

Tank Inspection Course
With
API 653 Exam Prep.

Practice Exam

API 653 EXAM 2001 QUESTIONS

Open Book

1. The liquid penetrant examination method is an effective means for detecting _____.
 1. internal discontinuities of a weld
 - ✓ 2. surface discontinuities of a weld
 3. both internal and surface discontinuities of a weld
 4. subsurface discontinuities of a weld
2. A WPS is a written qualified welding procedure prepared to _____.
 1. provide direction for making production welds to Code requirements
 - ✓ 2. provide direction for the welder to make temporary welds
 3. provide direction for the inspector for inspection of the welds
 4. provide direction for the welder to use as a general guideline
3. Welding in the 3G position qualifies a welder in what positions?
 1. Flat and horizontal
 - ✓ 2. Horizontal and vertical
 3. Flat and vertical
 4. Vertical and overhead
4. Which of the following is an essential variable for the WPS?
 1. A change in groove design
 2. A change in backing
 - ✓ 3. A change in post weld heat treatment
 4. A change in electrode angle
5. A welder may be qualified by RT if _____.
 - ✓ 1. the welder uses SMAW
 2. the welder uses GMAW Short Circuiting mode
 3. the welder uses GMAW Short Circuiting mode root pass with SMAW fill and reinforcement
 4. the welder obtains approval from the inspector
6. A peripheral seal, on an internal floating roof, shall be designed to accommodate _____ of local deviation between the floating roof and the shell.
 - ✓ 1. the manufacturer's standard
 2. ± 4 inches
 3. $\pm 1/8$ inch
 4. inspector's experience
7. What is the maximum allowable prod spacing using an AC prod technique?
 - ✓ 1. $t/2$
 2. 8 inches
 3. 10 inches
 4. No spacing required

✓8. Welders shall be qualified in accordance with _____.

1. API 1104
2. ASME Section V
- ✓ 3. ASME Section IX
4. AWS D1.1

9. Geometric unsharpness of the radiograph of a component under 2" thick shall not exceed _____.

- ✓
1. 0.020
 2. 0.030
 3. 0.040
 4. 0.050

10. Calibration of ultrasonic instrument should be checked _____.

- ✓
1. at the beginning of each shift
 2. before the end of the shift
 3. before an examination, at the finish of the examination
 4. once a week

11. Each piece of magnetizing equipment shall be calibrated _____.

- ✓
1. at the beginning of each shift
 2. at least once a year or whenever the equipment has been subject to major electrical repair
 3. whenever the technician feels like it
 4. at least once every 90 days

12. During calibration of an ammeter the unit shall not deviate by more than _____ of full scale.

- ✓
1. 10%
 2. 20%
 3. 30%
 4. 40%

13. An inspector is evaluating a radiograph, a bright white image of a "B" appears on a darker background of the radiograph, _____.

- ✓
1. the radiograph shall be considered unacceptable
 2. the radiograph should not be rejected
 3. the "B" is for identification of the welder
 4. the "B" is for identification of the weld

14. Ultrasonic examination of hot tap connections or reinforcement is required by API 653 when _____.

- ✓
1. in lieu of radiographic testing
 2. searching for weld flaws
 3. searching for laminations
 4. requested by the welder

15. During an internal inspection of a tank, pitting that measures 0.30 inches deep was found in the shell (0.625 Thickness). The required thickness of the shell in this area is 0.5 inches. Based on the above information should a repair be made?

1. Yes
2. No
3. The inspector option
4. Repair Contractor's option

The following applies to questions 16 through 25 below:

An inspection is performed on an AST 24' tall, 22' fill height, 94' diameter, water storage service, earth foundation. There is one area of general internal corrosion on the south side of the shell 20" wide and 20" in vertical length. There is evidence of bottom settlement.

16. Calculate the minimum thickness of the first course based on product alone.

1. 1.175"
2. 0.228"
3. 0.551"
4. 0.218"

17. Calculate the minimum thickness for the third course, if each course is 4' in height.

1. .122"
2. .100"
3. .275"
4. .132"

2nd course height 4' 2"
1st course height 4' 2"
3rd course height 4' 2"

18. Calculate the "L" length for an area of general corrosion found 10' from the bottom on the south side of the shell, $T_2 = .125"$.

1. 40"
2. 12.68"
3. 6.80"
4. 11.75"

19. There are three pits aligned vertically on the north side of the tank, in the first course. The diameter of the pits are 1.250", 1", and .500" in length along a vertical line 8" long. **Note:** Assume pit depth of slightly less than one-half of the minimum acceptable tank shell thickness, exclusive of the corrosion allowance.

1. Because the pits are aligned vertically no repair is required
2. Scattered pits may be ignored
3. If the pit is round, it may be ignored
4. A repair is required

20. Three circumferentially scattered pits are located on the west side of the tank 18" from the bottom. The pits measure .500", .477" and .732" in diameter. **Note:** Assume pit depth of one-half of the minimum acceptable tank shell thickness, exclusive of the corrosion allowance.

1. Because the pits are scattered circumferentially no repair is required
2. All pits may be ignored
3. If the pit is round, it may be ignored
4. A repair is required

The following applies to questions 16 through 25:

An inspection is performed on an AST 24' tall, 22' fill height, 94' diameter, water storage service, earth foundation. There is one area of general internal corrosion on the south side of the shell 20" wide and 20" in vertical length. There is evidence of bottom settlement.

21. A bulge is found on the tank floor, the diameter of the bulge is 30". What is the maximum permissible height for the bulge?
1. 11.1"
 2. .460"
 3. .962"
 4. 1.11"
22. An area of the tank bottom 6' from the shell has sloped down and settled. The settlement measures 2" at the deepest point. (Edge Settlement).
1. A more rigorous stress analysis must be performed
 2. The area should be repaired
 3. Sloped edge settlement is usually no problem
 4. The area should be documented and checked during the next inspection
23. What is the hydrostatic test height of this tank based on a minimum thickness found in question 16, as the controlling thickness?
1. 24'
 2. 34.2'
 3. 18.6'
 4. 21.9'
24. A depression is noted on a section of the bottom near the middle of the east quadrant. The depression measures 5/8" deep, with a diameter of 36 inches. Should a repair be recommended?
1. Yes
 2. No
 3. Not enough information given
 4. The tank holds water, no problem
25. If the liquid level in the tank were to be lowered by 5', what is the minimum thickness of the first course?
1. 1.73"
 2. .168"
 3. .200"
 4. No change from original design thickness

The following applies to questions 26 through 27 below:

O_r = 10 years
 RT_{bc} = .200
 RT_{ip} = .190
 $S_t P_r$ = .002
 UP_r = .010

MRT = RTbc - 0.333

26. Using data from above, calculate MRT. (metal loss from the bottom side corrosion).

1. .250
2. .070
3. .002
4. .080

27. Using data from above, calculate MRT. (metal loss from internal corrosion).

1. .250
2. .070
3. .002
4. .080

28. The weld ripples of reinforcement of butt-welded joints shall be _____ before radiography.

1. removed
2. ground flush, with grinding direction parallel to the weld
3. ground flush, with grinding direction perpendicular to the weld
4. removed if irregularities mask discontinuities

29. What is the hydrostatic test height of an in-service welded AST built to API 650, 8th Edition, 82' diameter, 40' tall with a minimum first course thickness of 0.197". The material of construction is A-516, Grade 70 (A 516M Grade 485).

1. 40'
2. 36' - 2"
3. 32' - 8"
4. 30' - 6"

30. For a single-wall material thickness, over 0.375" through 0.50", what is the hole-type designation for a source side penetrameter?

1. 15
2. 17
3. 20
4. 25

31. The temperature range to conduct a standard technique liquid penetrant examination is _____.

1. 50° to 135°
2. 50° to 125°
3. 70° to 115°
4. 50° to 80°

9.5
12.5
30.5

32. During an MT examination, _____ shall be performed on each area.

1. 100% coverage at the required sensitivity
2. a calibration of each piece of magnetizing equipment
3. at least three separate examinations
4. prod spacing of at least 10"

33. An AC yoke shall have a lifting power of at least _____.

1. 5 lbs.
2. 8 lbs.
3. 10 lbs.
4. 40 lbs.

