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Process Specification – Visual Weld Inspection

65678 PPPL NCSX Vacuum Vessel Sub Assembly

1. PURPOSE

This specification establishes the process parameters required to ensure visual weld inspections on the NCSX SE120-002 Vacuum Vessel Sub Assembly are performed within the guidelines required by PPPL product specification NCSX-CSPEC-121-02-01

2. SCOPE

This specification defines the minimum requirements for visual inspecting all welds applied to the NCSX VVSA highly shaped vessel walls and components when required by the MTM MIT.

3. DEFINITIONS

CWI – AWS Certified Welding Inspector
PPPL – Princeton Plasma Physics Laboratory
MTM – Major Tool & Machine, Inc.
NCSX – National Compact Stellarator Experiment
VVSA - Vacuum Vessel Sub Assembly
MIT – Manufacturing, Inspection, and Test plan (MTM Mfg. Routing)
IDC – MTM Inspection Data Checklist system
QAP – MTM Quality Assurance Planning system

4. REFERENCE DOCUMENTS

- PPPL Product Specification NCSX-CSPEC-121-02-01
- AWS QC1 – Standard for Certification of Welding Inspectors.
- AWS B1.11 – Guide for the Visual Examination of Welds
- AWS D1.6 – Structural Welding Code, Stainless Steel
- WPS328.5-PPPL – MTM Welding Procedure Specification
- WPS390-PPPL – MTM Welding Procedure Specification
- QA-SOP-01 – Non-Conformance Control
- MTM Mfg. Routing / Inspection Plan / Quality Assurance Plan 65678
- PS483 – Cleanliness Control
- QA-SOP-05 – Gage Calibration

5. EQUIPMENT AND SUPPLIES

- Equipment used for inspection may include, but is not limited to, scales, undercut gages, fillet weld gages, Cambridge gages, mismatch gages, mirrors, pyrometers, and magnifying devices. All equipment used for visual examination shall be capable of meeting the requirements of the applicable codes or specifications. Measuring devices must be capable of meeting the required precision for the specified dimension being measured. All gages used to make accept/reject decisions must be calibrated per MTM QA-SOP-05.

6. INSPECTION INSTRUCTIONS

- 6.1. All visual weld inspections will be performed at 8X magnification.
- 6.2. Adequate / auxiliary lighting will be utilized when necessary to maintain a minimum light intensity at the surface being inspected (using natural or supplementary lighting) of 100 foot-candles. The light intensity shall be verified using calibrated light meters as required (available from the MTM NDE lab).

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- 6.3. Each completed weld pass will be visually inspected for the entire length of the weld.
- 6.4. Direct visual inspections will be made when access is sufficient to place the inspector's eye within 24 inches and at an angle not less than 30 degrees from the surface of the component.
- 6.5. Mirrors may be utilized to improve the angle of vision.
- 6.6. Indirect visual inspections, utilizing bore-scopes, cameras, or other suitable instruments, may be substituted for direct examination providing the resolution of the instrument is at least equivalent to that obtainable by direct visual observation

7. ACCEPTANCE CRITERIA

- 7.1. Visually inspected welds will be accepted or rejected according to AWS D1.6, Paragraph 6.29.1 with the following exceptions:
 - 7.1.1. No visible porosity will be accepted
 - 7.1.2. Inter-pass visual inspections may be performed prior to cooling to ambient temperature, as long as the part is within the inter-pass temperature required by the WPS.
- 7.2. Weld preparations will be clean, smooth, free of burrs and heavy grinding marks.
- 7.3. Weld joint fit-up will be smooth and continuous, with a maximum allowable joint misalignment of 1/32".

8. TASK RESPONSIBILITIES

- 8.1. Qualified MTM Mfg. Personnel may only perform visual inspections under the guidance of a CWI, with the CWI retaining the responsibility of accepting or rejecting parts.
- 8.2. The primary visual inspection responsibility will be distributed as follows:
 - Final weld joint visual inspection: MTM CWI
 - Inter pass (stringer) visual weld inspections: Qualified MTM Mfg. personnel
 - Root pass visual weld inspection: Qualified MTM CWI
 - Weld joint fit-up / alignment verification: Qualified MTM Mfg. Team Leader
 - Weld preparation inspection prior to fit-up: Qualified MTM Mfg. Team Leader
- 8.3. The responsible Mfg. Team Leader and CWI will audit / monitor inter-pass visual inspections being performed by Mfg. personnel throughout the production process to verify accuracy is maintained.
- 8.4. If imperfections are discovered within inter-pass welds, they will be removed, repaired, and verified by the responsible Team Leader, and/or CWI prior to applying covering passes.
- 8.5. If imperfections are discovered in completed weld joints, they will be documented and repaired via. MTM Non-Conformance system.
- 8.6. CWI / Welding Engineering will provide documented requirements training to all personnel performing interim visual inspections to VVSA components. At a minimum, this training will address the following items:
 - The requirements of this process specification
 - Welding code / specifications / PQR / WPS requirements

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- Inspection instructions / equipment / methods
 - Inspection acceptance criteria
- 8.7. When qualification of the visual weld inspection procedure is specified, a fine line 1/32” wide or less in width, or other simulated imperfection, will be placed in the least discernable area on the surface of the part to serve as a reference. The inspector’s verification of the imperfection shall validate the lighting requirements and the inspection procedure.
- 8.8. All personnel performing visual inspections shall have documented evidence of having met the visual acuity requirements of the applicable specification or an equivalent visual acuity standard.

9. QUALITY ASSURANCE / DOCUMENTATION

- 9.1. The electronic completion (or “closing / clocking out”) of each sequential manufacturing operation within the MTM (Visual Manufacturing®) Routing which includes reference to this document as a task requisite acknowledges compliance to the relevant requirements. The designated MTM employee completing the electronic exchange acknowledges completeness and compliance to the routing instructions.
- 9.2. When necessary, additional documentation requirements will be provided within the associated MTM IDC, and QAP system.
- 9.2.1. When an IDC record and/or Inspection report is required, reference to the specific area being tested will be clearly discernable.
- 9.2.2. When an IDC record and/or Inspection report is required, it will include the following information:
- MTM Work Order number
 - Part identification number
 - Part description
 - Date of inspection
 - Gage serial number
 - Reference standard serial number
 - Inspector signature, or initials, or stamp
- 9.3. Exceptions / out of tolerance conditions will be documented within the MTM Non-Conformance system per QA-SOP-01.