PRACTICE EXAM 2: RED SEAL WELDER SIMULATION (125 QUESTIONS)

1. A wire brush used for cleaning stainless steel GMAW weld beads begins to leave a grey metallic residue on the weld surface. A colleague confirms the brush has previously been used on carbon steel plate. What is the correct action?

A. Rinse the affected area with acetone solvent to dissolve the metallic residue before the next pass

B. Replace the brush with a dedicated stainless steel brush that has never contacted carbon steel or other metals

C. Continue using the brush since the metallic residue will be melted and absorbed by the next weld pass

D. Switch to a nylon abrasive pad which will provide effective cleaning without any metallic contamination

2. A digital caliper falls from a bench height onto a concrete floor. After retrieving it, the welder zeros the instrument and proceeds with measurements. What is the primary concern with subsequent readings?

A. The battery connection may have been disrupted, introducing a systematic display voltage error

B. The fall may have loaded the jaw faces with concrete dust that is altering surface contact quality

C. Mechanical shock may have reset the internal calibration circuit requiring a factory recalibration

D. The jaw geometry or internal pivot mechanism may have been deformed, making all measurements unreliable

3. A chipping hammer shows a visible hairline crack running transversely through the handle midway along its length. What is the correct action before any further use of this tool?

A. Apply epoxy adhesive to the crack, allow to fully cure overnight, and re-inspect before returning to use

B. Wrap the cracked section with several layers of electrical tape and restrict use to light chipping only

C. Remove the tool from service immediately and replace the handle before returning it to the tool inventory

D. Limit the tool to striking forces below 50% of normal impact to prevent the crack from propagating

4. A 4.0 mm electrode is being used for structural SMAW production welding. Approximately what arc length should the welder maintain throughout the weld pass?

A. Approximately 4 mm — equal to the diameter of the electrode core wire itself

B. Approximately 8 to 10 mm to prevent the coating from contacting the weld pool surface

C. Approximately 12 to 15 mm to ensure full vaporization of the coating before reaching the pool

D. Approximately 1 to 2 mm to maximize arc pressure and force deep penetration into the joint

5. A welder needs to move an 1,100 mm × 600 mm × 12 mm steel plate weighing approximately 62 kg across the fabrication shop to a welding table 15 metres away. What is the safest method?

A. Place the plate on edge and walk it on its corner using body weight as a directional control guide

B. Use a shop dolly or flat-bed cart rated for the load with the plate lying flat and secured during movement

C. Carry the plate in an upright position between two workers using a firm grip on both short edges

D. Attach a chain from a single upper corner to the overhead crane and slide the plate at slow speed

6. A scaffold inspector applies a red tag to a working platform in the fabrication shop during the afternoon shift. What does the red tag signify and what must the welding crew do immediately?

A. The scaffold requires a maintenance inspection within the next 48 hours but remains usable in the interim

B. The scaffold requires additional guardrails added by a certified scaffold builder before end of the shift

C. The scaffold has been taken out of service and must not be used until the deficiency is corrected and the tag removed

D. The scaffold has exceeded its rated load for that shift and must be cleared of personnel and materials

7. A worker is cutting 50 mm diameter schedule 40 pipe (wall thickness approximately 4.5 mm) using a portable band saw with a 10 TPI blade. The blade breaks partway through the cut. What is the most likely contributing factor?

A. The pipe diameter exceeds the portable band saw capacity and requires a stationary cold saw instead

B. The cut was made without coolant, allowing thermal expansion of the blade during the cut

C. The pipe material hardness exceeded the rated hardness limit for the blade tooth material selected

D. The 10 TPI blade is too coarse for the 4.5 mm wall thickness — fewer than two teeth contact the wall simultaneously

8. While performing SMAW on a structural platform, spatter lands on a tarpaulin covering electrical equipment nearby. Ten minutes later, smoke begins rising from beneath the tarpaulin. What must the welder do first?

A. Stop welding immediately and address the developing fire before it grows into open flame

B. Continue welding the current pass while signalling a co-worker to investigate the smoke source

C. Complete the current electrode before responding since a weld restart introduces quality risk

D. Activate the building fire alarm before approaching the smoldering area independently

9. A confined space atmospheric test at the 1.5 metre working level shows 19.3% oxygen. What does this result require?

A. Entry is permitted with an air-purifying half-face respirator since the oxygen level is near normal range

B. Entry must not proceed — 19.3% is below the 19.5% minimum and the atmosphere is oxygen-deficient

C. Entry is permitted after confirming CO_2 remains below 5,000 ppm as the governing secondary parameter

D. Entry is permitted above 18% oxygen provided forced-air ventilation is actively supplied to the space

10. A welder receives a chemical splash from welding flux cleaner to both eyes. After initial first-aid treatment, which SDS section provides the most complete medical treatment guidance for this exposure?

A. Section 2 — Hazard Identification, which lists the specific hazard classification for eye contact

B. Section 8 — Exposure Controls and Personal Protection, specifying the PPE that prevents exposure

C. Section 4 — First-Aid Measures, which details the treatment procedure for each route of exposure

D. Section 11 — Toxicological Information, listing the health effects from chemical eye contact

11. A fabrication shop where plasma cutting occurs measures consistently at 100 dB-A at the operator position. Under applicable occupational health and safety legislation, what is the minimum required response?

A. Reduce plasma cutting amperage settings to bring the noise level below the action level threshold

B. Post noise hazard warning signs and ensure workers receive annual training on hearing hazard risks

C. Conduct baseline audiometric testing for all workers regardless of their time in the noise zone

D. Require hearing protection and implement feasible engineering controls to reduce exposure levels

12. Before beginning production welding on a CSA W47.1-certified project, a welder is handed a WPS that references PQR number 2024-15. After a thorough search, PQR 2024-15 cannot be located in the quality management system. What is the correct action?

A. Stop all welding on joints covered by that WPS and report the missing document to the quality supervisor immediately

B. Proceed using the WPS parameters since the PQR is a supporting administrative document and not required at the work face

C. Substitute an equivalent PQR from a similar base metal group until the correct document is located and retrieved

D. Contact the certification body directly to request a replacement copy of the missing qualification record

13. After completing a long structural weld, a fabricated assembly is measured and found to be 9 mm shorter than the drawing dimension along the weld axis. No angular deviation is observed. Which type of distortion has occurred?

A. Angular distortion pulling the plate ends toward the weld face direction after cooling

B. Transverse shrinkage across the joint centerline perpendicular to the weld axis

C. Longitudinal shrinkage parallel to the weld axis that has reduced the overall assembly length

D. Bowing distortion curving the member away from neutral in the direction of the weld face

14. A mill test report for a structural carbon steel shipment shows sulfur at 0.038% and phosphorus at 0.031%. For which welding defect mechanism are these elevated residual element levels most significant?

A. Hydrogen-induced cold cracking in the HAZ during the post-weld cooling cycle

B. Hot cracking through grain boundary film formation during weld metal solidification

C. Lamellar tearing in the base metal under applied through-thickness shrinkage stress

D. Sensitization of the weld metal from chromium carbide precipitation during cooling

15. A five-piece 90-degree mitered pipe elbow is being fabricated. Applying the formula cut angle = total angle ÷ (2 × number of cuts), what is the correct miter cut angle at each cut?

A. 18.0 degrees, calculated as 90 degrees divided by the total number of pieces in the elbow

B. 22.5 degrees, calculated as 90 degrees divided by the number of full mid-segments only

C. 9.0 degrees, calculated using six total cuts including entry and exit at each fitting junction

D. 11.25 degrees, calculated as $90 \div (2 \times 4) = 11.25$ degrees for the four cuts in a five-piece elbow

16. A rolling offset using 45-degree fittings requires 180 mm of vertical movement and 240 mm of horizontal movement. What is the true offset dimension used to calculate the travel length of the diagonal pipe section?

A. 210 mm, calculated as the average of the 180 mm and 240 mm offset components

B. 420 mm, calculated as the direct sum of both the vertical and horizontal offset components

C. 300 mm, calculated as $\sqrt{(180^2 + 240^2)} = \sqrt{(32{,}400 + 57{,}600)} = \sqrt{90{,}000} = 300$ mm

D. 216 mm, adjusted from the geometric mean of the two offset dimensions by the fitting factor

17. A two-leg wire rope bridle sling is rigged with each leg at 45 degrees from vertical to lift a vessel weighing 2,400 kg. What is the approximate tension in each sling leg?

A. 1,697 kg per leg, because at 45 degrees from vertical each leg carries 70.7% of the total load weight

B. 1,200 kg per leg, because a two-leg sling always divides the load equally regardless of sling angle

C. 2,400 kg per leg, because at 45 degrees from vertical each leg must support the full load weight

D. 848 kg per leg, because the sling angle factor at 45 degrees reduces each leg to 35.4% of total load

18. A WHMIS 2015 supplier label on a container of welding degreaser shows a flame pictogram and the signal word DANGER. Which part of the label provides the specific description of the flammable hazard that justifies the DANGER classification?

A. The product identifier, which communicates the chemical name and its associated flammable properties

B. The hazard statements on the label, which describe the specific nature and severity of the flammable hazard

C. The DANGER signal word alone, which is sufficient to communicate the full nature of the flammability risk

D. The supplier name and emergency contact, which allow workers to obtain detailed verbal hazard information

19. During a maintenance inspection of an ironworker machine, the operator notices the punch shows visible cracks radiating outward from the mounting hole at its base. What is the correct response?

A. Apply a hard-facing bead around the cracked area to reinforce the punch before the next operation

B. Use the punch for light-duty thin material only and schedule replacement at the next maintenance interval

C. Grind out the visible cracks, re-inspect by MT or PT, and return to service if no defects are found

D. Remove the punch from service immediately — a cracked punch can shatter explosively during operation

20. A welder holds a valid CWB certificate for SMAW in the flat and horizontal positions (1G, 2G, 1F, 2F) on carbon steel. A supervisor asks the welder to complete a vertical-up fillet weld (3F) on the same material and process. What governs this situation?

A. The welder may proceed since all positions on the same process and material are covered under one certificate

B. The welder may proceed under direct supervision provided the fillet weld is not on code-certified work

C. The welder must not perform the 3F weld without obtaining the appropriate CWB certificate that covers the vertical position

D. The welder may perform the weld and submit a retroactive qualification test coupon within 30 calendar days

21. An engineering drawing title block shows the notation "SCALE 1:5." A dimension label on the drawing reads 45 mm. What is the actual physical dimension of that feature on the fabricated component?

A. 225 mm, because a 1:5 scale means the drawing dimension is one-fifth of the actual object size

B. 9 mm, because a 1:5 scale means the object is one-fifth the size shown on the drawing

C. 45 mm, because stated dimensions on drawings always represent actual size regardless of the scale notation

D. 225 mm only when dimensions are in millimetres — the multiplier differs for drawings in imperial units

22. A section view shows two adjacent flanges cross-hatched with different hatch line angles. What does the use of different hatching angles communicate about these two regions?

A. The two regions are made of different base metals requiring separate welding procedures to join them

B. One region has been post-weld heat treated while the other remains in the as-welded condition

C. One region is the weld metal and the other is the base metal, differentiated for inspection reference

D. The two regions are separate individual parts — different hatch angles identify distinct components in assembly sections

23. A welding symbol shows a V-groove weld with the number 60 written outside and to the right of the V-shape, and the number 2 written inside the V. What do these two numbers represent?

A. A 60 mm fillet reinforcement cap with a 2 mm throat measurement across the full joint preparation

B. A 60-degree total groove angle with a 2 mm root opening at the bottom of the joint preparation

C. A 60 mm depth of bevel preparation with a 2 mm root face at the base of the groove

D. A 60 mm total weld length with a 2 mm maximum permitted crown above the base metal surface

24. The effective throat of a standard equal-leg fillet weld with 10 mm legs is approximately which value?

A. 10.0 mm, equal to the leg dimension measured from the weld toes to the root

B. 14.1 mm, calculated as the sum of both legs divided by the square root of two

C. 7.1 mm, calculated as 0.707 × 10 mm based on the 45-45-90 right triangle geometry

D. 5.0 mm, representing the half-leg value used in standard structural calculation formulas

25. A single-V groove butt weld on structural steel plate is to be prepared as a pre-qualified joint under CSA W59. What is the acceptable total groove angle range for this pre-qualified configuration?

A. 60 degrees ± 5 degrees — the standard pre-qualified groove angle range for single-V joints

B. 90 degrees ± 10 degrees — the minimum required for full electrode access during SMAW

C. 45 degrees ± 5 degrees — the standard angle for each plate independently in the joint

D. 75 degrees ± 5 degrees — as specified for single-V pre-qualified joints on structural steel grades

26. A welding symbol on a structural erection drawing includes a filled triangular flag at the junction of the reference line and the arrow. What does this flag symbol communicate to the erection crew?

A. The weld must be made using a portable inverter machine rated for outdoor field conditions

B. The weld must be completed within 24 hours of steel erection to avoid atmospheric contamination

C. The weld is a temporary tack weld to be removed and replaced after final alignment is confirmed

D. The weld must be made at the job site in the field rather than in the fabrication shop

27. A joint preparation uses a single-bevel groove where one plate is machined to a 30-degree bevel angle and the opposing plate is left square. What is the total groove angle of this joint configuration?

A. 60 degrees, because groove angle always equals twice the bevel angle regardless of joint symmetry

B. 30 degrees, because the total groove angle equals the bevel angle of the single bevelled plate only

C. 45 degrees, because the square plate contributes a virtual 15-degree land at the root area

D. 90 degrees, because a single-bevel joint requires 90 degrees total for adequate electrode access

28. A flat pattern is being developed for a rectangular duct section with a 90-degree turn and a constant 200 mm × 300 mm cross-section throughout. Which pattern development method is correct for this shape?

