ASME PCC-2 Study Guide

Practice Questions for API 510 Exam

This following is a Study Guide that helps you learn the details of ***ASME PCC-2, Repair of Pressure Equipment & Piping - 2018 Edition****. There will probably be about 5-12 questions from this document on your API exam. We do* ***NOT*** *spend much time in class discussing this publication. So, it is important that you become familiar with this content in your personal study sessions.*

The questions in this Guide are list in the order of the Repair Topics. An answer key is provided at the end of the Guide. We suggest you read the specific Repair Topic a couple of times before answering the questions. Do this Study Guide multiple times prior to your API exam! ***Your Goal … be able to score 85+% on this guide! Questions highlighted in Yellow are Open Book Questions!***

Good News! The majority of the PCC-2 questions will be Open Book!

Article 201: Butt-Welded Insert Plates

1. An insert plate is being used to repair a vessel shell that has experienced localized corrosion. Which of the following is correct? **This may have more than one correct answer, select all answers that apply.**

   A. The repair plate must be the same material as the vessel shell.
   B. The repair plate should be the same material as the vessel shell
   C. The repair plate must have the same P-Number as the vessel material.
   D. The repair plate should have the same P-Number as the vessel material.

2. The thickness of a butt-welded insert plate:

   A. should be as thick as the current thickness of the adjacent shell piece.
   B. must be as thick as the current thickness of the adjacent shell piece.
   C. should be as thick as the nominal thickness of the adjacent shell piece.
   D. must be as thick as the nominal thickness of the adjacent shell piece.

3. A 1.5" thick rectangular insert plate is being install per ASME PCC-2. What is the minimum allowed corner radius?

   A. 1"
   B. 3"
   C. 6"
   D. 12"

4. A square insert plate that is 1" thick is being install in a vessel in accordance with ASME PCC-2. What is the minimum allowed corner radius?

   A. 1"
   B. 3"
   C. 6"
   D. 12"

5. A rectangular insert plate that is 3/8" thick is being install per ASME PCC-2. What is the minimum allowed corner radius:

   A. 1"
   B. 2"
   C. 3"
   D. Unspecified radius

6. A 1.5" thick insert plate is being install in a carbon steel vessel. The new welds will ***not*** be post weld heat treated. Per ASME PCC-2, what is the minimum dimension for patch plate *(length, width or diameter)?*

   A. 12"
   B. 15"
   C. 18"
   D. 24"

7. A carbon steel 0.750" thick insert plate is being install per ASME PCC-2? The new welds will ***not*** be post weld heat treated. What is the minimum dimension for patch plate *(length, width or diameter)?*

   A. 6"
   B. 9"
   C. 12"
   D. 15"

8. A 1.00" thick insert plate is being install per ASME PCC-2? The new welds will be post weld heat treated. What is the minimum diameter for patch plate?

   A. 6"
   B. 12"
   C. 18"
   D. 24"

9. When installing an insert patch, the structural stability of the vessel may be affected in which of following situations?

   A. Any unsupported plate with a cutout in 300 Series SS vessel
   B. Unsupported plates with a large repair cutout
   C. Adding an insert plate which includes a nozzle
   D. Replacing a stiffener ring for a vessel in vacuum service

10. A 4 NPS *(4.5" OD)* is being installed on a carbon steel vessel using a new insert plate. The nozzle-to-shell weld is ***not*** post-weld-heat-treated. What is the minimum size *(diameter)* of insert plate allowed by ASME PCC-2?

    A. 9"
    B. 10.5"
    C. 12"
    D. 16.5"

11. A 16 NPS *(16" OD)* is being installed on a carbon steel vessel using a new insert plate. The nozzle-to-shell weld is ***not*** post-weld-heat-treated. What is the minimum size *(diameter)* of insert plate allowed by ASME PCC-2?

    A. 22"
    B. 24"
    C. 28"
    D. 32"

12. A round insert patch is installed in a vessel tube. The standard bevel for the tube and the repair patch is:

    A. 15 - 30 degrees.
    B. 22.5 – 37.5 degrees.
    C. 25 - 35 degrees.
    D. 33 – 45 degrees.

13. A rectangular insert patch is cold rolled to the proper curvature of the shell. The insert plate should be appropriately heat treated if the fiber elongation from cold rolling exceeds:

    A. 0.5% elongation.
    B. 1% elongation.
    C. 2.5% elongation.
    D. 5% elongation.

14. When an insert plate is used for a repair, the maximum amount of misalignment allowed is:

    A. 1/16".
    B. 1/8".
    C. 3/16".
    D. based on the applicable construction code.

15. An insert plate is used for a vessel repair. The misalignment exceeds what is allowed. The edge of the insert plate shall be tapered. The length of the taper must ***not*** be less than:

    A. 2 times the offset.
    B. 3 times the offset.
    C. 3".
    D. 6".

16. A rectangular carbon steel insert patch is installed in a vessel shell. Which of the following is correct? **This may have more than one correct answer, select all answers that apply.**

    A. Weld procedure qualification should meet the applicable construction code.
    B. Welder qualification should meet the applicable construction code.
    C. Recommended to use low-hydrogen electrodes.
    D. The weld must be a double-welded design.

