

Supplier Quality Manual



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1 Supplier Quality Requirements & Guidelines

1.1 INTRODUCTION

First Solar's MISSION is to create enduring value by enabling a world powered by clean, affordable solar electricity. To achieve this mission, we must optimize our energy yield predictability with world class quality and reliability. You, as our Suppliers, are critical to our mission success, and will be held to the highest standards as you drive process control and continuous improvement within your organization.

First Solar expects that our direct suppliers will manage sub-tier suppliers with controls commensurate with those First Solar applies to direct suppliers.

NOTE: ACCEPTANCE OF A FIRST SOLAR PURCHASE ORDER (PO) CONSTITUTES ACKNOWLEDGEMENT THAT THE SUPPLIER HAS READ, UNDERSTANDS, AND WILL COMPLY WITH THE REQUIREMENTS SET FORTH IN THIS MANUAL.

1.2 PURPOSE & SCOPE

The First Solar Global Supplier Quality Manual is intended to communicate the minimum quality requirements, processes, and systems for material and component suppliers to ensure all members of the supply base meet or exceed the requirements and guidelines for providing world-class products. This manual outlines the strategy used by First Solar to ensure that First Solar's supply base is continually improving to prevent quality and delivery disruptions, provide the lowest cost, and top level service.

Our suppliers are critical to our success, and are expected to be knowledgeable in the content of the First Solar, Inc. Global Supplier Quality Manual. We ask that as a part of doing business with First Solar, the appropriate stakeholder(s) within your organization review the manual and maintain a working knowledge of its content.

This manual does not replace, substitute or override any requirements set forth in any supply agreement, contract, material specification or drawing.

1.3 SUPPLIER SYSTEM REQUIREMENTS

ISO Certification / Compliance

First Solar expects our suppliers' quality management systems to be certified to the latest version of ISO 9001, or a comparable quality management system. In cases where certification is not possible, compliance is required. It is the suppliers' responsibility to provide evidence of compliance.

It is also highly recommended that suppliers conform to ISO 14001: Environmental Management Systems; and OHSAS 18001: Occupational Health and Safety Management Systems.

1.4 PROCESS DEFINITION AND CAPABILITY REQUIREMENTS

Process/Product Definition and Risk Management

- Suppliers are required to fully document their manufacturing and delivery process.
- Suppliers shall establish a risk management process to effectively assess elements in various aspects of their business that could negatively affect the quality of the products, delivery and services provided to First Solar, Inc. At a minimum, this includes...
 - Design (product) and/or Process Failure Modes and Effects Analysis (FMEA)
 - Control Plans
 - Process Flow Diagram

Process Capability

- First Solar will consistently provide superior quality products to our customers. To achieve this goal, all material suppliers will be expected to achieve target process capability levels and maintain control plans, as directed by First Solar.
 - Key product or process characteristics (may also be referred to as Category 1 characteristics) may be outlined in First Solar drawings and/or specifications. If there are no First Solar key characteristics defined, the supplier is responsible to identify key product and/or process characteristics and validate their capability. These must be documented in the supplier's control plan. The supplier's control plan must identify sampling method and frequency for all characteristics.
- Statistical Process Control (SPC) must be applied to all First Solar- and/or supplier identified key characteristics.
 - Real-time measurement and tracking with a statistical run chart as appropriate.
 - Effective monitoring and timely reaction and documentation to out-of-control conditions.
- Process Capability Description

- Short-term Process Capability: Statistical capability of a process with common causes of variation only. This type of variation is also referred to as inherent process variation.
- Long-term Process Capability - Statistical capability of a process generally in-control but could include special cause variation experienced through an extended period of manufacturing time (e.g. tool wear, machine aging, lot-to-lot variations, shift changes, machine-to-machine differences, etc.).
- First Solar Process Capability Requirements - Because special causes of variation can be introduced into a process on a long-term basis, First Solar sets separate process capability targets as follows:
 - Short-term Process Capability: 1.67 Cpk or higher
 - Long-term Process Capability: 1.33 Cpk or higher
- Specific timeframes defining a short-term and long-term production run will be determined based on the nature of the product and process involved.

1.5 SUPPLIER QUALIFICATION PROCESS

First Solar Change Management System (CMS)

- First Solar has established the Change Management System (CMS) which uses a phase-gate process to manage and implement changes to First Solar products and processes, as well as components and products supplied to First Solar. (Ref. section 1.9 Change Notification)
- Supplier activities must be coordinated for timely and successful completion to support the overall CMS project timeline and objectives. The Advanced Supplier Readiness (ASR) process is used in conjunction with the part approval process.