A. Radial line development, because all elements of the rectangular elbow converge at a virtual apex point

B. Triangulation, because the 90-degree change of direction requires all surfaces to be divided into triangles

C. Parallel line development, because the rectangular cross-section elements run parallel to the duct axis throughout

D. Graphical intersection, because the 90-degree turn requires projecting cross-sections from multiple orthographic views

29. A full-circumferential backing ring is to be fabricated for a pipe with 610 mm outside diameter. Using $\pi = 3.1416$, what is the required blank length for the ring stretchout?

A. 1,916.4 mm, calculated as $\pi \times 610$ mm for the full outside circumference of the pipe

B. 1,916.4 mm only applies if the ring groove depth is less than 3 mm from the outside surface

C. 958.2 mm, because only a half-circumference blank is required for a backing ring installation

D. 1,948.2 mm, adjusted from the outside diameter to account for the standard ring groove recess depth

30. A quality inspector marks a groove weld on 25 mm structural plate as non-conforming after measuring the weld face and finding it lies 4.5 mm below the adjacent base metal surface level. Which specific weld defect classification applies?

A. Undercut — a groove melted into the base metal surface at the weld toes during cap pass deposition

B. Overlap — weld metal that has flowed past the joint toes without achieving fusion at the edges

C. Concavity — a slight surface depression that remains within acceptance limits for the joint class

D. Underfill — the weld face falls below the base metal surface, reducing the effective joint cross-section

31. A radiographic image of a completed groove weld shows numerous small, uniformly distributed dark round spots approximately 1 to 2 mm diameter scattered throughout the weld metal cross-section. This pattern is most consistent with which weld condition?

A. Slag inclusions, which typically appear as irregular elongated dark zones aligned along pass boundaries

B. Uniformly distributed porosity from consistent atmospheric contamination throughout the deposited pass

C. Underbead cracks, which would appear as fine linear or branching indications rather than round spots

D. Tungsten inclusions from GTAW, which appear as dense bright spots rather than dark rounded voids

32. During inspection of a T-joint fillet weld with an 8 mm leg requirement, the actual weld face profile is visibly curved inward (concave) although both leg dimensions measure at 8 mm to the toes. What is the quality concern with this weld?

A. The weld is acceptable — the leg dimensions meet specification and concavity is a cosmetic issue only

B. The concave profile indicates inadequate travel speed that reduced fusion at the joint root area

C. The concave face reduces the effective throat below the theoretical minimum of 5.66 mm for 8 mm legs

D. The concave profile is a standard result of horizontal fillet welding and meets acceptance criteria

33. A pressure piping weld passes both radiographic examination and visual inspection. During hydrostatic pressure testing at 1.5 times design pressure, a steady water drip appears at the weld toe. Which condition most likely explains this result?

A. A fine toe crack that was too small to detect by RT opened under the sustained hydrostatic load

B. Surface porosity within RT acceptance limits has connected and opened into a leak path under pressure

C. Residual stress from inadequate PWHT caused the toe to yield and crack under the applied pressure

D. The joint root geometry left a small unfilled gap at the extreme toe that opened under hydrostatic loading

34. A 5 mm angular distortion is discovered in a welded assembly after completion. Flame straightening is proposed. For which base metal type is engineering approval specifically required before flame straightening proceeds?

A. ASTM A36 carbon steel, for which any form of flame straightening requires written engineering sign-off

B. CSA G40.21 Grade 350W HSLA steel in thicknesses exceeding 12 mm at the straightening location

C. 304L austenitic stainless steel, because flame straightening permanently destroys the passive surface layer

D. ASTM A514 quenched and tempered steel, because localized overheating permanently reduces its tempered strength

35. An ultrasonic test report identifies a planar reflector at mid-thickness in a pressure vessel shell weld, oriented parallel to the weld axis, with amplitude 14 dB above the reference

calibration level. The applicable code rejection criterion is 6 dB above reference. What disposition is required?

A. Accept the weld provisionally since mid-thickness planar reflectors away from the surface are lower risk

B. Reject the weld — the indication exceeds the 6 dB rejection level and requires excavation and repair

C. Perform supplemental radiographic examination to confirm the defect type before issuing a rejection

D. Re-examine using a different beam angle transducer before confirming the acceptance or rejection decision

36. A flat pattern for a cylinder 450 mm in diameter and 600 mm tall is being developed. The cylinder has a 30-degree elliptical cut across one end. Which edge of the flat blank will show a sinusoidal profile after the stretchout is laid out?

A. The cut end edge, because the elliptical cut projects as a sinusoidal curve across the stretchout width

B. Both side edges, because the circular geometry transfers a sinusoidal correction to both side dimensions

C. The straight end, because rolling the blank introduces curvature that distorts the originally straight edge

D. The stretchout length, which becomes elongated by the elliptical factor compared to a square-cut cylinder

37. During layout operations, a welder's combination square is found to shift slightly when the locking nut is tightened, consistently introducing a 1-degree angular error into every marked line. What is the correct action?

A. Apply a systematic 1-degree correction factor to all subsequent angles marked with this tool

B. Document the calibration error, use a digital protractor instead, and tag the combination square for calibration

C. Remove the combination square from the tool inventory and replace it with a correctly functioning instrument

D. Mark all angles at 1 degree less than the specified dimension to compensate for the consistent offset error

38. A CSA W59 structural drawing specifies CJP groove welds on all primary load-path connections. During fit-up inspection, one joint shows a root opening of 7 mm. The pre-qualified root opening maximum for this joint is 3 mm. What action is required before welding?

A. Proceed with welding using a larger electrode diameter to bridge the wider gap at the root opening

B. Increase the minimum preheat by 50°C to compensate for the elevated burn-through risk at the gap

C. Accept the deviation and document it on the inspection record as within the practical site tolerance

D. Re-fit the joint to bring the root opening within the pre-qualified tolerance before welding is authorized

39. A pipe spool drawing shows a welding symbol that includes a field weld flag at the reference line junction. The tail of the symbol contains the note "PWHT Required." Together, what do these two indicators specify?

A. Post-weld heat treatment must be performed in the fabrication shop before the spool leaves for the field

B. The weld must be made in the field, and post-weld heat treatment is required after the field weld is completed

C. PWHT is required for the shop welds only — field assembly welds with the flag symbol are PWHT-exempt

D. The flag means the weld goes all the way around, and PWHT must be applied around the full joint perimeter

40. During magnetic particle testing of a carbon steel structural weld, the electromagnetic yoke is positioned so the magnetic field runs parallel to the weld axis. Which crack orientation will be detected most effectively in this configuration?

A. Transverse cracks running perpendicular to the weld axis, because they interrupt the parallel field lines

B. Longitudinal cracks running parallel to the weld axis, because they align with the established field path

C. Subsurface cracks regardless of orientation, because the yoke field penetrates the full weld volume

D. Toe cracks at any orientation, because the yoke field concentrates at the geometric stress concentration

41. For a CJP double-V groove weld on 30 mm structural plate, what groove depth distribution between the two sides minimizes total weld metal volume and distortion most effectively?

A. 30 mm preparation on one side only, with back-gouging used to access the second side root only

B. 10 mm on the first side and 20 mm on the second side to allow easier access on the shallower first pass

C. Approximately 15 mm per side, balancing the weld volume and distributing shrinkage forces equally from both sides

D. 20 mm on the first (face) side and 10 mm on the second side to concentrate volume on the more accessible position

42. A completed structural groove weld is rejected during RT because of linear slag inclusions located at the fusion line of the third fill pass. E7018 electrodes were used and interpass cleaning was performed. What is the most direct corrective action?

A. Reduce amperage on fill passes to allow the pool to cool more slowly and give slag time to float completely

B. Change to E6013 electrodes which produce a self-releasing slag that eliminates interpass inclusion risk

C. Increase the preheat temperature to extend the time the pool remains fluid enough for slag flotation

D. Excavate the weld below the inclusion depth, re-inspect the excavation, and re-deposit the joint

43. A welded box section is measured after fabrication and shows a 3 mm angular deviation from the required 90-degree corner. The drawing tolerance is ±1.5 mm. What quality action is required?

A. Accept the part with a non-conformance record, since 3 mm is within recognized shop fabrication norms

B. Reject the part and either perform an approved correction or submit a formal engineering deviation request

C. Accept the part, since angular deviations in box sections are non-critical dimensions under most codes

D. Document the deviation in the inspection record and proceed to the next manufacturing operation

44. A double-sided structural groove weld is to be made. The first-side weld has been deposited and passed RT. Which correct sequence of operations applies to preparing and completing the second side?

A. Gouge to sound metal, wire-brush the groove, inspect visually and by MT or PT if required, then back-weld

B. Back-weld immediately using higher amperage to ensure complete re-fusion of the first-side root pass

C. Gouge only to the depth of the root pass, then deposit the back weld without additional NDT of the groove

D. Visual inspection of the first-side weld confirms adequacy — gouge and weld the second side without NDT

45. A T-joint fillet weld is measured using a fillet weld gauge and the leg on the vertical plate measures 8 mm while the leg on the horizontal plate measures 11 mm. What weld condition does this describe?

A. An oversized fillet where both legs exceed the minimum and the weld is acceptable on all criteria

B. A convex fillet weld where the crown height exceeds the specified surface profile requirement

C. An unequal-leg fillet weld where the bead profile is out of balance and may require corrective action

D. Normal horizontal fillet weld geometry where gravity consistently produces a longer lower leg

46. Which NDT method provides the best capability for measuring the through-thickness height of an internal planar defect in a thick pressure vessel weld to support a fitness-for-service assessment?

A. Radiographic testing, which provides a clear dimensional plan-view image of the planar defect extent

B. Magnetic particle testing, which accurately sizes surface indications for fitness-for-service input

C. Liquid penetrant testing, which quantifies both the length and aperture of surface-breaking planar defects

D. Ultrasonic testing using TOFD or PAUT, which measures defect depth, through-thickness height, and length

47. A structural drawing shows a welding symbol with the number 8 below the reference line on the left side and a weld-all-around circle at the junction of the reference line and arrow. No numbers appear to the right of the symbol. What does this complete symbol specify?

A. An 8 mm leg fillet weld deposited continuously around the entire perimeter of the joint without stopping

B. Eight individual fillet welds of unspecified size spaced equally around the joint perimeter

C. An 8 mm throat groove weld deposited at eight equally distributed points around the joint circumference

D. An 8 mm fillet weld applied only on the arrow side and continuing around that face of the joint only

48. A bevel groove preparation on a CJP butt joint is rejected by the fit-up inspector because the root face measures 5 mm. The pre-qualified specification is 3 mm ±1.5 mm. Why does an oversized root face create a quality concern?

A. A larger root face concentrates shrinkage stress at the joint centreline and increases hot cracking risk

B. A larger root face increases the total groove volume, requiring additional fill passes and filler metal

C. A larger root face prevents the root pass arc from fully penetrating and fusing through the joint root

D. A larger root face creates an asymmetric distortion force that increases angular deviation from true position

49. When cutting stainless steel plate using an abrasive cut-off wheel on an angle grinder, which specific property of the wheel must be confirmed on its label before use on this material?

A. The wheel must be rated for a minimum of 13,000 RPM to safely accommodate stainless steel hardness

B. The wheel must be silicon carbide abrasive since aluminum oxide cannot cut stainless steel alloys

C. The wheel must have a minimum 3 mm thickness to prevent deflection during the stainless steel cut

D. The wheel must be free of iron, sulfur, and chlorine contamination as stated on the wheel identification label

50. A band saw is being used to cut 40 mm wide flat bar stock with a 10 TPI blade. Approximately how many teeth are in simultaneous contact with the material during the cut?

A. 2 teeth, which just meets the minimum two-tooth-contact requirement for this application

B. Approximately 16 teeth, based on 40 mm ÷ (25.4 mm ÷ 10 TPI) = approximately 15.7 teeth in contact

C. Exactly 10 teeth in contact since TPI directly represents simultaneous tooth engagement per unit width

D. 4 teeth, which is the specified minimum contact requirement for cutting structural flat bar stock

51. A fabricator uses a guillotine shear to cut 8 mm structural plate and finds every cut shows significant rollover and a rough fracture zone along the entire bottom edge. What is the correct assessment of this observation?

A. Shear cutting always produces a deformed lower edge — the rollover and fracture zone are inherent to the shearing mechanism

B. The shear blades are dull and require re-sharpening to restore clean cut quality on the bottom edge

C. The blade clearance gap is set too wide, producing deformation beyond the normal fracture zone

D. The plate thickness exceeds the shear's capacity and the job must be transferred to a plate-cutting band saw

52. During OFC of 25 mm mild steel plate, the operator observes a clean square top edge, nearly vertical drag lines across the kerf face, and a completely clean bottom edge with no dross. What do these observations indicate?

A. The cutting oxygen pressure is marginally too high, producing clean results but with excess turbulence

B. The travel speed is too fast and the clean appearance will deteriorate as the plate temperature rises

C. The cutting parameters — tip size, oxygen pressure, and travel speed — are correctly matched for this thickness

D. A slightly oxidizing preheat flame is producing the clean lower edge through additional combustion at the base

53. An oxy-fuel cutting tip becomes partially blocked during an extended cutting run and the preheat flame becomes uneven. Which cleaning method must be used to clear the blocked preheat orifices?

A. Use a drill bit of the matching orifice diameter to ream the blocked orifice and restore correct flow

B. Use the correct-size tip cleaner — a soft tapered steel tool — to clear the orifice without enlarging it

C. Apply a short burst of cutting oxygen at full pressure directed through the affected preheat orifice to blow it clear

D. Heat the tip externally to red heat with the preheat flame, then quickly quench to crack and release the blockage

54. A welder is about to cut painted steel beams from a 1960s industrial structure with an OFC torch. The paint type is unknown. What safety precaution is most critical before beginning the cutting operation?

