. 3-8
Q3-6	d	(pg. 3-11)
Q3-7	a	(pg. 3-12)
Q3-8	e	(pg. 3-9)
Q3-9	d	(pg. 3-20)
Q3-10	d	(pg. 3-26)
Q3-11	b	(pg. 3-14, 15)
Q3-12	d	(pg. 3-14, 15)
Q3-13	a	(pg. 3-17, 24)
Q3-14	c	(pg. 3-17, 25)
Q3-15	a	(pg. 3-17)
Q3-16	c	(pg. 3-18)
Q3-17	c	(pg. 3-20, 26)
Q3-18	c	(pg. 3-14)
Q3-19	c	(pg. 3-22, 23)
Q3-20	b	(pg. 3-22)
Q3-21	b	(pg. 3-24)
Q3-22	c	(pg. 3-25)
Q3-23	b	(pg. 3-26)
Q3-24	b	(pg. 3-27)
Q3-25	d	(pg. 3-28)
Q3-26	b	(pg. 3-29)
Q3-27	c	(pg. 3-37)
Q3-28	e	(pg. 3-37)
Q3-29	e	(pg. 3-39)
Q3-30	d	(pg. 3-42)
Q3-31	e	(pg. 3-41)
Q3-32	e	(pg. 3-44, 46)
Q3-33	c	(pg. 3-42)
Q3-34	d	(pg. 3-5)
Q3-35	c	(pg. 3-32)
Q3-36	a	(pg. 3-34, 35)

WELDING INSPECTION TECHNOLOGY WORKBOOK

MODULE 4

WELD JOINT GEOMETRY AND WELDING SYMBOLS

Q4-1 Which of the following is not considered a type of joint?

a. butt
b. T
c. fillet
d. corner
e. edge

Q4-2 The term for the type of joint formed when the two pieces to be joined lie in parallel planes and their edges overlap is:

a. corner
b. T
c. edge
d. lap
e. butt

Q4-3 The term for that portion of a single bevel butt joint where the two pieces to be joined come closest together is:

a. radius
b. joint root
c. bevel angle
d. groove angle
e. none of the above

Q4-4 In a single V-groove weld, the term for the sloped surfaces against which the weld metal is applied is:

a. root face
b. root
c. groove faces
d. groove angle
e. bevel angle

Q4-5 The term for the type of weld produced by filling an elongated hole in an overlapping member attaching it to the member beneath is:

a. plug weld
b. spot weld
c. seam weld
d. slot weld
e. none of the above

Q4-6 The term for the type of weld configuration formed when the length of a round bar is placed parallel against a flat surface is:

a. double-flare-bevel-groove
b. single-flare-V
c. edge flange
d. corner flange
e. none of the above

Q4-7 The term for the type of weld having a generally triangular cross section and which is applied to either a T, corner, or lap joint is:

a. flange weld
b. flare weld
c. fillet weld
d. slot weld
e. spot weld

Q4-8 The term for the type of weld used to build up thinned surfaces, provide a layer of corrosion protection, or provide a layer of abrasion resistant material, is:

a. edge weld
b. flare weld
c. flange weld
d. slot weld
e. surfacing weld

Q4-9 The term for the type of weld applied to the opposite side of a joint before a single V-groove weld is completed on the near side of a joint is:

a. melt-through weld
b. backing weld
c. back weld
d. root weld
e. none of the above

Q4-10 In a completed groove weld, the term for the surface of the weld on the side from which the welding was done is:

a. crown
b. weld reinforcement
c. weld face
d. root
e. cap pass

Q4-11 In a completed weld, the term for the junction between the weld face and the base metal is:

a. root
b. weld edge
c. weld reinforcement
d. leg
e. toe

Q4-12 The term for the height of the weld face above the base metal in a groove weld is:

a. crown
b. buildup
c. face
d. weld reinforcement
e. none of the above

Q4-13 In a fillet weld, the leg and size are the same for what type of configuration?

a. effective throat
b. concave weld
c. convex weld
d. unequal leg fillet
e. oversize weld

Q4-14 When looking at the cross section of a completed groove weld, the difference between the fusion face and the weld interface is called the:

a. depth of fusion
b. depth of penetration
c. root penetration
d. joint penetration
e. effective throat

Q4-15 For a concave fillet weld, which throat dimensions are the same?

a. theoretical and effective
b. effective and actual
c. theoretical and actual
d. all of the above
e. none of the above

Q4-16 In a partial penetration single V-groove weld, the term for the dimension measured from the joint root to where the weld penetration stops is:

a. joint penetration
b. effective throat
c. root penetration
d. depth of fusion
e. weld interface

Q4-17 The size of a spot weld is determined by its:

a. depth of fusion
b. diameter of weld at point of contact
c. depth of penetration
d. thickness
e. none of the above

Q4-18 The primary element of any welding symbol is referred to as the:

a. tail
b. arrow
c. reference line
d. arrow side
e. weld symbol

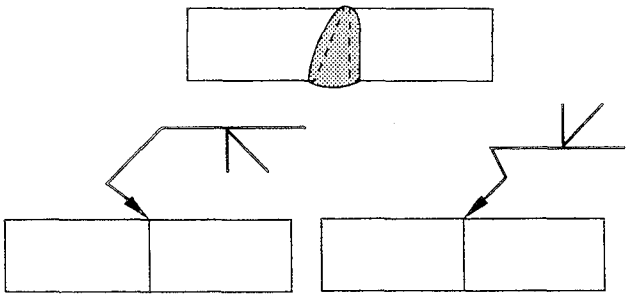
Q4-19 Information appearing above the reference line refers to the:

a. near side
b. arrow side
c. far side
d. other side
e. none of the above

Q4-20 The graphic description of the type of weld is called the:

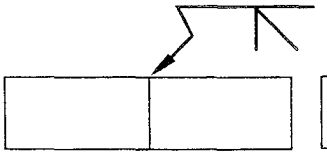
a. tail
b. welding symbol
c. weld symbol
d. arrow
e. none of the above

Q4-21 Which of the symbols below describes the weld shown?

