AMCA
AMERICAN MANUFACTURING COMPLIANCE AUTHORITY

GEARS MANUFACTURING QUALITY STANDARD

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AMERICAN MANUFACTURING COMPLIANCE AUTHORITY (AMCA)
QUALITY STANDARDS FOR GEARS MANUFACTURING

1. Purpose and Scope

These standards define the minimum quality requirements, manufacturing practices, inspection criteria, and documentation protocols for the production of gears under AMCA certification. The goal is to ensure that all gears manufactured meet strict standards of safety, precision, durability, and performance, and to provide a clear, consistent benchmark for quality across U.S.-based gear producers.

They apply to all types of mechanical power-transmission gears (spur, helical, bevel, worm, fine-pitch, etc.), and to all stages of manufacturing: material procurement, machining, heat treatment, finishing, inspection, and final release.

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2. Regulatory Foundation and Standard References

- All AMCA-certified gear manufacturing operations must operate under a documented Quality Management System (QMS) consistent with — and exceeding — the internationally accepted standard ISO 9001:2015. amcacert.com+2amcacert.com+2
- In addition, gear-specific manufacturing and quality shall align with the published standards of American Gear Manufacturers Association (AGMA), including but not limited to design, tolerancing, inspection practices, materials, heat treatment, and surface finish. agma.org+2PMC+2
- Where applicable, international standards (e.g. from International Organization for Standardization — ISO; or European standard bodies such as Deutsches Institut für Normung (DIN)) may be referenced for geometrical tolerances, material specifications, and hardening/finishing protocols to ensure global compatibility. ScienceDirect+1

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3. Raw Material Control & Traceability

- All raw materials (gear blanks, bars, billets, forgings) must be procured from

qualified domestic mills or suppliers. Mill Test Reports (MTRs) or equivalent documentation must accompany each lot, certifying chemical composition, mechanical properties, and heat-treatment history (if pre-treated).

- Upon receipt, perform Incoming Quality Control (IQC) to verify material identity against purchase specifications. Reject any material not meeting specified requirements before machining begins.
- Maintain traceability of material origin, lot number, and heat-treatment batch through the entire production and inspection process.

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4. Manufacturing Process & Permitted Methods

- Gears may be manufactured by appropriate methods depending on required quality class and application: hobbing, shaping, CNC machining, grinding, gear milling, shaving, or other approved processes. The chosen method must be documented and justified for the required finished quality. PMC+1
- For gears requiring high precision (tight tolerances, smooth operation, minimal noise and vibration), finishing operations (grinding, hard-machining, form-finishing) are strongly recommended after heat treatment to achieve required geometrical and kinematic accuracy. PMC+1
- Process parameters (cutting speeds, feeds, tool condition, heat-treatment cycles, quenching, tempering, case hardening, carburizing, surface hardening, etc.) must be documented, controlled, and periodically reviewed to ensure consistency and repeatability.

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5. Tolerance Classes, Dimensional Accuracy & Gear Quality Grades

- Gears must be manufactured and inspected according to recognized tolerance/accuracy classes defined by AGMA (and related standards) — higher grade numbers correspond to tighter tolerances and higher precision. PMC+1
- For fine-pitch spur and helical gears, tooth-to-tooth composite error, total

composite error, run-out, backlash, and other critical parameters must meet or exceed the tolerances associated with the selected AGMA Quality class. (Refer to the appropriate AGMA numbering system.) American Gear, Inc.+1

- The required quality class must be specified on engineering drawings or order documentation, based on application — e.g. high-speed transmissions, precision instruments, or heavy load industrial gearboxes must call for higher accuracy classes.

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6. Heat Treatment, Metallurgy & Surface Integrity

- For gears subjected to high load, wear, or fatigue cycles, heat treatment (case hardening, through-hardening, carburizing, induction hardening, etc.) must be applied following documented procedures. Hardness levels must be verified and recorded.
- Post–heat treatment operations (grinding, hard-machining, finish milling) must ensure that dimensional tolerances are maintained, and that gear tooth geometry (profile, lead, pitch) is not compromised.
- Surface finish and any coatings (if required for corrosion resistance or lubrication) must comply with specified standards for roughness, uniformity, and adhesion to prevent premature wear or failure.

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7. Inspection and Testing Procedures

- Every gear must undergo a complete inspection before release. Inspection must include, at minimum: tooth profile and form, pitch accuracy, lead/helix, run-out, concentricity, tooth-to-tooth spacing, composite errors, backlash, and any other application-specific requirements (e.g. surface finish, hardness, coating).
- Use calibrated precision measurement tools (gear measuring machines, CMMs, gear testers) appropriate for the required accuracy class. All measuring equipment must be maintained, periodically calibrated, and records retained.
- Where required, dynamic testing (noise, vibration, NVH), load testing, or “fit-and-function” tests must be performed to verify operational performance

under load and real-world conditions. Especially for high-precision or heavy-duty gears.