Advanced Supplier Readiness (ASR) – Overview

- The Advanced Supplier Readiness (ASR) process is a compilation of qualification requirements that the supplier must meet in order for their specific product or process to be approved for use by First Solar. The supplier will be required to demonstrate conformance to these requirements. The First Solar Supplier Quality representative will manage the supplier to ensure that all applicable requirements are met and verified on a timely basis.
- Advanced Supplier Readiness requirements: Conformance to all or part of the list below will apply depending on the requirements set forth by First Solar.
 - Supplier Change Request Form
 - Conformance to First Solar drawings and/or specifications
 - Design and/or Process Failure Mode and Effects Analysis (FMEA)

- Process Flow Diagram and Control Plan
- Measurement Systems Analysis (MSA, Gage Study, GRR)
- Process Capability
- Detailed Overall Supply Chain Map
- (Material) Safety Data Sheet (SDS)
- Supplier Qualification and Test plan, including Project Timeline
- Packaging Plan, Transportation Plan, & Labeling Plan
- Capacity Plan and Capacity Analysis
- Third Party and/or Regulatory Requirements (e.g. UL, IEC, TUV, ETL, etc.) Component Level Recognition may be required.
- Tier 2 Supplier Documentation/ Specifications/Prints
- Raw Material Certification, including Tier 2 Data as required
- Complete Layout for all Print and Specification requirements (dimensional, functional or performance)
- Certificate of Analysis (CoA) or Certificate of Compliance (CoC)
- Evidence of continual conformance to First Solar requirements
- Qualification Approval: Supplier will be notified by First Solar upon successful completion of qualification requirements.

Continual Conformance

- Supplier must provide documented evidence of conformance to all applicable First Solar requirements at a minimum frequency of annually. This requirement must be documented in the supplier's control plan.

First Solar Supplier Reliability Assurance Compliance Framework

- This section is directed at suppliers who have full responsibility for the design and control and production for a component or sub-system. (These include suppliers of BOS components such as inverters, transformers, plant controller, tracker electronics and actuators).
- First Solar recognizes the customer-supplier dialogue as the foundation for an effective reliability program and has structured these expectations for a performance-based approach with shared responsibility. This framework relies heavily on the all crucial customer-supplier dialogue, and it intentionally allows suppliers great freedom to uniquely tailor their internal reliability programs, while striving to achieve the expectations set by First Solar. This document contains criteria consistent with First Solar's expectations for jointly developing a plan for designing, qualifying and assuring products for reliability performance.

- First Solar Supplier Reliability Assurance Framework: FS-2-210-010-W10. Suppliers may request a copy from First Solar Supplier Quality.

Supplier Deviation Requests

For any requirements the supplier cannot meet as defined by First Solar, a Supplier Deviation Request must be submitted. This includes, but may not be limited to: terms and conditions; material specifications; drawings; ASR requirements; and requirements of this manual.

- The Supplier Deviation Request will be reviewed by First Solar management and subsequently dispositioned. The supplier will be notified with results of the disposition.
- Supplier Deviation Request Form: FS-4-310-000-W160. Suppliers may request a copy from First Solar Supplier Quality.

1.6 MEASUREMENT SYSTEMS ANALYSIS (MSA)

- Measurement System Analysis (MSA) is required to be performed to determine if measurement/test equipment has sufficient accuracy, precision, or resolution to adequately provide information about process performance, or the effects of process variation.
- The recommended tool is Gage Repeatability and Reproducibility (Gage R&R). Gage R&R using variables data is preferred, although attribute MSA is allowed when applicable.
- General Requirements:
 - The supplier shall develop or obtain appropriate measurement and test equipment (M&TE) to control their processes and/or to inspect material. These M&TE items must be shown in the control plan.
 - Gages used to inspect parts should be variable gages, where possible. If variable gages are not available, then attribute gages (“go/no go”) are acceptable for use with First Solar approval.
 - For all measurement devices identified in supplier’s control plan, a Gage R&R (variable or attribute) is required, unless directed otherwise by First Solar. If the supplier has a number of duplicate custom gages, a gage study to determine bias and correlation must also be completed.

- The First Solar guidelines for acceptance of Gage R&R (% R&R) are:

% Error	Result
< 10%	The measurement system is acceptable.
10 – 20%	The measurement system is considered marginal. Supplier should take steps to improve, and/or investigate alternate methods, and have a documented continuous improvement plan and timeline
20 – 30%	The measurement system needs improvement. Any gages with GR&R greater than 20% need First Solar approval. Considerations will be based upon the importance of application, cost of gage, cost of repairs, etc. The rationale for acceptance must be documented and/or continuous improvement plan documented, as applicable.
> 30%	The measurement system is not acceptable, and deviations must be documented and corrected prior to use for First Solar product.

