DCMA NSEO MANUFACTURING PROCESS SURVEILLANCE (MPS) CHECKLIST #29

CASTING (FOUNDRY) OPERATIONS

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| **SUPPLIER & CAGE:**  |  |
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| **LOCATION:** |  |
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| **PROCESS:** |  |

**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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| Surveillance Performed By:  |  |
|  |  |
| Date(s) of Surveillance: |  |
| Contract Number(s): |  |
|  |  |
| Part Number(s)/Serial number(s)/NSN: |  |
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| Part Nomenclature(s): |  |
|  |  |
| Supplier Personnel Contacted and Titles: |  |
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| Drawing Number & Revision: |  |

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**Process Concerns and Guidance:**

* Castings are inherently less sound than wrought materials and products.
* Inadequate procedures for chemical check analysis prior to pouring a melt can result in unacceptable material being processed.
* Improper casting methods can result in an excessive amount of (and/or excessive size of) internal voids, which can lead to poor mechanical properties and part failure.
* Poor casting practices can result in a high inclusion count, which can result in poor mechanical properties and possible failure.
* The casting process can result in high residual stresses; some castings must be stress relieved.
* Weld repairs can result in defects which can lead to failure. Weld repairs must be carefully controlled and documented. Weld repair is not appropriate for many casting alloys.
* Mechanical tensile tests have been performed properly, but calculations performed incorrectly, resulting in “acceptable” test values reported for unacceptable material.
* Castings with large and/or excessive internal voids and /or inclusions have failed during service.
* Improper stress relief of castings has resulted in failures.
* Weld repair defects have resulted in failures.
* There have been deviations from customer approved product qualification or 1st Article test reports. Weld repair of castings was performed without the welding procedure being approved.
* Failure to maintain material control can result in the use of incorrect raw materials and additives which can affect the mechanical properties of the material produced. Improper marking of rejected material has resulted in comingling with acceptable product.
* Non-Destructive Testing has not been performed according to procedure or has been performed using improper calibration techniques.
* Inadequate control of alloys materials, and additives has resulted in scrapped heats.
* Cast valve components have cracked during welding installation due to excessive inclusions (dross) in the material, although weldability testing was acceptable.
* Weld repair of castings has been performed without the welding procedure being approved.
* Excess gas – primarily hydrogen and nitrogen – if not removed during casting solidification, can result in unwanted porosity being present in the product.
* Particular attention should be given to alloy composition, dissolved gas content, entrained solids (such as oxides and intermetallic compounds), and improper temperature, as these are the four principal factors which contribute to metallurgical defects in castings. Poor fluidity, shrinkage porosity, gas porosity, and hot cracking may result.

**QARs should use the “BASIS OF DETERMINATION” column to document the objective quality evidence and/or clarify the rationale used to support their decision. (e.g. direct observation, documents verified etc.)**

S = Satisfactory U = Unsatisfactory

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| **SURVEILLANCE QUESTIONS** | **S** | **U** | **BASIS OF DETERMINATION** |
| 1. Are the personnel performing the manufacturing, testing, and quality assurance functions of the appropriate skill/experience level and/or properly trained/qualified in the procedure/specification? ***What are the requirements?***
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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?*
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| 1. Is **manufacturing equipment** 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?*
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| 1. Are work instructions, test procedures, travelers, etc. being used adequate, clear, and up to date (latest revision)? *What documents (identifying number & rev) were reviewed?*
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| 1. Is there a documented procedure/process to determine the acceptability of raw materials? (i.e., ingot, alloying additions, purchased scrap)? Are certifications for raw materials used in the foundry process reviewed for acceptance and maintained on file for review? Do the raw materials comply with contract/specification and/or supplier-imposed technical requirements?
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| 1. For Level I material, is the product controlled and traceable throughout the process?
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| 1. Is foundry equipment that may come in contact with molten product, such as ladles, crucibles, stirrers, skimmers and thermal blankets, controlled for use in a single alloy or family of alloys where cross contamination is not a concern?
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| 1. Does the foundry have a documented procedure for controlling, storing, and issuing raw materials and additives?
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| 1. Is the remaining metal after each pour (gates, risers and other scrap) labeled, sorted and stored in accordance with the foundry’s material control process?
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| 1. Are heat/lot traceability markings cast into final product or marked immediately after cooling and removal from the molds or is a process in place to assure traceability is maintained until markings are applied?
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| 1. Are the chemistry and mechanical properties of each heat/pour of metal verified after melting and/or casting even where pre-certified ingot is used?
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| 1. Is inspection data reviewed and accepted by qualified personnel? Is operator identification recorded? (name, badge number, clock, shift, etc.)
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| 1. Does the foundry use documented qualified procedures for performing welding repair on their castings? Does the foundry maintain records showing the training and qualification of the welders?
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| 1. Does the foundry use a documented procedure for performing and evaluating NDT on the final product?
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| 1. Is the work area where the work is being performed, clean and free from dirt and debris?
2. Does the foundry have a process for reviewing repetitive casting defects in order to make improvements to their casting process and foundry engineering? (will improve the acceptability of the final product)
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| 1. Is the proper melt process (VAR, VIM, etc.) required by contract/specification being used to produce the product?
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| 1. If applicable, are the requirements for the use of raw materials (versus recovered materials) being met?
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| 1. Are the requirements concerning detrimental materials (depending upon material and specification) being met?
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| 1. Is all required testing for the final product (chemistry, tensiles, NDT, intergranular attack, etc.) being performed to contract/specification requirements?
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| 1. Is an approved casting drawing applicable to the final product? If so, is the foundry using the approved drawing, including revision?
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| 1. Is heat treatment, such as stress relief, required? If so, is it performed to the correct parameters?
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| 1. Are test specimens, including separately cast test blocks, properly produced? Are they representative of the final casting?
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| Other observations: |  |  |  |
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| **Overall MPS 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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