A. Increase the cutting oxygen pressure by 20% to ensure the cutting stream penetrates through any paint layer

B. Apply a chemical paint stripper to the cutting path and allow it to dry completely before beginning OFC

C. Direct a continuous CO_2 gas flow over the cut zone to dilute and displace paint vapours during cutting

D. Test the paint for lead content and establish appropriate respiratory protection and control measures beforehand

55. During OFC operations, the welder hears a sharp pop followed by immediate flame extinction at the cutting tip. No sound continues from the torch body and no smoke is observed. What type of event has occurred?

A. A backfire — momentary flame extinction at the tip that re-ignites immediately and requires no special action

B. A flashback — the flame has propagated into the torch body and requires immediate complete gas shutdown

C. A tip pressure surge from excess cutting oxygen that has blown the flame off the preheat orifices

D. A cross-flow event requiring hose bleeding and pressure re-verification before any restart is attempted

56. A fabrication supervisor needs to prepare a 30-degree bevel along the full 2,000 mm length of a 20 mm plate edge for a CJP butt weld. Which setup produces the most consistent and efficient bevel?

A. Freehand OFC with a bevel protractor checked every 300 mm along the edge to verify angle consistency

B. A motorized OFC track cutter with the torch set to the specified 30-degree bevel angle for the full run

C. Progressive angle grinding using a bevel gauge against the marked layout line along the plate edge

D. Freehand PAC at reduced standoff distance to control the naturally produced kerf bevel angle

57. A PAC operator cutting 12 mm aluminum plate with 100% argon plasma gas finds significant dross firmly adhering to the cut bottom edge after the cut. What single parameter change most effectively reduces this dross?

A. Increase the standoff distance to allow the plasma column to expand for more even heating through the kerf

B. Reduce the amperage by 25% to lower the plasma thermal energy at the bottom of the cut zone

C. Increase the travel speed — the dross indicates the current speed is too slow, creating excess heat input

D. Switch to nitrogen plasma gas, which chemically prevents aluminum dross formation during the cut

58. During plasma arc cutting setup, the operator accidentally reverses the output cables and connects the torch to the positive terminal of the DC power source before the trial arc. What is the immediate consequence when the arc is struck?

A. No arc can be established because reversed polarity prevents the plasma from forming in the torch nozzle

B. The cut quality improves temporarily because DCEP concentrates more usable energy at the workpiece

C. The arc establishes normally but the cut quality gradually degrades as the plasma column geometry shifts

D. The nozzle and electrode sustain rapid thermal damage because DCEP concentrates arc energy at the torch components

59. A CAC-A groove produced for back-gouging is consistently wider than specified and shallower than required by the procedure. Which adjustment to electrode angle corrects this profile?

A. Increase the angle of the electrode from the plate surface to steepen the approach and produce a deeper, narrower groove

B. Decrease the electrode angle from the plate surface to redirect the arc energy downward into the base metal

C. Increase the travel speed with the same electrode angle to prevent lateral pool widening during gouging

D. Reduce the amperage, which will independently reduce groove width without proportionally affecting depth

60. What is the required compressed air pressure range at the CAC-A electrode holder for effective molten metal expulsion during production gouging operations?

A. 275 to 345 kPa (40 to 50 psi), which is sufficient for all commonly used electrode sizes in the shop

B. 550 to 690 kPa (80 to 100 psi), which is the standard operating pressure required for CAC-A work

C. 1,035 to 1,380 kPa (150 to 200 psi), needed to ensure the air jet penetrates the full molten pool depth

D. 415 to 480 kPa (60 to 70 psi), which is adequate for small diameter CAC-A electrodes only

61. A CAC-A operator performing back-gouging on a CJP weld determines that after three passes, the groove bottom still shows only weld metal and has not reached the weld root or base metal. What adjustment is required?

A. Increase the travel speed on the next pass to reduce the molten pool and allow the arc to cut deeper

B. Increase the air pressure to 830 kPa to force the air jet to penetrate deeper into the groove bottom

C. Deepen the gouge on the next pass and continue removing material until clean base metal is exposed

D. Switch to a smaller electrode to concentrate the arc energy into a more focused, deeper cutting zone

62. During OFC of structural angle iron, the flame extinguishes and re-ignites repeatedly at random intervals without any apparent trigger from the operator. What is the most likely cause of this intermittent behavior?

A. The fuel gas cylinder is nearly empty and the low pressure is insufficient to maintain stable combustion

B. The cutting tip is oversized for the material thickness, producing a pool that floods and extinguishes the preheat orifices

C. The oxygen regulator is cycling between open and closed states, creating pressure instability in the delivery system

D. A loose hose fitting is causing intermittent pressure drops that extinguish the flame and allow re-ignition from the hot tip

63. After setting the working pressure at an oxy-fuel cutting station, the oxygen cylinder valve is opened and the delivery pressure gauge rises to the set working pressure. When the oxygen needle valve on the torch is opened slightly, the delivery gauge reading drops by a small amount. When the needle valve is closed again, the delivery gauge returns to the set working pressure. What does this behavior indicate?

A. Normal regulator operation — the delivery gauge reflects the dynamic pressure at that point in the circuit under flowing and non-flowing conditions

B. The regulator requires replacement since it should hold a fixed output pressure with no variation regardless of downstream needle valve position

C. A calibration error exists in the delivery pressure gauge that must be corrected before the equipment is returned to service

D. The cylinder pressure is insufficient for the cutting tip size selected and a fuller cylinder is required for this operation

64. During PAC on 6 mm austenitic stainless steel, the consumables were just replaced as a matched set. The operator notices the kerf bevel angle has significantly increased, with one face more square and the other more bevelled than normal. What is the most likely cause?

A. The replacement nozzle bore is oversized, widening the plasma column and producing the increased bevel

B. The swirl ring was installed incorrectly, reversing the gas rotation direction and changing the kerf geometry

C. The increased shielding gas flow rate from the new components is deflecting the plasma column sideways

D. The new electrode is producing a different arc emission pattern that concentrates energy on one kerf face

65. A PAC system is producing a noticeably narrower kerf than normal with a high-pitched cutting sound, despite correct parameters on the power source display. Consumables were recently inspected and appear undamaged. What component is most likely causing the constricted plasma column?

A. The worn electrode emissive face is concentrating the arc into an abnormally narrow column configuration

B. Spatter inside the nozzle bore is partially blocking the orifice and narrowing the plasma column diameter

C. The swirl ring is damaged or clogged, restricting gas flow and increasing plasma column constriction

D. The shield cap is misaligned, creating backpressure that concentrates the shielding gas around the plasma

66. During OFC operations, the operator notices the acetylene cylinder body feels noticeably cold and frost is forming on the cylinder exterior. What does this condition indicate and what action is required?

A. This is normal cooling from gas evaporation at high flow rates and the operation may safely continue

B. The cylinder pressure has reached the minimum level and the regulator will automatically restrict delivery

C. The cylinder was overfilled at the supplier and the valve must be closed to prevent unsafe overpressure

D. Acetylene is being drawn too rapidly — slow down or change cylinders to prevent acetone co-extraction with the gas

67. After CAC-A defect excavation on a repair weld, the wire-brushed groove surface appears noticeably darker than the surrounding base metal and feels slightly harder than normal. What specifically explains this surface condition?

A. Carbon deposited from the CAC-A electrode has diffused into the groove surface, raising the local carbon content

B. The rapid quench from the compressed air stream has produced a thin martensitic layer through rapid cooling

C. Arc heat has oxidized the groove surface, producing iron oxide that appears darker than the base metal below

D. The copper coating on the CAC-A electrode has transferred to the groove surface during the gouging operation

68. An OFC operator cutting 50 mm structural plate observes that the cutting oxygen stream fully penetrates the upper 30 mm but the drag lines trail severely in the lower 20 mm and the cut fails to sever the plate cleanly. Which parameter requires adjustment?

A. Increase the travel speed to move the torch through the lower zone before the oxygen stream loses energy

B. Increase the preheat flame intensity to raise the lower zone metal to ignition temperature more effectively

C. Increase the cutting oxygen pressure to deliver sufficient oxygen flow to maintain the reaction through the full thickness

D. Reduce the tip size to create a more concentrated cutting oxygen stream with better energy at the cut bottom

69. A PAC operator switches from cutting 6 mm carbon steel to cutting 25 mm carbon steel on the same machine with all current settings unchanged. The 25 mm plate cut is incomplete, with severe dross and failure to penetrate. What is the most critical parameter change needed?

A. Switch the shielding gas from 75/25 Ar/CO2 to 100% argon to increase plasma temperature at the cut bottom

B. Increase the amperage significantly to provide the arc energy needed to penetrate through the greater plate thickness

C. Increase the standoff distance to allow the plasma column to fully develop before contacting the plate surface

D. Reduce travel speed only — the existing machine settings provide adequate thermal energy at a slower pace

70. During OFC cutting of structural steel, the operator notices a distinct greenish tint developing in the preheat inner cone of the oxy-acetylene flame. What does a green tint in this flame typically indicate?

A. A neutral flame condition that normally produces a slight green color at steel ignition temperatures

B. Small nitrogen contamination in the acetylene from the cylinder fill process reacting in the inner cone

C. Partial blockage of the preheat orifices causing the combustion zone to shift its spectral emission color

D. Copper from a worn or contaminated cutting tip is volatilizing and imparting its characteristic green color to the flame

71. A CAC-A operator reports the electrode is being consumed much faster than expected, requiring the holder to be reset every few minutes instead of the normal 10 to 15 minutes. Which condition most directly causes rapid electrode consumption?

A. The amperage is set too high for the electrode diameter, causing the carbon electrode tip to erode excessively

B. The compressed air pressure is too low, failing to carry away the heat that normally cools the electrode end

C. The electrode angle is too shallow, exposing more electrode surface area to the direct arc heat zone

D. The work lead is placed too far from the gouge area, creating voltage drop that concentrates heat at the electrode

72. An SMAW welder working in a remote field location experiences persistent arc blow with a DC transformer-rectifier machine despite repositioning the work lead several times. An AC-capable power source and appropriate electrodes are available. What makes AC the most effective solution for arc blow?

A. Switching to DCEN reverses the arc blow direction rather than eliminating the underlying magnetic force

B. AC power increases the arc voltage at the work lead connection point, reducing the deflecting field strength

C. AC current alternates polarity 120 times per second, preventing the static magnetic field that causes arc blow from building

D. AC machines inherently produce a higher amperage output that overwhelms the arc blow deflecting force

73. During a multi-pass SMAW groove weld with E7018, the root and hot passes are complete. The welder notices the root opening has completely closed. What has occurred and what corrective action is needed?

A. Temporary thermal expansion closed the gap — continue welding since the opening will recover upon cooling

B. Transverse shrinkage has permanently closed the root opening — assess whether the joint must be re-fitted or removed

C. The hot pass has fully consumed the root pass volume — proceed with fill passes and record the closure

D. Excessive heat during the hot pass has caused the joint to over-fuse — grind to restore the gap dimension

74. A WPS for A514 quenched and tempered steel specifies 175°C minimum preheat and 230°C maximum interpass temperature. At a field ambient temperature of 30°C, the inspector measures the interpass temperature at 262°C before the welder starts the next fill pass. What must happen?

A. Continue welding since the 230°C interpass limit on A514 is a guideline value rather than a mandatory code limit

B. Apply additional localised preheat to stabilize the temperature before beginning the next weld pass

C. Check that the minimum preheat requirement has not also been compromised before taking any further action

D. Stop and allow the joint to cool below 230°C maximum interpass temperature before depositing the next pass

75. During SMAW root pass welding on a pipe in the 5G fixed position, the welder approaches the 12 o'clock position at the top of the pipe. The root bead profile shows a tendency to crown more heavily at the top than at other clock positions. What technique adjustment is most appropriate at the top?

A. Slightly reduce the amperage at the 12 o'clock region to limit pool size in the more favorable flat position

B. Increase the weave width at 12 o'clock to spread the weld metal more broadly across the root

C. Maintain identical parameters and technique throughout the full pipe circumference for consistency

D. Increase travel speed specifically as the weld approaches the flat position to prevent overfilling at the top

76. A structural steel connection requires 8 mm leg fillet welds with E7018. After welding with 3.2 mm electrodes, measured legs consistently show 7 mm. What is the most likely root cause?

A. The amperage setting was too high, causing undercut at the toes that reduced the effective leg dimension

B. The 3.2 mm electrode diameter is undersized for producing an 8 mm fillet leg in a single pass

C. The travel speed was too fast for the current setting, reducing the deposited bead width per pass

D. The joint fit-up had excessive root opening that consumed deposited metal to fill the gap at the root

77. A production supervisor asks a welder to deposit an 8 mm leg fillet weld in a single pass on a T-joint using a 4.0 mm E7018 electrode. Why is this request likely to be unsuccessful?

A. A 4.0 mm E7018 is too large for fillet weld applications and should be replaced with a 3.2 mm electrode

B. The flux coating on 4.0 mm E7018 prevents adequate side-wall fusion on fillet welds above 6 mm leg size

C. A 4.0 mm electrode will produce a flat weld profile rather than the concave fillet specified for structural work

D. A 10 mm fillet leg typically requires multiple passes — a single pass with 4.0 mm E7018 produces approximately 6 to 8 mm legs

78. A horizontal butt weld completed with E7018 has excellent surface appearance throughout, but the cap pass consistently shows slight sagging of the bead toward the lower plate. Which correction addresses this most directly?

