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APPENDIX 5H

QUALITY CONTROL PROCEDURE FOR FIELD WELDING OF STRUCTURES

1.0 SCOPE

This procedure outlines the general requirements for welding quality control to assure that all field welding is performed in full compliance with the applicable job specifications.

2.0 QUALIFICATIONS FOR WELDING INSPECTORS

All welding inspectors who are to inspect welds covered by this specification shall be qualified by meeting the following minimum requirements.

- a. Inspectors shall have a thorough knowledge of the various welding processes and techniques employed in field construction, and shall be able to demonstrate the proper methods for shielded metal-arc welding, gas tungsten-arc welding, gas metal-arc welding, and oxyacetylene welding.
- b. Inspectors shall have a minimum of two years previous welding inspection experience, or equivalent experience and training in welding fabrication and non-destructive testing.
- c. Inspectors shall be required to demonstrate to the satisfaction of the engineer's metallurgical and quality control services representative, their knowledge of the fundamentals, techniques, and application of the inspection methods set forth in this standard, i.e., visual magnetic particle, liquid penetrant and radiographic inspection.

3.0 WELDING PROCEDURE

3.1 WELDING PROCEDURE SPECIFICATIONS

All welding performed by Contractors shall be in strict accordance with the applicable job specifications. When those specifications require engineering approval of welding procedures, no production welding shall be permitted without prior approval of such procedures by the engineer. When engineering approval is not specified but welding is to be performed under a code or standard which requires qualified welding procedure specifications, then the Contractor must prepare and qualify his welding procedures accordingly, prior to beginning any production work. The field welding inspector shall be responsible in all cases for determining that the Contractor's welding is being performed in accordance with properly qualified and, as necessary, engineering approved welding procedure specifications.

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3.2 WELDER QUALIFICATION

All welders and welding operators employed by Contractors who are to make welds under a code or standard which requires qualification of welders shall be tested and qualified accordingly before beginning production welding. Each Contractor shall be responsible for testing and qualifying his own welders. The engineer's field welding inspector shall be responsible in all cases for determining that the Contractor's welders have passed the necessary qualification tests and that the Contractor has on file at jobsite the proper qualification test record for each qualified welder.

4.0 INSTRUCTIONS FOR FIELD WELDING INSPECTORS

4.1 WELDING PROCEDURE SPECIFICATIONS

It is the responsibility of the field welding inspector to assure that all welding is performed in strict accordance with the appropriate qualified welding procedure specifications. Specific items to be checked follow.

- a. Determine that the proper welding procedure specification has been selected to match the base materials being welded and the welding processes being employed.
- b. Permit only welders properly qualified under the essential variables of each welding procedure specification to make welds under that procedure.
- c. Check to see that the welding electrodes, bare filler rod, consumable insert rings, and backing rings all match that which has been specified.
- d. Inspect weld joints as necessary prior to welding to ensure proper edge-penetration, cleaning, and fit-up.
- e. Check to see that the welding machine settings are correct and fall within the range of current and voltage specified.
- f. Check for proper preheat and interpass temperature.
- g. Inspect the in-process welding for proper technique, cleaning between passes, and appearance of individual weld beads.

4.2 POST WELD HEAT TREATMENT

The field welding inspector shall inspect each postweld heat treatment (thermal stress relieving) operation to ensure conformance with the applicable job specifications. Specific items to be checked shall include the following.

- a. A sufficient number and proper location of thermocouples shall be selected to accurately record temperatures.

- b. The thermocouples shall be connected to temperature indicator-recorders which will provide a permanent record of the heating rate, holding temperature and time, and the cooling rate.
- c. Temperature charts shall be checked for proper heating rate, holding temperature, holding time, cooling rate, and that the proper weld identification is recorded on the chart.

4.3 VISUAL INSPECTION OF WELDS

The field welding inspectors shall be responsible for carrying out the necessary welding surveillance to ensure that all welding meets the following requirements for visual quality and general workmanship. Visual inspection shall be performed prior to, during, and after welding.

