AMCA

AMERICAN MANUFACTURING COMPLIANCE AUTHORITY

SCREW/SWISS MACHINING QUALITY STANDARD

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American Manufacturing Compliance Authority (AMCA)

Quality Standards for Swiss/Screw Machining

1. Introduction

Swiss/Screw machining is a precision manufacturing process that involves the use of automatic lathes, often referred to as Swiss-type lathes, to produce high-precision, complex parts. This process is utilized in a wide range of industries, including aerospace, medical devices, automotive, and electronics, where high dimensional accuracy, tight tolerances, and superior surface finishes are essential. The following quality standards have been established by the American Manufacturing Compliance Authority (AMCA) to ensure consistent product quality, improve operational efficiency, and uphold the highest standards in Swiss/Screw machining.

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2. General Requirements

- **Compliance with Industry Standards**: All Swiss/Screw machining operations must comply with relevant industry standards such as ASTM, ISO 9001, and ISO 2768, as well as AMCA-specific guidelines.
- **Certification of Equipment and Operators**: All equipment used in Swiss/Screw machining must be certified to meet the required operational standards. Operators must undergo comprehensive training and hold certifications specific to Swiss/Screw machining processes, such as those provided by AMCA-accredited training programs.
- **Continuous Improvement**: All machining operations should maintain a focus on continuous improvement, utilizing lean manufacturing principles and Six Sigma methodologies to minimize waste and improve efficiency.

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3. Material Requirements

- **Material Specifications**: Only materials that meet the designated specifications for the part being manufactured should be used. Material certificates, such as those issued by mills or vendors, must be provided and

maintained as part of the quality control documentation.

- **Material Traceability**: The material used in Swiss/Screw machining must be traceable from delivery to the final product, including batch numbers, material certification, and any associated test results.

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4. Equipment Requirements

- **Machine Calibration**: Swiss/Screw machines must be calibrated regularly (at least annually) to ensure precision and accuracy in machining operations. Calibration should be performed according to the manufacturer's guidelines and AMCA requirements.
- **Preventive Maintenance**: A regular preventive maintenance schedule must be established and followed for all Swiss/Screw machining equipment. This includes routine checks for wear on critical components such as spindles, tools, and feed mechanisms.
- **Tooling Integrity**: Cutting tools, inserts, and other tooling must be inspected for wear and damage at regular intervals. Worn or damaged tools should be replaced immediately to avoid defects in the final product.

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5. Tolerances and Dimensional Control

- **Tolerances**: Swiss/Screw machining parts must meet the specified tolerances, typically ranging from ±0.001 inches (0.025 mm) for critical dimensions. A tolerance range must be agreed upon with the customer and adhered to at all times.
- **Dimensional Verification**: Parts must undergo dimensional verification using calibrated measurement equipment such as micrometers, coordinate measuring machines (CMM), or optical comparators. Verification should occur at each stage of the machining process to ensure the part remains within tolerance.
- **First Article Inspection (FAI)**: A first article inspection must be conducted for each new part design or batch. The FAI results must be documented and approved before mass production begins.

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6. Surface Finish and Quality

- **Surface Finish Requirements**: The surface finish of parts produced using Swiss/Screw machining should meet the specified roughness (Ra) values. Typical requirements might include finishes such as Ra 0.8–1.6 μm for general components or finer finishes for high-precision applications.
- **Surface Defects**: All parts must be free from surface defects such as scratches, tool marks, and burrs. If defects are detected during visual inspection, the part should be removed from the production line and further investigated.
- **Polishing and Deburring**: Any parts that require additional surface treatments, such as polishing or deburring, must meet specific standards. These treatments should be performed using approved methods to ensure consistency and precision.

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7. Process Control and Monitoring

- **Statistical Process Control (SPC)**: Swiss/Screw machining operations must employ Statistical Process Control (SPC) techniques to monitor key process variables such as spindle speed, feed rates, and temperature. This ensures consistent production quality and helps in identifying process deviations before they lead to defects.
- **Process Audits**: Regular internal process audits should be conducted to evaluate adherence to quality standards. These audits should include the review of machine setup, tooling integrity, operator performance, and part inspections.
- **Real-time Data Monitoring**: Implement real-time data acquisition systems that allow for the monitoring of key parameters such as cutting forces, vibration levels, and tool wear. This data can be used to optimize machining parameters and minimize the risk of errors.

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8. Inspection and Testing

- **In-Process Inspection**: Operators are responsible for performing in-process inspections using precision measuring tools (e.g., calipers, micrometers) at regular intervals. This ensures that any deviations from specifications are

caught early in the process.

- **End-of-Line Inspection**: Before final inspection, all parts must undergo an end-of-line inspection, including a full dimensional check, visual inspection, and surface finish verification. Any non-conforming parts should be flagged for further evaluation and corrective action.
- **Third-Party Testing**: For critical applications, such as aerospace or medical devices, third-party testing and certification may be required. This could include non-destructive testing (NDT) such as ultrasonic testing or X-ray analysis, to detect any hidden defects.

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9. Documentation and Traceability

- **Documentation Requirements**: All quality control checks, inspection results, and corrective actions must be documented throughout the production process. This includes keeping records of machine settings, tool changes, material certificates, and test results.
- **Traceability of Parts**: Each part must have a unique identification number (e.g., serial number, batch code) to ensure full traceability throughout the manufacturing process. This allows for quick identification in case of quality issues or recalls.
- **Quality Records**: All documentation related to the production process must be stored and maintained in accordance with AMCA's record retention policy. These records should be easily accessible for audits, customer requests, and compliance checks.

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10. Non-Conformance and Corrective Actions

- **Non-Conformance Management**: Any part that does not meet the required specifications must be immediately flagged as non-conforming. Non-conforming parts should be segregated, and corrective actions must be implemented to prevent recurrence.
- **Root Cause Analysis**: A root cause analysis (RCA) should be conducted to identify the underlying cause of any defects or deviations from specifications. Corrective actions should be implemented, and preventive measures should be established to minimize the occurrence of similar issues

in the future.

- **Continuous Monitoring**: After corrective actions have been implemented, the affected processes or machines should be closely monitored to ensure that the corrective actions have been effective.

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11. Conclusion

The quality standards outlined in this document are designed to ensure that Swiss/Screw machining operations consistently meet customer requirements and industry standards. Compliance with these standards is essential to achieving high-quality, precision parts that satisfy both functional and regulatory requirements. By following these guidelines, manufacturers can maintain a robust quality control system, minimize defects, and continuously improve their operations to stay competitive in the marketplace.

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