34. A DC yoke shall have a lifting power of at least _____.

1. 5 lbs.
2. 8 lbs.
3. 10 lbs.
4. 40 lbs.

35. A new tank will hold a product with the specific gravity of 1.05; The corrosion allowance is .10; The thickness of the first course is 1.25 inches; Hydrostatic test stress 25,000 PSI. What is the thickness required for the annular plate? (Note: Include corrosion allowance).

1. 5/16"
2. 11/16"
3. 3/8"
4. 7/16"

36. A leak is noted 1 1/2" away from the shell-to-bottom weld in the floor of an existing welded tank. The hole in the floor is 4" in diameter. What type of repair, in compliance with API 653, 3rd Edition, should be made?

1. Use RBI. Because the product might not contaminate the soil or waterways, no repair is required.
2. Weld build-up the area.
3. Install a 'tombstone' shaped, welded-on patch plate, intersecting the shell-to-bottom joint at approximately 90°.
4. Install a non-welded patch plate and fiberglass/epoxy to coat the area.

37. More than one contractor, manufacturer or installer may simultaneously qualify a welder. Each participating organization shall be represented by _____ during the test.

1. a certified welding inspector
2. a responsible employee
3. the welder's supervisor
4. a welding engineer

38. During a welder qualification test, for plate coupons, all surfaces (except areas designated "discard") shall _____.

1. show complete joint penetration and complete fusion of weld metal and base metal
2. show no more than 1/3t inadequate penetration
3. show no more than 1/3t nonfusion
4. be allowed one 5/32" crater crack

39. What is the hydrostatic test thickness for a new tank whose diameter is 150', and has a fill height of 40'? The shell material is A 36M.

1. 0.655
2. 0.611
3. 0.563
4. 0.500

40. In order to comply with API 650, the finished surface of a weld reinforcement on plate 1/2" thick, horizontal butt joints, may have a reasonably uniform crown not to exceed _____, for radiographic examination.

1. 1/4"
2. 3/16"
3. 1/8"
4. 1/16"

**Please close all materials.
The remainder of the exam is
"Closed Book".**

The second part of the exam is "Closed Book,"

41. Who has the ultimate responsibility for complying with the provisions of API Standard 653?
1. API
 2. Owner/operator ✓
 3. Inspector
 4. Contractor/builder
42. If cracks are suspected in nozzles or nozzle welds they should be checked by _____.
1. ultrasonic digital thickness gauge
 2. MT or PT examination ✓
 3. eddy current testing
 4. infra-red thermography
43. Which of the following may produce physiological impairment with long latency, such as cancer or pulmonary obstruction disease?
1. Water
 2. Sweet Crude Oil
 3. Benzene
 4. Non-toxic substances 3
44. Per API 653, tanks shall have a formal visual inspection once every _____ years or *RCA/4N* years, whichever is less.
1. three
 2. four
 3. five
 4. seven 3
45. Monthly visual inspections of the external condition of in-service tanks may be performed by _____.
1. API 653 inspectors
 2. owner/operator personnel
 3. NDE technicians ✓
 4. plant managers

46. According to API 650, which of the following types of connections shall be stress relieved?

1. All nozzles
2. All Group I, II, III or IIIA opening connections less than 12 inches
3. All Group IV, IVA, V or VI opening connections requiring reinforcement
4. All connections requiring reinforcement

47. The critical zone for repairs to tank bottoms is that portion of the bottom or annular plate within _____ inches of the inside edge of the shell.

- ✓ 1. 3
2. 6
3. 12
4. 24

48. What are the dimensions for a groove weld procedure specimen (face bend)?

1. 3 inches long and 3/4 inches wide
2. 6 inches long and 1 1/2 inches wide
3. 12 inches long and 2 1/2 inches wide
4. The inspector determines the dimensions

49. On a fixed-type roof, planks long enough to span at least _____ roof rafters should be laid and used as walkways.

1. none allowed
2. 1
3. 2
4. 3

50. Cathodic protection surveys are recommended to ensure the effectiveness of cathodic protection. How often should this survey be done?

1. Every 10 years
2. Every time the tank is empty
3. Annually
4. Semi-annually

51. Toxic atmospheres may originate from _____ or from the material on which hot work is being performed.

1. welding fumes
2. oxygen cylinders
3. stored product
4. zinc coatings

52. During the reconstruction of a tank, welding operators, welders and welding procedures must be qualified in accordance with _____.

1. API 650
2. ASME Section V
3. ASME Section IX
4. API 1104

53. Upon completion, the roof of a tank designed to be gas tight shall be tested by which one of the following methods?

1. Magnetic particle testing of all welds
2. Application of internal air pressure not exceeding the weight of the roof plates and applying a solution suitable for the detection of leaks
3. Penetrant testing the weld joints
4. Visual inspection of the weld joints

54. In regard to API 653, roof plates corroded to an average thickness of _____ inch in any 100 square inch area shall be repaired or replaced.

1. less than 0.09
2. 0.09
3. greater than 0.09
4. no API 653 requirement, owner's requirement

55. The use of open-type electric drilling machines is _____ recommended for making small openings in tank bottoms before hot work is performed.

1. highly
2. always
3. not
4. sometimes

56. Each welder making welds on a tank shall be certified by _____.

1. erection/fabrication manufacturer
2. purchaser
3. Nuclear Regulatory Commission
4. certified inspector

57. A qualified employee stationed outside one or more permit required confined spaces who monitors the entrants is called a(n) _____.

1. hole watch
2. attendant
3. helper
4. none ever required

58. For minor repairs to a tank bottom in otherwise good condition, first drill and tap a hole for insertion of a carbon dioxide or other inert gas line _____.

1. 6 inches from repair area
2. 12 inches from repair area
3. 24 inches from repair area
4. adjacent to repair area

59. A person designated by an employer as having the necessary training, education, etc., to perform assigned tank cleaning and entry related tasks is called a(n) _____.

1. hole watch
2. attendant
3. qualified person
4. rescuer

60. Which of the following tanks are used to reduce filling and breathing loss by eliminating vapor space?

1. Cone roof tank
2. Umbrella-roof tank
3. Vapor-dome roof tank
4. Floating roof tank

61. Per API 650, external floating roof deck plates having support leg or other rigid penetrations closer than _____ inches to lap weld seams must be full fillet welded not less than 2 inches on 10 inch centers.

1. 6
2. 12
3. 14
4. 18

62. During lining of a tank that has been in service, State and Federal safety regulations must be followed as well as the owner's _____.

1. tank entry permit procedure
2. on-site meeting schedule
3. attendance listing for tank inspectors
4. verbal approval

63. Foundation pads that have washed out or settled under the bottoms of atmospheric storage tanks can be repaired by _____.

1. pumping in water
2. pumping in argon
3. pumping in sand, dirt or thin concrete
4. pumping in gas

64. When corrosion rates are not known and similar service experience is not available, the actual bottom thickness shall be determined by inspections within the next _____ year(s) of tank operation to establish corrosion rates.

1. five
2. ten
3. three
4. one

65. _____ designates a material that may spontaneously ignite upon exposure to air.

1. Explosive
2. Historic
3. Polynical
4. Pyrophoric iron sulfide

66. Calcining can occur when concrete has been exposed to _____.

1. chemical attack
2. sulfate - type alkalis
3. chlorides
4. high temperature

67. A contributing factor for determining internal inspection intervals shall be time, not to exceed _____ years for any reason, if an RBI program is not in place.

1. 10
2. 5
3. 20
4. 15

68. Upon completion of welding of the new tank bottom, the welds shall be inspected by which one of the following methods?

1. Radiographs
2. Vacuum or air pressure
3. Penetrant testing
4. Hammer testing

69. What preparation is required to base metal before welding on tanks that had surfaces in contact with leaded gasoline?

