AMCA
AMERICAN MANUFACTURING COMPLIANCE AUTHORITY

MILLING & TURNING QUALITY STANDARD

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AMCA Quality Standards for Milling and Turning

Adopted by the American Manufacturing Compliance Authority (AMCA)

1. Scope and Purpose

These standards define the minimum quality, process control, documentation, and verification requirements for precision milling and turning operations. They apply to manufacturers engaged in subtractive machining of metallic and non-metallic components used across commercial, industrial, aerospace, and general engineering applications. Their purpose is to ensure product conformity, repeatability, and continuous improvement in machining processes.

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2. Definitions

2.1 Milling – A machining process that removes material using rotating multi-point cutting tools.
2.2 Turning – A machining process that removes material from a rotating workpiece using single-point cutting tools.
2.3 Critical Dimension – A feature whose deviation directly affects function, safety, or assembly fit.
2.4 Non-Conformance – Any condition where a product or process fails to meet specified requirements.
2.5 First-Article Inspection (FAI) – A complete verification of all characteristics on an initial production part.

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3. General Requirements

3.1 Compliance

All machining operations shall comply with applicable customer specifications, engineering drawings, technical data packages, and contractual requirements.

3.2 Personnel Competency

Operators, programmers, and inspectors must be trained and competent in machining principles, tool usage, measurement techniques, and safety standards.

3.3 Equipment Calibration

All measurement devices, CNC machines, and related equipment shall be

calibrated at intervals not exceeding 12 months, traceable to recognized national or international calibration authorities.

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4. Machining Requirements

4.1 Equipment Condition

- Machines must be maintained per manufacturer recommendations.
- Spindles, ways, hydraulic systems, and toolholders must be routinely inspected for wear.
- Preventive maintenance records must be kept for a minimum of 3 years.

4.2 Tooling

- Cutting tools shall be selected to achieve specified tolerances and surface finishes.
- Tools must be replaced or reground according to documented wear limits.
- Tool life monitoring systems should be used for automated operations.

4.3 Cutting Parameters

- Feeds, speeds, and depth of cut must be documented for each job.
- Deviations from validated parameters require approval from a qualified process engineer.

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5. Process Control Requirements

5.1 Workholding

- Fixtures and workholding devices must ensure rigid, repeatable positioning.
- Clamping methods must not distort the part or compromise dimensional requirements.

5.2 Setup Verification

- Initial setups must be independently verified prior to production.
- Zero points, offsets, and tool paths must be validated through dry runs or simulation.

5.3 In-Process Monitoring

- Critical dimensions shall be monitored at defined intervals during production.
- SPC (Statistical Process Control) methods are recommended for repeat-run parts.
- Any trend indicating variation toward tolerance limits requires corrective action.

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6. Dimensional and Geometric Requirements

6.1 Tolerances

- All machined features must meet dimensional and geometric tolerances specified in engineering documentation.
- Where no tolerance is provided, standard tolerances shall follow ISO 2768-m or equivalent, unless otherwise specified.

6.2 Surface Finish

- Surface roughness parameters must conform to drawing requirements.
- Surfaces not dimensioned for finish should meet Ra 3.2 µm (125 µin) or better unless otherwise stated.

6.3 Edge Conditions

- Edges must be free from burrs and sharp projections, unless intentionally designed.
- Chamfers and radii must be consistent with specified dimensions.

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7. Inspection and Verification

7.1 First-Article Inspection

- FAI shall be performed for new parts, revised drawings, or process changes.
- Results must be documented using an AMCA-approved FAI report.

7.2 In-Process Inspection

- Operators must perform documented checks at defined intervals.
- Inspection frequency must increase when dimensional drift is detected.

7.3 Final Inspection

All finished components must undergo:

- Dimensional verification of all critical features
- Visual inspection for surface anomalies
- Confirmation of material identification and traceability

7.4 Inspection Equipment

- Use CMMs, height gauges, micrometers, profilometers, and other calibrated tools suitable for required tolerances.
- Inspection setup must ensure thermal stability and cleanliness.

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8. Material and Traceability Requirements

- All materials shall be verified against purchase specifications before machining.
- Heat lot, grade, and certification documents must be traceable to each machined part or batch.
- Scrap or non-conforming materials must be segregated and clearly identified.

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9. Documentation Requirements

9.1 Process Documentation

Manufacturers shall maintain:

- Setup sheets
- Tool lists
- CNC programs (with revision control)
- Inspection plans
- Maintenance logs

9.2 Record Retention

All quality-related documentation must be retained for a minimum of 5 years unless otherwise contractually required.

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10. Non-Conformance and Corrective Action

- Non-conforming parts must be quarantined and documented using an AMCA Non-Conformance Report (NCR).
- Root cause analysis must be performed for all recurring issues.
- Corrective actions must be documented, implemented, and verified for effectiveness.

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11. Continuous Improvement

Manufacturers are encouraged to implement programs that improve productivity, accuracy, and process stability, including:

- Tool life optimization
- Machine capability studies
- Lean manufacturing methods
- Employee skills development

12. Safety and Environmental Considerations

- Proper guarding, PPE, and safe operating procedures must be enforced.
- Coolants, chips, and waste materials must be handled and disposed of according to environmental regulations.

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