A. Increase the travel speed on the cap pass to move through the horizontal zone before the pool sags

B. Reduce the amperage on the cap pass to produce a smaller, less fluid pool that resists downward movement

C. Angle the electrode 5 to 10 degrees upward toward the upper plate to direct arc force against the sagging tendency

D. Switch from a weave to a stringer bead pattern to reduce the total pool volume during the cap pass

79. An SMAW electrode is labeled with the designation 490XX-H4 under CSA W48. What does the H4 suffix specifically communicate?

A. The electrode deposits weld metal with a maximum diffusible hydrogen content of 4 mL per 100 g of deposited metal

B. The electrode requires a minimum application preheat of 40°C on any carbon steel base metal

C. The electrode was impact tested at negative 40°C during classification testing for toughness qualification

D. The electrode meets the requirements for hydrogen service vessels under the applicable CSA pressure vessel standard

80. A welder using E6010 electrodes experiences persistent backward arc blow near the end of a long structural butt weld, despite the work lead being at the far end. What additional corrective technique addresses arc blow in this situation?

A. Increase the amperage to produce a stronger arc column that resists magnetic deflection forces

B. Wrap the welding cable several turns around the structural member adjacent to the weld to generate a counter-magnetic field

C. Switch from E6010 to E6011 electrodes which are specifically formulated to resist magnetic arc blow

D. Reduce the electrode diameter to 2.5 mm to narrow the arc column and make it less susceptible to deflection

81. Which SMAW electrode type represents the worst choice for welding a repair on a chrome-molybdenum alloy steel pressure vessel fitting where hydrogen-induced cold cracking must be prevented?

A. E8018-B2, designed for 1.25% Cr-0.5% Mo alloy steel with a low-hydrogen coating chemistry

B. E9018-B3, providing matching chemistry and a low-hydrogen deposit for 2.25% Cr-1% Mo steel

C. E6013, which produces a high-hydrogen rutile deposit that dramatically increases the cold cracking risk

D. E7018-A1, providing a 0.5% molybdenum deposit appropriate for some dissimilar or transition joints

82. An electrode designated E8018-B2 is being selected for a Cr-Mo pressure vessel welding procedure. What do the letter B and number 2 in the alloy suffix communicate about this electrode's deposit chemistry?

A. The electrode uses a basic coating type and requires a minimum 200°C preheat for all applications

B. The designation indicates the electrode is designed for two-sided groove welds only on Class B pressure vessels

C. The deposit forms a bainitic microstructure that requires a 200°C bake-out treatment after welding

D. The deposited weld metal contains approximately 1.25% chromium and 0.5% molybdenum as alloying additions

83. During SMAW root pass welding on a 6G fixed pipe joint with E6010, the keyhole becomes progressively larger as the welder approaches the 6 o'clock overhead section. What adjustment prevents the keyhole from becoming excessively large in this position?

A. Widen the weave motion at the bottom to spread the pool and prevent excessive localized heat buildup

B. Reduce the amperage slightly as the pipe transitions from the inclined to the overhead portion of the pass

C. Maintain constant parameters around the full circumference to ensure consistent root bead chemistry

D. Switch to a smaller electrode diameter specifically for the overhead quarter of the root pass

84. In SMAW production welding, one welder uses electrode stubs of 50 mm before discarding while another welds down to 25 mm stubs. Which practice is safer and why?

A. The 50 mm practice is safer — welding with very short stubs places the electrode holder uncomfortably close to the arc heat and the weld pool

B. The 25 mm practice is safe and more economical since the holder insulation provides full protection at all stub lengths

C. Both practices are equally safe provided the electrode holder insulation is undamaged and rated correctly for the amperage

D. The 25 mm practice is preferred for code work since longer stubs constitute wasted filler metal and are a cost variance

85. A vertical-up SMAW groove weld on 20 mm A516 Grade 70 carbon steel is completed using E7018 electrodes from a freshly opened sealed container. MT examination hours after welding reveals underbead cracks in the HAZ. What is the most likely cause?

A. Excessive amperage produced a coarse-grained HAZ microstructure that cracked under residual stress

B. The vertical-up position introduced high restraint stress that exceeded the HAZ tensile strength at cooling

C. Insufficient preheat allowed the HAZ to cool too rapidly, forming hard martensite susceptible to hydrogen-induced cracking

D. The iron powder additions in the E7018 coating introduced hydrogen that accumulated in the HAZ during cooling

86. An SMAW electrode is designated E7018-1 H4R under the AWS A5.1 extended classification system. What does the three-character suffix "-1 H4R" together communicate about this electrode?

A. Position 1 qualification only, H4 hydrogen rating, and R indicating the electrode requires refrigerated storage

B. Improved arc stability on AC, maximum 4 mL/100g hydrogen, and rutile coating composition type

C. Impact tested at -40°C, maximum 4 mL/100g hydrogen, and enhanced remote current control capability

D. Improved notch toughness at lower temperature, maximum 4 mL/100g diffusible hydrogen, and moisture-resistant coating

87. A welder completing a multi-pass structural groove weld with E7018 observes that each fill pass is producing a convex, high-crowned bead that creates slag traps in the groove corners. Which technique change most directly addresses this?

A. Use a shorter arc length on fill passes to concentrate heat at the centre of each deposited pass

B. Reduce the weave width and use slightly higher amperage to produce a flatter, more fluid bead profile

C. Increase the preheat temperature to extend the time the pool remains fluid during bead formation

D. Apply wire brushing only to the corner slag traps between passes without fully cleaning the entire bead

88. An overhead SMAW weld produces metal icicles — spikes of solidified weld metal hanging downward from the joint face at several locations along the pass. Which parameter or technique change prevents this defect?

A. Reduce the amperage and use narrow stringer beads to maintain a small, fast-freezing overhead pool

B. Increase travel speed to pass through the heat zone before the pool accumulates enough mass to drip

C. Increase arc length to reduce the direct heat delivered to the pool surface and prevent overheating

D. Switch to a larger electrode diameter to increase deposition rate and fill the overhead zone more quickly

89. A welder passes a 3G vertical-up plate groove qualification test using E7018 under AWS D1.1. The following day the welder is asked to perform a 4G overhead plate groove weld on the same material. What is required before the 4G weld may be performed?

A. No action required — a successful 3G qualification extends to all plate groove positions including overhead

B. Supervisor observation of a trial overhead weld is sufficient before the welder begins production work

C. The welder must pass a separate 4G overhead plate groove qualification test since 3G does not cover overhead

D. Written authorization from the welding inspector is sufficient to extend the 3G qualification to include 4G

90. A GMAW operator increases amperage smoothly from the short circuit range upward. At intermediate settings, the arc becomes harsh, irregular, and produces heavy large-particle spatter. At higher settings, the spatter suddenly decreases and the bead becomes smooth again. What is happening during the problematic intermediate range?

A. The wire is partially melting before exiting the contact tip, causing irregular droplet formation at intermediate current

B. Shielding gas turbulence at higher amperage is disrupting the arc before it stabilizes at maximum current

C. Contact tip wear is creating intermittent contact resistance that stabilizes from thermal expansion at high current

D. The arc is passing through the globular transfer transition zone between the short circuit and spray transfer modes

91. During GMAW production welding, the wire is feeding inconsistently — sometimes rapidly and sometimes slowly — even though no wire feed speed adjustment has been made. This causes variable bead height and arc instability. What is the most likely cause?

A. The contact tip bore has become elongated from wear, creating intermittent contact that affects the feed rate signal

B. The drive roll clamping tension is set too low, allowing the wire to slip intermittently against the feed rolls

C. The gas flow rate is excessive, creating back-pressure turbulence that physically interferes with wire advancement

D. Primary supply voltage fluctuation at the facility level is causing the wire feeder motor speed to vary

92. A GMAW procedure specifies 75/25 Ar/CO_2 shielding gas at 18 L/min. The gun nozzle is inspected and found to be approximately 80% blocked with hardened spatter. How does this spatter blockage affect the shielding performance?

A. The blockage restricts gas flow, reduces shielding coverage, and creates turbulence that draws atmospheric air into the arc zone

B. The blockage increases back-pressure in the gas line, improving gas density and arc shielding effectiveness

C. No effect on shielding occurs since gas volume is regulated upstream and the nozzle does not restrict flow

D. The spatter blockage causes the shielding gas to pre-mix with ambient air inside the nozzle before exiting

93. A FCAW operator using E71T-1M wire with 75/25 Ar/CO2 shielding wants to increase deposition rate without changing the wire diameter or switching processes. Which parameter change correctly achieves this in spray transfer?

A. Increase the voltage from 28 V to 32 V while holding wire feed speed constant to increase arc energy

B. Reduce the CTWD from 19 mm to 10 mm to reduce resistive preheating and increase the effective amperage

C. Increase the wire feed speed while adjusting voltage proportionally upward to maintain stable spray transfer

D. Switch from a drag to a push gun angle to redirect the arc force and increase the melt-off rate of the wire

94. A structural fabricator is choosing between E70T-1 and E70T-5 FCAW-G wires for welding A572 Grade 50 plate at 30 mm thickness where hydrogen-induced cold cracking is a concern. Which statement correctly distinguishes them for this application?

A. E70T-1 is preferred for thick sections because its rutile slag chemistry recovers more deoxidants at high amperages

B. E70T-5 should be avoided on 30 mm plate because the basic slag becomes too viscous for clean multi-pass removal

C. Both wires are equally suitable since A572 Grade 50 at 30 mm is well within either wire's normal operating range

D. E70T-5 is preferred because its basic slag chemistry produces lower diffusible hydrogen than the rutile T-1 classification

95. A robotic GMAW cell produces consistent weld quality across each part except for porosity that occurs in one specific zone on every part. Manually welding the same zone by hand produces sound welds. What is the most likely cause of the localized robotic porosity?

A. The robot travel path angle at that zone is incorrect, but angular deviation causes incomplete fusion not porosity

B. A consistent airflow pattern or draft source in the cell disrupts shielding gas coverage at that specific path location

C. The wire feed speed sub-program is incorrectly calibrated, reducing wire delivery at that specific weld zone

D. The fixture grounding path changes at that location, altering the arc current return path and causing contamination

96. An MCAW wire classified as E70C-6M under AWS A5.18 is proposed as a substitute for ER70S-6 solid wire in an existing qualified structural welding procedure. What action is required?

A. A new procedure qualification with PQR test welds is required because MCAW is a different filler metal category from solid wire

B. No qualification action is required since both classify as 70 ksi carbon steel filler metals for the same base metal group

C. A WPS editorial amendment is sufficient since the chemistry and mechanical properties of both wires are functionally identical

D. Supervisor approval and an amended WPS notation are sufficient since both wires use the same shielding gas system

97. A GMAW operator is producing horizontal fillet welds with spray transfer and observes that the lower toe consistently shows overlap or cold lap without any undercut at the upper toe. Which technique correction addresses the lower toe specifically?

A. Increase the arc voltage to widen the arc and provide more heat distribution across the lower toe area

B. Reduce the wire feed speed to lower the deposition rate and allow the pool to wet-out at the lower toe

C. Tilt the electrode work angle slightly more toward the lower plate to direct more arc force at the lower toe

D. Increase travel speed to move the pool forward faster and prevent it from running downward at the lower toe

98. A welder using E71T-1M FCAW-G wire produces the first pass of a multi-pass structural weld and finds the slag is tightly adherent across the entire bead, requiring heavy chipping force for removal. What is the most likely cause?

A. The wire spool was stored improperly, allowing moisture to change the core flux chemistry and bonding characteristics

B. The interpass temperature exceeded the maximum limit, causing the slag to chemically bond to the bead more strongly

C. The E71T-1M wire is incorrectly classified — T-1 slag systems always self-release cleanly in production welding

D. The voltage is set too low relative to the wire feed speed, producing an underpowered arc and excessive slag adhesion

99. A GMAW operator welding 3 mm aluminum sheet with ER4043 wire and 100% argon shielding reports porosity throughout the weld despite clean sheet metal and confirmed dry gas supply. What moisture source is most likely specific to the aluminum GMAW process?

A. Metallic spatter from the aluminum wire is oxidizing in the arc and generating gas-phase contamination

B. Moisture present on the wire surface, within the aluminum oxide layer, or in the drive system path

C. The argon shielding is insufficient for aluminum GMAW — helium additions are always required for this process

D. Copper from the contact tip is oxidizing on the aluminum surface and generating porosity-forming compounds

100. An E71T-8 self-shielded FCAW weld passes visual inspection but ultrasonic examination detects slag inclusions between passes despite thorough interpass cleaning. Which characteristic of E71T-8 slag makes inclusion detection by UT particularly challenging?

A. Aluminum oxide in E71T-8 slag has higher acoustic impedance than conventional silicate slag, reducing its impedance contrast with steel and producing weaker UT reflections from trapped inclusions

B. Self-shielded slag deposits in a mechanically softer state than gas-shielded slag and compresses under the UT transducer rather than reflecting the sound beam

C. Vanadium compounds in the E71T-8 core specifically absorb ultrasonic energy and suppress the reflection signal from trapped slag inclusions

D. The basic slag chemistry of T-8 wires produces fine crystalline inclusions that scatter rather than coherently reflect the ultrasonic beam

101. A fabricator must GMAW weld 2.0 mm wall austenitic stainless steel tubing for a pharmaceutical process application. Which transfer mode and shielding gas combination is most appropriate?

A. Spray transfer using 98/2 Ar/O2 at high amperage for maximum penetration control on thin stainless tubing

B. Globular transfer using 75/25 Ar/CO2 to balance penetration and bead appearance on thin section stainless

C. Short circuit transfer using 100% CO2 shielding to minimize heat input and distortion on thin wall tubing

D. Short circuit or pulsed spray transfer using 98/2 Ar/O2 or a similar argon-rich blend for thin stainless wall

102. An FCAW-G operator using E71T-1 wire in the vertical-up position notices the slag is consistently running ahead of the arc and getting trapped beneath the advancing bead. Which parameter adjustment most directly prevents slag entrapment?

