DCMA NSEO MANUFACTURING PROCESS REVIEW (MPR) CHECKLIST #38

FORMING OPERATIONS

INCLUDING BENDING OF PIPE, TUBE AND BAR

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

**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:** |  |

**Process Concerns and Guidance:**

* The bar, tube or pipe can be formed into elbows, tees, reducers and other shapes. Improper lubrication, pressure, temperature, time, filler and etc. may cause out of round, wall thinning, wrinkles, buckles, bulges or other surface conditions.
* Inadequate procedures for forming / bending can result in unacceptable material being processed.
* Proper setup and alignment
* Contractor personnel may not be properly trained to perform forming operations.
* Raw material may not be pre-cut to the proper shape or size
* Use of marking materials and/or forming lubricants that do not meet contract requirements for detrimental materials can result in unacceptable product.
* Deviation from customer approved product qualification, procedure qualification or 1st Article test reports may require re-qualification testing and submittal of results.
* Weld repair of bar, tube, pipe or formed items may require authorization/approval prior to weld repair. The welding procedure requiring qualification and approval.
* Failure to maintain material control can result in the use of incorrect raw materials which can affect the mechanical properties of the material produced. Improper marking of rejected material has resulted in comingling with acceptable product.
* Forming methods and / or dies may not allow for the production of necessary testing materials / specimens, such as prolongations required for mechanical testing.
* Improper / inadequate starting material selection may result in product which does not meet dimensional requirements after forming – primarily bending operations.
* Improper pre-heating can introduce defects to material during forming operations.
* Required marking, “built in” to drawings and specifications, which is to be applied by / during forming operations, is overlooked.

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

1. Are the people performing the manufacturing/forming, testing and quality assurance functions of the appropriate skill/experience level and/or properly trained/qualified to produce conforming product? Are the forming employees trained and familiar with portions of the system applicable to their position?

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1. What type of training/certification is required for the work performed at this facility? Are training records available (review sample) and are they accurate and complete? Are any personnel certifications expired and are the personnel still working in the process?

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1. Are inspection and manufacturing/forming personnel trained in the use of procedures? Is there a documented training plan, and are these recorded a part of employees’ files? Identify any applicable procedural training.

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

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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 inspection data reviewed and accepted by qualified personnel? Is the operator identification recorded? (name, badge number, clock, shift, etc.)

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1. Does the organization use documented, qualified procedures for performing welding repair? Are the welders trained and qualified to the welding procedures they are asked to perform? Does the organization maintain records showing the training and qualification of the welders?

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**B. MATERIALS**:

1. Are procedures/work instructions adequate for control of materials? Identify the process being observed. What is being processed? (list) For Level I material, is the product controlled and traceable throughout the process?

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1. Are certifications for raw materials used in the forming process reviewed for acceptance and maintained on file for review?

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1. Do the raw materials comply with contract/specification and/or supplier-imposed technical requirements? What were the materials reviewed?

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1. Are raw materials traceable / identified, as required? Check the certification or appropriate data.

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1. Are MILSPEC welding consumables used when required by the welding procedure, contract or governing specification? Are the welding consumables used to perform weld repairs certified to the applicable MILSPEC, AWS, or other commercial specification?

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1. Are lubricants used? List the lubricants. Do the lubricants contain any unacceptable ingredients (i.e. sulfur, chlorine, halogens, etc.)? Does the organization maintain copies of certifications? (If there are shelf lives for various materials, check the manufacturer’s certification or appropriate data for this information.)

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1. Are fillers used for internal support? Identify the filler material (i.e. sand, rosin, ball, disc, etc. or combination).

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1. Is water used in the forming process? Does the water meet the required grade? Does the water contain the proper additives to reduce corrosion?

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**C. MACHINERY**:

1. Is manufacturing equipment adequate to produce and assess conforming supplies in accordance 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. Has the forming / bending equipment been qualified, as required? Are qualification test results and approval being maintained by the organization?

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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 Government owned material and/or equipment adequately protected/maintained in accordance with a documented process?

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1. Do procedures call for the use of calibrated instrumentation to control the temperature, pressure, time, etc. (as applicable)? Are calibrated instruments being used where required by internal procedure or by the governing specifications?

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1. Are procedures/work instructions adequate for control of proper equipment (i.e. rollers, dies, press, etc.)? Are the required rollers / dies / press properly identified, stored and maintained? Is the equipment required to be coated prior to use or storage (film, diffusion, nitride, chemical vapor deposition, etc)? Verify available records.

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

1. Does the organization have a documented quality system? If so, what recognized quality management system does the organization quality system comply with?

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1. Is a documented procedure used for preparing the test coupons to accomplish, mechanical testing and weldability testing (if required)? Are these procedures available to and in use by the personnel performing these tests?

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1. Do any of the procedures in use at the organization or in use by one of the organization’s subcontractors require qualification? Have these procedures been qualified? Are records of qualification available?

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1. Do any of the procedures in use at the organization or in use by one of the organization’s subcontractors require review/approval by the government? Have these procedures been approved by the Government/customer? If applicable, list the Reference Approval Number.

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1. Does the organization conduct internal assessments or audits when required by contract or internal quality system requirements? If so, does the organization maintain records of internal reviews such as schedule, results, and corrective actions? Has the organization ever been subjected to a 3rd party quality audit? If so, by whom? Describe any significant findings and if they have been corrected.