1. Scrape down to bare metal 6" (15 cm)
2. Scrape down to bare metal 12" (30 cm)
3. Abrasive blast any immediate areas affected
4. Steam clean any immediate areas affected

70. Tank plates being welded which do not have proper identification shall be subjected to _____.

1. chemical analysis
2. UT thickness measurements
3. PT testing
4. RT testing

71. The maximum reinforcement thickness for vertical butt joints, less than or equal to 1/2" thick is _____.

1. 1/16" — 1.6 mm
2. 1/8" — 3.2 mm
3. 3/32" — 2.4 mm
4. 3/16" — 4.8 mm

72. _____ is the maximum eight hour time-weighted average of any airborne contaminant to which an employee may be exposed.

1. Threshold limit value
2. Permissible exposure limit
3. Lower flammable limit
4. Upper flammable limit

73. _____ identifies a procedure for installing a nozzle in the shell of a tank that is in service.

1. Repair
2. Alteration
3. Hot tap
4. Reconstruction

74. Annular bottom plates shall have a radial width that provides at least _____ inches between the inside of the shell and any lap-welded joint in the remainder of the bottom.

1. 10
2. 30
3. 24
4. 18

6/24/65

75. For known materials, all shell plates and bottom plates welded to the shell shall meet, as a minimum, the chemistry and mechanical properties of material specified for the application with regard to thickness and design metal temperature, per _____.

1. ASM Requirements
2. ASME Requirements
3. API 650 Requirements
4. ASTM 7 Requirements

6/24/65

76. What action should be taken after a flat spot is discovered in the second ring of a 200' diameter AST?

1. The shell distortion shall be evaluated
2. The area shall be cut out and replaced
3. Since no product is leaking out of the area, it may be ignored
4. The inspector has the option to repair or ignore

1/5

77. Routine in-service visual inspections of the external condition of the tank shall not exceed _____.

1. one month
2. six months
3. one year
4. five years

1/5

78. Reports recommending repairs shall include _____.

1. sketches showing location and extent
2. MSDS for radiography developer
3. name of contractor
4. location of the tank

1/5

79. When making major repairs on tank bottoms, water flood technique is used _____.

1. to keep the floor cool when welding to prevent distortion
2. as a corrosion prevention technique
3. to prevent external dust from being sucked into the tank while the air mover is operating
4. to displace flammable liquids beneath the tank floor

80. Minimum thickness for tank bottom plate, when there is no means of leak detection and containment, is _____ inch.

1. .10
2. .075
3. .15
4. .05

1/5

81. When used, the ultrasonic thickness measurements shall be made at intervals not to exceed _____.

1. one month
2. one year
3. five years, (unknown corrosion rate)
4. ten years, (unknown corrosion rate)

82. The term hot work is defined as _____.

1. work that is required to be done immediately
2. work done on a tank that meets API 650, Appendix M
3. fire fighting technique
4. an operation that can produce a spark or flame hot enough to ignite flammable vapors

83. The most likely point of occurrence of cracks in riveted tanks is around _____.

1. internal piping
2. flanged connections
3. roof seals
4. rivet holes

84. A qualified person who is authorized by the entry supervisor to enter a confined space is called a(n) _____.

1. hole watch
2. qualified person
3. entrant
4. rescuer

85. Qualified inspectors shall have education and experience equal to at least one of the following:

1. a degree in engineering plus 1 year of experience in inspection of tanks, pressure vessels or piping
2. two years of experience in work related field
3. two year certificate in technology from technical college
4. high school education

86. The maximum acceptable undercutting of the base metal for vertical butt joints is _____ inch.

1. 3/32 — 24
2. 1/8 — 32
3. 1/64 — 64
4. 3/64 — 12

87. When used, ultrasonic thickness measurements shall be made at _____ year intervals after commissioning new tanks.

1. 5
2. 7
3. 10
4. 15

88. On a reconstructed tank, all new shell joints shall be _____.

1. full fillet welded with complete fusion
2. butt-welded with complete penetration and complete fusion
3. lap-welded with complete penetration and complete fusion
4. single groove with backing strip

89. While work is being performed in and around an area with an inert atmosphere _____.

1. no monitoring is required
2. the area should be continuously flooded with water
3. the area should be continuously monitored with an oxygen analyzer
4. the welder must use a class Z49.1 filter type respirator

90. A double-welded butt weld is _____.

1. a joint between two abutting parts lying in approximately the same plane
2. a joint between two abutting parts lying in approximately the same plane that is welded from both sides
3. a joint between two overlapping members in which the overlapping edges of both members are welded with fillet welds
4. a fillet weld whose size is equal to the thickness of the thinner joined member

91. The minimum acceptable shell plate thickness for tanks with diameters equal to or less than _____ feet shall be calculated using the following method: $t_{min} = \frac{2.6DHG}{SE}$

1. 100
2. 150
3. 175
4. 200

92. All requirements of API 650, _____, shall be considered before changing the service of a tank to operation at temperatures above 200°F.

1. Appendix M
2. Appendix J
3. Appendix C
4. Appendix K

93. Openings in tank shells larger than required to accommodate a _____ inch flanged or threaded nozzle shall be reinforced.

1. one
2. two
3. three
4. four

94. The API 653 standard employs the principles of _____.

1. API 650
2. ASME Article 4
3. AWS D1.1
4. API 1104

95. Due to strength requirements, the minimum thickness of an annular plate ring is usually greater than _____ inch.

1. 0.30
2. 0.10
3. 0.22
4. 0.17

96. An entry permit shall be issued by a qualified person for all entries into a tank. Employees may be allowed to enter a permit required confined space if _____.

1. oxygen content is 19.5% 23.5% 22-51
2. flammable vapors are 30% LFL
3. toxic substances are 30% PEL/TLV
4. lead-in-air is .75 milligrams per cubic meter

97. The acceptability of welds examined by radiography shall be judged by the standards in _____.

1. ASME Section V, Division 7
2. ASME Section IX, Paragraph QW191
3. ASME Section VIII, Division 1, Paragraph UW-51(b)
4. API 1104

98. Per API 653, what is the maximum allowable banding, using a vertical 36" sweep board?

1. 1"
2. 1/2"
3. 3/8"
4. 3/32"

99. A full hydrostatic test is not required after replacement of a door sheet if the tank is otherwise exempt from hydrostatic testing and the spacing between the shell-to-bottom weld and lower edge of the door sheet is _____.

1. 24" or greater, if the tank is less than or equal to 1/2" thick
2. 12" or greater, if the tank is less than or equal to 1/2" thick
3. 6" or greater, if the tank is less than or equal to 1/2" thick
4. in compliance with table 9-1 of API 653, except it shall not extend to the floor

100. What is the extremely toxic, flammable gas that is encountered in the production, storage and processing of sour crude oil?

1. Hydrogen sulfide
2. Leaded gas
3. Lead alkalines
4. Dust

101. The addition of manways and nozzles greater than 12-inch NPS or increasing or decreasing the tank shell height is considered _____.

1. reconstruction
2. rebuilding
3. reworking

4. alteration

102. When bottom annular plates are required by paragraph 3.5.1 of API 650, the radial joints shall be radiographed. For single welded joints using a backup bar, one spot radiograph shall be taken on _____ percent of the radial joints.

- 1. 10
- 2. 30
- 3. 50
- 4. 100

103. What is the maximum allowable misalignment on a 3/4" vertical butt joint?

- 1. 10%
- 2. 1/16"
- 3. 10% or maximum of 1/8"
- 4. 12% or maximum of 3/32"

104. Atmospheric storage tanks are those tanks that have been designed to operate in their gas and vapor spaces at internal pressures which approximate _____ pressure.

- 1. 16 lbs. to 25 lbs.
- 2. 12 lbs. to 15 lbs.
- 3. more than 25 lbs.
- 4. atmospheric

105. What form best describes the hazardous properties of a substance as required by OSHA?

- 1. Material Safety Data Sheet
- 2. Welding Procedure
- 3. Permit
- 4. Original job contract

106. Who is responsible for maintaining written procedures that cover work in petroleum storage tanks?

- 1. Appropriate labor union
- 2. Employer
- 3. OSHA
- 4. Local jurisdictional requirements

107. Welder identification on roof welds and flange-to-nozzle neck welds shall _____:

- 1. be hand or machine stamped
- 2. be stamped every 3 feet
- 3. be stamped on the top side of each nozzle and in every 3 feet of roof weld
- 4. not require identification

108. Annular bottom plates must extend a minimum of _____ inches outside the tank shell.

- 1. 1 1/2
- 2. 2
- 3. 3
- 4. 4

109. For penetrations using insert plates, how shall the completed butt welds between the insert plate and shell plate be inspected?