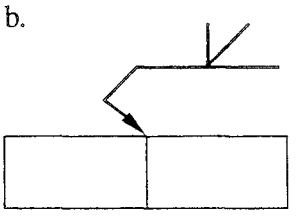


a.

b.



c.



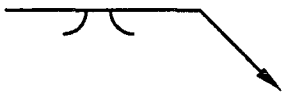
d.

e. none of the above

Q4-22 When a weld symbol is centered on the reference line, this indicates:

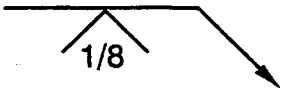
a. that the welder can put the weld on either side
b. that there is no side significance
c. that the designer doesn't know where the weld should go
d. that the welder should weld in whatever position the weld is in
e. none of the above

Q4-23 The symbol below depicts what type of joint?



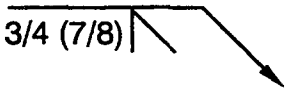
a. flare V-groove
b. flare bevel groove
c. edge flange
d. corner flange
e. none of the above

Q4-24 In the welding symbol below, the 1/8 dimension refers to what?



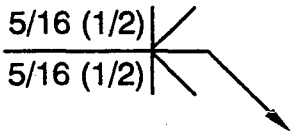
a. groove angle
b. root face
c. depth of preparation
d. weld size
e. root opening

Q4-25 In the welding symbol below, the 3/4 dimension refers to what?



a. weld size
b. effective throat
c. depth of bevel
d. root opening
e. none of the above

Q4-26 If applied to a 1 inch thick weld joint, the welding symbol below describes what type of weld?

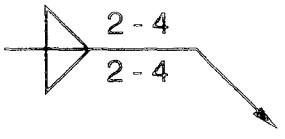


a. full penetration double bevel-groove weld
b. full penetration double V-groove weld
c. partial penetration double bevel-groove weld
d. partial penetration double V-groove weld
e. none of the above

Q4-27 A triangular-shaped weld symbol represents what type of weld?

a. bevel groove
b. flare groove
c. flange groove
d. V-groove
e. fillet weld

Q4-28 The symbol below describes what type of weld?



a. staggered intermittent fillet weld
b. chain intermittent fillet weld
c. segmented fillet weld
d. intermittent fillet weld
e. none of the-above

Q4-29 The first dimension appearing to the immediate right of the weld symbol generally refers to the:

a. weld reinforcement
b. root opening
c. pitch distance
d. weld length
e. none of the above

Q4-30 In the case of a plug or slot weld, a dimension placed within the weld symbol would indicate?

a. depth of filling
b. slot weld width
c. plug weld diameter
d. angle of countersink
e. none of the above

Q4-31 The required spot weld size parameter can be shown as:

a. a dimension to the right of the symbol
b. a dimension of the required nugget diameter
c. a value for the required shear strength per spot
d. a or b above
e. b or c above

Q4-32 A number appearing to the right of the spot weld symbol refers to:

a. spot weld size
b. spot weld length
c. number of spots required
d. pitch distance between adjacent spots
e. none of the above

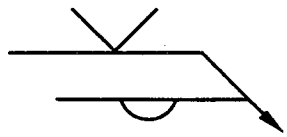
Q4-33 What elements are required in a welding symbol?

a. reference line
b. weld symbol
c. arrow
d. all of the above
e. a and c above

Q4-34 In the welding symbol below, the supplementary symbol shown on the other side location represents:

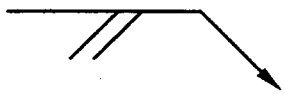
a. back weld
b. backing weld
c. melt-through of weld from other side
d. a and b above
e. b and c above

Q4-35 The welding symbol below shows the use of what type of completed weld?



a. single bevel-groove weld with backing weld
b. single bevel-groove weld with back weld
c. single V-groove weld with backing weld
d. single V-groove weld with back weld
e. none of the above

Q4-36 The symbol below shows what type of joint configuration?

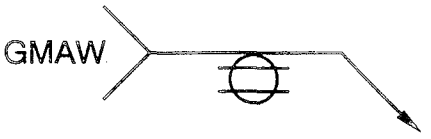


a. square groove
b. skewed groove
c. sloped groove
d. scarf
e. none of the above

Q4-37 The part of the welding symbol which can be used to convey any additional information that cannot be shown otherwise is referred to as:

a. the weld symbol
b. the arrow
c. the reference line
d. the tail
e. none of the above

Q4-38 The welding symbol below shows what type of weld?



a. gas metal arc spot weld
b. resistance spot weld
c. gas metal arc seam weld
d. resistance seam weld
e. gas metal arc slot weld