17. Which of the following is ***not*** a potential concern when installing carbon steel insert plates?

    A. Cracking
    B. Distortion
    C. Embrittlement
    D. Flat spot

18. An insert plate is used in a small diameter vessel. There is no way to weld from the inside. So, this will be a one-sided weld. What welding process is recommended for the root pass?

    A. GMAW
    B. GTAW
    C. SAW
    D. SMAW

19. An insert plate is used in a small diameter vessel. There is no way to weld from the inside. What welding process is ***not*** recommended for welding any pass?

    A. All GMAW transfer modes
    B. GMAW Globular mode
    C. GMAW Short-circuit mode
    D. GMAW Spray mode

20. An insert patch that is 0.500" thick is installed in a vessel shell. The maximum undercut allowed for the patch weld is:

    A. 0.031"
    B. 0.050"
    C. 0.062"
    D. 0.100"

21. An insert patch that is 0.375" thick is installed in a shell. Per ASME PCC-2, the minimum spacing allowed between this new weld and an existing non-PWHT'd welds is:

    A. 1.5".
    B. 3".
    C. 6".
    D. 8".

22. An 0.750" thick insert patch is installed in a vessel shell. Per ASME PCC-2, the minimum spacing allowed between this new weld and an existing non-PWHT'd welds is:

    A. 6".
    B. 8".
    C. 10".
    D. 12".

23. A 1.500" thick insert patch is installed in a vessel shell. Per ASME PCC-2, the minimum spacing allowed between this new weld and an existing non-PWHT'd welds is:

    A. 6".
    B. 8".
    C. 10".
    D. 12".

24. A 1.500" thick insert patch is installed in a vessel shell. The adjacent existing weld was previously post-weld heat treated. Per ASME PCC-2, the minimum spacing allowed between this new weld and the existing PWHT'd welds is:

    A. 3".
    B. 6".
    C. 10".
    D. 12".

25. An insert plate is used to repair a vessel. It is impractical to avoid an existing weld. The insert plate should intersect the existing weld at an angle ***not*** less than:

    A. 10 degrees.
    B. 22.5 degrees.
    C. 30 degrees.
    D. 45 degrees.

26. A 0.750" thick insert patch is installed in a vessel shell. The insert plate stops at an existing weld. It intersects the existing weld at 90 degrees. Per ASME PCC-2, what is the minimum distance to be cut the existing welds beyond the new insert plates welds?

    A. 6".
    B. 9".
    C. 12".
    D. 18".

27. The insert plate stops at an existing weld. It intersects the existing weld at 90 degrees. How must all of the replaced existing welds be examined?

    A. 100% RT or UT at completion
    B. 100% RT or MT at completion
    C. 100% RT or UT at completion or MT or PT both sides at the completion of weld
    D. 100% MT or PT on root pass and completion of weld

28. An insert plate is used to repair a vessel. Postweld heat treatment of the insert plate:

    A. is always required.
    B. must be done if required by the applicable construction code.
    C. if done should always be at a temperature about the lower transformation temperature.
    D. is never recommended due to potential distortion of the shell.

29 An insert plate is used to repair a vessel. The extend of NDE for all the new welds shall be:

A. Spot RT or UT.
B. Full RT or UT.
C. 100% MT or PT on the root pass, hot pass and final pass.
D. RT or UT in accordance with the applicable construction code.