- 1. 100% RT
- 2. Spot RT
- 3. MT
- 4. Visual

110. When making a perimeter repair, seal off all openings between the floor plates and the tank foundation by packing them with _____ or some other suitable, non-corrosive material.

- 1. asphalt
- 2. liquid hydrogen
- 3. mud
- 4. graphite and grease

111. Dual-element transducers can have the ability to operate from thin sections of:

- 1. 1.000 - 2.000 inch
- 2. 2.000 - 3.000 inch
- 3. 0.005 - 0.009 inch
- 4. 0.050 - 1.000 inch

112. The maximum operating temperature for tanks constructed to API 650 (not including appendices) is _____.

- 1. 500° F
- 2. 500° C
- 3. 200° F
- 4. 200° C

113. New _____ for floating roof support legs and for fixed roof support columns shall be installed when replacing a tank floor.

- 1. mud rings
- 2. leg guides
- 3. bearing plates
- 4. support leg pins

114. Where does the new nameplate need to be attached to a reconstructed tank?

- 1. Adjacent to the existing nameplate
- 2. Does not need one
- 3. On the roof
- 4. Over the suction piping

115. The corrosion rate for an AST is 5 mils per year. Based on API 653 requirements when should the next external UT inspection be scheduled? Note: Remaining Corrosion Allowance is .17 inches.

- 1. 17 years
- 2. 15 years
- 3. 20 years
- 4. 10 years

116. The design thickness of a reconstructed tank is based on _____.

1. original shell thickness
2. measurements taken within 180 days prior to relocation
3. measurements taken when the tank was removed from service
4. new product loads

117. The maximum design liquid level for product shall be determined by calculating the maximum design liquid level for each shell course based on _____.

1. amount of product needed
2. the specific gravity of the product
3. material coating
4. number of penetrations in the first shell course

118. In order to be in compliance with API 2207, when must the work area be monitored for oxygen deficiency and combustible and toxic atmospheres?

1. Every 4 hours
2. Every 8 hours
3. Every 12 hours
4. While work is in progress

119. You are adding a 6 inch blending nozzle to the bottom course, the shell is 5/8" thick. What size insert plate is required when used with a reinforcement plate?

1. 12" diameter
2. 18" diameter
3. Three times the diameter of the penetration
4. The diameter of the reinforcement plate, plus 12"

120. Who is responsible for compliance with the API 650 standards?

1. Manufacturer
2. Purchaser
3. State Inspector
4. API 653 Inspector

121. _____ settlement occurs when the tank shell settles sharply around the periphery, resulting in deformation of the bottom plate.

1. Uniform
2. Edge
3. Out-of-Plane
4. Rigid Body Tilting

122. A full hydrostatic test can be waived on a tank _____.

1. after replacement of door sheet that intersects the shell-to-bottom weld
2. when a 36-inch nozzle has been installed
3. after partial or complete jacking of a tank shell
4. if the owner or operator has authorized the exemption in writing

123. Which type of tank settlement will rotate the tank in a tilted plane?

1. Uniform settlement
2. Rigid body
3. Out-of-Plane settlement
4. Differential settlement

Polhem
2
?

124. Where hot work is to be performed, a fire extinguisher or _____ shall be available and personnel shall be instructed in its use.

1. alcohol spray
2. sand bucket
3. fire water hose
4. pressurized fire water hose

9
2

125. The minimum thickness of new roof plates shall be _____ inch, plus any corrosion allowances, as specified in the repair specifications.

1. 1/2
2. 7/8
3. 3/16
4. 3/8

1/2
7/8
3/16
3/8

126. Express 50 mills as _____ inch(es).

1. .500
2. .050
3. .005
4. .0005

2
100
1000

127. For replacement of tank bottom floor, what is a suitable non-corrosive material for use between the old and new floor?

1. Dirt
2. Sand or concrete
3. Fiberglass insulation
4. Air

9

128. According to API 653, the basis for repairs and alterations shall be an _____.

1. API Standard 650 equivalence
2. API Standard 2207 equivalence
3. ASME Section V equivalence
4. AWS D 1.1 equivalence

129. All new shell joints shall be _____ joints, with complete penetration.

1. butt welded
2. lap welded
3. riveted
4. chemically bonded

130. During the repair of an AST, one new vertical shell weld was installed. How many radiographs are required on the vert? (The shell is 1.25" thick).

1. One radiograph shall be taken in every vertical joint
2. 100% of the vertical joint
3. Two radiographs shall be taken in the vertical joint
4. No radiographs required

131. Settlement can result from _____.

1. frequent freezing and thawing of the ground
2. nearby equipment operating with extreme vibration
3. too much product being stored in the tank
4. high wind

132. Storage tanks shall be _____ and gas-freed prior to commencement of dismantling.

1. filled
2. drained
3. cleaned
4. vented

133. All bottom plates shall have a minimum nominal thickness of _____ inch, exclusive of any corrosion allowance specified by the purchaser for the bottom plates.

1. 3/8 — 9.525
2. .250 — 6.35
3. .516 — 13.10
4. .325 — 8.26

134. _____ means the work necessary to reassemble a tank that has been dismantled and relocated to a new site.

1. Reconstruction
2. Rebuilding
3. Reworking
4. Alteration

135. Repairs shall not be attempted on a tank that is filled with _____ or on a tank that has contained _____ until the tank has been emptied, cleaned and gas freed in a safe manner.

1. nitrogen
2. oil
3. water
4. grain

136. According to API 653, a full hydrostatic test, held for 24 hours, shall be performed on:

1. a new tank
2. an in-service tank
3. a reconstructed tank
4. an out-of-service tank

137. Misalignment in completed vertical joints over 5/8" shall not exceed what percentage of the plate thickness?

1. 25% with a maximum of 1/16" — 1.6
2. 2% with a maximum of 3/64" — 1.2
3. 5% with a maximum of 3/8" — 9.56
4. 10% with a maximum of 1/8" — 3.2

138. New or altered reinforcing plates of shell penetrations shall be given a(n) _____ test, in accordance with API Standard 650.

1. diesel
2. air
3. stress
4. gas

139. Ultrasonic acceptance standards, in accordance with API 653, shall be _____.

1. ASME Section VIII
2. ASME Section V
3. ASME Section XI
4. Agreed upon by the purchaser and the manufacturer

140. Column-based clip-guides shall be welded to the tank bottom to prevent _____.

1. internal erosion
2. structural uplifting
3. lateral movement of column bases
4. lateral expansion and contraction

141. Any specific design considerations, other than normal product loading, shall be specified by _____.

1. owner/operator
2. contractor
3. engineer
4. welding foreman

142. A(n) _____ is an electrode of an electrochemical cell at which oxidation (corrosion) occurs.

1. bathode
2. anode
3. cathode
4. electrolyte

143. A(n) _____ is an electrode of an electrochemical cell at which a reduction reaction occurs.

1. bathode
2. anode
3. cathode
4. electrolyte

144. A _____ is a discontinuity in a coating film that exposes the metal surface to the environment.

1. vacation
2. surface interruption
3. stress riser
4. holiday

145. _____ occurs when two metals with different compositions (thus different electrolytic potentials) are connected in an electrolyte (usually soil).

1. Scattered metal growth
2. Scattered metal blistering
3. Galvanic corrosion
4. Erosion

146. A Galvanic system is a _____.

1. system that uses a metal less active than the structure to stop corrosion
2. system that uses a metal more active than the structure to stop corrosion
3. system that uses a chemical to stop corrosion
4. system that uses a coating to stop corrosion

147. All tanks shall be given a formal visual external inspection by an inspector qualified in accordance with API 653, Paragraph 4.10 at least every _____ years.

