DCMA NSEO MANUFACTURING PROCESS REVIEW (MPR) CHECKLIST #24

PLATING

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| **SUPPLIER & CAGE:**  |  |
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| **LOCATION:** |  |
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**Program Type:**

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|  | Level I/SUSBAFE (LI/SS) |  | Navy Propulsion Program (NPP) |  | Deep Submergence Systems/Scope of Certification Program (DSS-SOC) |
|  | Nuclear Plant Material (NPM) |  | Naval Nuclear Propulsion Program (NNPP) |  | Aircraft Launch & Recovery Equipment (ALRE) |
|  | Fly By Wire Ships Control Systems (FBWSCS) |  | Ships Critical Safety Items (SCSIs) |  | Other: |

**Contractual Requirement(s) for this Process:**

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**Supplier Procedure Number(s), Title(s) & Revision Level(s)/Date(s):**

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| **Process Reviewed By:**  |  |
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| **Date(s) of Review:** |  |
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**Process Concerns and Guidance:**

* Inadequate stress relief baking of hardened steel prior to plating can result in base material cracking during the plating process.
* Improper plating techniques can result in plating that does not adhere properly to the base metal or could cause hydrogen embrittlement of the base metal. This could lead to premature catastrophic failure of the part, which can potentially result in complete functional and/or structural failure of the component in which the part is installed.
* Improper or inadequate hydrogen embrittlement relief baking of hardened steel after plating can result in base material cracking.
* Baking some tool steels above 275F may reduce their hardness.
* Failure to maintain plating baths within established parameters will yield deposits with inconsistent properties that may not meet the finish requirements verified during periodic process control testing.
* Entrapment of some plating solutions in part seams can lead to base material attack and premature failure of the part.
* Inadequate corrosion protection can be caused by incomplete plating coverage and/or variation in plating quality and thickness.
* Process Control testing not being performed as required
* Lot Testing (especially for passivation and phosphating) not being performed as required
* Solution Control of processing baths inadequate
* Oven Control (Uniformity and Probe Checks) not performed as required
* Thickness testing equipment verification not performed as required
* Processing equipment maintenance inadequate
* Test failure, replacement testing and retesting not adequately defined and controlled (Process Control & Lot Testing)
* Platers have failed to provide uniform plating thickness and/or complete coverage.
* Non-adherent (peeling or flaking) plating
* Pitting and undesirable marks where rack hooks contact the parts
* Poorly controlled stripping resulting in significant base material attack
* Inadequate stripping and re-plating over old plating

**Additional Oversight Checklists**

* Addendums to this MPR checklist are available to use for a more in-depth process review. If used, the completed Addendum(s) are to be uploaded to the SAP Database in PDREP with the base checklist.

* + 24 MPR-MPS - Addendum 1 – Black Oxide on Steel – MIL-DTL-13924D – Class1
	+ 24 MPR-MPS – Addendum 2 – Black Oxide on Stainless – MIL-DTL-13924D-Class4
	+ 24 MPR-MPS – Addendum 3 – Chromium Plating – MIL-DTL-23422F
	+ 24 MPR-MPS – Addendum 4 – Salt Spray Testing – ASTM B117-09
	+ 24 MPR-MPS – Addendum 5 – Ovens, Stress, and Hydrogen Embrittlement Relief – AMS 2750D
	+ 24 MPR-MPS – Addendum 6 Teflon Coating – MIL-P-24074B – Type II
	+ 24 MPR-MPS – Addendum 7 Zinc Phosphate – MIL-DTL-16232G – Type Z – Class 3 (Zinc Phosphate, No Oil)

**A**. **MANPOWER:**

1. Are the personnel performing the plating, and quality assurance functions of the appropriate skill/experience level and/or properly trained/certified to produce conforming product? ***What are the requirements? (some plating specifications have specific operator qualification requirements)***

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1. Record all operations observed (include type and specification, where applicable) and the corresponding operators’ names. Are any personnel certifications expired and are they still working in the process?