A. Increase voltage to produce a more fluid arc that pushes the slag rearward and prevents forward runout

B. Increase wire feed speed to produce a larger pool that physically displaces the slag from the arc path

C. Reduce wire feed speed to produce a smaller, faster-freezing pool that does not push slag ahead of the arc

D. Switch from E71T-1 to E71T-5 wire which has a stiffer basic slag that resists runout in vertical position

103. A GMAW operator notices that the weld quality is excellent at the start of each new wire spool but deteriorates significantly — more spatter, erratic arc — during the final 10% of every spool regardless of wire brand. What is the most likely cause?

A. The spool brake tension increases as the spool diameter decreases, causing a measured drop in wire feed speed

B. Moisture or contamination on the outer wire layers from improper storage between use shifts entering the arc zone

C. The wire becomes mechanically work-hardened from prolonged exposure to tension on the outer spool layers

D. Wire cast memory increases as spool diameter decreases, causing the small-diameter outer turns to feed erratically

104. A GMAW procedure is qualified using 1.2 mm ER70S-6 solid wire. A production engineer proposes substituting 0.9 mm ER70S-6 for a job welding 2.0 mm sheet metal. What is the qualification implication of this change?

A. A new procedure qualification is required because wire diameter is an essential variable under most applicable codes

B. No qualification action is required since both are the same ER70S-6 classification and differ only in diameter

C. A WPS amendment only is sufficient since smaller wire provides better thin-metal control with identical chemistry

D. Only supervisor and quality manager approval is needed since ER70S-6 of any diameter deposits identical weld metal

105. A fabricator is evaluating MCAW versus GMAW solid wire for a high-volume structural beam flange-to-web fillet welding application in the flat position. Which specific advantage of MCAW over solid wire justifies the higher consumable cost?

A. MCAW wire is approved for all positions without adjustment, reducing the need for positioner equipment

B. MCAW wire does not require external shielding gas, reducing the overall operational cost significantly

C. MCAW produces a protective slag layer during welding that provides better multi-pass fusion characteristics

D. MCAW achieves higher deposition rates and superior side-wall fusion compared to an equivalent diameter solid wire

106. An FCAW operator using E71T-8 self-shielded wire is directed to increase the electrode stick-out (CTWD) from the standard 19 mm to 38 mm for improved access. What is the primary effect of this change on the welding output?

A. Arc stability increases because the longer stick-out provides a buffer zone that prevents pool contact

B. Bead width increases because the extended stick-out redirects the arc force laterally across the joint

C. Effective amperage decreases because the longer wire extension increases resistive preheating of the electrode

D. Penetration increases because the longer arc column develops greater momentum before striking the workpiece

107. A GMAW operator is welding titanium-stabilized austenitic stainless steel (Grade 321) structural assemblies. Which shielding gas selection is most appropriate for maintaining the titanium stabilizer's effectiveness?

A. 75/25 Ar/CO2, which provides the optimum balance of arc stability and penetration for all austenitic stainless grades

B. 98/2 Ar/O2 or a similar high-argon, low-oxidant blend to minimize oxidation of the titanium stabilizing element

C. 100% CO2, which provides the deepest penetration on all stainless steel grades at reduced consumable cost

D. 50/50 Ar/He blend, which provides the elevated arc temperature required for welding all austenitic stainless grades

108. A GTAW welder working on 316L stainless steel pipe reports that the weld pool is sluggish and not flowing properly despite correct amperage, correct arc length, 100% argon shielding, and verified ER316L filler. What is the most likely cause?

A. The tungsten electrode is becoming contaminated and is reducing the effective arc heat at the pool

B. 100% argon is insufficient for 316L stainless — an Ar/H2 blend is required for correct pool fluidity

C. The ER316L filler rod is too large in diameter, introducing excess cold metal that is chilling the pool

D. The joint area is not sufficiently clean and residual oxide or surface contamination is inhibiting fusion

109. A GTAW machine is set to DCEN for carbon steel welding with a pointed EWCe-2 tungsten. When the arc is struck, the tungsten tip immediately balls and the arc is unstable. What has most likely been connected incorrectly in the circuit?

A. The torch cable is connected to the positive terminal — DCEP polarity is concentrating arc energy at the electrode

B. The HF start unit is in AC mode, producing an alternating field that prevents stable DCEN arc establishment

C. The post-flow timer is set too short, causing immediate tungsten oxidation before arc stability is achieved

D. The gas lens has been replaced with a standard collet body, reducing arc shielding uniformity around the electrode

110. Before striking the root pass arc on a 2.0 mm wall 304L stainless steel tube joint with argon back purge flowing, what specific condition must be confirmed inside the tube at the weld zone?

A. Argon flow is visible as a slight haze visible at the far end of the tube section from the joint

B. A minimum of 30 seconds of purge flow at 5 L/min has elapsed before the arc may be established

C. The oxygen content inside the tube has dropped below approximately 0.1% (1,000 ppm) at the weld location

D. The argon has fully displaced all nitrogen from the tube as confirmed by a visible color change at the outlet

111. A GTAW carbon steel pipe procedure specifies ER70S-2 filler. The welding shop is out of ER70S-2 and only ER70S-6 is available. What is the primary concern with substituting ER70S-6?

A. ER70S-6 has higher silicon content that produces an excessively viscous pool, degrading pipe root pass control

B. Changing from ER70S-2 to ER70S-6 may be an essential variable change under the applicable code requiring PQR testing

C. ER70S-6 is not approved for manual GTAW rod applications and is only classified for GMAW wire use

D. The higher silicon content in ER70S-6 promotes sensitization in the carbon steel HAZ adjacent to the root pass

112. A GTAW welder is welding 12.7 mm aluminum plate in the flat position using AC with a 3.2 mm EWZr-1 tungsten at 200 A. During welding, the ball at the tungsten tip grows to three times the electrode diameter and begins spitting metal. What is the problem?

A. EWZr-1 tungsten is incompatible with AC welding at any amperage and pure tungsten must be used instead

B. The arc length has become excessively long, focusing cathodic cleaning energy onto the electrode tip

C. The argon flow rate is too low, failing to cool the electrode surface and allowing excessive heat buildup

D. The 200 A AC exceeds the rated current capacity of the 3.2 mm electrode, causing excessive balling and spitting

113. A GTAW welder accidentally dips the tungsten into the weld pool during a stainless steel root pass, contaminating the electrode. After re-grinding the tungsten and preparing a new tip, what action is required regarding the already-deposited weld metal?

A. The contaminated portion of the weld must be excavated and the area rewelded with the re-prepared electrode

B. No additional action is needed — the contamination affects only the tungsten and not the deposited weld quality

C. Continue welding, document the event, and allow the post-weld RT examination to characterize any inclusions

D. Apply post-weld heat treatment to diffuse any tungsten particles embedded in the weld pool during contact

114. A 316L stainless steel pipe root pass is completed with argon back purge flowing at 5 L/min throughout. The root bead surface appears smooth and well-formed from the outside. When the pipe is examined internally, the root shows heavy black granular sugaring. What is the most likely cause?

A. The 5 L/min flow rate was too high, creating turbulence that mixed atmospheric air into the back purge stream

B. The ER316L filler rod was added too rapidly, disturbing the back-side shielding during filler metal addition

C. A leak in the purge seal at one end of the spool allowed atmospheric oxygen to enter despite adequate flow

D. The torch post-flow was set too short, exposing the hot root bead to atmospheric oxygen immediately after arc extinction

115. An aluminum GTAW operator using a 3.2 mm EWP tungsten electrode at 200 A AC observes the tungsten ball growing progressively larger during welding and eventually spitting molten tungsten into the weld pool. The argon shielding is confirmed correct. What is the cause?

A. The 3.2 mm EWP tungsten is a DC-only type and is being overloaded by the alternating current waveform

B. 200 A AC exceeds the AC current capacity of the 3.2 mm EWP electrode, causing excessive thermal balling and spitting

C. The filler rod diameter is too small, requiring the arc to dwell too long at each addition point and overheating the electrode

D. The high-frequency stabilization amplitude is set too high, concentrating excessive arc energy at the electrode tip surface

116. A GTAW welder welding aluminum notices the cathodic cleaning band (bright shiny zone) beside the weld bead is noticeably wider on the right side than on the left side. What most likely causes this asymmetric cleaning band?

A. The filler rod is being introduced only from the right side, directing more cathodic cleaning current rightward

B. The aluminum surface has different oxide thickness on each side due to prior chemical treatment differences

C. The gas lens is producing asymmetric shielding, providing wider protection coverage on the right side

D. The torch work angle is off-center, directing the cathodic cleaning arc preferentially toward the right side

117. When GTAW welding with an Ar/5% H2 blend on austenitic stainless steel, the weld pool shows significantly improved fluidity and a smoother bead profile compared to pure argon. What is the specific mechanism by which hydrogen produces this improvement?

A. Hydrogen's high thermal conductivity increases arc energy transfer, raising the effective heat input delivered to the pool

B. Hydrogen reacts with surface chromium oxide in the pool, removing it as water vapor and cleaning the fusion interface

C. Hydrogen partial pressure suppresses atmospheric nitrogen absorption that causes pool sluggishness on stainless steel

D. Diatomic hydrogen dissociation and recombination in the arc zone creates an additional exothermic energy release

118. An automated orbital GTAW machine programs the same amperage for all positions around a carbon steel tube. The completed weld shows excessive crown at 12 o'clock (flat) and undercut at 6 o'clock (overhead). What program modification corrects both conditions?

A. Increase travel speed at 12 o'clock to reduce pool buildup and decrease travel speed at 6 o'clock to reduce undercut

B. Increase amperage uniformly by 10% around the full circumference to improve fusion at the undercut position

C. Program a lower amperage at 12 o'clock to reduce the crown and a slight amperage reduction at 6 o'clock to tighten the pool

D. Add programmed filler wire feed at the 6 o'clock position to compensate for the material lost to undercut at overhead

119. A GTAW root pass on duplex stainless steel (2205) pipe uses ER2209 filler and 100% argon back purge. After welding, the PWHT schedule specifies a solution anneal followed by

rapid water quench cooling. Why is controlled post-weld cooling rate critical for duplex stainless steel?

A. Rapid cooling creates excessive thermal stress gradients that physically crack the root bead in thick-wall pipe

B. Cooling through specific temperature ranges can cause sigma phase or other embrittlement phases to form in the microstructure

C. Rapid cooling prevents the austenite phase from fully reforming, producing an all-ferrite microstructure with low toughness

D. The solution anneal temperature is too close to the sensitization range, requiring slow cooling to prevent carbide precipitation

120. A GTAW welder is 60% through the root pass on a stainless steel pressure vessel nozzle connection when the back purge gas supply runs out. The deposited root bead shows excellent bright silver color throughout. What is the correct action?

A. Continue welding quickly to complete the root pass before the oxygen concentration inside the vessel rises significantly

B. Complete the pass without purge, then plan for chemical passivation of the full nozzle bore after cooling

C. Weld only until the current purge gas condition is adequate, then hold at that point before resuming the arc

D. Stop immediately, repair or restore the purge gas supply to verified conditions, then confirm purge quality before resuming

121. A SAW procedure uses an active flux with a low-manganese solid wire. The completed multi-pass weld analysis shows higher manganese and silicon in the upper passes than in the lower passes. What caused this variation?

A. The arc voltage was higher during the upper passes, recovering more manganese and silicon from the active flux

B. The EL12 wire chemistry changed progressively through the coil as higher-impurity wire was drawn from the spool interior

C. The elevated interpass temperature on upper passes increased the degree of base metal dilution into the deposit

D. The active flux decomposes at different rates at the higher temperatures generated during the later upper passes

122. A SAW pressure vessel procedure has a maximum qualified heat input of 3.5 kJ/mm based on Charpy impact testing. Current parameters are 32 V, 700 A, and 450 mm/min travel speed. Is the procedure within the qualified heat input limit?

A. No — the heat input is 4.27 kJ/mm, calculated as (32 × 700 × 60) ÷ (450 × 1,000), which exceeds the limit

B. No — the heat input is 3.73 kJ/mm and marginally exceeds the 3.5 kJ/mm qualified procedure limit

C. Yes — the heat input is 2.99 kJ/mm, calculated as (32 × 700 × 60) ÷ (450 × 1,000) = 2.99 kJ/mm, within the limit

D. Yes — the heat input is 3.47 kJ/mm and falls just within the 3.5 kJ/mm qualified maximum limit

123. After four hours of SAW production on a humid coastal site, a fused SAW flux recovery hopper feels damp when touched. What specific action is required regarding the recovered fused flux?

A. Continue using the recovered flux — fused flux is moisture-resistant by nature and does not require drying

B. Dry the recovered fused flux at 120 to 150°C before returning it to the flux delivery hopper for further use

C. Discard all recovered flux immediately and replace with freshly opened flux for the remainder of the shift

D. Continue using the flux and compensate by raising the arc voltage 2 V to counteract any chemistry effects

124. In a tandem SAW system, the lead wire operates on DCEP and the trail wire operates on AC. What specific advantage does AC on the trail wire provide in this tandem configuration?

A. AC increases the deposition rate of the trailing wire, maximizing the productivity of the tandem system

B. AC reduces the cost of the trail wire power source since AC machines are less expensive than DC rectifiers

C. AC produces a different slag chemistry on the trail wire deposit that is compatible with the lead wire slag

D. AC prevents magnetic arc interference between the two wires by eliminating the static field from the DCEP lead arc

125. A SAW operator observes a faint visible glow and occasional spark emission above the flux surface while the machine is running. What condition causes this arc breakthrough and what must be corrected?