1. 10
2. 7
3. 6
4. 5

148. Welding consumables shall conform to the _____ classification that is applicable to the intended use.

1. ASNT
2. AWS
3. ASME
4. API

149. The rules given in API 653 are _____ for tank inspection, repairs, alterations and reconstruction.

1. minimum requirements
2. maximum requirements
3. guideline requirements
4. suggested requirements

150. _____ means any work on a tank involving cutting, burning, welding or heating operations that changes the physical dimensions and/or configuration of a tank.

1. Repair
2. Reconstruction
3. Reworking
4. Alteration

QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATIONS (WPS)
(See QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code)

Company Name: _____ By: _____
Welding Procedure Specification No. SMAW-1 Date: _____ Supporting PQR No.(s) SMAW-A1
Revision No. _____ Date: _____
Welding Process(es): SMAW Type(s): ALL
Automatic, Manual, Machine, or Semi-Auto

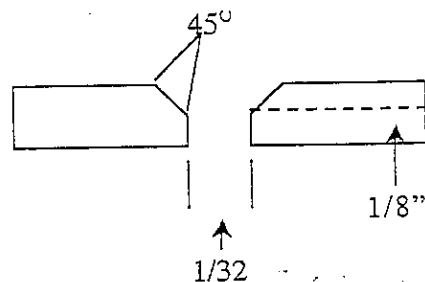
JOINTS (QW-402)

Joint Design GROOVE
Backing (Yes) _____ (No) X
Backing Material (Type) _____
(Refer to both backing and retainers)

- ☐ Metal ☐ Nonfusing Metal
☐ Nonmetallic ☐ Other

Sketches, Production Drawings, Weld Symbols or Written Description should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of weld groove may be specified.

(At the option of the Mfr., sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g., for notch toughness procedures, for multiple process procedures, etc.)



***BASE METALS (QW-403)**

P-No. 1 Group No. 1 to P-No. 23 Group No. _____

Specification type and grade _____
to Specification type and grade _____

Chem. Analysis and Mech. Prop. _____
to Chem. Analysis and Mech. Prop. _____

Thickness Range:
Base Metal: Groove 1/8" - 1" Fillet _____
Pipe Dia. Range: Groove 1/2" - 26" Fillet _____
Other: _____

***FILLER METALS (QW-404)**

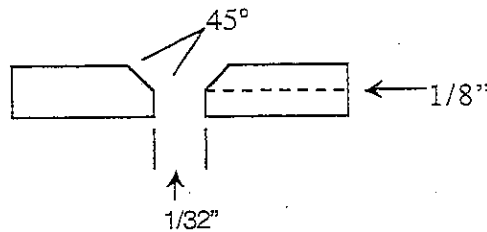
Spec. No. (SFA)	<u>5.1 and 5.5</u>	<u>5.1 and 5.5</u>	
AWS No. (Class)	<u>E-6010</u>	<u>E-7018</u>	
F-No.	<u>3</u>	<u>4</u>	
A-No.			
Size of Filler Metals	<u>3/32" 1 1/8"</u>	<u>1/16" - 7/32"</u>	
Weld Metal			
Thickness Range:			
Groove	<u>.250</u>	<u>1/2"</u>	
Fillet			
Electrode-Flux (Class)	<u>N/A</u>	<u>N/A</u>	
Flux Trade Name	<u>N/A</u>	<u>N/A</u>	
Consumable Insert	<u>N/A</u>	<u>N/A</u>	
Other			

*Each base metal-filler metal combination should be recorded individually.

QW-483 SUGGESTED FORMAT FOR PROCEDURE QUALIFICATION RECORD (PQR)
 (See QW-200.2, Section IX, ASME Boiler and Pressure Vessel Code)
 Record Actual Conditions Used to Weld Test Coupon

Company Name _____
 Procedure Qualification Record No. SMAW 1A Date 5/599
 WPS No. SMAW - 1
 Welding Process(es) SMAW
 Types (Manual, Automatic, Semi-Auto.) MANUAL

JOINTS (QW-402)



Groove Design of Test Coupon

(For combination qualifications, the deposited weld metal thickness will be required for each filler metal or process used.)

BASE METALS (QW-403)

Material Spec. A-53
 Type or Grade B
 P. No. 1 to P-No. 1
 Thickness of Test Coupon 1/2"
 Diameter of Test Coupon 10"
 Other _____

POST WELD HEAT TREATMENT (QW-407)

Temperature Ambient
 Time _____
 Other _____

FILLER METALS (QW-404)

SFA Specification <u>5.5</u>	<u>5.1</u>
AWS Classification <u>E-6010</u>	<u>E-7018</u>
Filler Metal F-No. <u>3</u>	<u>4</u>
Weld Metal Analysis A-No. <u>Good</u> ✓	<u>Good</u>
Size of Filler Metal _____	_____
Other _____	_____
Weld Metal Thickness <u>1"</u>	<u>1"</u>

GAS (QW-408)

	Percent Composition		
	Gas(es)	(Mixture)	Flow Rate
Shielding	<u>N/A</u>	_____	_____
Trailing	_____	_____	_____
Backing	_____	_____	_____

ELECTRICAL CHARACTERISTICS (QW-409)

Current DC
 Polarity DCEN
 Amps. 120 Volts 25
 Tungsten Electrode Size 1/8
 Other _____

POSITION (QW-405)

Position of Groove Downhill
 Weld Progression (Uphill, Downhill) _____
 Other _____

TECHNIQUE (QW-410)

Travel Speed 15 IPM
 String or Weave Bead String
 Oscillation Yes
 Multipass or Single Pass (per side) _____
 Single or Multiple Electrodes _____
 Other _____

PREHEAT (QW-406)

Preheat Temp. None
 Interpass Temp. _____
 Other _____

QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATIONS (WPS)
(See QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code)

Company Name: _____ By: _____
 Welding Procedure Specification No. SMAW-1 Date: 5/3/00 Supporting PQR No.(s) SMAW-A1
 Revision No. _____ Date: _____
 Welding Process(es): SMAW Type(s): ALL
 Automatic, Manual, Machine, or Semi-Auto

JOINTS (QW-402)

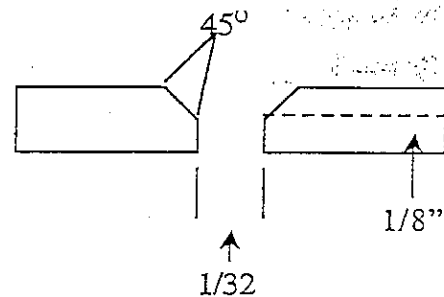
Details

Joint Design GROOVE
 Backing (Yes) _____ (No) X
 Backing Material (Type) _____
 (Refer to both backing and retainers)

- ☐ Metal ☐ Nonfusing Metal
☐ Nonmetallic ☐ Other

Sketches, Production Drawings, Weld Symbols or Written Description should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of weld groove may be specified.

(At the option of the Mfr., sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g., for notch toughness procedures, for multiple process procedures, etc.)



***BASE METALS (QW-403)**

P-No. 1 Group No. 1 to P-No. 23 Group No. _____

OR

Specification type and grade _____
 to Specification type and grade _____

OR

Chem. Analysis and Mech. Prop. _____
 to Chem. Analysis and Mech. Prop. _____

Thickness Range:

Base Metal: Groove 1/8" - 1" Fillet _____
 Pipe Dia. Range: Groove 1 1/2" - 26" Fillet _____
 Other: _____

***FILLER METALS (QW-404)**

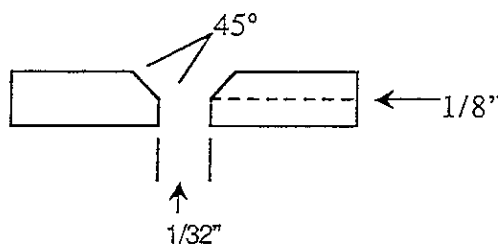
Spec. No. (SFA)	<u>5.1 and 5.5</u>	<u>5.1 and 5.5</u>	
AWS No. (Class)	<u>E-6010</u>	<u>E-7018</u>	
F-No.	<u>3</u>	<u>4</u>	
A-No.			
Size of Filler Metals	<u>3/32" 1 1/8"</u>	<u>1/16" - 7/32"</u>	
Weld Metal			
Thickness Range:			
Groove	<u>.250</u>	<u>1/2"</u>	
Fillet			
Electrode-Flux (Class)	<u>N/A</u>	<u>N/A</u>	
Flux Trade Name	<u>N/A</u>	<u>N/A</u>	
Consumable Insert	<u>N/A</u>	<u>N/A</u>	
Other			

*Each base metal-filler metal combination should be recorded individually

QW-483 SUGGESTED FORMAT FOR PROCEDURE QUALIFICATION RECORD (PQR)
 (See QW-200.2, Section IX, ASME Boiler and Pressure Vessel Code)
 Record Actual Conditions Used to Weld Test Coupon

Company Name _____
 Procedure Qualification Record No. SMAW 1A Date _____
 WPS No. SMAW - 1
 Welding Process(es) SMAW
 Types (Manual, Automatic, Semi-Auto.) MANUAL

JOINTS (QW-402)



Groove Design of Test Coupon

(For combination qualifications, the deposited weld metal thickness will be required for each filler metal or process used.)