30. An insert plate is used to repair a vessel. UT of 100% of the new welds will be performed. What else is recommended?

A. UT procedure is qualified to ASNT SNT-TC-1A
B. UT technician is qualified to API 2201
C. MT or PT the root pass
D. MT or PT the root & final passes

31. An insert plate is used to repair a vessel. Spot RT of will be performed on the new welds. What else is recommended?

A. MT or PT only the root pass for single-groove welds
B. MT or PT the root & final pass single-grooves welds
C. MT or PT only the root pass for double-grooves welds
D. Spot UT to confirm RT results

32. An insert plate is used to repair a vessel. Spot RT is required on the new welds. What else is recommended? **This may have more than one correct answer, select all answers that apply.**

A. The vessel shall be pressure tested
B. If practical, the vessel should be pressure tested in accordance with the construction code
C. NDE can always be used in lieu of a pressure test
D. NDE can be used in lieu of a pressure test if pressure testing is not practical

33. An insert plate is used to repair a vessel. A pressure test will be performed. Testing should be:

A. completed prior to the application of coatings or insulation.
B. completed prior to the application of insulation. But can be done after coatings.
C. done at a pressure that 150% of vessel MAWP.
D. always performed with water and not air.

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Article 202: External Weld Buildup for Internal Thinning

1. Localized degradation has occurred on the shell internal surface. When can external weld buildup ***not*** be used to repair this damaged area?

   A. Wall loss exceeds the corrosion allowance
   B. Wall loss exceeds 50% of the nominal thickness
   C. The type of degradation is a cracking mechanism
   D. When the shell is made of nickel alloys

2. Localized thinning has occurred on the shell internal surface. When can external weld buildup ***not*** be used to repair this thinned area?

   A. As an in-service repair to a vessel in gasoline service
   B. As an in-service repair to a vessel in hydrogen cyanide service
   C. Stainless steel vessels
   D. Vessel have plate that is copper alloyed with aluminum

3. Localized thinning has occurred on the shell internal surface. When can external weld buildup ***not*** be used to repair this thinned area?

   A. Vessel in liquid service that is *"blocked-in"*
   B. Vessel in diesel service
   C. Vessel with remaining wall less than 50% of $t_{minimum}$
   D. Vessel subject to sulfidation corrosion

4. Localized thinning has occurred on the shell internal surface. The Owner wishes to use external weld buildup to repair this area. Which of the following is correct?

   A. Tensile strength of the base must be less than 70,000 psi
   B. Tensile strength of the electrode must exceed 80,000 psi
   C. Electrode's tensile strength shall be tested from electrodes of the same lot
   D. Electrode's tensile strength shall be at least equal to the strength of the base

5. Localized thinning has occurred on the shell internal surface. The Engineer wishes to use external weld buildup to repair this area. The vessel diameter is 96", and the nominal thickness of the shell is 0.625", and $t_{minimum}$ of the shell is 0.500". The full-thickness weld build shall extend past the corroded *(in all directions)* by:

   A. 3.7"
   B. 4.1"
   C. 5.2"
   D. 5.8"
   E. *"I HAVE NO IDEA !!!"*

"E" may be true for you, but won't count on your test!

6. Localized thinning has occurred on the shell's internal surface. External weld buildup will be used to repair this area. The edge of the weld buildup should have a taper that does ***not*** exceed:

   A. 22.5 degrees.
   B. 30 degrees.
   C. 45 degrees.
   D. 90 degrees.

7. External weld buildup will be used to repair an area that has thinned by internal corrosion. All corners of the weld buildup shall have a radius that is ***not*** less than:

   A. the $t_{minimum}$ of the shell.
   B. the weld buildup thickness.
   C. 1".
   D. 6".

8. External weld buildup will be used to repair an area that has thinned by internal corrosion. There is already one similarly repaired area on the shell. The shell is 60" in diameter and the nominal thickness of the shell is 0.500", and $t_{minimum}$ of the shell is 0.400". These two repair areas must be at least:

   A. 2.6" apart.
   B. 2.9" apart.
   C. 3.7" apart.
   D. 4.1" apart.
   E. 6" apart.

9. External weld buildup will be used to repair an area that has thinned by internal corrosion. The shell has a 60" diameter and the nominal thickness of the shell is 0.625", and $t_{minimum}$ of the shell is 0.450". The weld buildup thickness is:

   A. unlimited.
   B. limited to 0.450".
   C. limited to 0.625".
   D. limited to 1.250".

10. External weld buildup will be used to repair an area that has thinned by internal corrosion: Prior to welding, what NDE should be done in the repair area? **This may have more than one correct answer, select all answers that apply.**

    A. Eddy current scans to determine average wall thickness.
    B. Thickness readings are taken to determine the extent of the damage.
    C. Volumetric examination to determine the repair area does not have any cracks.
    D. Appropriate NDE to verify surface quality.

11. External weld buildup will be used for a repair. Prior to welding the repair area should be thoroughly cleaned with:

    A. Diesel.
    B. Gasoline.
    C. Solvent, like acetone.
    D. Water.

12. External weld buildup will be used for a repair. But the vessel is in service and the area needing repair has a small leak. Which of the following statements is correct?