- More information can be found in Measurement Systems Analysis published by AIAG (Automotive Industry Action Group) or equivalent. (www.aiag.org)

1.7 MATERIAL CERTIFICATION

Supplier Material Certifications – First Solar Portal

Suppliers may be required to submit a Certificate of Analysis (CoA) or Certificate of Conformance (CoC) via the First Solar online “COA/COC Portal.” The CoA/CoC Portal can be accessed electronically via [First Solar Analytical Portal Link](#).

Please contact First Solar Supplier Quality representative to obtain login ID and password.

At a minimum, each submission will require the following information: Location sent to (PBG / KLM / Delivery Site, etc.), First Solar Part number, Purchase Order Number, Lot Number, Shipment Number (Bill of Lading, Date of Shipment, or Invoice Number).

If not required to submit via the portal, the supplier may be required to submit a hard copy certificate.

The supplier’s CoA or CoC documentation must be received by First Solar prior to receipt of material by First Solar, and no later than 24 hours after material shipment from the supplier.

For specific information on how to use the portal, please contact the First Solar Supplier Quality representative.

- First Solar CofA Portal Search and Data Entry Procedure: FS-3-310-000-W101. Suppliers may request a copy from First Solar Supplier Quality.

1.8 IDENTIFICATION & DELIVERY

Identification and Traceability

- First Solar suppliers are required to establish and maintain documented procedures for identifying products and materials used from receipt of raw materials and through all stages of production, packaging, storage delivery, and installation to First Solar.
- Suppliers shall develop, document, and implement an appropriate system with the capability to correlate material lot traceability to corresponding sub-supplier lot traceability.
- First Solar may require greater degrees of traceability depending on product (I.e. Julian date, tool/cavity designations, etc.) Additional requirements may be defined in First Solar material specifications or drawings.

Packaging and Labeling

- Package and product labeling must conform to First Solar bar code requirements where stated.
- All packaging solutions must conform to any local and statutory guidelines/requirements.
- If no other specification exists, finished steel products should be packaged using ASTM A700: “Standard Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment.” This includes, but is not limited to: stamped, rolled, formed and tubular steel.
- First Solar Barcode Label Specification: FS-3-600-000-W9. Suppliers may request a copy from First Solar Supplier Quality.

Logistics Documentation

- At a minimum, packaging lists must provide the following information:
 - First Solar Site Name
 - Delivery Address
 - Pack List Number (Number as referenced on Supplier Invoice)
 - First Solar Material Master or MM#
 - Quantity being Shipped
 - Description of Material

- Purchase Order Number
- Company contact person and number

1.9 CHANGE NOTIFICATION

Change Notice Requirements

- First Solar requires a minimum of sixty (60) days advanced notification of intended changes by a supplier or sub-tier supplier. The supplier must obtain written approval for any of the following changes in advance of implementing any changes. This includes, but is not limited to:
 - Changes from a sub-tier supplier
 - Location of manufacture, including a change in location within the original site
 - Equipment used to manufacture, monitor or measure
 - Method of manufacture
 - Materials used in manufacture, including type of, or source of materials
 - Packaging or labeling configuration
 - Storage conditions or storage locations
 - Testing of material, including changes in the test method
 - Any other change related to material supplied to First Solar
- To submit a Change Request to First Solar, the supplier must use the Supplier Change Request (SCR) form.
- First Solar Supplier Change Request Form: FS-4-310-000-W23. Suppliers may request a copy from First Solar Supplier Quality.

1.10 PROBLEM SOLVING

Methodology: Effective Problem Solving and Root Cause Analysis

- First Solar strives to clearly define the expectations we have of suppliers, provide a process to deliver on these expectations, and provide a method for corrective action when expectations are not met. To that end, First Solar requires suppliers to implement a formal (documented) problem solving and root cause analysis process. At a minimum, the steps shown below must be included in your problem solving and root cause analysis process. Problem solving and root cause analysis requires the use of data collection and analysis to validate an effective and robust solution has been implemented.