BASE METALS (QW-403)

Material Spec. A-53 Table 422/page 78
 Type or Grade B
 P. No. 1 to P-No. 1
 Thickness of Test Coupon 1/2"
 Diameter of Test Coupon 10"
 Other _____

POST WELD HEAT TREATMENT (QW-407)

Temperature Ambient None
 Time _____
 Other _____

GAS (QW-408)

	Percent Composition		
	Gas(es)	(Mixture)	Flow Rate
Shielding	<u>N/A</u>		
Trailing			
Backing			

FILLER METALS (QW-404)

ISFA Specification	<u>5.5</u> ✓	<u>5.1</u>
AWS Classification	<u>E-6010</u>	<u>E-7018</u>
Filler Metal F-No.	<u>3</u>	<u>4</u>
Weld Metal Analysis A-No.	<u>1 (Good)</u>	<u>1 (Good)</u>
Size of Filler Metal	<u>3/32</u>	
Other		
Weld Metal Thickness	<u>1" X</u>	<u>1" X</u>

ELECTRICAL CHARACTERISTICS (QW-409)

Current DC
 Polarity DCEN / DCEP
 Amps. 120 Volts 25
 Tungsten Electrode Size 1/8
 Other _____

POSITION (QW-405)

Position of Groove Downhill
 Weld Progression (Uphill, Downhill) Downhill
 Other _____

TECHNIQUE (QW-410)

Travel Speed 15 IPM
 String or Weave Bead String
 Oscillation Yes
 Multipass or Single Pass (per side) _____
 Single or Multiple Electrodes Single
 Other _____

PREHEAT (QW-406)

Preheat Temp. None 100°F
 Interpass Temp. _____
 Other _____

API 653 Prep.

2003 Exam Answer Key

1. 2 (Page 122, Par. T-600) ASME V
2. 1 (Page 13, Par. QW-200.1a) ASME IX
3. 3 (Page 151, Par. QW-461.9) ASME IX
4. 3 (Page 19, Par. QW-252) ASME IX
(Page 62, Par. QW-407) ASME IX
5. 1 (Page 49, Par. QW-304) ASME IX
6. 2 (Page H-4, Par. H.4.4.3) API 650
7. 2 (Page 135, Par. T-773.3) ASME V
8. 3 (Page 11-1, Par. 11.1.1) API 653
(Page 7-2, Par. 7.3.2) API 650
9. 1 (Page 29, Par. T-285) ASME V
10. 3 (Page 67, Par. T-461) ASME V
11. 2 (Page 134, Par. T-761) ASME V
12. 1 (Page 134, Par. T-761c) ASME V
13. 1 (Page 29, Par. T-284) ASME V
14. 3 (Page 12-1, Par. 12.1.2.1) API 653
15. 2 (Page 4-3, Par. 4.3.2.2) API 653
16. 4 (Page 4-3, Par. 4.3.3.1) API 653

Solution: Use the formula, Minimum Thickness
Calculation for Welded Tank Shell:

$$t_{min} = \frac{2.6 (H-1) DG}{SE}$$

$$t_{min} = \frac{2.6 (22-1) (94)(1)}{23,595} \quad \text{Values substituted}$$

$$t_{min} = \frac{5,132.4}{23,595}$$

$$t_{min} = .218"$$

17. 1 (Page 4-3, Par. 4.3.3.1) API 653
- Solution: Use the formula, Minimum Thickness
Calculation for Welded Tank Shell.

$$t_{min} = \frac{2.6 (H-1) DG}{SE}$$

$$t_{min} = \frac{2.6 (14-1) (94)(1)}{25,960(1)} \quad \text{Values substituted}$$

$$t_{min} = \frac{3,177.2}{25,960}$$

$$t_{min} = .122$$

18. 2 (Page 4-2, Par. 4.3.2) API 653
- Solution: Use the formula, Actual Thickness
Determination.

$$L = 3.7 \sqrt{(Dt_2)}$$

$$L = 3.7 \sqrt{(94) (.125)} \quad \text{Values substituted}$$

$$L = 3.7 \sqrt{(11.75)}$$

$$L = 3.7 \times 3.428$$

$$L = 12.68"$$

19. 4 (Page 4-3, Par. 4.3.2.2b) API 653
- Solution: Use the Pit Measurement Technique.

$$d_1 + d_2 + d_3 \dots \leq 2"$$

$$1.250 + 1 + .500 = 2.750" \quad \text{Values substituted}$$

20. 1 (Page 4-3, Par. 4.3.2.2a) API 653

21. 2 (Page B-7, Par. B.3.3) API 653

22. 4 (Page B-5, Par. B.3.3) API 653

Solution: Use the formula, Internal Bottom
Settlements or Bulges. Edge settlement is
calculated in the same fashion.

$$B = 0.37R$$

$$B = 0.37 (6) \quad \text{Values substituted}$$

$$B = 2.22"$$

Note: Figure B-10 and B-11 could be used.

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23. 1 (Page 4-5, Par. 4.3.3.2) API 653
Solution: Use the formula, Hydrostatic test height for welded tank shells.

$$H_t = \frac{S_t E t_{min}}{2.6D}$$

$$S_t = \{.472T = .472 (55,000) = 25,960\}$$

$$H_t = \frac{(25,960) (1) (.218)}{2.6(94)}$$

$$H_t = \frac{5659.28}{244.4}$$

$$H_t = 23.16'$$

24. 1 (Page B-5, Par. B.3.3) API 653
Solution: Use the formula, Internal Bottom Settlements or Bulges. Edge settlement is calculated in the same fashion.

$$B = 0.37R$$

$$B = 0.37 (1.5) \text{ Values substituted}$$

$$B = .555" \text{ (Fig. B-9, same answer)}$$

25. 2 (Page 4-3, Par. 4.3.3.1) API 653
Solution: Use the formula, Minimum Thickness Calculation for Welded Tank Shell.

$$t_{min} = \frac{2.6 (H-1) DG}{SE}$$

$$t_{min} = \frac{2.6 (17-1) (94) (1)}{23,595(1)} \text{ Values substituted}$$

$$t_{min} = \frac{3.910.4}{23,595}$$

$$t_{min} = .168"$$

26. 4 (Page 4-8, Par. 4.4.7.1) API 653
Solution: Use the formula, Minimum Thickness for Tank Bottom Plate.

$$MRT = RT_{bp} - O_r (S_t P_r + UP_r)$$

$$MRT = .200 - 10(.002 + .010) \text{ Values substituted}$$

$$MRT = .200 - 10(.012)$$

$$MRT = .200 - .12$$

$$MRT = .080$$

27. 2 (Page 4-8, Par. 4.4.7.1) API 653
Solution: Use the formula, Minimum Thickness for Tank Bottom Plate.

$$MRT = RT_{ip} - O_r (S_t P_r + UP_r)$$

$$MRT = .190 - 10(.002 + .010) \text{ Values substituted}$$

$$MRT = .190 - 10(.012)$$

$$MRT = .190 - .12$$

$$MRT = .070$$

28. 4 (Pg 21, Par T-222.2) ASME Sec V

29. 4 (Page 4-5, Par. 4.3.3.2) API 653
Solution: Use the formula, Hydrostatic test height for welded tank shells.