    A. The vessel must be taken out of service.
    B. The leak may be stopped using a wooden plug.
    C. The leak may be stopped using a non-metallic plug.
    D. The leak may be stopped by peening.

13. External weld buildup is performed to restore the integrity of a shell caused by internal corrosion. One of the concerns is burn-through. Which of the following will minimize the risk of burn-through?

    A. Use a small diameter electrode.
    B. Increase welding machine amperage.
    C. Slow the travel speed of the electrode.
    D. Use a high-hydrogen electrode

14. When performing external weld buildup, the electrode should always have a:

    A. bead overlap less than 10%.
    B. diameter that is less than the remaining base material thickness.
    C. tensile strength that is greater than the base metal.
    D. tensile strength that is less than the base metal.

15. Concerning external weld buildup, which of the following statements are correct? **This may have more than one correct answer, select all answers that apply.**

    A. The weld procedure used shall be qualified to Sect IX or as required by applicable code.
    B. The welder that is welding shall be qualified to Sect IX or as required by applicable code.
    C. If vessel is in service, then the requirements of API 580 must be followed.
    D. A follow-up post weld heat treatment is never required.
    E. The typical weld processes used for external weld buildup are SMAW and GTAW.

16. Which are true concerning the use of a Temper Bead welding for external weld buildup of a carbon steel vessel? **This may have more than one correct answer, select all answers that apply.**

    A. Temper bead welding can never be used.
    B. Temper bead welding can never be used to eliminate a code required PWHT.
    C. Temper bead welding can always be used to eliminate PWHT.
    D. Temper bead welding can be used to eliminate code required PWHT.
    E. Temper bead welding should not be used to eliminate a PWHT needed for service conditions.

17. External weld buildup is being performed. To minimize the risk of burn-through, the beads should be installed with a bead overlap of about:

    A. 10%.
    B. 25%.
    C. 33%.
    D. 50%.

18. External weld buildup is performed to restore the integrity of a shell caused by internal corrosion. Where should the 1st weld passes be started?

    A. In the center of the repair area
    B. On the outer perimeter of the repair area
    C. At the thinnest part of the repair area
    D. At the thickest part of the repair area

19. External weld buildup is performed to restore the integrity of a shell. At the completion of the repair, what NDE is required? **This may have more than one correct answer, select all answers that apply.**

    A. MT or PT
    B. RT or UT flaw detection
    C. UT thickness measurements
    D. Light hammer testing

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Practice Questions for API 510 Exam

Article 209: <u>Alternatives to PWHT</u>

1. PWHT is used in ferritic welds to: **This may have more than one correct answer, select all answers that apply.**

   A. diffuse hydrogen.
   B. increase grain size.
   C. provide tempering.
   D. reduce hardness.

2. PWHT of ferritic materials is performed at a temperature that is:

   A. below the lower transformation temperature.
   B. between the lower and upper transformation temperature.
   C. above the upper transformation temperature.
   D. above the casting temperature.

3. During repairs to carbon steel vessels, when might the use of a PWHT alternatives ***<u>not</u>*** be a good idea?

   A. If material is subject to reheat cracking
   B. If PWHT is a requirement from the construction code
   C. If PWHT is specified because of a process service, i.e caustic
   D. On larger vessels

4. What is one type of alternative to PWHT?

   A. Peening
   B. Elevated Preheat Temperature
   C. Elevated Interpass Temperature
   D. Elevated Preheat Maintenance Temperature

5. What is one type of alternative to PWHT?

   A. API - Applied Pressure Induction
   B. Bead Cross-over Welding
   C. MSTS – Minimum Stress Through Saturation
   D. Stress Control Welding
   E. Temper Bead Welding

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Practice Questions for API 510 Exam

Article 210: <u>In-Service Welding on CS Components</u>

1. What are the primary concern(s) technical concerns when performing In-Service welding? **This may have more than one correct answer, please select all answers that apply.**

   A. Burn through
   B. Carburization
   C. Coking
   D. Hydrogen Cracking

2. Which of the following is correct concerning in-service welding on materials less than the 0.250" thick?

   A. Welding machine should operate at less than 15 amps
   B. Electrode diameter should not exceed 0.094"
   C. Requirements detailed in API 2102 should be followed
   D. Never perform in-service welding on materials ≤ 0.250"

3. Which is ***<u>not</u>*** a factor in Hydrogen Cracking of welds?

   A. Allowable stress of the base metal
   B. Hydrogen … Duh!
   C. Residual tensile stresses from welding
   D. Weld microstructure

4. Crack-susceptible microstructures typically have a microstructure high in:

   A. Austenitic structure.
   B. Ductility.
   C. Hardness.
   D. Toughness.

5. For in-service welding, high microstructure hardness is controlled by controlling the:

   A. Preheat and PWHT temperatures.
   B. Rod size and Shielding Gas.
   C. Ferrite Equivalence and Preheat Temperature.
   D. Carbon Equivalence and the Cooling Rate.

