DCMA NSEO MANUFACTURING PROCESS REVIEW (MPR) CHECKLIST #23

HEAT TREAT

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

* As-cast or as-wrought materials typically do not have appropriate properties for engineering service. Heat treatment at specific times and temperatures must be prescribed to induce metallurgical reactions (e.g., phase transformations) which provide suitable mechanical properties, physical properties, relief of residual stresses, and/or corrosion resistance.
* Numerous parts are often heat treated simultaneously. Control of the heat treating process, including control of furnaces, furnace instrumentation, and thermocouples must be sufficient to ensure uniform heat treatment of all heat treated parts.
* Poor quenching practices, lack of furnace uniformity, and use of incorrect temperatures, holding times, and/or furnace atmospheres has resulted in parts which fail to meet specified properties (or unacceptable property variations within a part).
* Inadequate cleanliness control of parts to be heat treated, or heat treatment fixtures, has led to detrimental material concerns.
* Incomplete or missing documentation of heat treatment such as furnace charts has resulted in delays due to uncertainty regarding the condition of the material.
* Failure to maintain material traceability and positive identification throughout the heat treat process has resulted in delays due to uncertainty regarding the condition of the material.

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

1. Are the heat treat personnel of the appropriate skill/experience level and/or properly trained/certified to produce conforming product? ***What are the requirements?***

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

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1. Is there a system in place for remedial training when errors occur?

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**B. MATERIALS**:

1. Is traceability being maintained, and is the material being heat-treated identified by heat number, batch number, serial number or equivalent to assure material control and prevent material mix up? (NAV23-25)

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1. Are materials being heat treated properly marked in accordance with the contract specification? Are unique identifiers legible and traceable upon completion of the heat treating process?

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1. Are materials being heat treated cleaned and prepared in accordance with the technical specification and heat treating procedure?

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1. Are test coupons being heat-treated together with the material? (NAV23-26)

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1. Does the supplier’s heat treating equipment contain Mercury? If so; is it identified, and are procedures being followed to ensure that material does not become contaminated? (NAV23-7A/B/C)

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**C. MACHINERY**:

1. What type of furnace is being used for heat treating (car bottom, front load, side load etc)? List the make and model number, heat source, and burner control methods if possible. (NAV23-3/A/B/C/4B)

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1. Does the supplier have a system for calibration of the temperature control equipment? (e.g. controller, thermocouple, lead wire) (NAV23-14)

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1. Are heat treating equipment and quality assurance equipment (including hardness testing) identified in a manner to reflect the personnel responsible for performing calibration/inspection with the item identity/serial number? Is the calibration current? If calibration is subcontracted, what is the name of the company, and are sufficient subcontractor controls in place? (NAV23-15/A-E)

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1. Are time-at-temperature control charts or strip charts being used and are they traceable to individual material lots being heat treated? If not describe what alternate controls are used. (NAV23-11A/B)

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1. Are an adequate number of thermo-couples being used, and are they placed properly for the furnace load? (NAV23-3D/4C/G)

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

1. List the type(s) of heat treatment being performed: homogenize, stress relief, normalize, heat soak, anneal, tempering/quenching, age hardening or other (specify). (NAV23-1A)

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1. Does the supplier utilize a written procedure to conduct all facets of heat treatment and is it readily available to the operators? Does the procedure contain parameters in accordance with specifications (Mil-H-6875, Mil-Std-1684) for time and temperature requirements? (NAV23-1B/C/8/24)

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1. Do the supplier’s procedures document the process for resolving nonconformance on heat-treated material? (NAV23-13)

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1. Does the supplier’s procedure address the furnace fuel source requirements? (NAV23-6)

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1. Does the supplier have a system or procedure to perform oven/furnace surveys? Are the surveys performed within the proper time interval and at the correct temperature? (NAV23-16/17/18)

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1. Is a traveler or equivalent work process control document being utilized and serialized to each furnace load? Does the document contain requirements for time, temperature, cooling methods, and documentation requirements? (NAV23-9/10)

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1. What is the method of loading and unloading the furnace or oven? (NAV23-4A/D/E)

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1. Are the heat treatment operations performed by a continuous process or individual furnace load? (NAV23-2)

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1. What is the method of cooling/quenching utilized and how is the furnace load transported to the cooling location? (NAV23-4F)

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1. What is the method utilized to confirm successful heat treat to specific, required mechanical properties (hardness, tensile testing, etc.)? Does this method meet specified requirements, and does the procedure ensure test coupons are heat treated together with the material? (NAV23-12A/B/C)

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

1. Is safety equipment available and in use, if needed; to include fire protection devices? ***What are the safety requirements for this process?***

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1. Is the area where the work is being performed uncluttered, free from debris, and maintained in a safe manner? Describe actual worksite conditions.

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1. Has sufficient work area been allocated to the process being performed?

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1. Are high pressure gas cylinders stored properly and in an area separate from the finishing area?

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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. The QAR should witness a Heat Treat and the verification testing (hardness, tensile test, etc.) performed if possible.***

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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. During the heat treat, are personnel cognizant of parameters (time, temperature, cooling method) required by the heat treat procedure and work instructions? (NAV23-22)

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1. Are the furnaces and controllers calibrated? Is the temperature correct? Is the correct cooling method/medium used? (NAV23-19/20/21)

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1. Are results being properly documented (furnace charts, travelers)? (NAV23-23)

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1. After heat treat, does the material meet the required mechanical properties (Rockwell, Brinell hardness, tensile and yield strengths etc)?

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| Other 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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