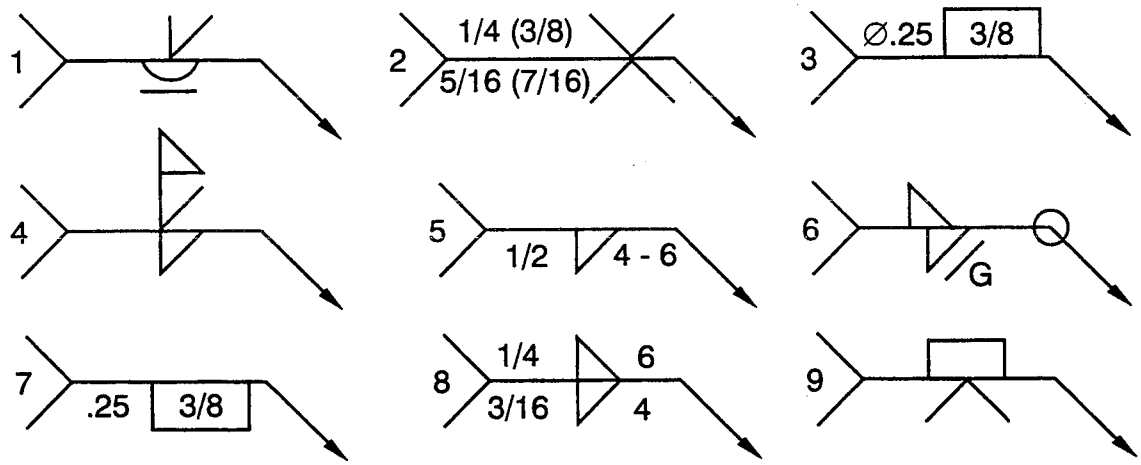
Q4-39 A number in parentheses just above/below the weld symbol in a welding symbol for slot welds describes:

a. the length of weld
b. the type of welding
c. the number of welds required
d. the type of electrode to use
e. none of the above

Q4-40 A number not in parenthesis to the left of the groove weld symbol in a welding symbol refers to the:

a. depth of bevel
b. the length of weld
c. the weld quality standard
d. the weld procedure to use
e. none of the above

Consider the welding symbols below for questions Q4-41 through Q4-44.



Q4-41 Which of the symbols above represents an intermittent fillet weld?

a. 1
b. 8
c. 6
d. 4
e. 5

Q4-42 Which of the symbols above represents a groove weld with melt-through?

a. 2
b. 3
c. 6
d. 7
e. none of the above

Q4-43 Which of the symbols above represents a plug weld not completely filled?

a. 1
b. 3
c. 5
d. 7
e. 9

Q4-44 Which of the symbols above represents a groove weld with backing weld or back weld?

a. 1
b. 2
c. 6
d. 7
e. 9

ANSWER KEY—MODULE 4

Q4-1	c	(pg. 4-1)
Q4-2	d	(pg. 4-2)
Q4-3	b	(pg. 4-5)
Q4-4	c	(pg. 4-5)
Q4-5	d	(pg. 4-18)
Q4-6	a	(pg. 4-17)
Q4-7	c	(pg. 4-18)
Q4-8	e	(pg. 4-21)
Q4-9	b	(pg. 4-21)
Q4-10	c	(pg. 4-21)
Q4-11	e	(pg. 4-23)
Q4-12	d	(pg. 4-23)
Q4-13	c	(pg. 4-25)
Q4-14	a	(pg. 4-24)
Q4-15	b	(pg. 4-26)
Q4-16	c	(pg. 4-24)
Q4-17	b	(pg. 4-53)
Q4-18	c	(pg. 4-30)
Q4-19	d	(pg. 4-30)
Q4-20	c	(pg. 4-29)
Q4-21	b	(pg. 4-31–33)
Q4-22	b	(pg. 4-31)
Q4-23	a	(pg. 4-31)
Q4-24	e	(pg. 4-32, 65)
Q4-25	c	(pg. 4-32, 68)
Q4-26	a	(pg. 4-70)
Q4-27	e	(pg. 4-31, 44)
Q4-28	b	(pg. 4-43, 44)
Q4-29	d	(pg. 4-32)
Q4-30	a	(pg. 4-45)
Q4-31	e	(pg. 4-53)
Q4-32	d	(pg. 4-53)
Q4-33	e	(pg. 4-30)
Q4-34	c	(pg. 4-36)
Q4-35	c	(pg. 4-84)
Q4-36	d	(pg. 4-31)
Q4-37	d	(pg. 4-32)
Q4-38	c	(pg. 4-31)
Q4-39	c	(pg. 4-46)
Q4-40	a	(pg. 4-32)
Q4-41	e	(pg. 4-44)
Q4-42	e	(pg. 4-42)
Q4-43	b	(pg. 4-45)
Q4-44	a	(pg. 4-64)

WELDING INSPECTION TECHNOLOGY WORKBOOK

MODULE 7

METRIC PRACTICE FOR WELDING INSPECTION

For conversion Factors, refer to "Conversion Chart for Common Welding Terms" on page 10-9 of the workbook and for Formulae refer to page 10-8.