6. Why does likelihood of hydrogen cracking increase with in-service welding? *(compared to out-of-service welding)*

   A. The process on the other side causes coking which causes high carbon in the weld.
   B. The process on the other side causes rapid cooling.
   C. With field welding, it is difficult to achieve adequate shielding of the weld.
   D. Vibrations in the field causes molecular compaction which creates hard zones.

7. During in-service welding, which of the following is used to minimize microstructure hardness? **This may have more than one correct answer, please select all answers that apply.**

   A. Low Hydrogen Electrodes
   B. Argon gas
   C. Special weld procedures
   D. Preheat

8. During in-service welding, which of the following is correct?

   A. High heat input lowers likelihood of burn-through & minimizes microstructure hardness.
   B. High heat input increases likelihood of burn-through & minimizes microstructure hardness.
   C. Low heat input lowers likelihood of burn-through & minimizes microstructure hardness.
   D. Low heat input increases likelihood of burn-through & increases microstructure hardness.

9. When welding on thinner materials it may be necessary to use a smaller diameter rod. What are the potential results? **This may have more than one correct answer, select all that apply.**

   A. Less likely to burn-through
   B. More likely to burn-through
   C. Less likely to form weld microstructure that is susceptible to hydrogen cracking
   D. More likely to form weld microstructure that is susceptible to hydrogen cracking

10. During in-service welding, if there is an increase in the process flow rate the likelihood of:

    A. burn-through increases.
    B. H_2 cracking increases.
    C. forming martensitic structure increases.
    D. forming microstructure soft zones increases.

11. During in-service welding, if there is a decrease in the process flow rate the likelihood of:

    A. burn-through increases.
    B. H_2 cracking increases.
    C. forming austenitic structure increases.
    D. forming microstructure hard zones increases.

12. Which is difficult to perform with In-Service welding?

    A. Controlled deposition welding
    B. Minimizing risk of burn-through
    C. PWHT
    D. Temper-bead welding

13. A weld procedure is being qualified for In-Service welding. Which of the following is considered an Essential Variable for the qualification test? **This may have more than one correct answer, select all that apply.**

    A. Bevel Angle
    B. Carbon Equivalence
    C. Cooling Rate
    D. Peening

14. A weld procedure is being qualified for In-Service welding. Which of the following is considered an Essential Variable for the qualification test? **This may have more than one correct answer, select all that apply.**

    A. Deposition Sequence
    B. Welding Position
    C. Postweld Backout
    D. Welding Current

15. An in-service welding procedure is being qualified for weld metal buildup. The test coupon wall thickness is 3/8". What bend tests should be conducted?

    A. Bends tests are not needed
    B. 4 Face Bends
    C. 2 Face Bends and 2 Side Bends.
    D. 2 Face Bends and 2 Root Bends or 4 Side Bends.

16. An in-service welding procedure is being qualified for an attachment weld. The test coupon wall thickness is 5/8". What bend tests should be conducted?

    A. Bends tests are not used to qualify an attachment weld procedure
    B. 4 Face Bends
    C. 2 Face Bends and 2 Side Bends.
    D. 2 Face Bends and 2 Root Bends or 4 Side Bends.

17. An in-service welding procedure is being qualified for weld metal buildup. The test coupon wall thickness is 3/4". What bend tests should be conducted?

    A. Bends tests are not needed
    B. 4 Face Bends
    C. 2 Face Bends and 2 Side Bends.
    D. 2 Face Bends and 2 Root Bends or 4 Side Bends.

18. An in-service welding procedure is being qualified. Which of the following is correct? **This may have more than one correct answer, select all that apply.**

    A. Hardness test are done in accordance with ASTM EIEIO-50
    B. At least 4 sets of hardness readings are required
    C. Each set of hardness readings should have at least 5 Vickers hardness readings
    D. Each set of hardness readings should have at least 5 Rockwell hardness readings
    E. The hardness readings should be taken in the small-grain HAZ

19. An in-service welding procedure is being qualified for an attachment weld. In the bend tests, what is the acceptance criteria for flaws in the weld or HAZ?