- Maintain inspection records for each lot or order, including serial numbers, measurement data, material lot references, heat treatment batch, and final pass/fail status.

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8. Documentation & Traceability

- Each gear order must be accompanied by a documented manufacturing plan, including material certificate, process flow (machining → heat treatment → finishing → inspection), and quality requirements/acceptance criteria.
- All quality control data (incoming material certificates, in-process checks, final inspection results, calibrations) must be recorded and retained for traceability, audits, and customer verification.
- Non-conforming parts must be clearly identified, segregated, and dispositioned (rework, scrap, or return); corrective and preventive actions (CAPA) must be documented for any recurring issues.

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9. Quality Management System & Continuous Improvement

- The gear manufacturer must maintain an AMCA-approved QMS that ensures control of all processes, documentation, nonconformities, supplier management, training, and audit readiness. This QMS must be periodically audited internally and externally as required by AMCA.
- Employees involved in gear manufacturing, inspection, and quality control must be trained and qualified. Training records must be maintained.
- Implement a system of continual improvement: periodic review of production metrics, nonconformity trends, customer feedback, and process capability (Cp/Cpk) to strive toward tighter tolerances, higher reliability, and fewer defects.

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10. Compliance, Certification & Ethical Standards

- Certification under AMCA requires transparent adherence to all above requirements. Any attempt to use fraudulent documentation (e.g. fake certifications) to bypass quality requirements is strictly prohibited. EIN Presswire+1
- Manufacturers must commit to "Made-in-USA" compliance for all covered gear production under this standard, including sourcing, machining, heat treatment, finishing and final inspection — ensuring full traceability and domestic origin. amcacert.com+1
- Suppliers or sub-contractors used must themselves meet equivalent material and quality standards; all subcontracted processes must be documented and traceable within the QMS.

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11. Customer Communication & Specification Compliance

- All customer orders must include clear documentation of required gear type, quality grade, material specification, heat treatment requirement, surface finish/coating specification, inspection criteria, and delivery requirements.
- Any deviations from standard tolerances or specifications must be clearly communicated to the customer and approved in writing prior to production or delivery.
- For critical applications (e.g. aerospace, heavy industrial, high-speed transmissions), provide customers with full documentation package (material certificates, inspection reports, heat treatment data, test results) along with the final gear delivery.

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12. Review and Revision of Standards

- These standards shall be reviewed periodically (at least every 2 years) by the AMCA Standards Committee to incorporate advances in materials, manufacturing methods, inspection technology, and evolving industry requirements.
- All revisions must be formally documented; each new version must include

a “Change Log” summarizing modifications, and manufacturers must be notified and required to comply with updated requirements within a defined transition period.

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13. Enforcement, Auditing, and Non-Conformance Handling

- AMCA reserves the right to perform scheduled and unannounced audits of certified manufacturing facilities to verify compliance with all standards and documentation practices.
- In case of non-conformance (documentation issues, substandard gear quality, traceability lapses, process deviations), AMCA may demand corrective action, impose sanctions, or revoke certification if standards are not met within a defined time.
- Non-conforming gear deliveries must be quarantined; recall procedures initiated if substandard gears have been shipped.

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14. Summary of Minimum Gear Quality Criteria

Category	Requirement
Material & Traceability	Mill-certified domestic material, MTR retained, IQC performed
Manufacturing Process	Approved method based on required gear grade; documented process flow
Tolerances / Accuracy	Meet specified AGMA or equivalent Standard tolerances for the selected quality class
Heat Treatment & Finishing	Where required, properly applied with post-treatment finishing; hardness and surface integrity verified
Inspection & Testing	Complete inspection (geometry, tooth form, run-out, backlash, composite error); dynamic/load tests where applicable
Documentation	Full traceability, QC records, calibration logs, inspection reports, material certificates
QMS & Auditing	Documented QMS exceeding ISO 9001; internal and external audits; CAPA for defects

Category	Requirement
Ethics & Certification Validity	No use of fraudulent certification; compliance with “Made in USA” requirements; sub-contractor oversight

Notes:

- While this document uses “AGMA” standards for gearing specifics (tolerances, quality classes, inspection methods), the AMCA Quality Standards are not limited to AGMA — alternative recognized standards (e.g., ISO, DIN) may be applied when clearly specified in contractual or engineering documentation.
- This standard does **not** replace the need for engineering review. For each gear design or application, the responsible engineer must specify appropriate tolerances, materials, heat treatment, surface finish, and inspection requirements.
- For specialized applications (e.g. high-speed transmissions, aerospace, heavy-duty industrial use), additional requirements (e.g. NVH, fatigue testing, dynamic balancing) may be added per customer specifications or regulatory demands.

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