Q7-1 A 50.0 lb can of welding electrodes weighs how many kg?

a. 227 kg
b. 25 kg
c. 22.7 kg
d. 23,000 kg
e. none of the above

Q7-2 A weld joint is measured and found to be 345 mm long. How long is that joint in terms of inches?

a. 135 in.
b. 13.58 in.
c. 8760 in.
d. 876 in.
e. 13.0 in

Q7-3 What is the wire feed speed that is measured to be 175 in/min?

a. 0.070 m/s
b. 74.0 mm/s
c. 7.4 mm/s
d. 70 mm/s
e. 75 mm/s

Q7-4 Which of the following are the proper base unit(s) for linear measurement in the U.S. system?

a. yard
b. inch
c. foot
d. mile
e. all of the above

Q7-5 What is the base unit (according to AWS) for measuring mass in the SI system?

a. meter
b. kilogram
c. megapascal
d. liter
e. none of the above

Q7-6 A gas flow rate of 30 cfh is what in ℓ/min?

a. 1.4 ℓ/min
b. 14 ℓ/min
c. 140 ℓ/min
d. 64 ℓ/min
e. 640 ℓ/min

Q7-7 The metric system, or SI, is far more complicated than the U.S. system.
a. true
b. false

Q7-8 Many U.S. industries presently use the SI.
a. true
b. false

Q7-9 To be most effective, the U.S. worker must know which measurement system?
a. metric
b. SI
c. U.S. customary
d. all of the above

Q7-10 AWS has mandated the requirement that the metric system be used.
a. true
b. false

Q7-11 AWS has prepared a guide for aiding the transition to metrication. Its designation is:
a. D1.1
b. Section VIII
c. A3.0
d. A1.1
e. none of the above

Q7-12 Which of the following countries are not officially on the SI system?
a. Japan
b. Britain
c. Mexico
d. Australia
e. United States

Q7-13 In the U.S. customary system, what is the base unit ounce used to measure?
a. mass
b. volume
c. all of the above
d. distance

Q7-14 The U.S. system of measurement is based on powers of 10.
a. true
b. false

Q7-15 Pressure and tensile strength are measured in the SI using what as the base unit?
- a. liter
- b. meter
- c. pascal
- d. newton
- e. hertz

Q7-16 A regulator indicates 50 psi of gas pressure. What is this in kPa?
- a. 7.25 kPa
- b. 725 kPa
- c. 345 kPa
- d. 3.45 kPa
- e. 3,450 kPa

Q7-17 Deposition rate is measured in what units in the U.S. and SI systems?
- a. kg
- b. lb
- c. kg/hr
- d. lb/hr
- e. c and d above

Q7-18 When rounded to the nearest tenths, what is 4,532.182?
- a. 4,532.1
- b. 4,532.18
- c. 4,532
- d. 4,532.2
- e. 4,530

Q7-19 A material having a tensile strength of 8.5×10^4 psi has what value in megapascals?
- a. 5.9×10^6 MPa
- b. 5.86×10^3 MPa
- c. 58 MPa
- d. 586 MPa
- e. all of the above

Q7-20 A material having a tensile strength of 700 MPa has what value in psi?
- a. 10.150 psi
- b. 101.50 psi
- c. 1,015 psi
- d. 101,500 psi
- e. $1{,}015 \times 10^8$ psi

ANSWER KEY—MODULE 7 (Some Solutions Provided)

Q7-1 c (pg. 7-10, 11)
lbs to kg conversion factor is 0.454
$0.454 \times 50 = 22.7$

Q7-2 b (pg. 7-10, 11)
mm to inches conversion factor is 3.937×10^{-2}
$345 \times 3.937 \times 10^{-2} = 1358.265 \times 10^{-2}$ inches on calculator

Q7-3 b (pg. 7-10, 11)
inches/minute to mm/s conversion factor is 0.423
$175 \times 0.423 = 74.025$ mm/s on calculator

Q7-4 e (pg. 7-2)
Q7-5 b (pg. 7-3)
Q7-6 b (pg. 7-10, 11)
cfh to l/min conversion factor is 4.719×10^{-1}
$30 \times 4.719 \times 10^{-1} = 14.157$

Q7-7 b (pg. 7-3)
Q7-8 a (pg. 7-1)
Q7-9 d (pg. 7-1)
Q7-10 b (pg. 7-2)
Q7-11 d (pg. 7-1)
Q7-12 e (pg. 7-1)
Q7-13 c (pg. 7-2, 3)
Q7-14 b (pg. 7-2, 3)
Q7-15 c (pg. 7-4)
Q7-16 c (pg. 7-10, 11)
psi to kPa conversion factor is 6.895
$50 \times 6.895 = 345$

Q7-17 e (pg. 7-10, 11)
Q7-18 d (pg. 7-7)
Q7-19 d (pg. 7-10, 11)
conversion factor for psi to MPa is 6.895×10^{-3}
$8.5 \times 104 \times 6.895 \times 10^{-3} = 58.6075 \times 101$ on the calculator
= 586 MPa

Q7-20 d (pg. 7-10, 11)
conversion factor for MPa to psi is 1.450×10^{2}
$700 \text{ MPa} \times 1.45 \times 10^{2} = 1{,}015.00 \times 10^{2}$ on the calculator
= 101,500 psi

WELDING INSPECTION TECHNOLOGY WORKBOOK

MODULE 8

WELDING METALLURGY FOR THE WELDING INSPECTOR

Q8-1 As a metal is heated:
- a. energy is added to the structure
- b. the atoms move further apart
- c. the atoms vibrate more vigorously
- d. the metal expands
- e. all of the above

Q8-2 The state of matter which exhibits the least amount of energy is:
- a. solid
- b. liquid
- c. gas
- d. quasi-liquid
- e. none of the above

Q8-3 A problem occurring in weldments caused by the nonuniform heating produced by the welding operation is:
- a. porosity
- b. incomplete fusion
- c. distortion
- d. slag inclusions
- e. none of the above

Q8-4 Which of the following is not a method used to eliminate or reduce residual stresses?
- a. vibratory stress relief
- b. external restraint
- c. thermal stress relief
- d. peening
- e. annealing