    A. No flaw that exceeds 1/16" (0.063")
    B. No flaw that exceeds 1/8" (0.125")
    C. No flaw that exceeds the lesser of 1/16" or the one-half the wall thickness
    D. No flaw that exceeds the lesser of 1/8" or the one-half the wall thickness

20. When In-Service welding is performed it should be examined with NDE in accordance with the applicable construction or post-construction code. If hydrogen cracking is a concern, the in-service welds should be examined:

    A. within 1 hour of the completion of the weld.
    B. within 12 hours of the completion of the weld.
    C. after a delay of 6-24 hours after the completion of the weld.
    D. after a delay of 24-72 hours after the completion of the weld.

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Article 211: Weld Buildup, Weld Overlay & Clad Repairs

1. Weld Overlay refers to adding:

   A. weld metal to carbon steel or low alloy materials to restore base metal thickness.
   B. corrosion resistant weld metal (alloy) to carbon steel or low alloy materials.
   C. alloy weld metal to carbon steel or low alloy materials to restore alloy cladding.
   D. weld passes in a specific method to temper the previous passes.

2. Weld metal buildup is performed on a corroded steel vessel shell. The tensile strength of the electrode, should:

   A. greater than or equal the allowable stress of the shell plate.
   B. greater than or equal the yield stress of the shell plate.
   C. greater than or equal 95% of the tensile strength of the shell plate.
   D. greater than or equal the tensile strength of the shell plate.

3. What are common electrodes that are used when performing SS weld overlay on carbon steel base metal?

   A. Type 309
   B. Type 310
   C. Type 309 followed by Type 308
   D. Type 308 followed by Type 309

4. What is one potential problem when using weld overlayed areas in equipment that operates in cyclic temperature?

   A. Differential thermal expansion
   B. Lack of fusion
   C. Polythionic stress cracking
   D. Thermal carburization

5. Prior to performing Back Cladding, the existing cladding shall be:

   A. checked for thickness on both sides of the weld within 6" of the new weld.
   B. checked for disbonding on both sides of the weld within 12" of the new weld.
   C. etched with nitric acid.
   D. removed a minimum of 1/4" from the edge of the plate.

6. The Back Cladding weld cap height shall ***not*** exceed:

   A. the height of the cladding.
   B. 1/16".
   C. 1/8".
   D. the lesser of 10% of the plate thickness or 1/32".

7. SS weld overlay is performed on a 5% Cr shell that is 0.5" thick. There are some weld repairs needed to the 5 Cr material prior to performing the weld overlay. What should be done after the 5 Cr repairs are completed, but before the weld overlay is performed?

   A. No addition work is needed prior to performing weld overlay
   B. Preheat to 500 °F
   C. PWHT
   D. UT flaw detection to check for delayed cracking

8. SS weld overlay is performed on a CS shell that is 0.5" thick. There are some weld repairs needed to the base material prior to performing the weld overlay. What should be done after the carbon steel repairs are completed, but before the weld overlay is performed?

   A. No addition work is needed prior to performing weld overlay
   B. Preheat to 500 °F
   C. PWHT
   D. Use Metallography to determine if grain structure is appropriate

9. SS weld overlay is performed on a CS shell that is 2.0" thick. There are some weld repairs needed to the base material prior to performing the weld overlay. What should be done after the carbon steel repairs are completed, but before the weld overlay is performed?

   A. No addition work is needed prior to performing weld overlay
   B. Preheat to 300 °F
   C. PWHT
   D. Use Metallography to determine if grain structure is appropriate

10. SS weld overlay is performed on a shell that has a 7% Cr base material that is 1.0" thick. PWHT heat will need to be performed. The final PWHT:

    A. may be substituted with a 300 °F preheat.
    B. must be done prior to the weld overlay.
    C. must be done after to the weld overlay is complete.
    D. may be done after the 1st layer of weld overlay or when the overlay is completed.

11. Weld buildup is performed on a CS shell. After welding the repair area:

    A. may be examined by NDE (MT, PT, etc.).
    B. may be examined by NDE (MT, PT, etc.) in accordance with appropriate code.
    C. must be examined by NDE (MT, PT, etc.).
    D. must be examined by NDE (MT, PT, etc.) in accordance with appropriate code.

12. Weld buildup is performed on a CS shell that is ½" thick. After welding the repair area:

    A. should be examined by RT.
    B. should be examined by UT flaw detection.
    C. should be examined by RT or UT flaw detection.
    D. shall be examined by RT or UT flaw detection.