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1. Are training records available (review sample) and are they accurate and complete?

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1. Are the credentials of the training/certification official in accordance with specification requirements? ***What are the requirements?***

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1. Is there a system in place for remedial training when errors occur? Is the system documented, and are there records of remedial training available, if applicable?

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**B. MATERIALS**:

1. Are materials controlled and traceable throughout the process, if required?

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1. Are certifications for raw materials used in the plating process reviewed for acceptance and maintained on file for review? (NAV24-A11)

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1. Do the raw materials comply with contract/specification and/or supplier-imposed technical requirements, including the prohibition of reclaimed material as may be required? ***What were the materials reviewed?*** (NAV24-A12)

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1. Are there adequate methods to segregate accepted and rejected materials and controls to ensure conforming material is consistently used in the process? (NAV24-A16

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1. Are raw materials traceable/identified, as required, and within shelf life, if applicable? ***(There are shelf lives for chemicals. Check the manufacturer’s certification or the chemical drum for this information.)***

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1. Are processing solution controls adequate and include an analysis schedule for each processing bath and an analysis record for each processing bath with established control parameters for each bath constituent?
	1. Are written chemical analysis procedures for processing solutions available and followed?
	2. Are processing baths maintained within all parameters at the established analysis frequency?

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1. Was the base material's integrity compromised by processing and/or practices? ***If so, how (e.g. improper baking; improper cleaning, rinsing, plating, or improper stripping, etc)?***

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1. If required by specification, are test coupons processed with production material and properly identified? (NAV24-A26)

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**C. MACHINERY**:

1. Is **manufacturing equipment** (tooling, fixtures, jigs, temperature controllers, ammeters, voltmeters, etc.) adequate to produce/assess conforming supplies in compliance with contractual specifications and drawing(s)? *What Items were sampled and were they part of the supplier’s calibration program and within the calibration/check cycle?* (NAV24-A20)

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1. Is **inspection and testing equipment** of the required adequacy, accuracy, precision, and range to assure supplies produced comply with specifications and drawings? *What Items were sampled and were they part of the supplier’s calibration program and within the calibration/check cycle?* (NAV24-A10)

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1. Does equipment, requiring qualification or certification approval, have contractual approval for use?

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1. Identify the thickness measuring equipment available at this facility. Is all thickness testing equipment calibrated and within periodicity? (NAV24-A24/25)

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1. Are standards, traceable to NIST, available to verify the accuracy of the thickness testing equipment?

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1. Are finishing tanks, electrical equipment, bus bars, and electrodes relatively free of corrosion? (NAV24-A29A)

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1. Are processing tanks placarded with the solutions they contain and their operating parameters? (NAV24-A17)

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1. Are processing baths, which are operated at non-ambient temperatures, equipped with temperature controlling and indicating devices? (NAV24-A18)

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1. Are processing baths requiring agitation equipped with acceptable devices to accomplish this requirement? (NAV24-A19)

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1. Are clocks and/or timers available, where applicable? (NAV24-A21)

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1. Are wiping and cleaning cloths used for parts checked for grease, oil, etc? (NAV24-A27D)

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1. Are rinse tanks free of contamination detrimental to the process, and are there separate rinses following acid and caustic solutions? (NAV24-A23A/B)

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1. Was the base material's integrity compromised by processing and/or practices? ***If so, how (e.g. improper baking; improper cleaning, rinsing, or plating; improper stripping; etc)?***

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1. Is there a certified stress relief/bake oven available? If so, does it meet the following requirements: (NAV24-A28/A-D)
	1. Temperature uniformity surveys (TUS) performed quarterly on processing ovens. (frequency may be reduced to twice/year after four consecutive successful surveys)
	2. Accuracy meets required tolerances in temperature ranges used. (*What are the maximum and minimum ranges required for the facility?*)
	3. System accuracy tests (SAT) performed twice/month on temperature control and recording systems (frequency may be reduced to monthly if a preventative maintenance program is in effect)
	4. The oven chart recorder has a maximum resolution of 250F per inch of chart paper and a maximum chart recording increment of 10F.
	5. The chart recorder (circular and strip) speed verified annually, and it is accurate to within +/- 3 minutes per hour

