PS-483

Process Specification – Cleanliness / Contamination Control
65678 PPPL NCSX Vacuum Vessel Sub Assembly

1. PURPOSE

This specification establishes the process parameters required to ensure the cleanliness of the NCSX SE120-002 Vacuum Vessel Sub Assembly, and all sub-components is maintained within the guidelines required by PPPL product specification NCSX-CSPEC-121-02-01

2. SCOPE

This specification defines the minimum requirements for the control of cleanliness during receiving, handling, fabrication, assembly, testing, and preparation for shipment to ensure that all vessel components are free of scale, water, dirt, oil, rust, grease, unspecified markings, foreign matter, debris, and contaminants throughout the manufacturing process and shipping to PPPL.

3. DEFINITIONS

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
PAC – Plasma Arc Cutting

4. REFERENCE DOCUMENTS

- PPPL Product Specification NCSX-CSPEC-121-02-01
- ASTM A-380 Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems (with the exception to any chlorinated products)
- MTM QAWI008 – Receiving Ordered Material
- MTM Mfg. Routing / Inspection Plan / Quality Assurance Plan 65678
- QA-SOP-01 Non-Conformance Control

5. EQUIPMENT AND SUPPLIES

- MTM Blast Booth
- MTM Paint Booth
- MTM Wash Booth, High temp / high pressure wash unit
- Crystal Simple Green® specialized cleaner (or approved equivalent)
- De-Ionizing tanks
- Lint free wipes
- Solvent (e.g. Acetone, Isopropanol)
- Virgin Aluminum Oxide Blast Media

6. CLEANING AND HANDLING REQUIREMENTS

6.1. Receiving Inspection operations

6.1.1. Raw material will be visually inspected and verified for cleanliness in accordance with ASTM A-380, paragraph 7.2, and as specified within the manufacturing routing

6.1.2. Purchased components will be visually inspected for cleanliness. Each piece must be clean to the extent that it is free of dirt, oil, grease, and residue. Each piece (or lot) must be adequately wrapped to prevent contamination.

6.1.3. Standard catalog components (e.g. copper seals, CF flanges, hardware) that are provided in hermetically sealed bags will remain in their sealed container until required for use unless otherwise directed by MTM Engineering. If determined that a sealed bag should be opened, the parts will be re-packaged, and re-sealed accordingly.

6.2. General handling / storage requirements (applies to all manufacturing operations)

6.2.1. All handling equipment such as slings, hooks, and lift-truck forks will be protected with wood, cloth, plastic, or rubber buffers, where feasible, to minimize contact with iron surfaces.

6.2.2. Contact with iron, or iron alloy tools and work surfaces will be avoided when possible. If not possible, contacted surfaces will be visually inspected for contamination, and if necessary, re-cleaned prior to use.

6.2.3. Where necessary to maintain cleanliness, production components and fixturing will be covered with a protective polyethylene sheet when not being worked on for an extended period of time. Part temperature must be below 150 Degrees Fahrenheit prior to covering.

6.2.4. Fixturing and bracing components that come into direct contact with the production part surfaces will be made from Austenitic stainless steel.

6.2.4.1. When it is necessary to weld fixturing and/or bracing in place, attachment tabs (of the same material composition as base material) will be utilized to prevent metallurgical contamination.

6.2.5. Production part cleanliness requirements also apply to (part contacting) bracing / fixturing surfaces.

6.3. Panel Die Forming operations

6.3.1. Prior to use, the functional faces of each die set will be thoroughly cleaned to remove any residual machining coolant, dirt, oil, harmful debris, unnecessary marking and/or model maker materials. This will be accomplished by one or more of the following processes.

6.3.1.1. Remove bonded materials by scraping, or with authorized abrasive products.
6.3.1.2. Remove loose debris with compressed air.
6.3.1.3. High pressure washing.
6.3.1.4. Solvent wipe with Isopropanol (or approved equivalent).

6.3.2. The forming die set functional surfaces, and production panels will be visually monitored for cleanliness during the forming process. If it is noticed during the forming process, that harmful foreign matter has accumulated on the die set, or production panel, the forming operation will halt until the component is re-cleaned.

6.4. Subcontract Forming Operations

6.4.1. Parts are to be covered and protected from the elements and road debris during transportation to and from the sub-contractor.