13. Existing SS overlay on a carbon steel base is eroded and will be repaired. The damaged overlay is removed. Prior to applying the new overlay, the carbon steel surface should be examined using:

    A. a copper sulfate solution to verify the complete removal of the stainless steel.
    B. sulfuric acid to etch the CS to verify the complete removal of the HAZ.
    C. metallography to assure embrittled areas have been removed.
    D. WFMPT to assure H_2S cracking has not occurred.

14. Multilayer SS weld overlay is being performed. What should be done after the 1st layer is is welded?

    A. Examine with MT
    B. Examine with PT
    C. Raise the temperature to 500 °F for 1 hour to assist in out gassing hydrogen
    D. Nothing, just weld the 2nd layer

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Practice Questions for API 510 Exam

Article 304: Flaw Excavation & Weld Repair

1. When grinding out a flaw, overloading the grinding wheel can cause: **This may have more than one correct answer, select all correct answers**

   A. formation of untempered martensite structure.
   B. formation of tempered austenite.
   C. shallow surface cracks.
   D. wheel residue to be impregnated in the finished material.

2. When grinding out a flaw, uneven and rough finishes could result in a failure by:

   A. erosion.
   B. fatigue.
   C. galvanic corrosion.
   D. liquid-metal embrittlement.

3. When removing a flaw, rotary files should be considered for use on:

   A. all alloyed materials.
   B. austenitic materials.
   C. chrome alloys.
   D. nickel alloys.
   E. titanium alloys. *(do I hear P-53's?)*

4. A flaw is removed by grinding on a carbon steel material. This grinding wheel should:

   A. not be used again.
   B. examined with PT for cracking.
   C. only be used in the future on the same materials *(ASTM # & grade)*.
   D. only be used in the future on the materials with the same P#.
   E. not be used on austenitic stainless materials.

5. An austenitic SS is contaminated with residue from a grinding wheel that was previously used on Carbon Steel materials. What is a possible future problem?

   A. Fatigue
   B. Hard microstructures
   C. Surface pitting
   D. Wet H_2S cracking

6. What should be done prior to grinding out stress corrosion cracks in stainless steel?

   A. Qualify the amount of heat input
   B. Qualify the grinding wheel type
   C. Select a quick cutting tool like a rotary file
   D. Select a wide cutting tool to distribute the heat input

7. Repairs are being made to a vessel that has experienced caustic cracking. To prevent additional cracking, which of the following should be considered during the repairs? **This may have more than one correct answer, select all correct answers**

   A. Clean the area with appropriate cleaning procedures
   B. Preheat
   C. Pre-PWHT
   D. Use flaw-removal methods that generate lower heat

8. When removing flaws, flapping is:

   A. a technique that is commonly used to smooth large rough areas.
   B. a technique that is commonly used prior to adding a hot tap.
   C. good for quickly removing deep linear flaws.
   D. good only for removal of superficial surface blemishes.

9. When removing a flaw, what is one potential problem when using thermal gouging?

   A. Brittle heat-affected zones may be created
   B. Oxidation residue may damage the gouged area
   C. Residue left in some alloys will cause future surface pitting
   D. Stress corrosion cracking may occur

10. A small crack is going to be removed by grinding. Which of the following is correct?

    A. The excavated area must be repaired with weld-buildup.
    B. When performing weld buildup in this area, the GTAW process must be used.
    C. If weld buildup is not used, the edges of the excavated area must have a 3:1 taper.
    D. The edges of the excavated area must always have a 3:1 taper.

11. Thermal gouging is used to remove a flaw. What needs to be done prior to welding?

    A. Remove an additional 1/32" of material by a type of grinding
    B. Remove an additional 1/16" of material by a type of grinding
    C. Acid-etch the remaining surface to look for hard microstructures
    D. Caustic-etch the remaining surface to look for hard microstructures

12. A surface crack is going to be removed. Prior to grinding, what technique may be used to prevent the crack from growing during the crack-removal grinding?