A. The flux blanket depth is insufficient — increase the flux feed rate and depth to completely submerge the arc

B. The arc voltage is set too low, causing the arc to concentrate near the surface rather than below the flux layer

C. The wire feed speed is too high, causing arc energy to exceed what the current flux depth can contain

D. The flux granule size is too coarse, leaving large gaps between granules through which the arc light escapes

Practice Exam 2: Answer Key and Explanations

1. B — A brush previously used on carbon steel embeds ferrous particles in its bristles that transfer to the stainless steel surface on subsequent contact, introducing iron contamination that initiates corrosion. Using a dedicated stainless steel brush that has never contacted carbon steel or other metals prevents this cross-contamination entirely. This is a non-negotiable requirement for maintaining stainless steel's passive corrosion-resistant surface.

2. D — Dropping a precision instrument onto a hard surface can deform the jaw geometry, bend the measuring beam, or damage the pivot mechanism even without visible external damage. All subsequent measurements taken with deformed contact surfaces will be incorrect throughout the full measurement range. A drop is an instrument-replacement trigger event — assume the instrument is unreliable until verified.

3. C — A cracked handle on a striking tool is a remove-from-service condition with no temporary repair or restricted-use accommodation permitted. During the high-impact stroke of chipping, the crack propagates instantly under the load, allowing the tool head to become a high-velocity projectile. The handle must be replaced before the tool returns to any use.

4. A — Correct SMAW arc length equals the diameter of the electrode core wire — approximately 4 mm for a 4.0 mm electrode. This distance maintains the shielding gas envelope from the coating, controls the arc energy distribution, and produces a consistent bead profile. A longer arc allows atmospheric contamination and spreads heat; a shorter arc causes stubbing and slag trapping.

5. B — At approximately 62 kg, the plate exceeds safe single-person manual handling capacity. A shop dolly or flat-bed cart rated for the load moves the plate flat and controlled, eliminating the manual lifting hazard and strain injury risk. Edge-rolling on a corner and single-point crane dragging are uncontrolled movement methods that risk plate instability and dropped-load injuries.

6. C — A red tag is the universal signal that a scaffold has been formally taken out of service by the inspecting authority due to a safety deficiency. No one may use a red-tagged scaffold for any purpose until the deficiency is corrected and the tag is removed by the scaffold builder or authorized competent person. Continued use of a red-tagged scaffold is a code violation and safety breach.

7. D — For 50 mm diameter schedule 40 pipe with approximately 4.5 mm wall thickness, the two-tooth-contact rule requires a minimum tooth spacing of no more than 2.25 mm, or approximately 11 TPI minimum. A 10 TPI blade has a tooth spacing of 2.54 mm, meaning only approximately 1.77 teeth contact the 4.5 mm wall simultaneously — below the minimum two-tooth requirement. Individual teeth catch and break against the thin wall under impact loading.

8. A — Discovery of smoldering material during active hot work requires immediate cessation of all welding or cutting and direct attention to the fire source before it develops into open flame. The fire watch obligation and the welder's personal response both converge on the same action — stop and address the fire. Continuing the weld while another person investigates is not acceptable when the hazard is already identified.

9. B — The established safe oxygen range for confined space entry is 19.5% to 23% by volume. At 19.3%, the atmosphere is classified as oxygen-deficient, and entry is prohibited regardless of

any other atmospheric readings. Oxygen-deficient atmospheres impair cognitive function and physical performance rapidly and can cause unconsciousness without warning or perceived distress.

10. C — Section 4 (First-Aid Measures) of the SDS is the dedicated medical response section, structured specifically to provide treatment instructions for each route of exposure including eyes, skin, inhalation, and ingestion. Section 8 prescribes prevention PPE; Section 11 describes long-term health effects. For an acute chemical eye injury, Section 4 is the operative reference.

11. D — At 100 dB-A, the noise level exceeds the threshold where OHS legislation mandates both mandatory hearing protection and feasible engineering controls to reduce exposure at source. Posting signs, conducting testing, and training are administrative measures that do not substitute for the engineering and PPE controls legally required at this noise level.

12. A — The PQR is the evidentiary foundation of the WPS — without a retrievable, documented PQR, the WPS has no demonstrated qualification basis and cannot be used for code-certified work. All production welding under that WPS must stop until the documentation issue is resolved. Proceeding with an unsupported WPS is a code violation that invalidates the welds produced.

13. C — Longitudinal shrinkage is the contraction of weld metal parallel to the weld axis, which shortens the overall assembly length along the direction of welding travel. Angular distortion would change the geometry perpendicular to the weld face; transverse shrinkage closes the joint gap. A measured reduction in assembly length along the weld axis is the definition of longitudinal shrinkage.

14. B — Sulfur and phosphorus in steel have a strong thermodynamic tendency to segregate to solidification grain boundaries as low-melting-point sulfide and phosphide films. These films cannot withstand the tensile stresses of weld metal solidification contraction and fracture, producing hot cracks (solidification cracks) at or near the weld metal centreline. High S and P in base metal are the primary compositional factors in hot crack susceptibility.

15. D — For a five-piece elbow, the number of cuts = pieces − 1 = 4. Applying the formula: cut angle = total angle ÷ (2 × cuts) = 90° ÷ (2 × 4) = 90° ÷ 8 = 11.25°. This calculation must be applied consistently: always subtract one from the piece count for the number of cuts, then divide the total angle by twice the cut count.

16. C — A rolling offset combines vertical and horizontal offsets simultaneously, requiring the true offset to be calculated as the hypotenuse: $\sqrt{(180^2 + 240^2)} = \sqrt{(32,400 + 57,600)} = \sqrt{90,000} = 300$ mm. The travel length is then 300 × 1.414 = 424 mm. Only option C correctly calculates the true offset using the Pythagorean relationship.

17. A — At 45 degrees from vertical, the tension in each leg of a two-leg sling equals the load divided by two, multiplied by the inverse cosine of the angle: (2,400 ÷ 2) ÷ cos(45°) = 1,200 ÷ 0.7071 = 1,697 kg. This equals 70.7% of the total load weight per leg — confirming why sling angle management is a critical rigging safety calculation.

18. B — Hazard statements on a WHMIS 2015 label are the standardized phrases that describe the specific nature and severity of each identified hazard (for example, "Extremely flammable liquid and vapour"). They explain the basis for the signal word classification, while the signal word alone indicates only relative severity tier without describing the mechanism or nature of the hazard.

19. D — A cracked punch in a high-cycle impact tool is a catastrophic fracture risk. During the ironworker's punching stroke, the instantaneous stress concentration at the crack tip propagates the crack explosively, potentially sending high-velocity fragments toward the operator. No repair option, restricted-use plan, or monitoring interval is appropriate — immediate removal from service is the only safe response.

20. C — CWB certificates issued under CSA W47.1 are process-position-material specific, and a welder may only perform production welds covered by their current valid certificates. A certificate covering 1G/2G/1F/2F positions does not extend to vertical (3F) welding. The welder must obtain the appropriate CWB certificate before performing the out-of-scope position.

21. A — Drawing scale notation 1:5 means one unit on the drawing represents five units on the actual object — the drawing is reduced to one-fifth of the actual size. The actual dimension is obtained by multiplying the drawing dimension by the scale factor: 45 mm × 5 = 225 mm. Measuring dimensions directly off a drawing with a ruler is prohibited — always apply the stated dimension.

22. D — Drafters apply different hatch angles to adjacent regions in a section view to visually distinguish separate individual components that share the same section plane. Without different angles, two adjacent parts would appear as one continuous piece. Different hatch angles carry no implication about material composition, heat treatment, or weld joint location.

23. B — In AWS A2.4 groove weld symbol notation, a number placed inside the groove symbol (within the V) represents the root opening, and a number placed outside the groove symbol represents the groove angle. Therefore: 60 outside the V = 60-degree total groove angle; 2 inside the V = 2 mm root opening at the joint bottom.

24. C — The effective throat of a standard flat equal-leg fillet weld is calculated as 0.707 times the leg size, derived from the 45-45-90 triangle geometry of the weld cross-section. For 10 mm legs: 0.707 × 10 = 7.07 mm ≈ 7.1 mm. This theoretical throat dimension is the actual stress-carrying cross-section used in structural fillet weld strength calculations.

25. A — CSA W59 pre-qualified single-V groove joints require a total groove angle of 60 degrees ± 5 degrees for structural steel applications. This range provides adequate electrode access for SMAW fill passes while limiting the total weld metal volume. Angles outside this range require procedure qualification testing to demonstrate adequate weld quality.

26. D — The field weld flag — a filled solid triangle at the reference line-arrow junction — specifies that the weld must be made at the construction or erection site, not in the fabrication shop. This distinction affects quality control hold points, inspection authority requirements, procedure selection, and the documentation trail between shop and field operations.

27. B — A single-bevel groove has only one plate prepared with a bevel; the opposing plate remains square and contributes zero degrees to the joint opening. The total groove angle therefore equals only the bevel angle of the one prepared plate — 30 degrees in this case. Confusing groove angle with bevel angle is a common reading error that leads to incorrect groove preparation.

28. C — Parallel line development applies to shapes whose longitudinal elements remain parallel to the central axis throughout, which accurately describes all faces of a rectangular duct section through a 90-degree turn. The cross-section shape changes direction but the side-wall and top/bottom elements remain parallel to the duct axis, making parallel line development the correct method.

29. A — The circumference (stretchout length) for a full circular ring blank is calculated as π × diameter. For 610 mm OD: 3.1416 × 610 = 1,916.4 mm. This is the required flat blank length regardless of ring cross-section dimensions, provided the calculation is based on the specified reference diameter.

30. D — Underfill is the specific defect classification for a weld face that lies below the adjacent base metal surface level, reducing the effective cross-sectional area of the joint below design requirements. At 4.5 mm below the surface, the joint cross-section is materially deficient and cannot develop the design strength — this is a rejectable underfill condition.

31. B — Uniform porosity appears on RT as multiple small, evenly distributed dark round spots throughout the weld metal, reflecting gas bubbles that solidified in place. Slag inclusions are irregular and elongated, aligned with pass boundaries. Cracks are linear or branching. Tungsten inclusions appear as bright dense spots because tungsten absorbs more radiation than steel.

32. C — A concave fillet face curves inward, reducing the perpendicular distance from the weld root to the weld face below the theoretical throat. For an 8 mm equal-leg fillet, the minimum theoretical throat is $0.707 \times 8 = 5.66$ mm. A concave face reduces the actual throat below this value, directly reducing the load-carrying capacity below the design intent.

33. A — A fine toe crack can be below the resolution threshold of radiographic testing, which detects volumetric discontinuities most reliably, and tight enough to be invisible during visual inspection. Hydrostatic pressure testing at 1.5 times design pressure applies sustained loading that opens tight cracks and forces fluid through, revealing defects that all prior inspections missed.

34. D — ASTM A514 is a quenched-and-tempered structural steel where all strength and toughness properties result directly from the controlled Q&T heat treatment. Localized overheating during flame straightening either over-tempers the heated zone (reducing strength) or re-austenitizes it (destroying the tempered condition entirely). Engineering approval is required because the material cannot be re-processed in the field.

35. B — A UT indication amplitude 14 dB above the reference level exceeds the code rejection criterion of 6 dB by 8 dB — a substantial margin above the rejection threshold. Code acceptance criteria are absolute limits, not guidelines subject to engineering judgment. The weld must be rejected, excavated to below the indication depth, and rewelded.

36. A — When a cylinder with a diagonal end cut is unrolled flat as a stretchout, the cut end projects as a sinusoidal curve across the stretchout width. This is a fundamental result of parallel line development — the ellipse formed by the diagonal cut on the cylindrical surface maps to a mathematical sine wave when the surface is unrolled flat. The straight end remains straight.

37. C — A combination square with a verified consistent mechanical error must be removed from service. Applying correction factors, substituting other tools, or restricting use introduces human error potential into every subsequent measurement and does not address the underlying tool defect. Defective precision measuring tools have no conditional-use pathway — they must be replaced.

38. D — A 7 mm root opening versus a 3 mm ± 1.5 mm pre-qualified maximum is a significant deviation that removes the joint from its pre-qualified status under CSA W59. Welding an out-of-tolerance joint risks incomplete root penetration, burn-through, and a non-conforming joint configuration. The joint must be re-fitted within the specified tolerance before welding authorization is granted.

39. B — The field weld flag specifies that welding occurs at the construction site, not in the fabrication shop. The PWHT notation in the tail specifies that post-weld heat treatment is required after that weld is completed. Together, they define both the work location and the post-weld treatment requirement as sequential obligations for that specific joint.

40. A — The MT yoke generates a magnetic field that runs parallel to the yoke axis and therefore parallel to the weld axis in this configuration. Cracks that run perpendicular to the field (transverse cracks) create the strongest flux leakage, attracting the magnetic particles into a clear indication. Cracks parallel to the field (longitudinal cracks) create minimal leakage and may be missed entirely.

41. C — A symmetric 50/50 double-V groove distributes approximately equal weld metal volumes and shrinkage forces on both sides of the plate neutral axis. The contraction forces from both sides counteract each other, minimizing net angular distortion. An asymmetric distribution creates an unbalanced net force that bows the plate toward the larger weld volume.

42. D — Slag inclusions already deposited in the weld metal cannot be eliminated by parameter changes or technique adjustments — they are permanent discontinuities. Physical excavation to below the inclusion depth, re-inspection to confirm complete removal, and re-welding to restore the joint is the only code-acceptable corrective action.

43. B — A 3 mm angular deviation against a ±1.5 mm tolerance means the deviation is twice the allowable tolerance limit. The part is formally non-conforming and must either be corrected to within tolerance by an approved method or submitted for a formal engineering deviation request. Accepting and proceeding to the next operation is not a valid disposition.