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1. Does the organization have a documented process for evaluation, review and selection of suppliers for their raw material? (i.e., bar, tube, pipe, etc.)? If so, does this process include a review for past performance and review of technical capability? Provide listing of suppliers, noting the type/alloy of material provided?

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1. Are procedures, work instructions, 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. pipe, tube, bar etc.)? If so, does it include reviewing material certifications and/or re-performing material verification testing to confirm material meets specification requirements and reviewing the traceability of certified material to the paperwork? Does this procedure/process take into account differences in the source of the material and require different levels of verification based on past supplier performance, or receiving certified and traceable material with test reports, or versus uncertified scrap (i.e. changing sample sizes or performing additional testing on material before acceptance)?

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1. Does the organization have a documented procedure for controlling, storing, and issuing raw materials, filler, and lubricants? Does this procedure require these materials to be labeled/marked and stored in a manner to preclude mix-up with other similar materials? Does the organization control scrap material? Does the procedure cover the disposition of material that does not meet chemical and/or mechanical requirements?

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1. Is there a procedure for developing, documenting and controlling the entire forming process, including all engineering, time, temperature, pressure, and die/pattern design when a 1st article or qualification test is required? Does this procedure include a change control process that addresses analyzing any changes to the forming processes for their effect on the end product and whether or not validation and/or re-qualification of the 1st article / qualification test is required? Once the 1st article / qualification test is accepted by the customer, is the customer notified when there are modifications to the production of a form / shape that impacts the acceptability of the original 1st article / qualification test?

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1. Does the organization have a specific forming procedure for each alloy group the organization forms? Do these procedures define what is considered a single heat or lot, and do the heat/lot definitions comply with the applicable specifications for the alloy? Do these procedures identify when mechanical test coupons are required? Are the test coupons marked to maintain traceability to the heat/lot and to the actual production material?

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1. Do the procedures identify the size and shape of the test coupons required? Does this meet the requirements of the applicable forming specifications?

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1. Do the procedures require heat/lot traceable records that record the parameters used during the forming process? Are heat/lot traceability markings marked immediately after cutting to size prior to forming and after forming? Or is a process in place to assure traceability is maintained until markings are applied?

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1. Are the mechanical properties of each heat/lot of metal verified after forming?

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1. Does the organization use a documented procedure for performing and evaluating *NDT on the final product? For NDT performed in house, list the NDT performed. Is* NDT used as certification of the final product being performed by a NDT examiner certified in the applicable discipline? Are records kept that detail the size and location of any rejectable indications noted during the inspections?

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1. For sub-contracted NDT, list the NDT subcontracted and list subcontractors used. Is any oversight or evaluation performed on subcontractors performing NDT? Does the organization receive reports detailing the size and location of any rejectable indications noted during the inspections?

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1. Does the organization use a documented procedure for visually inspecting and evaluating the final product? Is magnification being used? Are records kept that detail the size and location of any indications noted during the inspections?

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1. Does the organization have a process for reviewing repetitive forming defects in order make improvements to their process, which will improve the acceptability of the final product?

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1. Are records maintained when welding repairs are performed? Do the records contain the information required by the applicable welding or forming specification such as location of the repair, welder performing the repair, welding procedure used, welding consumables used, and the results of follow-up NDT?

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1. Are records maintained when rework or other repairs are performed? Do the records contain the information required, such as type of rework/repair, location, personnel performing the rework/repair, procedure used, and the results of follow-up inspection?

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1. Does the organization subcontract the testing of any of its material, such as mechanical or weldability testing? Does the organization use a documented procedure to select/evaluate subcontracted test lab(s) performing mechanical testing? Are test labs required to be certified through a 3rd party such as American Association of Laboratory Accreditation (A2LA) or NADCAP? Is a list of qualified testing labs, along with their capabilities, maintained, and does the organization perform any oversight or confirmation testing to provide assurance that the lab is performing properly?

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1. Are required preforming and/or forming temperatures controlled per applicable requirements? If hot forming, identify the heating source (furnace, heat induction coil, torch, etc.).

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1. Is the reduction of wall thickness during the forming process identified and recorded, if applicable? Are adequate controls in place to assure that the correct forming machine, correct filler material and correct filler size is used?

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1. Is the correct forming machine (e.g. ram type, roll type, compression type, rotary type, rotary type with a booster, or other type) and/or dies used and recorded, if applicable?

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1. Does the procedure identify the starting material to be cut to a size and/or shape prior to the forming process per applicable requirements? Is the starting material properly cut?

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1. Are the correct lubricant(s) and filler(s) used per applicable requirements?

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1. Does the organization have any process to clean the item to remove any lubricants, filler materials or other materials / contaminants prior to heat treat or further processing?

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1. Where forming equipment is used on multiple alloy types are cleaning procedures identified and utilized to prevent or limit cross contamination of different alloys?

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

1. Are any processes (mechanical testing, NDT, etc.) conducted under controlled environmental conditions (clean room, humidity/temperature, etc.) as required by contractual and/or supplier-imposed technical requirements? ***What are the environmental conditions and are they monitored (charts, gages, etc., within calibration)?***

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1. Are the work areas where the work is being performed, clean and free from dirt and debris?

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1. Are there an adequate number of fire protection devices maintained and readily available for use? Are eye-wash stations located in the work area, and are they easily accessible?

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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 by the supplier to verify competency of the supplier personnel.***

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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: |  |

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| 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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