    A. Drill the ends of the crack
    B. Drill small holes along the crack at a spacing that does not exceed $\frac{1}{2}$"
    C. Peen the ends of the crack.
    D. Peen the entire crack

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Answers with References

201: Butt-welded Insert Plates

1.	B,D	3.2	
2.	C	3.3	
3.	C	3.4	
4.	B	3.4	
5.	D	3.4	
6.	B	3.6.1	*(See Calc)*
7.	B	3.6.1	*(See Calc)*
8.	A	3.6.1 & 3.4	*(See Calc)*
9.	B	3.7	
10.	A	3.8(b)	*(See Calc)*
11.	C	3.8(b)	*(See Calc)*
12.	C	Fig 201-3.5-1	
13.	D	4.1.3	
14.	D	4.1.5	
15.	B	4.1.5	
16.	A,B,C	4.2.1, 4.2.3 & 4.2.4	
17.	C	4.2.7	
18.	B	4.2.8	
19.	C	4.2.8	
20.	A	4.2.9	*(See Calc)*
21.	C	4.3.1(a)	
22.	C	4.3.1(b)	*(See Calc)*
23.	D	4.3.1(b)	*(See Calc)*
24.	A	4.3.3	
25.	C	4.4.1	
26.	A	4.4.1 & Fig 201-3.8-2	
27.	C	4.4.2 & Fig 201-3.8-2	
28.	B	4.5.1	
29.	D	5.1	
30.	C	5.1	
31.	B	5.2	
32.	B,D	6.1	
33.	A	6.4	

Calcs

6. Less of 12t *(12 x 1.5)* or 15 = 18 or 15 = 15"
7. Less of 12t *(12 x 0.75)* or 15 = 9 or 15 = 9"
8. Diameter = 2 Radius = 2 x 3 = 6"
10. Noz $\leq$ 12" OD: 2 x OD = 2 x 4.5 = 9"
11. Noz > 12" OD: 6 + Noz + 6 = 6 + 16 + 6 = 28"
20. Less of 1/32 or 10%tw = 0.031 or 0.050 = 0.031"
22. Greater of 10 or 8tw *(8 x 0.75)* = 10 or 6 = 10"
23. Greater of 10 or 8tw *(8 x 1.5)* = 10 or 12 = 12"
24. 2 tw = 2 x 1.5 = 3"

202: Ext Weld Buildup

1.	C	2.2	
2.	B	2.3	
3.	A	2.5	
4.	D	3.1.1.2	
5.	B	3.1.2.2	*(See Calc)*
6.	C	3.1.2.3	
7.	B	3.1.2.5	
8.	B	3.1.2.7	*(See Calc)*
9.	C	3.1.2.8	
10.	B,C,D	4.1.1, 4.1.2 & 4.1.3	
11.	C	4.2.2	
12.	D	4.2.3	
13.	A	4.4.3	
14.	B	4.4.4	
15.	A,B,E	4.5.1, 4.5.2 & 4.5.3	
16.	D,E	4.5.7	
17.	D	4.5.8	
18.	B	4.5.9.2	
19.	A,C	5.1 & 5.2	

Calcs

5. $B = 0.75\sqrt{48 \times 0.625} = 4.1"$

8. $B = 0.75\sqrt{30 \times 0.500} = 2.9"$

209: Alternative to PWHT

1.	A,C,D	1.2(a)
2.	A	1.2(b)
3.	C	2.5
4.	B	4.1
5.	E	4.2.1

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210: In-Service Welding on CS

1.	A,D	1.0 (2nd & 3rd ¶)
2.	B	1.0 (2nd ¶)
3.	A	1.0 (3rd ¶)
4.	C	1.0 (3rd ¶)
5.	D	1.0 (3rd ¶)
6.	B	1.0 (4th ¶)
7.	A,C,D	1.0 (4th ¶)
8.	B	1.0 (5th ¶)
9.	A,D	1.0 (5th ¶)
10.	B	2.6
11.	A	2.6
12.	C	2.7
13.	B,C	4.1.1.2 & 4.1.1.3
14.	A,C,D	4.1.1.7, 4.1.1.9 & 4.1.1.11
15.	B	Table 210-4.2.1-1
16.	B	Table 210-4.2.1-1
17.	C	Table 210-4.2.1-1
18.	C	4.2.1.2
19.	D	4.2.1.4(a)
20.	D	5.2

211: Buildup,O'lay & Clad Repair

1.	B	1.5.1
2.	D	3.5
3.	C	3.6
4.	A	3.8.1
5.	D	4.4.2
6.	B	Fig 211-4.4.1-1(b)
7.	C	4.5.3
8.	A	4.5.3
9.	C	4.5.3
10.	D	4.7.3
11.	B	5.1.2
12.	C	5.1.2
13.	A	5.2
14.	B	5.3.1

304: Flaw Excavation

1.	A,C	2.2.1
2.	B	2.2.1
3.	D	2.2.1
4.	E	2.2.2
5.	C	2.2.2
6.	A	2.2.3
7.	A,D	2.2.3
8.	D	2.5.1
9.	A	2.6.1
10.	C	3.1
11.	B	3.3
12.	A	4.1.1

SDG