$$H_t = \frac{S_t E t_{min}}{2.6D}$$

$$S_t = 33,000 \text{ (From Table 4-1)}$$

$$H_t = \frac{(33,000) (1) (.197)}{2.6(82)}$$

$$H_t = \frac{6501}{213.2}$$

$$H_t = 30.49' \text{ or (approx. 30' 6" From API 650 Table 3 - 2)}$$

30. 2 (Pg 27, Tbl T-276) ASME Sec V, Art 2
31. 2 (Pg 124, Par T-652) ASME Sec V, Art 6
32. 1 (Pg 134, Par T-772) ASME Sec V, Art 7
33. 3 (Pg 134, Par T-762(b)) ASME Sec V, Art 7
34. 4 (Pg 134, Par T-762(c)) ASME Sec V, Art 7
35. 3 (Page 3-6, Par. 3.5.3) API 650
36. 3 (Page 9-6, Par. 9.10.1.2 (b)) API 653
37. 2 (Pg 47, Par. QW-300.3) ASME Sec IX, Art 3
38. 1 (Pg 10, Par. QW-194) ASME Sec IX, Art 1

API 653 Prep.

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39.	2	(Page 3-7, Par. 3.6.3) API 650	74.	3	(Page 3-5, Par. 3.5.2) API 650
		$T_t = \frac{2.6D(H-1)}{S_t}$	75.	3	(Page 7-1, Par. 7.3.1.3) API 653
			76.	1	(Page 4-6, Par. 4.3.5.3) API 653
		$T_t = \frac{2.6 \times 150 (40-1)}{24,900}$	77.	1	(Page 6-1, Par. 6.3.1.2) API 653
			78.	1	(Page 6-4, Par. 6.9.1) API 653
		$T_t = \frac{390 (39)}{24,900}$	79.	4	(Page 2, Par. 5.3) API 2207
			80.	1	(Page 6-3, Table 6-1) API 653
		$T_t = \frac{15,210}{24,900}$	81.	3	(Page 6-1, Par. 6.3.3.2) API 653
			82.	4	(Page 1, Par. 1.1) API 2207
		$T_t = 0.611$ (round to .625 plate)	83.	4	(Page 15, Par. 5.4) API 575
40.	4	(Page 6-3, Par. 6.1.3.4) API 650	84.	3	(Page 24, Par. 7.4.2) API 2015
41.	2	(Page 1-1, Par. 1.3) API 653	85.	1	(Page D-1, Par. D.2.1a) API 653
42.	2	(Page 22, Par. 7.2.9.5) API 575	86.	3	(Page 5-1, Par. 5.2.1.4) API 650
43.	3	(Page 25, Par. 7.4.5) API 2015	87.	1	(Page 6-1, Par. 6.3.3.2) API 653
44.	3	(Page 6-1, Par. 6.3.2.1) API 653	88.	2	(Page 8-1, Par. 8.2.2) API 653
45.	2	(Page 6-1, Par. 6.3.1.1) API 653	89.	3	(Page 3, Par. 4.6.d) API 2207
46.	3	(Page 3-17, Par. 3.7.4.3) API 650	90.	2	(Page 3-1, Par. 3.1.1.1) API 650
47.	1	(Page 3-1, Par. 3.9) API 653	91.	4	(Page 4-3, Par. 4.3.3.1) API 653
48.	2	(Page 152, Par. QW-462) ASME IX	92.	1	(Page 4-1, Par. 4.2.4.3) API 653
49.	3	(Page 23, Par. 7.2.10) API 575	93.	2	(Page 3-11, Par. 3.7.2.1) API 650
50.	3	(Page 24, Par. 11.3.2) API 651	94.	1	(Page 1-1, Par. 1.1.3) API 653
51.	1	(Page 43, Par. 12.3.2.5) API 2015	95.	2	(Page 4-9, Par. 4.4.8.1) API 653
52.	3	(Page 11-1, Par. 11.1.1) API 653	96.	1	(Page 28, Par. 8.3.3.1) API 2015
53.	2	(Page 5-4, Par. 5.3.6.1) API 650	97.	3	(Page 6-3, Par. 6.1.5) API 650
54.	1	(Page 4-1, Par. 4.2.1.2) API 653	98.	1	(Page 10-4, Par. 10.5.5) API 653
55.	3	(Page 2, Par. 3.2) API 2207	99.	4	(Page 12-4, Par. 12.3.2.2.8) API 653
56.	1	(Page 7-2, Par. 7.3.1) API 650	100.	1	(Page 24, Par. 7.4.2) API 2015
57.	2	(Page 5, Par. 3.2.2) API 2015	101.	4	(Page 3-1, Par. 3.1) API 653
58.	4	(Page 2, Par. 5.2.a) API 2207	102.	3	(Page 6-3, Par. 6.1.2.9b) API 650
59.	3	(Page 9, Par. 3.2.54) API 2015	103.	3	(Page 10-3, Par. 10.4.4.1) API 653
60.	4	(Page 3, Par. 4.2.3) API 575	104.	4	(Page 2, Par. 4.2.1) API 575
61.	2	(Page C-1, Par. C.3.3.3) API 650	105.	1	(Page 8, Par. 3.2.40) API 2015
62.	1	(Page 10, Par. 11.2) API 652	106.	2	(Page 1, Par. 1.4) API 2015
63.	3	(Page 41, Par. 8.3) API 575	107.	4	(Page 11-1, Par. 11.2.2) API 653
64.	2	(Page 6-2, Par. 6.4.2.2) API 653	108.	2	(Page 3-5, Par. 3.5.2) API 650
65.	4	(Page 9, Par. 3.2.52) API 2015	109.	1	(Page 12-3, Par. 12.2.1.8) API 653
66.	4	(Page 4-9, Par. 4.5.1.2a) API 653	110.	3	(Page 3, Par. 4.4.b) API 2207
67.	3	(Page 6-2, Par. 6.4.2.1) API 653	111.	4	(Page 1, Par. 3.1) API 575
68.	2	(Page 5-4, Par. 5.3.4) API 650	112.	3	(Page 1-1, Par. 1.1.1) API 650
69.	2	(Page 1, Par. 2.2.4) API 2207	113.	3	(Page 9-9, Par. 9.10.2.1.7) API 653
70.	1	(Page 7-1, Par. 7.3.1.2) API 653	114.	1	(Page 13-1, Par. 13.1.2) API 653
71.	3	(Page 5-1, Par. 5.2.1.5) API 650	115.	2	(Page 6-1, Par. 6.3.3.2b) API 653
72.	2	(Page 9, Par. 3.2.47) API 2015	116.	2	(Page 8-1, Par. 8.4.1) API 653
73.	3	(Page 3-1, Par. 3.10) API 653	117.	2	(Page 8-1, Par. 8.4.2) API 653
			118.	4	(Page 2, Par. 2.2.7) API 2207
			119.	4	(Page 9-5, Par. 9.8.2b) API 653
			120.	1	(Page 1-2, Par. 1.3) API 650
			121.	2	(Page B-4, Par. B.2.3.1) API 653