- a. All weld beads, passes, and completed welds shall be free of slag, cracks, porosity, incomplete penetration and lack of fusion.
- b. Cover passes shall be free of coarse ripples, irregular surface, non-uniform bead pattern, high crown, deep ridges or valleys between beads, and shall blend smoothly and gradually into the surface of the base metal.
- c. Butt welds shall be slightly convex, of uniform height, and shall have full penetration.
- d. Fillet welds shall be of specified size, with full throat and, unless otherwise specified, the legs shall be of approximately equal length.
- e. Repair, chipping, or grinding of welds shall be done in such a manner as not to gouge, groove, or reduce the base metal thicknesses.
- f. Where different base metal thicknesses are jointed by welding, the finished joint shall have a taper no steeper than 1:4 between the thick and thin sections.

4.4 MAGNETIC PARTICLE INSPECTION

- a. The field welding inspector shall be responsible for determining that all magnetic-particle inspection is properly performed.
- b. When the applicable job specifications require magnetic particle inspection of welds, the field welding inspector shall be responsible for determining that the proper technique is followed and that the results are properly interpreted. The field welding inspector shall require the inspection Contractor's responsible personnel to demonstrate their knowledge and understanding of the applicable specifications prior to performing any production testing.

- c. Special attention shall be given to the following items for all magnetic particle inspection.
- (1) Determine that surfaces to be inspected have been properly cleaned and are free of crevices which can produce false indications by trapping the iron powder.
 - (2) Determine that the power source, current density, prod spacing, and application of iron powder all comply with the applicable specification requirements.
 - (3) Permit no arcing between the prods and weld surfaces.
 - (4) Interpret all linear or linearly disposed indications as defects.
 - (5) Probe questionable indications by thermal cutting, chipping, grinding, or filing to confirm the presence or absence of actual defects.

4.5 LIQUID PENETRANT INSPECTION

- a. The field welding inspector shall be responsible for determining that all liquid penetrant inspection is properly performed.
- b. When the applicable job specifications require liquid penetrant inspection for welds, the field welding inspector shall be responsible for determining that the proper technique is followed and that the results are properly interpreted. The field welding inspector shall require the inspection Contractor's responsible personnel to demonstrate their knowledge and understanding of the applicable specifications prior to performing any production testing.
- c. Special attention shall be given to the following items for all liquid penetrant inspection.
- (1) Determine that surfaces to be inspected have been properly cleaned and are free of crevices which can produce false indications by trapping the dye penetrant.
 - (2) Check to see that cleaner, dye penetrant, and developer are properly applied and the specified time intervals for dye penetration and developing are followed.
 - (3) Determine that indications are properly interpreted. Defects will be identified as red stains against the white developer background. Red lines or linearly disposed red dots are indicative of cracks. Porosity and pinhole leaks appear as local red patches or dots.

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- (4) Examine questionable indications by a 5x or stronger hand lens, and probe by grinding or filing to confirm the presence or absence of defects.

4.6 RADIOGRAPHIC INSPECTION

- a. The field welding inspectors shall be responsible for determining that all radiographic inspection is properly performed.
- b. When the applicable job specifications require radiographic inspection of welds, the field welding inspector shall be responsible for determining the proper radiographic technique is followed and that the completed films are properly interpreted. The field welding inspector shall require the Contractor's responsible personnel to demonstrate their knowledge and understanding of the applicable specifications prior to beginning the radiographic inspection. The field welding inspector shall also review each completed radiograph.
- c. Special attention shall be given to each of the following items for all radiographic inspection.
 - (1) Check the type of film intensifying screens, penetrameters, and source of radiation for conformance to the job specifications.
 - (2) Check the relative location of film, penetrameters, identifying numbers, and radiation source for each typical exposure.
 - (3) Review all completed film for quality and interpretation of defects. Check the exposed and developed film for proper density and visibility of penetrameters. Radiographic film of unacceptable quality or with questionable indications of defects shall be re-radiographed.

4.7 REPAIRS

It shall be the responsibility of the field welding inspector to determine that all weld defects in excess of specified standards of acceptance shall be removed, repaired, and re-inspected in accordance with the applicable job specifications.

4.8 RECORDS

It shall be the responsibility of the field welding inspector to determine that proper records of nondestructive testing are kept on file at the job-site.

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