***Note: Ovens must meet the temperature uniformity requirements of AMS 2750D for Furnace Class 5 (± 25⁰F), Instrumentation Type D, unless more stringent requirements are specified.***

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**D**. **METHODS**:

1. Does the supplier have procedures for plating that meet applicable contract/drawing/specification requirements, are readily available to shop personnel, and cover all applicable processes performed? Identify the procedure number and revision. What drawing/specifications are applicable? (NAV24-A1/2A/B)

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1. Is the supplier’s procedure required to be approved by the customer? If applicable, verify the approval and list the procedure and the Reference Approval Number. (NAV24-A3A/B)

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1. Are the plating procedures/work instructions adequate for the control of the proper equipment, materials, test specimens/coupons (when required), temperature monitoring (preheat, spraying temperature, cooling etc.), and pressure and flow settings for abrasive blasting (when applicable)? (NAV24-A4A/B/C/E/I)

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1. Are the plating procedures/work instructions adequate for the control of the method for masking areas (when applicable), preparation of the base material, and the plating bath time/rate of application? (NAV24-A4D/F/G)

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1. Are the plating procedures/work instructions adequate for the control of the make-up and concentration ranges of solutions, operating temperature ranges of solutions, voltage/amperage ranges (current densities), where applicable, and a frequency of solution analysis that maintains each bath within established parameters **(some specifications have set minimum frequencies)**? (NAV24-A4K-N)

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1. Are the plating procedures/work instructions adequate for the control of the inspection process, include sample sizes, and require that records be maintained? (NAV24-A4H/J/Q)

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1. Are the plating procedures/work instructions (flowchart, traveler, router, etc.) adequate to provide operational controls for cleaning, plating, baking etc. and the established frequencies for calibration and accuracy of temperature indicators, oven meters, etc.? (NAV24-A4O/P

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1. Is adequate care and protection taken to prevent damage during transport within the facility and for shipment? (NAV24-A32A)

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1. Is adequate control provided to ensure that packaging, marking, and documentation is in accordance with applicable requirements? (NAV24-A32B)

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1. Is stress baking performed and documented when this baking is required by contractual documents or specification based on material hardness? Is the baking temperature held within the specified requirement? Does baking duration meet specified requirements? (NAV24-A28E/F)

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1. Is hydrogen embrittlement relief baking performed and documented when baking is required by contractual documents or specification based on material hardness? Are parts at the required baking temperature within the **time allotted after** **plating** (ref. contractual documents, including plating specification)? Is this adequately documented? Is baking **temperature** held within the specified range? Does baking **duration** meet specified requirements? Is load traceability to recorder charts maintained?

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1. Review **periodic process control testing** (visual, adhesion tests, hardness, thickness, corrosion resistance, etc.) documentation and verify that all process control tests are being performed at the frequencies required by the plating specification and records exist for each test. List number of documents reviewed, required tests and the frequency of performance, noting if each test performed meets the requirements. (NAV24-A6/7B)

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1. Is material/product, which has been through the plating or inspection process, positively controlled, traceable, and have the inspections/processes performed been documented adequately to provide a positive indication of the status of the material and maintained to confirm the inspection process was performed (e.g. individual inspected, operation sign-off, inspection stamped/initialed/signed accepted or rejected)? (NAV24-A5/7A/8/13/14)

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1. Is there a procedure in place for customer notification in the event of a process control testing failure which includes identification of all affected hardware shipped to the customer, isolation of all affected product, investigation of failure cause and implementation of corrective action?