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|-----|---|--|------|---|--------------------------------------|
| 39. | 2 | (Page 3-7, Par. 3.6.3) API 650 | 74. | 3 | (Page 3-5, Par. 3.5.2) API 650 |
| | | $T_t = \frac{2.6D(H-1)}{S_t}$ | 75. | 3 | (Page 7-1, Par. 7.3.1.3) API 653 |
| | | S_t | 76. | 1 | (Page 4-6, Par. 4.3.5.3) API 653 |
| | | $T_t = \frac{2.6 \times 150 (40-1)}{24,900}$ | 77. | 1 | (Page 6-1, Par. 6.3.1.2) API 653 |
| | | | 78. | 1 | (Page 6-4, Par. 6.9.1) API 653 |
| | | $T_t = \frac{390 (39)}{24,900}$ | 79. | 4 | (Page 2, Par. 5.3) API 2207 |
| | | | 80. | 1 | (Page 6-3, Table 6-1) API 653 |
| | | $T_t = \frac{15,210}{24,900}$ | 81. | 3 | (Page 6-1, Par. 6.3.3.2) API 653 |
| | | | 82. | 4 | (Page 1, Par. 1.1) API 2207 |
| | | $T_t = 0.611$ (round to .625 plate) | 83. | 4 | (Page 15, Par. 5.4) API 575 |
| 40. | 4 | (Page 6-3, Par. 6.1.3.4) API 650 | 84. | 3 | (Page 24, Par. 7.4.2) API 2015 |
| 41. | 2 | (Page 1-1, Par. 1.3) API 653 | 85. | 1 | (Page D-1, Par. D.2.1a) API 653 |
| 42. | 2 | (Page 22, Par. 7.2.9.5) API 575 | 86. | 3 | (Page 5-1, Par. 5.2.1.4) API 650 |
| 43. | 3 | (Page 25, Par. 7.4.5) API 2015 | 87. | 1 | (Page 6-1, Par. 6.3.3.2) API 653 |
| 44. | 3 | (Page 6-1, Par. 6.3.2.1) API 653 | 88. | 2 | (Page 8-1, Par. 8.2.2) API 653 |
| 45. | 2 | (Page 6-1, Par. 6.3.1.1) API 653 | 89. | 3 | (Page 3, Par. 4.6.d) API 2207 |
| 46. | 3 | (Page 3-17, Par. 3.7.4.3) API 650 | 90. | 2 | (Page 3-1, Par. 3.1.1.1) API 650 |
| 47. | 1 | (Page 3-1, Par. 3.9) API 653 | 91. | 4 | (Page 4-3, Par. 4.3.3.1) API 653 |
| 48. | 2 | (Page 152, Par. QW-462) ASME IX | 92. | 1 | (Page 4-1, Par. 4.2.4.3) API 653 |
| 49. | 3 | (Page 23, Par. 7.2.10) API 575 | 93. | 2 | (Page 3-11, Par. 3.7.2.1) API 650 |
| 50. | 3 | (Page 24, Par. 11.3.2) API 651 | 94. | 1 | (Page 1-1, Par. 1.1.3) API 653 |
| 51. | 1 | (Page 43, Par. 12.3.2.5) API 2015 | 95. | 2 | (Page 4-9, Par. 4.4.8.1) API 653 |
| 52. | 3 | (Page 11-1, Par. 11.1.1) API 653 | 96. | 1 | (Page 28, Par. 8.3.3.1) API 2015 |
| 53. | 2 | (Page 5-4, Par. 5.3.6.1) API 650 | 97. | 3 | (Page 6-3, Par. 6.1.5) API 650 |
| 54. | 1 | (Page 4-1, Par. 4.2.1.2) API 653 | 98. | 1 | (Page 10-4, Par. 10.5.5) API 653 |
| 55. | 3 | (Page 2, Par. 3.2) API 2207 | 99. | 4 | (Page 12-4, Par. 12.3.2.2.8) API 653 |
| 56. | 1 | (Page 7-2, Par. 7.3.1) API 650 | 100. | 1 | (Page 24, Par. 7.4.2) API 2015 |
| 57. | 2 | (Page 5, Par. 3.2.2) API 2015 | 101. | 4 | (Page 3-1, Par. 3.1) API 653 |
| 58. | 4 | (Page 2, Par. 5.2.a) API 2207 | 102. | 3 | (Page 6-3, Par. 6.1.2.9b) API 650 |
| 59. | 3 | (Page 9, Par. 3.2.5.4) API 2015 | 103. | 3 | (Page 10-3, Par. 10.4.4.1) API 653 |
| 60. | 4 | (Page 3, Par. 4.2.3) API 575 | 104. | 4 | (Page 2, Par. 4.2.1) API 575 |
| 61. | 2 | (Page C-1, Par. C.3.3.3) API 650 | 105. | 1 | (Page 8, Par. 3.2.40) API 2015 |
| 62. | 1 | (Page 10, Par. 11.2) API 652 | 106. | 2 | (Page 1, Par. 1.4) API 2015 |
| 63. | 3 | (Page 41, Par. 8.3) API 575 | 107. | 4 | (Page 11-1, Par. 11.2.2) API 653 |
| 64. | 2 | (Page 6-2, Par. 6.4.2.2) API 653 | 108. | 2 | (Page 3-5, Par. 3.5.2) API 650 |
| 65. | 4 | (Page 9, Par. 3.2.5.2) API 2015 | 109. | 1 | (Page 12-3, Par. 12.2.1.8) API 653 |
| 66. | 4 | (Page 4-9, Par. 4.5.1.2a) API 653 | 110. | 3 | (Page 3, Par. 4.4.b) API 2207 |
| 67. | 3 | (Page 6-2, Par. 6.4.2.1) API 653 | 111. | 4 | (Page 1, Par. 3.1) API 575 |
| 68. | 2 | (Page 5-4, Par. 5.3.4) API 650 | 112. | 3 | (Page 1-1, Par. 1.1.1) API 650 |
| 69. | 2 | (Page 1, Par. 2.2.4) API 2207 | 113. | 3 | (Page 9-9, Par. 9.10.2.1.7) API 653 |
| 70. | 1 | (Page 7-1, Par. 7.3.1.2) API 653 | 114. | 1 | (Page 13-1, Par. 13.1.2) API 653 |
| 71. | 3 | (Page 5-1, Par. 5.2.1.5) API 650 | 115. | 2 | (Page 6-1, Par. 6.3.3.2b) API 653 |
| 72. | 2 | (Page 9, Par. 3.2.47) API 2015 | 116. | 2 | (Page 8-1, Par. 8.4.1) API 653 |
| 73. | 3 | (Page 3-1, Par. 3.10) API 653 | 117. | 2 | (Page 8-1, Par. 8.4.2) API 653 |
| | | | 118. | 4 | (Page 2, Par. 2.2.7) API 2207 |
| | | | 119. | 4 | (Page 9-5, Par. 9.8.2b) API 653 |
| | | | 120. | 1 | (Page 1-2, Par. 1.3) API 650 |
| | | | 121. | 2 | (Page B-4, Par. B.2.3.1) API 653 |

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122.	4	(Page 12-3, Par. 12.3.2.1b) API 653
123.	2	(Page B-1, Par. B.2.2.2) API 653
124.	4	(Page 44, Par. 12.5.1) API 2015
125.	3	(Page 9-9, Par. 9.11.1.1) API 653
126.	2	(Page 2, Par. 3.24) API 652
127.	2	(Page 9-8, Par. 9.10.2.1.1) API 653
128.	1	(Page 9-1, Par. 9.1.1) API 653
129.	1	(Page 8-1, Par. 8.2.2) API 653
130.	2	(Page 12-2, Par. 12.2.1) API 653
131.	1	(Page 15, Par. 5.4) API 575
132.	3	(Page 10-1, Par. 10.2) API 653
133.	2	(Page 3-5, Par. 3.4.1) API 650
134.	1	(Page 3-1, Par. 3.13) API 653
135.	2	(Page 5-4, Par. 5.4.4) API 650
136.	3	(Page 12-3, Par. 12.3.1.1) API 653
137.	4	(Page 5-2, Par. 5.2.3.1) API 650
138.	2	(Page 12-5, Par. 12.4) API 653
139.	4	(Page 6-4, Par. 6.3.4) API 650
140.	3	(Page 3-48, Par. 3.10.4.6) API 650
141.	1	(Page 8-1, Par. 8.1) API 653
142.	2	(Page 2, Par. 3.2) API 651
143.	3	(Page 2, Par. 3.5) API 651
144.	4	(Page 2, Par. 3.21) API 652
145.	3	(Page 5, Par. 4.2.2) API 651
146.	2	(Page 10, Par. 6.2.1) API 651
147.	4	(Page 6-1, Par. 6.3.2.1) API 653
148.	2	(Page 7-1, Par. 7.4) API 653
149.	1	(Forward Page iii) API 653
150.	4	(Page 3-1, Par. 3.15) API 653