Q8-5 The type of alloying in which the alloy atoms are located in the spaces between the atoms of the parent metal is referred to as:
- a. atomic alloying
- b. substitutional alloying
- c. space alloying
- d. interstitial alloying
- e. none of the above

Q8-6 Rapid quenching of a steel from the austenitic range results in a hard, brittle structure known as:
- a. pearlite
- b. carbide
- c. cementite
- d. ironite
- e. martensite

Q8-7 Very slow cooling of steel may result in the production of a soft, ductile microstructure which has as a lamellar appearance when viewed under high magnification. This structure is referred to as:

a. martensite
b. pearlite
c. bainite
d. ferrite
e. cementite

Q8-8 When rapid cooling produces a martensitic structure, what sub-critical heat treatment may be applied to improve the ductility of the steel?

a. quenching
b. tempering
c. annealing
d. normalizing
e. none of the above

Q8-9 It is determined that a welding procedure is creating an excessive heat input. Which of the changes listed below would result in a reduction of the heat input?

a. decrease current
b. decrease voltage
c. increase travel speed
d. change from weave to stringer bead technique
e. all of the above

Q8-10 The use of preheat will tend to:

a. result in a wider heat-affected zone
b. produce a lower heat-affected zone hardness
c. slow down the cooling rate
d. reduce the tendency to produce martensite in the heat-affected zone
e. all of the above

Q8-11 Which of the following changes will warrant an addition or increase in the required preheat?

a. decreased carbon equivalent
b. increased carbon equivalent
c. increased base metal thickness
d. a and c above
e. b and c above

Q8-12 What heat treatment is characterized by holding the part at the austenitizing temperature for some time and then slow cooling in the furnace?

a. normalizing
b. quenching
c. annealing
d. tempering
e. stress relief

Q8-13 What heat treatment is characterized by holding the part at the austenitizing temperature for some time and then cooling in still air?

a. normalizing
b. quenching
c. annealing
d. tempering
e. stress relief

Q8-14 Steel heated above the lower transformation temperature (A1) will change microstructural alignment. This temperature is:

a. 1333°F
b. 933°F
c. 1560°F
d. 3600°C
e. none of the above

Q8-15 Atoms in the solid (frozen) state:

a. have a specific "home" position
b. have no distinct structure
c. are essentially fixed in a definite structured position
d. a and c above
e. none of the above

Q8-16 What is the heat input for a molten weld pool at 5 ipm travel speed, 25 volts, and 100 amperes? (Refer to page 10-8 for Formula)

a. 300 J/in.
b. 300,000 J/in.
c. 30,000 J/in.
d. 3.633 J/in.
e. none of the above

Q8-17 One way that atoms are added to a pure metal to form an alloy is:

a. peening
b. substitutionally
c. automatically
d. solidification
e. diffusion

Q8-18 The process where carbon is added to the surface of a steel to harden it is:

a. decarburization
b. pack carburizing
c. precipitation hardening
d. quenching
e. none of the above

Q8-19 Steel exists in which of the following crystal structures?

a. BCT
b. FCC
c. BCC
d. all of the above
e. HCP

Q8-20 Which of the following usually follows quenching?

a. tempering
b. stress relieving
c. normalizing
d. annealing
e. none of the above

Q8-21 Which of the following can be accomplished using either thermal or mechanical techniques?

a. annealing
b. tempering
c. quenching
d. stress relieving
e. none of the above

Q8-22 Which of the following results in the softest condition for carbon steel?

a. annealing
b. quenching
c. stress relieving
d. tempering
e. normalizing

Q8-23 For a steel having a chemistry of: 0.16% carbon, 0.84% manganese, 0.09% nickel, 0.25% chromium, 0.052% copper, and 0.40% molybdenum, what is its Carbon Equivalent?

$$\left(CE = \%C + \frac{\%Mn}{6} + \frac{\%Ni}{15} + \frac{\%Cr}{5} + \frac{\%Cu}{13} + \frac{\%Mo}{4}\right)$$

a. 0.23
b. 0.34
c. 0.37
d. 0.41
e. 0.46

Q8-24 Stainless steels are defined as having at least what percent chromium?
a. 7%
b. 12%
c. 15%
d. 20%
e. 30%

Q8-25 Sensitization, or carbide precipitation, of austenitic stainless steels can be reduced by which of the following methods?
a. solution annealing, water quenching
b. using stabilized grades containing titanium or niobium (columbium)
c. using the low carbon grades of stainless steels
d. all of the above
e. using high carbon stainless steels

Q8-26 Metals must be molten for diffusion to occur.
a. true
b. false

Q8-27 Hydrogen can diffuse into a solid metal at room temperature.
a. true
b. false

Q8-28 Metals can dissolve into each other when both are in the solid form.
a. true
b. false

Q8-29 The process whereby nitrogen is dissolved into the surface of carbon steel is:
a. sensitization
b. nitrogen removal
c. carburizing
d. nitriding
e. none of the above

Q8-30 Welding metallurgy is concerned with the changes in the metals during welding.
a. true
b. false