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1. Is batch process data (i.e. tank number, temperature, concentration, voltages, etc.), documented and traceable to finished parts?

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**E.** **ENVIRONMENT**:

1. Has sufficient work area been allocated to the process being performed with equipment constructed and arranged to permit a uniform and controlled operation? Is the area where the work is being performed uncluttered, clean, and free from dirt and debris? (NAV24-A29B/30/31/A)

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1. Are chemicals stored in an area separate from the finishing area with alkalis and acids segregated from one another? (NAV24-A29C)

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1. Are tanks, such as anodize, chrome, hot alkaline cleaners, hot deoxidizers, etc, equipped with exhaust systems? (NAV24-A29E)

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1. Are adequate safety precautions and procedures in place and practiced by personnel including adequate ventilation in the finishing area, adequate fire protection devices and eye wash stations available and maintained, and personal protective equipment (face shields, chemical-resistant aprons and gloves, etc.) available and in use when necessary. (NAV24-A29D/31B)

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1. Are adequate cleaning facilities available and in use?

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1. Does the supplier observe ESD practices, if applicable? (***This may be required when brush plating to repair the finish on assembled electronic components.)*** Are these procedures adequate? Record procedure numbers/revisions reviewed, when applicable.

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1. Are all lot tests required by the plating specification being performed?

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**F. PRODUCT EXAMINATION:**

***The QAR must perform a product examination in order to verify the output of the process being reviewed and document the results below. If at all possible the QAR should witness performance of the process to verify competency of supplier personnel. (NAV24-A15/A)***

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| Date(s) Conducted: |  |
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| Product Examination Performed By: |  |
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| Contract Number(s): |  |
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| Part Number(s)/Serial number(s): |  |
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| Part Nomenclature(s): |  |
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| Supplier Personnel Contacted and Titles: |  |
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| Drawing Number & Revision: |  |
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| Lot Size and Sample Size: |  |

1. Is the plater qualified for and familiar with the plating procedure(es) being observed? Indicate the plating procedure(s) being used and indicate if the plater has the procedure(s) available. (NAV24-A15D-G)

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1. Indicate the base material(s) and the plating material(s) for the operation(s) being observed. (NAV24-A15B/C)

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1. Are parts visually examined prior to plating for material defects, dimensions (critical surfaces), heat treat condition, dissimilar metals, presence of residual stresses, etc.? (NAV24-A27A)

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1. Are pieces to be plated cleaned prior to the process? List the methods and materials used if applicable. Is cleanliness maintained after cleaning, prior to plating, and are parts protected from contamination during and after the plating process? (NAV24-A22A-C)

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1. If test specimens are required, do the number, size, material, and condition of the test specimens used meet the plating specification’s requirements?

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1. Are parts visually examined after removal from cleaning process solutions for copper immersion products, non-soluble smuts, pitting, excessively etched surfaces, etc.? (NAV24-A27B)

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1. Are parts visually examined for a water-break-free surface during the rinsing process after cleaning (before plating)? (NAV24-A27C)

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1. Does the inspector complete the inspection record properly and is it adequate to meet procedural requirements?, Do inspection records clearly identify the results of the inspections and tests performed and include traceability back to the procedure, lot/heat numbers, instruments used, personnel who performed each inspection, and the finished product inspected? Are the records maintained to confirm that all required inspection processes were performed?

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| Additional PE Characteristics Examined: | # Observations |
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1. Identify the inspection methods (W, I, T, V) used to verify conformance with procedures and standards:

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| **W** |  |  | **I** |  |  | **T** |  |  | **V** |  |

**PE Comments/Concerns**

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| **Overall MPR Results:** | **SATISFACTORY** |  | **UNSATISFACTORY** |  |

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| **Corrective Action Generated?** | **No** |  |  | **Yes** |  |  | **CAR#** |  |

FOLLOW-UP ACTION REQUIRED?

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**SUMMARY/NOTES/COMMENTS/CONCERNS**:

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