44. A — The correct second-side welding sequence is: gouge to sound metal, wire-brush to remove carbon deposits, perform visual and specified NDT inspection, then deposit the back weld. This sequence ensures complete removal of any root defects from the first side and confirmation of clean base metal before the second-side weld is deposited over it.

45. C — Fillet weld legs should be equal in a standard equal-leg specification. Legs of 8 mm and 11 mm indicate an unbalanced profile where the bead deposited more metal along the horizontal plate. Depending on the code and specified leg size, one leg may fall below the required minimum, requiring corrective action. Unequal legs also change the stress distribution in the joint.

46. D — TOFD and PAUT are the NDT methods capable of measuring the through-thickness height, depth, and length of internal planar defects — the three dimensional parameters required for fracture mechanics fitness-for-service calculations. RT provides only a plan-view projection and cannot measure through-thickness defect height. MT and PT are surface methods only.

47. A — The number 8 below the reference line specifies an 8 mm leg fillet weld on the arrow side. The weld-all-around circle at the reference line-arrow junction specifies continuous deposition around the entire joint perimeter without interruption. The absence of length and pitch numbers to the right of the symbol confirms the weld is continuous rather than intermittent.

48. C — The root face provides a small bridge of base metal at the joint root that the root pass arc must melt through to achieve full penetration. A root face of 5 mm is significantly thicker than the pre-qualified maximum of 4.5 mm (3 mm + 1.5 mm tolerance), creating a land too thick for the root pass arc to reliably fuse through. The result is incomplete joint penetration at the root.

49. D — Standard aluminum oxide abrasive wheels contain iron compounds that transfer to the stainless steel surface on contact, embedding iron particles that initiate corrosion in service. Wheels specifically labeled as free of iron, sulfur, and chlorine are required for all stainless steel cutting and grinding work. This information appears explicitly on the wheel's identification label.

50. B — At 10 TPI, the tooth spacing is 25.4 mm ÷ 10 = 2.54 mm per tooth. For a 40 mm wide flat bar, the number of teeth in simultaneous contact is 40 mm ÷ 2.54 mm = 15.7, approximately 16 teeth. This far exceeds the minimum two-tooth-contact requirement, confirming the blade selection is appropriate for this material width.

51. A — The rollover (plastically deformed upper edge) and fracture zone (rough lower edge) are inherent characteristics of the shear cutting mechanism — the blade exceeds the material shear strength and the lower portion fractures before the blade completes its traverse. This is not an operational defect but the natural result of shearing, and the lower edge requires dressing before use as a weld joint face.

52. C — A clean square top edge, nearly vertical drag lines on the kerf face, and a dross-free clean bottom edge are collectively the diagnostic indicators of correctly matched OFC parameters. Vertical drag lines confirm the travel speed matches the cutting oxygen's through-thickness penetration rate; the clean edges confirm correct tip size and oxygen pressure for the plate thickness.

53. B — Tip cleaners are soft tapered steel tools specifically sized for each orifice diameter to clear blockages without enlarging or deforming the orifice geometry. Using a drill bit permanently enlarges the orifice, altering gas flow rates and flame characteristics. The tip cleaner removes the blockage while preserving the original calibrated orifice diameter.

54. D — Steel from industrial structures built in the 1960s frequently incorporated lead-based paint and other heavy-metal coatings. Lead oxide fumes generated during OFC are toxic at very low airborne concentrations. Testing for lead content before cutting is essential to determine whether supplied-air respiratory protection or other enhanced controls are required for the specific hazard level present.

55. A — A backfire is a momentary flame extinction at the torch tip — a single "pop" — followed by immediate re-ignition at the tip, without any propagation into the torch body. The absence of squealing, smoke, or torch-body effects distinguishes it from a flashback. No special response is required beyond confirming the flame re-established cleanly.

56. B — A motorized OFC track cutter mechanically maintains constant standoff distance, travel speed, and bevel angle throughout the full 2,000 mm cut, producing a consistent 30-degree bevel without operator variation. Freehand technique cannot maintain consistent angle and speed over long production lengths, and angle grinding is inefficient for full-length bevels on production plate thickness.

57. C — Low-speed dross in PAC on aluminum forms when the travel speed is too slow, causing excess heat input to accumulate in the kerf zone. The plasma jet melts material faster than it can

be expelled, and some re-solidifies as dross before being cleared. Increasing travel speed reduces heat input per unit length, allowing the plasma jet to expel the melt before it re-solidifies.

58. D — In PAC, reversed polarity (DCEP) makes the torch nozzle and electrode the anode, concentrating approximately 70% of the arc energy at these copper and hafnium components. They cannot sustain the anode heat loading for more than a few seconds, resulting in rapid thermal erosion or destruction of both consumables. DCEN is mandatory for all transferred-arc plasma cutting.

59. A — A groove that is wider than specified and shallower than required results from a shallow electrode angle (nearly horizontal), which spreads arc force laterally rather than directing it downward into the base metal. Increasing the electrode angle from the plate surface (steeper approach) redirects arc force downward, producing a deeper and narrower groove profile as required.

60. B — Standard CAC-A compressed air operating pressure is 550 to 690 kPa (80 to 100 psi). This range provides the air velocity and volume needed to continuously expel molten metal from the groove as fast as the arc generates it. Insufficient air pressure allows molten metal to re-solidify in the groove rather than being expelled cleanly.

61. C — The objective of back-gouging is to expose clean, uncontaminated base metal below the original weld root. If three passes have removed only weld metal without reaching base metal, the gouge depth is still insufficient. Additional passes must continue until bright, clean base metal is consistently visible across the full groove bottom.

62. D — A loose hose fitting creates an intermittent gas pathway — when line vibration or pressure dynamics briefly break the seal, pressure drops at the torch and extinguishes the flame. When the seal reforms under supply pressure, gas re-flows and the hot torch tip re-ignites it. This random, non-triggered pattern is the characteristic signature of an intermittent fitting leak.

63. A — When a torch needle valve is opened, gas flows and the delivery side of the regulator experiences a small pressure drop as the regulator responds to downstream demand. When the valve closes and flow stops, the regulator restores the delivery pressure to the set point. This is normal behavior for both single-stage and two-stage regulators and confirms the system is functioning as designed.

64. B — The swirl ring imparts a specific rotational direction to the plasma gas stream that determines which kerf face receives more square geometry versus more bevel. Incorrect installation of the swirl ring reverses the designed gas rotation direction, producing the mirror image of the intended kerf geometry. This is a recognized and consistent cause of unexpected kerf profile after consumable replacement.

65. C — The swirl ring controls gas distribution and the geometry of plasma column constriction through the nozzle orifice. A damaged or clogged swirl ring restricts gas flow and tightens constriction beyond the designed geometry, producing an abnormally narrow plasma column, a constricted kerf, and a characteristically high-pitched cutting sound from the more forceful plasma stream.

66. D — Acetylene is stored dissolved in acetone in the cylinder porous media. When acetylene is drawn off faster than the porous structure can release it cleanly, the acetone co-vaporizes and exits with the gas stream. The frost and cold cylinder body surface are diagnostic indicators of excessive draw rate through endothermic evaporation. The cylinder must be changed or the draw rate slowed.

67. A — During CAC-A gouging, the carbon electrode partially vaporizes in the extreme temperature arc, depositing carbon atoms on the groove surface through direct deposition and diffusion. This locally enriches the groove surface carbon content, which would be incorporated into the back weld deposit if not removed. Wire brushing mechanically removes the carbon-enriched layer before inspection and rewelding.

68. C — Failure to penetrate through the lower third of 50 mm plate indicates the cutting oxygen stream does not deliver sufficient pressure or volume to sustain the exothermic iron-oxygen reaction through the full plate thickness. Increasing cutting oxygen pressure delivers more oxygen to the lower kerf zone, enabling the combustion reaction to continue through the full depth and produce a complete cut.

69. B — The primary limiting factor in PAC on thick plate is available arc energy in amperes. Parameters set for 6 mm steel provide a fraction of the energy required to melt and expel material through 25 mm. Increasing amperage significantly is the critical adjustment — travel speed, standoff, and gas changes cannot compensate for insufficient fundamental arc energy.

70. D — Copper salts and copper vapor produce a characteristic green spectral emission in combustion. A worn or contaminated cutting tip introduces copper from the tip body into the

oxy-acetylene flame during operation, producing the visible green color. This indicates tip wear requiring replacement — continuing to use a deteriorating tip compromises cut quality and tip life.

71. A — The CAC-A electrode current rating is matched to the electrode diameter to provide controlled gouging with acceptable electrode consumption rates. Operating significantly above the rated amperage for the electrode diameter melts the carbon electrode material itself excessively, requiring the holder to be reset much more frequently than designed. The amperage must be reduced to the range appropriate for the electrode diameter in use.

72. C — AC current reverses polarity 120 times per second, preventing the accumulation of the static, directional magnetic field in the base metal that causes DC arc blow. The continuously reversing field cannot build the asymmetric magnetic force that deflects the arc. Switching to AC with an AC-compatible electrode (E7018, E6011) is the most effective and direct remedy for persistent DC arc blow.

73. B — Transverse shrinkage forces from the root and hot pass weld metal contracting across the joint axis can permanently close the root opening during the thermal cycle. Once the gap is closed, the groove geometry no longer matches the WPS specification and fill passes cannot achieve the designed penetration profile. The joint condition must be assessed — either the weld is removed and the joint re-fitted, or an engineering determination is made about acceptability.

74. D — The maximum interpass temperature for A514 quenched-and-tempered steel is a mandatory code limit, not a guideline. Exceeding 230°C risks over-tempering the Q&T HAZ microstructure or permitting grain growth that permanently degrades toughness below the design minimum. The joint must be allowed to cool below the maximum interpass limit before the next pass begins.

75. A — At the 12 o'clock position on a 5G pipe, the joint is in the flat welding position where gravity assists pool flow, and the pool naturally accumulates more metal than at side or overhead positions. Reducing amperage slightly in this region limits pool size and restricts the crown buildup that the flat-position gravity dynamics would otherwise produce with uniform parameters.

76. B — A 3.2 mm E7018 electrode produces approximately 6 to 7 mm fillet weld legs in a single horizontal pass at normal parameters. Consistently achieving 8 mm legs requires either a 4.0 mm electrode or a multi-pass approach with the 3.2 mm. The undersized electrode relative to the required leg size is the direct root cause of the consistent dimensional shortfall.

77. D — A 4.0 mm E7018 electrode at normal SMAW parameters deposits a fillet weld with approximately 6 to 8 mm legs in a single pass. Producing a 10 mm leg in a single pass requires either impractically slow travel speed or unusually high amperage — neither is achievable with standard technique. A 10 mm leg is a multi-pass weld requirement, not achievable in a standard single pass with this electrode.

78. C — In horizontal butt or fillet welding, gravity continuously pulls the fluid pool toward the lower plate. Angling the electrode work angle 5 to 10 degrees upward toward the upper plate directs arc force slightly upward, counteracting the gravitational pull on the pool and correcting the sagging tendency. This is the direct positional correction for horizontal bead sag.

79. A — The H4 suffix in AWS A5.1 and CSA W48 electrode designations indicates the electrode produces weld metal with a maximum diffusible hydrogen content of 4 mL per 100 g of deposited metal when tested per the standard method. H4 is the most restrictive hydrogen designation available and is required for the most crack-susceptible applications.

80. B — Wrapping the welding cable around the structural member creates a solenoid counter-magnetic field that opposes the existing magnetic asymmetry in the steel that is deflecting the arc. This technique supplements work lead repositioning and is effective when positional changes alone have not been sufficient to control the arc blow.

81. C — E6013 uses a high-titania rutile coating that produces relatively high diffusible hydrogen levels in the deposited weld metal — far above the low-hydrogen threshold. For Cr-Mo alloy steel pressure vessel repairs where hard HAZ microstructures and high restraint create cold cracking risk, using a high-hydrogen electrode is the worst possible selection. All other listed options are low-hydrogen alloy designations.

82. D — In the AWS A5.5 low-alloy electrode classification system, letter-number alloy suffixes encode the nominal composition of the deposited weld metal. The B2 suffix specifically designates a deposit containing approximately 1.25% chromium and 0.5% molybdenum, corresponding to the P11 grade Cr-Mo alloy steel commonly used in elevated-temperature pressure vessel and piping applications.

83. B — At the 5G 6 o'clock (overhead) position, the pool in an open-root root pass has less gravitational drainage assistance, causing the keyhole to grow if the heat input remains constant. Reducing the amperage as the weld approaches the overhead section decreases pool fluidity and size, allowing the welder to maintain a controlled, consistent keyhole size through the most challenging position of the root pass.

84. A — Welding down to 25 mm stubs places the electrode holder very close to the arc heat, the molten pool, and the radiant energy from the joint. This creates a burn risk to the welder's hand, increases awkwardness in maintaining correct electrode angles, and risks arc flash contact between the holder body and the workpiece in the final moments of the stub. The 50 mm practice maintains safe clearance throughout.

85. C — Underbead cracking appearing hours after welding with E7018 from sealed containers points to insufficient preheat rather than electrode hydrogen. Inadequate preheat allows the HAZ to cool rapidly through the austenite-to-martensite transformation range, forming hard, brittle martensite that is susceptible to hydrogen-induced cold cracking under residual stress. Sealed containers rule out moisture as the hydrogen source.

86. D — In the AWS A5.1 extended classification system: "-1" designates enhanced notch toughness tested at lower impact temperatures than the base classification; "H4" designates a maximum diffusible hydrogen content of 4 mL per 100 g; and "R" designates a moisture-resistant coating formulation that resists atmospheric hydrogen absorption and extends the permissible atmospheric exposure time between oven storage periods.