6.4.1.1. MTM quality assurance personnel will inspect (and document) the parts for material thickness, surface finish, cleanliness, and magnetic permeability prior to delivery to the contractor, and after receiving the formed parts.
6.4.1.2. The MTM material handler will visually inspect the part at the point of drop off, and pick up for cleanliness and surface imperfections.
6.4.1.3. Straps and/or chains must not come into direct contact with the part surfaces.
6.4.1.4. If stacking similar panels is necessary, adequate protection must be provided to ensure protection between parts.

6.4.2. The general handling / storage requirements (above) also apply to the sub-contractor. It is the responsibility of MTM Purchasing Department to ensure the requirements are precisely followed by the contractor.

6.4.3. Parts are to be handled by approved lifting equipment only. The use of plate gripping parts clamps is not acceptable.

6.4.4. Equipment surfaces (e.g. Plate Rollers, Press Brake Dies, etc…) that contact the parts, must be clean and free of loose contaminants.

6.4.4.1. The forming equipment (part contacting) surfaces, and production panels will be visually monitored for cleanliness during the forming process. If it is noticed during the forming process, that harmful foreign matter has accumulated on the functional tool faces, or production panel, the forming operation will halt until the component is re-cleaned.

6.5. Annealing operations

6.5.1. Parts are to be covered and protected from the elements and road debris during transportation to and from the metal treating contractor.

6.5.1.1. When installing onto the transportation device (e.g. shipping skid, wood struts, or truck bed), the parts are to be orientated convex side up.
6.5.1.2. The MTM material handler will visually inspect the part at the point of drop off, and pick up for cleanliness.
6.5.1.3. Straps and/or chains must not come into direct contact with the part surfaces.
6.5.1.4. If stacking similar panels is necessary, adequate protection must be provided to ensure protection between parts.

6.5.2. The general handling / storage requirements (above) also apply to the heat treat contractor. It is the responsibility of MTM Production Management / Production Control, and Material Handlers to ensure the requirements are precisely followed.

6.5.3. Parts are to be handled by provided lifting provisions only. If other handling mechanisms are necessary, they must comply with the above general handling requirements, and MTM engineering approval is required prior to use. The use of plate gripping parts clamps is not acceptable.

6.5.4. Internal furnace surfaces (e.g. brick, supporting structures, or shims) that contact the parts, must be clean and free of loose contaminants.

6.5.5. The parts must rest only on the peripheral edges during the thermal cycle. (The formed panels have approximately ½" (minimum) of excess material remaining on the perimeter that will be removed and discarded during later processing)

6.5.6. After the parts are positioned in the furnace, they are to be visually inspected for suitable support, and cleanliness. If dirt or debris exists on the part or contacting supporting structure, it must be removed using an approved solvent or cleaning process prior beginning the heat treat cycle.

6.6. Blasting operations

6.6.1. As required by the MTM Mfg. Routing, components will be blast cleaned using virgin aluminum oxide media only.

6.6.2. Surfaces with high tolerance surface finish will be masked off accordingly (e.g. polished vacuum facing surface, machined surfaces, etc…). Afterward, any tape residue will be removed using Isopropanol (or Acetone, followed by Isopropanol) and lint free wipes.

6.6.3. Specific blast media grit size, and necessary masking requirements will be stated within the MIT.

6.7. Cutting / Trimming / Welding / grinding / polishing operations

6.7.1. All grinding wheels, paper abrasives, and stainless steel wire brushes will be kept segregated for use on either stainless/nickel alloy or carbon steel as applicable. The tools used on stainless/nickel alloy will be marked specifically for use on stainless/nickel alloy only. Unidentified tools, or tools previously used on ferrous material, will not be used on components associated with this specification.

6.7.2. Cutting and trimming will be accomplished by either PAC, or abrasive cutting wheel. If using PAC for finish cuts, the resulting Oxide layer will be completely removed.

6.7.2.1. For incremental panel trimming during the forming operation, adequate radii will be applied to all edge corners in order to avoid gouging and scraping the forming die material.

6.7.3. Each weld joint and weld joint area (approximately 3” zone) will be cleaned with Isopropanol prior to welding.

6.7.4. Each weld joint will be visual inspected for cleanliness and conformance to the requirements of this specification at the point of fit-up, tack welding, and each inter-pass.

6.7.5. After each weld joint is completed, any oxides or contaminants that reside on the weld surface and heat affected zone will be completely removed.

