

SECTION 18410 DUCTWORK WELDING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to welding ductwork on-site. May also be used for other sheet metal fabrication when specified on specifications or drawings.

1.2 RELATED SECTIONS

- A. Section 18100, General Welding Requirements.
- B. Section 18450, Ductwork Welding Procedure Specifications.

PART 2 - PRODUCTS

2.1 BASE MATERIAL

- A. Weld only materials identified in the design document and on each WPS. The reference in the WPS to P-numbers is to those listed in ASME Sect. IX, paragraph QW 422, and S-numbers to those of ASME Sect. IX, Appendix C.

2.2 WELDING MATERIALS AND FILLER METALS

- A. Store, handle, and identify welding electrodes and consumables at all times to avoid material degradation and ensure they are identifiable as acceptable material until the material is actually consumed in the process.

2.3 WELDING GAS

- A. Use welding grade gasses and mixtures with a dew point of -40°F or lower for welding including purging.

PART 3 - EXECUTION

3.1 WELDING PROCEDURE QUALIFICATION

- A. Supporting PQRs are listed on each WPS.

3.2 WELDER AND WELDING OPERATOR PERFORMANCE QUALIFICATION

- A. Welder training (mock-ups) should be considered when welding in areas of restricted accessibility or other unusual conditions.

3.3 BASE MATERIAL PREPARATION

- A. Materials may be prepared by machining, grinding, arc-gouging, plasma, laser, burring, filing, chipping, shearing, or flame cutting, or combinations of these methods. Flame cut only PI materials.
- B. When arc-gouging, plasma, or flame-cutting methods are used, remove slag, dross, and excess oxidized metal from weld surfaces prior to welding. Taper notches uniformly into the

surrounding surfaces to allow welding to be completed in an acceptable manner. Discoloration resulting from these operations is not considered to be harmful oxidation and may be accepted without additional surface conditioning.

- C. Immediately prior to and during welding, remove paint, oil, rust, scale, water, or other material that is detrimental to the welding operation.
- D. Use low-halogen-type grinding wheels, wire brushes, flapper wheels, tapes, and cleaning fluids for the fabrication of P8 materials.
- E. Use low-sulphur-type grinding wheels, wire brushes, flapper wheels, tapes, and cleaning fluids in the fabrication of nickel-base alloys.

3.4 WELDING REQUIREMENTS

- A. Make copies of this section and the applicable WPS available for ready reference to the welders or welding operators and quality control.
- B. Make continuous fillet welds when the root or face are in contact with the wetted perimeter or the air stream to eliminate cracks and crevices.
- C. Make pressure boundary weld joints and seams continuous.
- D. Grind weld joints which are a portion of a gasket seating surface smooth and flush with adjacent base metals.
- E. Wire brush welded joints and seams to remove surface oxides, burrs, sharp edges, and weld spatter.
- F. Brush stainless steel material with clean, stainless steel wire brushes which have not previously been used on any other materials.
- G. Weld continuously production groove and butt welds with full joint penetration. Backwelding of groove welds is acceptable.
- H. Do not weld if there is impingement of rain, snow, sleet, or high wind in the weld area.
- I. Tack Welds and Temporary Attachments:
 - 1. Use qualified welders to make tack welds and temporary attachments (including fit-up lugs) in accordance with the requirements of the WPS assigned to weld the joint. Visually examine tack welds for defects. If found to be defective, remove the defects.
 - 2. When tack welds are deposited in weld grooves in order to secure alignment, either:
 - a. remove completely when they have served their purpose or
 - b. prepare the tacks' starting and stopping ends so they may be incorporated into the final weld.
 - 3. Do not weld carbon steel temporary attachments directly to austenitic stainless steel. First overlay with weld metal of a composition similar to the component at the point of attachment. Then weld to the component with electrodes of a composition similar to the component.
 - 4. Dress smooth and visually examine the area from which attachments have been removed.
- J. Interpass Cleaning:
 - 1. Prior to depositing succeeding weld passes, remove slag, flux, weld craters, and excessive weld spatter from the weld and adjacent weld preparation or base material

by grinding, chipping, wire brushing (hand or power), or deslagging tools to the extent that the conditions will not be detrimental to deposition of sound weld metal.

2. Do not weld over defective weld metal. Remove cracks and areas lacking fusion prior to depositing additional weld metal.
 3. For P8 (austenitic stainless steel) material, use cleaning tools not previously used on carbon or low-alloy steels.
- K. Use welding filler metal for welding with the gas tungsten arc process (unless otherwise specified on the WPS). Consumable inserts are considered to be a filler material. Wash passes without the use of filler metal are not allowed.
- L. Make all welds which become inaccessible because of the fabrication sequence available upon completion to the inspector's satisfaction prior to the weld being made inaccessible.