ANSWER KEY—MODULE 8

Q8-1	c	(pg. 8-2, 3)
Q8-2	a	(pg. 8-3)
Q8-3	c	(pg. 8-4)
Q8-4	b	(pg. 8-4)
Q8-5	d	(pg. 8-6)
Q8-6	e	(pg. 8-9, 10)
Q8-7	b	(pg. 8-9)
Q8-8	b	(pg. 8-10)
Q8-9	e	(pg. 8-12)
Q8-10	e	(pg. 8-12, 13)
Q8-11	e	(pg. 8-13)
Q8-12	c	(pg. 8-13)
Q8-13	a	(pg. 8-13, 14)
Q8-14	a	(pg. 8-10)
Q8-15	d	(pg. 8-2)
Q8-16	c	(pg. 8-12)
Q8-17	b	(pg. 8-6)
Q8-18	b	(pg. 8-16)
Q8-19	d	(pg. 8-5)
Q8-20	a	(pg. 8-14)
Q8-21	d	(pg. 8-4)
Q8-22	a	(pg. 8-14)
Q8-23	e	(pg. 8-13)
Q8-24	b	(pg.8-16)
Q8-25	d	(pg. 8-18)
Q8-26	b	(pg. 8-15)
Q8-27	a	(pg. 8-15)
Q8-28	a	(pg. 8-15)
Q8-29	d	(pg. 8-16)
Q8-30	a	(pg. 8-1)

WELDING INSPECTION TECHNOLOGY WORKBOOK

MODULE 9

WELD AND BASE METAL DISCONTINUITIES

Q9-1 A discontinuity is:
- a. always a defect
- b. always a reject
- c. always acceptable
- d. rejectable if it exceeds code limits
- e. none of the above

Q9-2 Whether a particular weld discontinuity is critical can be judged on the basis of:
- a. whether it is surface or subsurface.
- b. whether it is linear or nonlinear.
- c. whether it has a sharp end condition.
- d. all of the above
- e. none of the above

Q9-3 What discontinuity is generally considered to be the most severe?
- a. porosity
- b. incomplete fusion
- c. slag inclusion
- d. crack
- e. arc strike

Q9-4 Which of the following discontinuities is less likely to be found visually?
- a. toe crack
- b. undercut.
- c. lamellar tear
- d. overlap
- e. none of the above

Q9-5 Underbead cracks can result from which of the following welding practices?
- a. use of wet electrodes
- b. welding on contaminated steels
- c. welding over paint
- d. all of the above
- e. none of the above

Q9-6 The weld discontinuity that results from improper termination of the welding arc is referred to as:
- a. undercut
- b. overlap
- c. crater crack
- d. incomplete fusion
- e. all of the above

Q9-7 Of the following processes, which is unlikely to have slag inclusions in a completed weld?
a. SMAW
b. PAW
c. FCAW
d. SAW
e. none of the above

Q9-8 The discontinuity that results from the entrapment of gas within the weld cross section is referred to as:
a. crack
b. slag inclusion
c. incomplete fusion
d. porosity
e. none of the above

Q9-9 What weld discontinuity results when the welder travels too slowly, causing excess weld metal to flow out of the joint and lay on the base metal surface without fusing?
a. undercut
b. underfill
c. overlap
d. incomplete fusion
e. none of the above

Q9-10 What weld metal discontinuity results when the welder fails to completely fill the weld groove?
a. underfill
b. undercut
c. overlap
d. incomplete fusion
e. none of the above

Q9-11 Excessive weld metal buildup on a groove weld is referred to as:
a. excess convexity
b. excess weld reinforcement
c. overfill
d. all of the above
e. none of the above

Q9-12 The weld discontinuity that results from the initiation of the welding arc outside the weld joint is referred to as:
a. incomplete fusion
b. undercut
c. overlap
d. scratch start
e. arc strike

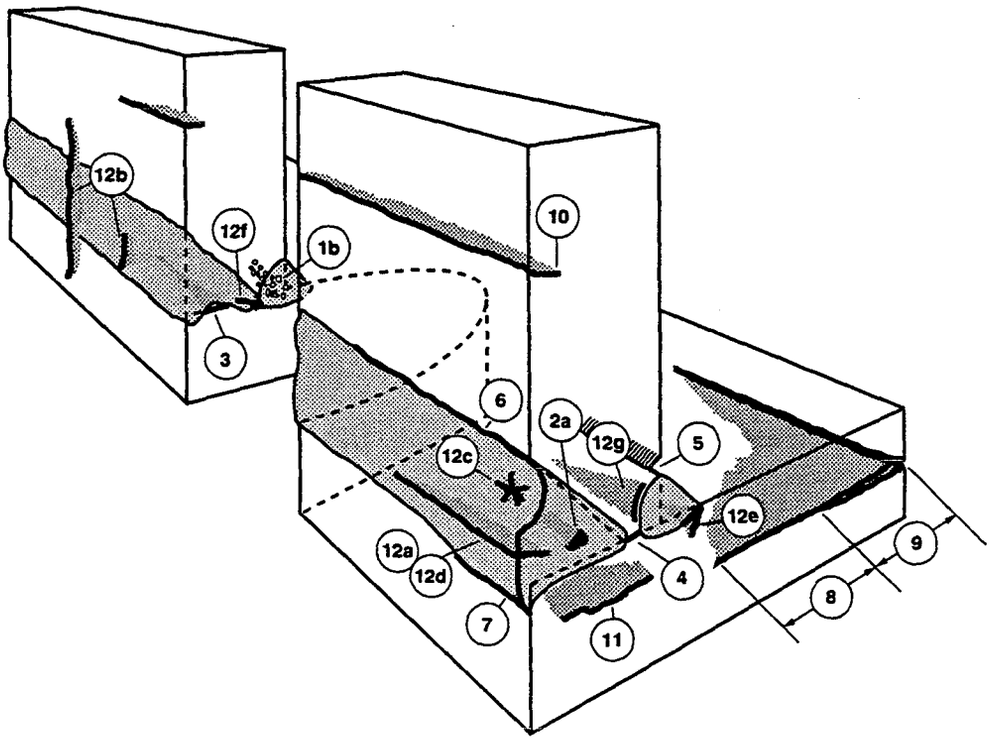
Q9-13 What weld discontinuity shows up as a light region on a radiograph?