6.7.6. After all welding is completed, in order to remove any foreign matter, or free iron contamination that may have accumulated during the fabrication process, all affected surfaces, with the exception of machined surfaces, and surfaces with high tolerance surface finish requirements, will be thoroughly cleaned by one or more of the following processes:

6.7.6.1. Grinding / sanding, wire brushing, and/or sand blasting.

6.8. High pressure washing operations

6.8.1. The parts will be washed using heated, de-ionized water, a mild non-chlorinated cleaning solution (e.g. Simple Green®, or authorized equivalent), and a high pressure washer. The spray pressure at the nozzle will be approximately 1,000 to 1,500 psi and the cleaning solution temperature will be approximately 150°F.

6.8.2. Following detergent wash, all parts will be final rinsed with de-ionized water and wiped dry with clean new rags.

6.9. Cleaning / Assembly operations

6.9.1. Cleaning and assembly prior to vacuum testing

6.9.1.1. After the VVSA Period and/or sub-component has been through its final polishing sequence, and prior to assembling the seals, blank-off flanges, and preparing the part for thermal cycling and vacuum testing, all vacuum facing surfaces will be cleaned by one or more of the following:

6.9.1.1.1. High pressure washing, followed by blowing dry with oil free instrument air
6.9.1.1.2. Wiped down with solvent, and wiped dry with lint-free wipes

6.9.1.2. After the cleaning is complete, the entire interior surface will be visual inspected, and certified for cleanliness by a qualified MTM Q/A representative. Appropriate lighting and equipment will be used to ensure the necessary level of cleanliness is achieved.

6.9.1.3. After the final interior cleaning is finished and confirmed, the installation of covers, and blank plates will be done as soon as possible to seal and protect the interior from contamination.

6.9.1.3.1. When necessary to ensure cleanliness, subsequent handling of vacuum facing components (e.g. installation / assembly of seals, and CF flanges, etc…) will be performed wearing lint free gloves.
6.9.1.3.2. When practical, and necessary to maintain cleanliness, the entire VVSA will be covered with polyethylene at all times when not being worked. Tape may be used to secure the polyethylene, but the adhesive surface of the tape should not be allowed to come into contact with highly polished / functional surfaces of the part. If tape does come into contact with the part, the residue will be removed using Isopropanol (or Acetone, followed by Isopropanol).

6.9.1.4. During subsequent handling of the finish cleaned assembly, care will be taken, as necessary, to avoid contamination / recontamination.

6.9.1.5. If the part becomes contaminated after the final cleaning, it will be spot cleaned using the appropriate method listed above.

6.9.2. Final cleaning operation

6.9.2.1. Once the interior has been cleaned, and the flanges and seals have been assembled, the interior will be considered at its final stage of cleanliness. Necessary provisions will be maintained to protect the interior surfaces from becoming contaminated (e.g. temporary covers, masking, etc…)
6.9.2.2. After the Port Extensions have been removed, and all primary manufacturing operations have been completed, any resulting debris and / or contaminants will be removed by blowing with compressed air, and wiping clean with Isopropanol, using lint free wipes.

6.10. Final visual inspection operations

6.10.1. Following the final cleaning of the VVSA components / assemblies, and prior to shipping, the parts will be visually inspected for cleanliness and certified as specified within the MTM Mfg.

routing instructions in accordance with ASTM A-380 paragraph 7.2, by a qualified MTM Q/A representative. Appropriate lighting and equipment will be used to ensure the necessary level of cleanliness is achieved.

6.10.2. Immediately afterward, all openings will be covered with their respective cover-plates, or fit with temporary protective covers which will remain in place until removed at PPPL.

6.11. Shipping operations

6.11.1. Shipping personnel will ensure all protective covers have remained securely in place prior to, during, and after loading for shipping. If it is noticed that a cover has become loose, or damaged, the appropriate Q/A, and CFT personnel will be notified for visual inspection, and to provide remedial disposition prior to proceeding.

6.11.2. The entire vessel component will be covered and wrapped to ensure the vessel is properly sealed, and cleanliness is maintained throughout shipping. This will be confirmed by the appropriate Q/A, and CFT representatives prior to covering and shipping.

7. QUALITY ASSURANCE / DOCUMENTATION

7.1. 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.

7.2. When necessary, additional documentation requirements will be provided within the associated MTM IDC, and QAP system.

7.2.1. When an IDC record and/or Inspection report is required, reference to the specific area being tested will be clearly discernable.

7.2.2. 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

7.3. Exceptions / out of tolerance conditions will be documented within the MTM Non-Conformance system per QA-SOP-01.