3.5 PREHEAT/INTERPASS FOR WELDING

- A. Apply preheat for welding by flame, induction, or resistance methods. Remove soot formed on stainless steel material as a result of flame heating as soon as practicable after removal of the heat source.
- B. When heating with an oxyacetylene flame, use a neutral flame and constantly move the flame about the entire weld joint.
- C. Do not exceed the interpass temperature of the applicable WPS.
- D. Measure preheat by temperature indicating crayons, contact pyrometers (digital or analog), infrared thermometers, optical pyrometers, or thermocouples. Do not use low-melting metallic alloys. Apply temperature indicating crayon measurements to the surfaces adjacent to the weld joint, using low-halogen type for stainless steel and low-sulphur type for nickel alloys.

3.6 PURGING REQUIREMENTS

- A. Purge when required by the WPS during welding until a minimum of 3/16 in. of weld metal has been deposited. Analyze the exit gas for no more than 1% oxygen. If the exit gas cannot be analyzed, maintain for six volume changes of the purge volume prior to welding. Purge gas flow rate may be increased during the preweld purge period and reduced during the welding operation to a minimum positive pressure. Provide an exit so that pressure cannot build up during the welding operation.
- B. Construct purge dams of wood, metal, rubber, or plastic. Make them readily retrievable.
- C. Use shielding/purging gas flowmeters designed for the type of gas used.
- D. Weld root purge may be omitted from a WPS when making:
 1. Backing strip welds.
 2. Fillet and partial penetration welds.
 3. Double-welded joints which are backgouged or background before welding the second side.
 4. Repair welds in materials (including welds) in which the remaining material thickness after excavation is not less than 0.100 in.

3.7 WELD REINFORCEMENT

- A. A maximum of 1/8-in. face and root reinforcement is permitted on groove welds.

3.8 REPAIRS BY WELDING

- A. Repair or replace a weld having one or more defects (imperfections of a type or magnitude exceeding the acceptance criteria specified). Reexamine the new work by the same methods, to the same extent, and by the same acceptance criteria as required for the original weld.
- B. In-process interbead cleaning of welds to remove surface roughness, excess reinforcement, weld spatter, slag, visible porosity, undercut, crater cracks, and overlap detected by the welder during welding is not considered repairs.
- C. Major repairs require the concurrence of the engineer before proceeding with the repair. Major repairs are defined to be the weld repair of recurring weld defects which may be indications of welding process or material problems.
- D. Make excavations of areas being repaired or reworked of sufficient size and dimensions to remove defects and allow accessibility for welding. Do not create sharp corners or undercutting of the sidewalls. Contour the sides of the excavation uniformly with the adjacent base material sufficiently to allow repair welding.

3.9 IN-PROCESS MONITOR

- A. The CM or subcontractor monitors in-process welding to ensure completed welds will meet the requirements of this section, Section 18100, and the contract. Include the following in the monitoring activity:
 - 1. Preweld:
 - a. Proper material.
 - b. Weld joint dimensions (fit-up).
 - c. Alignment.
 - d. Surface cleanliness.
 - e. Qualified welder.
 - f. Proper procedure.
 - g. Proper filler metal.
 - 2. During Welding:
 - a. Procedure adherence.
 - b. Workmanship.
- B. Inspect and examine welds to the requirements of Section 18100. The visual acceptance criteria for welds is included in Attachment A.

3.10 WELDING DOCUMENTATION

- A. Documentation requirements are in accordance with Section 18100.

ATTACHMENT A

DUCTWORK VISUAL EXAMINATION ACCEPTANCE CRITERIA

Examine all ductwork welds for compliance with the applicable welding procedures, drawings, and the requirements of this specification for at least the following items:

- A.1 Weld Defects
Cracks, lack of fusion, incomplete penetration (when full penetration is required), overlap, undercut in excess of para.A.5, slag, and porosity in excess of paragraph A.4 are unacceptable.
- A.2 Reinforcement of Groove Welds
A maximum of 1/8-in. face reinforcement and root reinforcement are acceptable.
- A.3 Fillet Weld Size and Contour
A maximum of 1/8-in. convexity is permissible for fillet welds. The minimum specified throat is required.
- A.4 Porosity or Inclusions
One visible pore or inclusion no larger than 0.5 times the thickness of the thinner member is permitted. Also, three visible pores or inclusions no larger than 0.25 times the thickness of the thinner member are permitted.
- A.5 Undercut
Undercut may not exceed 0.15 times the base metal thickness for materials 0.187 in. and less in thickness or exceed 0.25 times the base metal thickness for materials greater than 0.187 in. thick.
- A.6 Arc Strikes
Grind cracks and blemishes resulting from arc strikes to a smooth contour. Check the area for freedom from cracking and for adequate thickness. The base material specification guidelines for removing surface imperfections may be used as a guide for evaluating for adequate thickness.
- A.7 Weld Spatter
Remove all weld spatter from surfaces to be painted or from bearing surfaces. Tightly adhering weld spatter (that which adheres after aggressive wire brushing) on other surfaces is permissible.
- A.8 Length and Location
Verify the weld length and location is as required by the specification, drawing, or welding procedure specification.

END OF SECTION 18410