87. B — Convex fill pass beads result from a weave that is too wide or amperage that is too low, producing a bead without the fluidity to flatten and flow to the groove walls. Reducing weave width limits lateral spread, and slightly increasing amperage improves pool fluidity — both changes produce a flatter bead profile that fills the groove corners cleanly without creating slag traps for subsequent passes.

88. A — Icicles in overhead SMAW form when the pool is too large and fluid for the overhead position, accumulating mass that exceeds the surface tension holding it against the joint face. Reducing amperage and using narrow stringer beads produces a smaller, faster-freezing pool that solidifies before gravity pulls it down, eliminating the accumulation mechanism.

89. C — Under AWS D1.1, a 3G vertical-up plate groove qualification covers 1G (flat), 2G (horizontal), and 3G (vertical) positions but does not extend to 4G (overhead). The overhead position requires a separate qualification test. Only a combined 3G + 4G test, or a 6G pipe qualification, qualifies a welder for all four plate groove positions simultaneously.

90. D — As GMAW amperage increases from the short circuit range, the arc passes through the globular transfer transition zone before reaching the spray threshold. In the globular zone, droplets are large and irregular, transferring erratically without the controlled rhythm of short

circuit or the fine axial spray of spray transfer, producing exactly the heavy irregular spatter and rough bead described.

91. B — Under-tensioned drive rolls cannot grip the wire firmly enough to maintain constant feed speed, causing the wire to slip intermittently and feed in irregular bursts. Each slip event produces a momentary reduction in wire delivery, causing the arc to extend and the bead height to drop, then recover — the direct cause of the variable bead height and arc instability reported.

92. A — The gun nozzle directs and confines the shielding gas around the arc zone. An 80% blockage severely restricts the total gas volume exiting while creating high-velocity turbulence at the remaining openings. This turbulence draws atmospheric air into the shielding zone by entrainment, effectively contaminating the weld environment despite the gas flowing from the source.

93. C — In GMAW with a CV power source, wire feed speed directly controls amperage and deposition rate — faster WFS = more current = more metal melted per unit time. Increasing WFS while adjusting voltage proportionally upward maintains the arc length and spray transfer stability at the higher energy level, achieving the increased deposition rate without leaving the spray transfer mode.

94. D — E70T-5 uses a basic lime-type slag chemistry analogous to the low-hydrogen SMAW electrode coatings, producing weld deposits with significantly lower diffusible hydrogen than the rutile T-1 classification. For 30 mm A572 Grade 50 plate where greater thickness increases restraint and cold cracking risk, the lower hydrogen content of T-5 wire provides the justified technical advantage.

95. B — A robotic welding path is fixed and repeatable — the torch passes through exactly the same spatial position on every part. If a consistent draft or airflow source exists in the cell at a specific location, the robot's arc moves into that air movement zone on every cycle, disrupting the shielding gas coverage at that exact point. Manual welders intuitively vary their position and compensate without recognizing the draft effect.

96. A — MCAW wires (AWS A5.18 "C" composite designation) and solid GMAW wires (AWS A5.18 "ER" designation) are classified as different filler metal types. Filler metal classification type is an essential variable in most applicable welding codes — a change from solid wire to metal-cored composite wire requires new PQR testing to qualify the revised filler type.

97. C — In horizontal fillet welding with spray transfer, lower toe cold lap occurs when the arc force is directed away from the lower plate, leaving insufficient energy to melt and wet the lower toe. Angling the work angle toward the lower plate redirects the high-energy spray stream directly at the lower toe, providing the thermal energy needed for fusion at that location without requiring parameter changes.

98. D — When voltage is set too low relative to wire feed speed in FCAW-G, the arc is underpowered for the wire delivery rate — the power source cannot melt the incoming wire at the set speed, producing a short, cold arc. The slag system does not reach the fluidity and temperature needed for clean separation from the bead, producing the tightly adherent slag requiring heavy mechanical force to remove.

99. B — Aluminum GMAW porosity that occurs with clean base metal and dry gas supply has three moisture sources specific to the aluminum GMAW process: moisture adsorbed onto the thick aluminum oxide layer of the base metal surface, surface moisture or contamination on the wire from improper spool storage, and moisture releases from plastic liner materials or conduit seals within the drive system.

100. A — E71T-8 self-shielded wires use aluminum-based deoxidizing compounds in their core, producing aluminum oxide (Al_2O_3) as a primary slag constituent. Aluminum oxide has acoustic impedance of approximately 30 to 40 MRayl — significantly higher than conventional silicate slag at approximately 15 to 20 MRayl — placing it measurably closer to steel's 47 MRayl. This reduced impedance mismatch at the inclusion-steel interface produces lower UT reflection amplitudes from trapped E71T-8 slag inclusions compared to silicate inclusions of equivalent size, making them harder to reliably detect and size.

101. D — For 2.0 mm wall stainless steel tubing, the requirements are minimum heat input to prevent distortion and burn-through, and minimal pool oxidation to protect corrosion resistance. Short circuit or pulsed spray transfer provides the low heat input control needed for thin wall; an argon-rich, low-oxidant shielding gas (98/2 Ar/O2 or similar) prevents excessive chromium oxidation at the weld surface.

102. C — With E71T-1 in the vertical-up position, a pool that is too large and fluid tends to push the lower-density slag ahead of the advancing arc, allowing it to flow beneath the next metal deposit as a trapped inclusion. Reducing wire feed speed produces a smaller, stiffer pool that advances without outrunning the slag, keeping the slag behind the arc where it can float clear of the joint.

103. B — Wire on the outermost layers of a spool has been exposed to whatever environmental conditions existed during storage. If the spool was stored open, on a humid shelf, or in a variable-temperature environment, the outer layers accumulate surface moisture and atmospheric contamination that the inner layers do not. When these contaminated layers enter the arc near spool end, they consistently degrade arc stability.

104. A — Wire diameter is an essential variable in GMAW procedure qualification under AWS D1.1 and ASME Section IX. Changing from 1.2 mm to 0.9 mm changes the heat input per unit length, bead geometry, parameter operating window, and arc characteristics enough to require a new PQR and qualified WPS. The same ER70S-6 chemistry designation does not override the essential variable requirement for the diameter change.

105. D — The metallic powder core of MCAW wire contributes to the deposited weld metal in addition to the steel tube sheath, producing higher deposition rates than solid wire of the same diameter at the same wire feed speed. Additionally, the wider arc cone from MCAW's tubular construction improves penetration and fusion at groove sidewalls compared to the more focused arc of solid wire — both advantages directly benefit production beam welding.

106. C — Increasing electrode stick-out lengthens the free wire conductor between the contact tip and the arc. The additional conductor length increases resistive preheating of the wire (I^2R heating) before it reaches the arc, reducing the current demanded by the power source to complete wire melting. This reduces effective amperage, penetration, and heat input at unchanged wire feed speed settings.

107. B — Titanium in Grade 321 stainless steel functions as a carbide stabilizer, and it is also a strong oxide former at welding temperatures. Shielding gas blends with high CO2 or O2 content aggressively oxidize the titanium in the weld pool, burning off the stabilizer and potentially reducing corrosion resistance. A high-argon, low-oxidant blend such as 98/2 Ar/O2 minimizes titanium oxidation while maintaining arc stability for GMAW.

108. D — A sluggish, non-flowing GTAW pool with correct amperage, arc length, shielding, and filler confirms the problem is at the base metal surface. Residual oxide, oil, grease, or inadequate mechanical cleaning on the joint face prevents the arc from properly wetting and melting the base metal. Thorough cleaning to bright metal immediately before GTAW is essential, particularly on stainless steel.

109. A — For DCEN GTAW, the torch cable must be connected to the negative terminal and the work cable to the positive. If the torch is connected to the positive terminal, the torch electrode

becomes the anode, and approximately 70% of arc energy concentrates at the electrode tip rather than the workpiece. This immediately overheats and balls the pointed tungsten, producing the observed arc instability.

110. C — The effectiveness of a back purge is confirmed by measuring the oxygen content at the weld zone, not by visual gas observation or elapsed time. Most codes and specifications require the oxygen level to drop below approximately 0.1% (1,000 ppm) before arc initiation. Visual haze and purge duration are unreliable indicators that can give false confidence that adequate displacement has occurred.

111. B — ER70S-2 and ER70S-6 carry different AWS filler metal classifications reflecting meaningfully different chemical compositions — S-2 contains titanium, zirconium, and aluminum triple-deoxidizers while S-6 has higher silicon and manganese content. Under most applicable welding codes, filler metal classification is an essential variable, and substituting one classification for another requires confirming PQR coverage or conducting new qualification testing.

112. D — For a 3.2 mm EWZr-1 tungsten electrode, the AC current capacity is approximately 140 to 180 A per standard electrode rating tables. Operating at 200 A AC significantly overloads the electrode — the electrode-positive half-cycle delivers more energy to the tungsten tip than it can dissipate through the electrode body and surrounding gas. The result is progressive balling beyond the stable size limit and spitting.

113. A — When tungsten contacts the weld pool, weld metal transfers onto the electrode and tungsten transfers into the pool as inclusions. The contaminated area of the weld must be excavated and removed — tungsten inclusions are non-acceptable under all applicable welding codes and cannot be left in the weld. Continuing to weld with a re-prepared electrode without removing the contaminated metal perpetuates the defect in the production joint.

114. C — With a confirmed adequate purge flow (5 L/min) maintained throughout and a good-looking external bead surface, the oxygen source that produced the sugaring must have entered from inside the pipe despite the flow. A purge seal leak at one end allows atmospheric oxygen to be drawn into the purge zone alongside the argon flow, contaminating the back side of the root pass without affecting the torch-side appearance.

115. B — The AC current capacity for 3.2 mm EWP tungsten is approximately 100 to 180 A maximum across all standard reference sources. Operating at 200 A delivers more thermal

energy to the electrode tip during the electrode-positive half-cycle than the 3.2 mm electrode body can dissipate. The tungsten ball grows progressively beyond its stable surface-tension limit and begins ejecting molten droplets into the pool — the direct consequence of sustained over-amping for that electrode diameter.

116. D — The cathodic cleaning band width in aluminum GTAW reflects where the electrode-positive half-cycle of AC directs its cathodic bombardment. A torch that is not centered over the joint directs more arc current and cathodic cleaning energy toward the side it is angled toward, producing a wider cleaning band on that side and a narrower cleaning band on the other. Symmetric cleaning band width confirms centered torch work angle.

117. A — Hydrogen gas has significantly higher thermal conductivity than argon. When added to argon shielding in small amounts (2 to 5%), it increases the thermal conductivity of the arc column, accelerating heat transfer from the arc to the weld pool. The elevated heat input produces a hotter, more fluid pool with improved wetting characteristics and a distinctly smoother bead profile.

118. C — At 12 o'clock (flat position), constant-amperage orbital welding produces excessive crown because the flat position pool is larger and more fluid, building up material. Reducing amperage at 12 o'clock reduces pool size and crown. At 6 o'clock (overhead position), the same amperage produces a pool too large and fluid to be held by surface tension, causing the pool to sag away from the toes and create undercut. Reducing amperage at 6 o'clock produces a smaller, tighter pool that surface tension can hold against the joint face.

119. B — Duplex stainless steels are susceptible to formation of embrittling secondary phases — primarily sigma phase (σ) — when cooled slowly through approximately 600 to 900°C during or after heat treatment. Sigma phase and other intermetallic phases form preferentially at ferrite-austenite boundaries and dramatically reduce both toughness and corrosion resistance. Solution annealing followed by rapid quenching suppresses these phases by preventing their nucleation and growth.

120. D — Back purge must be continuously maintained throughout the root pass and confirmed at adequate oxygen levels before arc initiation. Continuing to weld after the purge supply fails exposes the hot root metal to rising oxygen concentrations, producing progressive sugaring and oxidation of the deposited root pass. The only safe response is to stop immediately, restore and verify the purge, and re-confirm conditions before resuming.

121. A — Active SAW flux contains manganese and silicon oxide compounds that transfer to metallic Mn and Si in the arc zone and dissolve into the weld metal. The quantity transferred is directly proportional to arc voltage — a longer arc at higher voltage contacts more flux surface area, recovering more alloying elements per unit length of weld. Higher voltage during upper passes explains the elevated Mn and Si content found in those passes.

122. C — Applying the heat input formula: HI = (V × A × 60) ÷ (speed mm/min × 1,000) = (32 × 700 × 60) ÷ (450 × 1,000) = 1,344,000 ÷ 450,000 = 2.987 ≈ 2.99 kJ/mm. This is well below the qualified maximum of 3.5 kJ/mm, confirming the procedure is within its toughness-qualified heat input range for the impact testing conditions.

123. B — Fused SAW flux has good inherent moisture resistance due to its glass-like vitrified structure. However, surface moisture exposure during prolonged humid conditions still requires corrective drying. The standard recommendation for fused flux is 120 to 150°C for 1 to 2 hours — lower temperature than bonded flux because the primary moisture is surface adsorption rather than absorption into the flux granule interior.

124. D — When two DC arcs operate in close proximity in tandem SAW, their static magnetic fields interact and cause mutual deflection of each arc from its intended path. Using AC on the trailing wire eliminates this magnetic interference because the continuously reversing current field cannot sustain a consistent directional force on the lead arc's static magnetic field. This is the specific technical justification for AC on the trail wire in tandem configurations.

125. A — SAW requires the arc to operate completely submerged beneath the granular flux blanket, typically at 25 to 40 mm flux depth. When the blanket is insufficient in depth, the arc breaches the flux surface, exposing the arc radiation and allowing spatter to escape. The solution is to increase the flux delivery rate and deepen the flux blanket above the arc to restore complete submersion.