AMCA
AMERICAN MANUFACTURING
COMPLIANCE AUTHORITY

FORGING
QUALITY STANDARD

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AMERICAN MANUFACTURING COMPLIANCE AUTHORITY (AMCA)
QUALITY STANDARDS FOR FORGING OPERATIONS

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1. Purpose and Scope

These Quality Standards for Forging, issued by the **American Manufacturing Compliance Authority (AMCA)**, establish minimum requirements for the production, inspection, and documentation of forged metal components. These standards apply to open-die, closed-die, ring-rolled, and precision-forged products manufactured for commercial, industrial, and defense applications.

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2. Definitions

Forging: A manufacturing process involving controlled plastic deformation of metal using compressive forces.
Heat Lot: A quantity of metal produced from a single melt with uniform chemical composition.
Forging Plan: A documented sequence detailing temperature control, deformation steps, tooling, and post-processing.
Non-Destructive Examination (NDE): Inspection methods that do not damage the product (e.g., UT, MT, PT).
Final Acceptance: Approval granted after the product meets all dimensional, mechanical, and metallurgical requirements.

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3. Material Standards

3.1 **Material Certification**

- Suppliers shall provide full material certifications, including chemical composition, mechanical properties, and heat-lot traceability.
- Material substitutions are prohibited without written AMCA-compliant approval.

3.2 **Storage and Handling**

- Raw materials must be stored to prevent corrosion and contamination.
- Bars, billets, and slabs must be tagged with heat-lot identification at all times.

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4. Process Control Requirements

4.1 **Forging Plan**

- Each forging operation shall have a documented plan specifying pre-heat temperatures, deformation sequences, lubrication requirements, and post-forging cooling methods.
- Plans must be reviewed and updated annually or when process changes occur.

4.2 **Temperature Control**

- Forging temperatures must remain within the metal manufacturer's recommended working range.
- Temperature-monitoring equipment shall be calibrated every six months.
- Over-heating or burning of metal is strictly prohibited and requires scrapping of the affected part.

4.3 **Tooling Requirements**

- Dies, hammers, presses, and manipulators shall undergo routine inspection for wear, cracks, and dimensional integrity.
- Tooling shall be replaced or repaired before causing surface or dimensional defects in forgings.

4.4 **Lubrication and Surface Treatment**

- Only AMCA-approved lubricants shall be used, applied in a manner preventing contamination or surface degradation.
- Any coating used must not alter metallurgical properties.

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5. Product Requirements

5.1 **Dimensional Accuracy**

- Finished forgings must meet all customer-specified tolerances.
- Dimensional deviations beyond tolerance require documented corrective action.

5.2 **Surface Quality**

- Forgings must be free of folds, laps, cracks, seams, burns, scaling excess, or other defects affecting performance.
- Minor, non-structural imperfections may be blended only with written approval and not beyond 10% material removal in any location.

5.3 **Mechanical Properties**

- Tensile strength, yield strength, elongation, reduction of area, and hardness shall meet specified requirements for the material grade.
- Test coupons must represent the forging heat and deformation conditions.

5.4 **Microstructure Requirements**

- Grain size, flow lines, and inclusion content must conform to applicable specifications.
- Excessive grain growth or distortion is cause for rejection.

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6. Heat Treatment Standards

6.1 **Procedure Compliance**

- All heat treatments (annealing, quenching, tempering, normalizing) shall follow approved written procedures.
- Furnace temperature uniformity must be verified annually.

6.2 **Traceability**

- Each forging must remain traceable to the heat-treatment batch.
- Time-at-temperature records must be retained for a minimum of 10 years.

6.3 **Quenching and Cooling**

- Cooling media must be monitored for contamination, temperature, and performance.
- Inconsistent quenching leading to unacceptable hardness variation is grounds

for rejection.

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7. Inspection and Testing Requirements

7.1 **Visual Inspection**

- 100% of forgings must undergo visual examination for surface defects prior to machining.
- Lighting shall meet a minimum of 500 lux during inspection.

7.2 **Dimensional Inspection**

- Calibrated instruments (CMM, micrometers, gauges) must be used.
- Sampling plans shall comply with AMCA-QC-105 or customer-defined requirements.

7.3 **Non-Destructive Examination (NDE)**

- Ultrasonic, magnetic particle, dye penetrant, or radiographic testing shall be performed per the product specification.
- NDE personnel must be certified to ASNT SNT-TC-1A or equivalent.

7.4 **Destructive Testing**

- Mechanical testing must follow ASTM or equivalent applicable standards.
- Failures require full investigation, including metallographic analysis when necessary.

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8. Documentation and Recordkeeping

8.1 **Traceability**

- Each forging must be traceable from raw material to final inspection.
- Unique identification shall be maintained throughout processing.

8.2 **Process and Inspection Records**

- Forging plans, heat-treatment logs, calibration reports, and inspection results must be retained for a minimum of 10 years.
- Electronic records must be protected from unauthorized modification.

8.3 **Non-Conformance Reports (NCRs)**

- All deviations must be documented in NCRs.
- NCRs must include root-cause analysis and corrective actions.

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9. Corrective and Preventive Actions

9.1 **Non-Conformance Handling**

- Suspect forgings must be quarantined and reviewed by Quality Assurance.
- Rework must not compromise material integrity and must follow an AMCA-approved procedure.

9.2 **Corrective Action Process**

- Root-cause analyses must use recognized methods (e.g., 5-Why, Fishbone).
- Follow-up verification is required to confirm the effectiveness of corrective actions.

9.3 **Preventive Actions**

- Trends in defects, equipment failure, or process drift must be analyzed quarterly.
- Preventive actions shall be documented and reviewed by management.

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10. Personnel and Training

- Forging operators must receive annual training on safety, temperature control, and equipment operation.
- Inspectors and heat-treat technicians must maintain certification to applicable industry standards.
- Training records must be maintained for each employee.

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11. Safety and Environmental Requirements

- Work areas must comply with occupational safety regulations, including proper guarding of presses and hammers.
- Handling of lubricants, coolants, and quench media must meet environmental guidelines.
- Waste materials must be disposed of per federal and state regulations.

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12. Final Acceptance and Certification

- A forging is considered acceptable only when it meets all dimensional, mechanical, metallurgical, and documentation requirements.
- Final certification must reference material heat lots, forging batch records, inspection results, and NDE findings.
- AMCA reserves the right to audit compliance at any time.

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