a. porosity
b. tungsten inclusion
c. slag inclusion
d. a and b above
e. b and c above

Q9-14 Which of the following is not a base metal discontinuity resulting from improper steelmaking practices?

a. lamination
b. lamellar tear
c. seam
d. pipe shrinkage
e. none of the above

Questions Q9-15 through Q9-19 refer to the figure shown below:



Q9-15 What discontinuity is shown by #12b?

a. longitudinal crack
b. transverse crack
c. underbead crack
d. toe crack
e. root crack

Q9-16 What step-like discontinuity is shown by #11?

a. lamination
b. porosity
c. lamellar tear
d. seam
e. lap

Q9-17 What discontinuity is shown by #12g?

a. toe crack
b incomplete fusion
c. root crack
d. lamellar tear
e. underbead crack

Q9-18 What discontinuity is shown by #5?

a. undercut
b. underfill
c. overlap
d. incomplete fusion
e. toe crack

Q9-19 What discontinuity is shown by #10?

a. lamination
b. seam
c. delamination
d. base metal crack
e. incomplete fusion

ANSWER KEY—MODULE 9

Q9-1	d	(pg. 9-1, 27)
Q9-2	d	(pg. 9-2)
Q9-3	d	(pg. 9-3)
Q9-4	c	(pg. 9-23, 24)
Q9-5	d	(pg. 9-6)
Q9-6	c	(pg. 9-5)
Q9-7	b	(pg. 9-12)
Q9-8	d	(pg. 9-13)
Q9-9	c	(pg. 9-17, 18)
Q9-10	a	(pg. 9-17)
Q9-11	b	(pg. 9-19)
Q9-12	e	(pg. 9-20)
Q9-13	b	(pg. 9-13)
Q9-14	b	(pg. 9-23, 24)
Q9-15	b	(pg. 9-4)
Q9-16	c	(pg. 9-23, 24)
Q9-17	e	(pg. 9-6, 7)
Q9-18	a	(pg. 9-15)
Q9-19	b	(pg. 9-24)

WELDING INSPECTION TECHNOLOGY WORKBOOK

MODULE 10

VISUAL INSPECTION AND OTHER NDE METHODS AND SYMBOLS

Q10-1 Which of the following nondestructive testing methods are limited to the detection of surface discontinuities?

a. visual
b. penetrant
c. radiographic
d. a and b above
e. b and c above

Q10-2 To be most effective, visual inspection should be performed:

a. before welding
b. during welding
c. after welding
d. all of the above
e. none of the above

Q10-3 The time period during which the penetrant remains on the surface of the part allowing it to be drawn into any surface discontinuities is called:

a. waiting time
b. penetrating time
c. soak time
d. dwell time
e. none of the above

Q10-4 Which type of magnetizing current provides the best iron particle mobility?

a. AC
b. DC
c. DCEP
d. b and c above
e. all of the above

Q10-5 What MT technique could be used for the discovery of longitudinal flaws?

a. head shot (circular magnetism)
b. side shot
c. coil shot (longitudinal magnetization)
d. a and b above
e. b and c above

Q10-6 Which of the following magnetizing methods produce a circular magnetic field in the test piece?

a. head shot
b. passing an electrical current through the part
c. prod
d. all of the above
e. none of the above

Q10-13 What device is used during radiography to indicate the resolution sensitivity of a radiograph?
a. IQI
b. dosimeter
c. lead screen
d. all of the above
e. none of the above

Q10-14 Which nondestructive test method uses sound energy as a probing medium?
a. MT
b. RT
c. UT
d. PT
e. ET

Q10-15 The process whereby ultrasonic indications are related to dimensions in a test standard is referred to as:
a. setup
b. calibration
c. standardization
d. synchronization
e. none of the above

Q10-16 As-welded groove welds are usually inspected ultrasonically using what technique?
a. straight beam
b. shear wave
c. angle beam
d. b and c above
e. all of the above

Q10-17 Capillary action plays a role in which NDT method?
a. ET
b. UT
c. RT
d. PT
e. MT

Q10-18 Which NDT method is considered to be a true volumetric test?
a. RT
b. UT
c. PT
d. MT
e. ET

Q10-7 Which of the following magnetizing methods can produce a longitudinal magnetic field in the test piece?

a. head shot
b. coil shot
c. yoke
d. a and b above
e. b and c above

Q10-8 What NDT method is best for evaluating subsurface porosity?

a. PT
b. MT
c. RT
d. VT
e. all of the above

Q10-9 Which of the following statements is correct for radiographic testing?

a. A reduction in thickness will produce a lighter image on the film.
b. A low density discontinuity will produce a lighter image on the film.
c. A high density discontinuity will produce a lighter image on the film.
d. a and b above
e. b and c above

Q10-10 Radiographic testing (RT) can be performed using which of the following?

a. X-ray machine
b. Cesium 137
c. Iridium 192
d. Cobalt 60
e. all of the above

Q10-11 MT can be used most effectively to inspect which of the following?

