AMERICAN MANUFACTURING COMPLIANCE AUTHORITY

CNC MACHINING QUALITY STANDARD

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AMERICAN MANUFACTURING COMPLIANCE AUTHORITY (AMCA)
QUALITY STANDARDS FOR CNC MACHINING
Version 1.0

1. Introduction

The American Manufacturing Compliance Authority (AMCA) establishes the following CNC Machining Quality Standards to ensure consistent, safe, and high-precision manufacturing outcomes. These standards apply to all CNC machining operations, including milling, turning, drilling, grinding, and multi-axis machining. Compliance with these standards ensures accuracy, repeatability, productivity, and safety across all machining environments.

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2. General Quality Requirements

2.1 Documentation and Control

- All machining operations must follow controlled and approved technical drawings, CAD models, process instructions, and revision-controlled documents.
- Any changes to specifications must be authorized through a formal change control process.
- Quality documentation—including inspection reports, machine logs, and material certifications—must be maintained for a minimum of five years.

2.2 Operator Qualifications

- CNC operators must be trained and certified on the specific machines they operate.
- Refresher training is required annually to maintain certification and ensure adherence to new AMCA standards.
- Only authorized personnel may edit or load CNC programs.

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3. Machine Setup and Calibration

3.1 Machine Condition

- Machines must be inspected daily for cleanliness, lubrication levels, tool integrity, and safety interlocks.
- Preventive maintenance shall follow manufacturer schedules and must be documented.

3.2 Calibration

- Machine calibration must be performed at intervals not exceeding six months, or sooner if accuracy issues are detected.
- Calibration tools (e.g., probes, gauges, lasers) must themselves be certified and traceable to recognized national measurement standards.

3.3 Program Verification

- All CNC programs must undergo simulation and dry-run validation before production.
- First-article inspections (FAI) are required for all new or modified programs.

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4. Materials and Incoming Inspection

4.1 Material Verification

- All incoming materials must be verified against purchase order requirements, including alloy type, grade, heat number, and certification.
- Material test reports (MTRs) must be stored and linked to production batches for full traceability.

4.2 Storage and Handling

- Materials shall be stored in designated, labeled areas to avoid cross-mixing.
- Raw material surfaces must be protected from corrosion, deformation, or contamination.

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5. Machining Process Standards

5.1 Dimensional Accuracy

- Unless otherwise specified, default tolerances shall follow ISO 2768-m or equivalent national standards.
- Critical dimensions require documented process capability studies (Cp, Cpk ≥ 1.33).

5.2 Surface Finish

- Surface finish requirements must be defined on drawings.
- Surfaces designated as functional or mating surfaces require enhanced inspection using profilometers or optical measurement tools.

5.3 Tooling Requirements

- Cutting tools must be inspected before use for wear, chips, or coating damage.
- Tool life management systems must track tool usage, life expectancy, and replacement intervals.
- Tool offsets must be set using certified measurement instruments.

5.4 Coolant and Lubrication

- Coolants must meet manufacturer concentration specifications and be tested at least weekly.
- Contaminated or degraded coolant must be replaced immediately.

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6. In-Process Inspection Standards

6.1 Inspection Frequency

- Inspection frequency must be defined in the control plan based on risk, tolerance sensitivity, and production volume.
- High-precision or safety-critical components require 100% inspection unless statistically justified otherwise.

6.2 Measurement Tools

- Measuring devices (calipers, micrometers, CMMs, height gauges) must be calibrated at least annually.
- CMM programs must be validated and linked to the latest part revision.

6.3 Statistical Process Control (SPC)

- SPC charts must be used for key characteristics.
- All trends toward out-of-tolerance conditions must trigger immediate investigation and corrective action.

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7. Final Inspection and Documentation

7.1 Final Dimensional Check

- A complete dimensional inspection must be performed on one part per batch or according to the control plan.
- All deviations must be recorded, reviewed, and approved by quality management.

7.2 Non-Conforming Product

- Non-conforming parts must be clearly tagged and isolated.
- Rework requires approval and must follow documented rework procedures.
- Scrap must be recorded, reviewed, and included in continuous improvement metrics.

7.3 Documentation Requirements

- Final inspection reports must include actual measurements, operator signatures, equipment used, and environmental conditions when applicable.
- Certificates of conformance (COCs) must accompany outgoing shipments when required by the customer.

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8. Safety Standards

8.1 Machine Safety

- All guards, interlocks, and emergency stops must be functional and tested regularly.
- Operators must use appropriate PPE, including safety glasses, gloves, and hearing protection.

8.2 Workholding Safety

- Fixtures, vises, and clamps must be inspected before use to ensure structural integrity.
- Workpieces must be secured to prevent movement under load.

8.3 Fire and Chemical Safety

- Coolants, lubricants, and cleaning agents must be stored according to MSDS requirements.
- Fire extinguishers must be accessible and inspected monthly.

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9. Packaging and Shipping Standards

9.1 Protection of Finished Parts

- Parts must be visually inspected before packing.
- Protect critical surfaces with caps, foam, or corrosion-preventive material.
- Packaging must prevent contact damage during transport.

9.2 Labeling

- Packages must clearly display part numbers, revision levels, quantities, and batch or lot numbers.

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10. Continuous Improvement Requirements

10.1 Corrective and Preventive Actions (CAPA)

- All deviations require corrective actions with documented root-cause analysis.
- Preventive actions should address systemic issues and reduce future risk.

10.2 Performance Metrics

- Key quality indicators include scrap rate, rework rate, first-pass yield, and machine downtime.
- Metrics must be reviewed monthly by management.

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11. Compliance and Auditing

- Internal audits must be performed at least annually.
- Non-compliance findings require documented action plans.
- Suppliers providing CNC machining services must comply with all AMCA standards and may be subject to on-site audits.

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Printed in the United States of America