a. austenitic stainless steel welds on carbon steel
b. austenitic stainless steel welds on stainless steel
c. carbon steel welds on carbon steel
d. a and b above
e. b and c above

Q10-12 Which of the following discontinuities will not usually be revealed using RT?

a. crack
b. incomplete joint penetration
c. porosity
d. lamination
e. none of the above

Q10-25 What resolution sensitivity is normally required for RT?
a. 2%
b. 4%
c. 5%
d. 7%
e. 9%

Q10-26 What is the basic element of evaluation in any quality control program?
a. radiographic testing
b. penetrant testing
c. visual inspection
d. all of the above
e. none of the above

Q10-27 When should the applicable job documents be reviewed?
a. after the job is completed
b. before welding begins
c. at any time when information is necessary
d. a and b above
e. b and c above

Q10-28 What is the role of the AWS CWI in NDE?
a. see that inspections are done
b. verify personnel qualifications for NDE inspection
c. prepare proper records
d. see that proper records are maintained
e. all of the above

Q10-29 A number in parentheses just above or below a test symbol describes:
a. the length of weld to be tested
b. the extent of testing
c. the number of tests to perform
d. the type of test to perform
e. none of the above

Q10-30 A number to the right of a nondestructive testing symbol refers to the:
a. number of tests to perform
b. the length of weld to be tested
c. the applicable quality standard
d. the test procedure to use
e. none of the above

Q10-31 Test information above the reference line refers to the arrow side.
a. true
b. false

Q10-19 Which NDT method uses an alternating current coil?

a. MT
b. UT
c. ET
d. a and c above
e. b and c above

Q10-20 Changes in heat treatment can be measured using which NDT method?

a. ET
b. RT
c. MT
d. UT
e. none of the above

Q10-21 Which of the following NDT methods can detect surface cracks?

a. RT
b. VT
c. ET
d. PT
e. all of the above

Q10-22 Which NDT method is most likely to reveal subsurface laminations in a rolled plate?

a. RT
b. UT
c. ET
d. MT
e. none of the above

Q10-23 Piezoelectricity is a property used by which NDE method?

a. ET
b. UT
c. RT
d. a and b above
e. b and c above

Q10-24 Which is the best technique for orienting magnetic lines of force when conducting MT testing?

a. two directions
b. single direction
c. residual magnetism
d. all of the above
e. none of the above

ANSWER KEY—MODULE 10

Q10-1	d	(pg. 10-10, 14)
Q10-2	d	(pg. 10-2)
Q10-3	d	(pg. 10-14)
Q10-4	a	(pg. 10-20)
Q10-5	a	(pg. 10-19)
Q10-6	d	(pg. 10-19, 20)
Q10-7	e	(pg. 10-19)
Q10-8	c	(pg. 10-22)
Q10-9	c	(pg. 10-22, 23)
Q10-10	e	(pg. 10-22)
Q10-11	c	(pg. 10-20, 21)
Q10-12	d	(pg. 10-22)
Q10-13	a	(pg. 10-23)
Q10-14	c	(pg. 10-24)
Q10-15	b	(pg. 10-25)
Q10-16	d	(pg. 10-26)
Q10-17	d	(pg. 10-16)
Q10-18	b	(pg. 10-27)
Q10-19	d	(pg. 10-20, 28)
Q10-20	a	(pg. 10-28)
Q10-21	e	(pg. 10-13, 16, 22, 28)
Q10-22	b	(pg. 10-27)
Q10-23	b	(pg. 10-25)
Q10-24	a	(pg. 10-19)
Q10-25	a	(pg. 10-23)
Q10-26	c	(pg. 10-1)
Q10-27	e	(pg. 10-2)
Q10-28	e	(pg. 10-2, 3)
Q10-29	c	(pg. 10-30)
Q10-30	b	(pg. 10-30)
Q10-31	b	(pg. 10-30)

WIT—Useful Formulae

Area of Square or Rectangle

Area = length x width or: Area = width x thickness

Area or Circle

$$\text{Area} = \pi \times \text{radius}^2 \quad \text{or:} \quad \text{Area} = \pi \times \frac{\text{diameter}^2}{4} \quad \text{or:} \quad \text{Area} = 0.7854 \times \text{diameter}^2$$

Percent Elongation

$$\% \text{ Elongation} = \frac{\text{Final Gage Length} - \text{Original Gage Length}}{\text{Original Gage Length}} \times 100$$

Percent Reduction of Area

$$\% \text{ Reduction of Area} = \frac{\text{Original Area} - \text{Final Area}}{\text{Original Area}} \times 100$$

Tensile Strength

General

$$\text{UTS} = \frac{\text{P max}}{\text{Area}}$$

where: P max = load to break specimen
Area = specimen's original cross-sectional area

Pipe

$$\text{UTS for full section pipe} = \frac{\text{P max}}{0.7854\,(\text{OD}^2 - \text{ID}^2)}$$

Yield Strength

$$\text{YS} = \frac{\text{Load at specified offset}}{\text{Original cross-sectional area}}$$

Welding Heat Input

$$\text{J/in.} = \frac{\text{V x A x 60}}{\text{Travel Speed (ipm)}}$$

where: J = Joules (energy)
V = welding voltage
A = welding amperage
ipm = inches per minute

Carbon Equivalent

$$\text{CE} = \%\text{C} + \frac{\%\text{Mn}}{6} + \frac{\%\text{Ni}}{15} + \frac{\%\text{Cu}}{13} + \frac{\%\text{Mo}}{14}$$