The steps are:

- **Identify Team Members**
 - Identify a lead person who is accountable for the process, and any support team members.
- **Problem Definition**
 - Describe the symptoms of the problem that First Solar is seeing. Specify the problem by identifying - in quantifiable terms- who, what, when, where, how, how many – as applicable.
- **Containment Action(s)**
 - Define and implement containment actions to isolate the non-conformance until a permanent corrective action is available. Containment is an immediate measure used to protect First Solar until the root cause is determined and the permanent correction can be implemented and verified.
 - Supplier must provide the means to conduct containment activities throughout the entire supply chain, including locations where the product is used.
 - **NOTE:** In any case where the supplier is not capable of providing adequate containment of material, First Solar will take measures to contain product as needed, up to, and including contracting a third party to execute containment.
- **Identify Root Cause(s)**
 - Identify all potential causes which explain why the non-conformance occurred. Isolate and verify the root cause for both “why made” and “why shipped” aspects.
- **Identify Permanent Corrective Action(s)**
 - Identify a corrective action(s) that will resolve the non-conformance and will not cause undesirable side effects. Define a contingency action, if necessary, based on the risk assessments. This step describes what you will do to address both “why made” and “why shipped” aspects.
 - Choose on-going controls, including mistake-proofing methodology, such as the use of process or design features to prevent manufacture or shipping of nonconforming product/service.
- **Implement and Validate Permanent Corrective Action**
 - Implement the permanent corrective action(s.) Define on-going controls to ensure the root cause is eliminated. These controls must be documented in the control plan, FMEA and process flow diagram as applicable. Once implemented, measure, monitor and evaluate the effects. If necessary, implement contingency actions.
- **Identify Preventive Action(s)**

- Modify systems, practices and procedures to prevent additional or similar non-conformances. Choose on-going controls, including mistake-proofing methodology, such as the use of process or design features to prevent manufacture of nonconforming product/service.
- Apply lessons-learned to similar products, systems and/or manufacturing locations to prevent additional non-conformances.
- **Closure**
 - The supplier shall, at a minimum, review and revise control plans, FMEA, process flow diagram, and work instructions to document changes made as a result of corrective and preventive actions. The supplier must provide written evidence of closure to First Solar.

Required Steps, Closure Times

- Initial Response is required within 24 hours of formal notification.
 - The supplier must respond with a containment plan recommendation within 24 hours of initial First Solar notification of the non-conformance.
- Containment plan must be implemented with 72 hours of formal notification.
- Closure of the Non Conformance is expected within 60 days of identification of root cause.
- The supplier is expected to provide periodic status updates during the corrective action process.
 - The supplier must update First Solar upon identification of root cause and permanent corrective action.
 - The supplier must provide updates to First Solar with status of corrective measure(s) and implementation status.
 - The supplier must provide updates to First Solar upon closure of the issue.

1.11 SUPPLIER MONITORING & FEEDBACK

Performance

- Supplier performance is monitored and measured based on a number of categories, including: Commercial, Quality, Delivery and Technical performance. Suppliers may be asked to participate in a formal, proactive long-term improvement process, Supplier Quality Continuous Improvement (SQCI), where improvement targets are set and results are measured over time.
- Poor or inadequate performance by a supplier may lead to a supplier being placed on a performance improvement plan (PIP), and ultimately de-sourced if improvement targets are not met.

Supplier Audits

- On-site quality audits will be conducted at the supplier location(s) on a periodic basis. The audit may include sub-supplier locations as well. Frequency may be determined, in part, by the following factors:
 - Criticality of product or service provided
 - Supply base risk
 - Quality performance
 - Delivery performance
 - Previous audit performance
- **Areas Audited/Evaluated**
 - Quality Systems
 - Production Systems
 - Materials Systems
 - Environmental Health & Safety Systems
 - Capacity Analysis
 - Control Plan/Process Audit
- Suppliers are required to generate and implement specific action plans to address any audit nonconformance identified by First Solar.

1.12 CONTINUOUS IMPROVEMENT

Continuous improvement is fundamental to our business and meeting our customers' rising expectations in terms of quality, reliability, and cost controls. As a First Solar supplier, you are integral to our mission success and will be expected to continually strive to improve your products, processes, and systems.

- Suppliers are required to document and execute a formal process for Continuous Improvement that proactively fosters a culture of zero defects, flawless product qualification and launch, value enhancement, cost reduction, operational excellence, risk reduction, and safety improvements.
- Some common examples of Continuous Improvement programs are:
 - **Cost reduction projects** (examples include the use of Six Sigma, Lean Six Sigma, Value Analysis/Value Engineering)
 - **Waste reduction projects** (examples include the use of Kaizen events, Setup Reduction, Value Stream Mapping, Standardized Work, Process Flow)

- **Variation reduction projects** (examples include the use of Six Sigma, Standardized Work, Statistical Process Control (SPC))
- **Factory reorganization projects** (examples include the use of 5-S Programs, Single Unit or Cellular Manufacturing, Focused Factory, Kaizen events)
- **Inventory reduction projects** (examples include the use of Kanban systems, Single Unit or Cellular Manufacturing)
- **Yield Improvement projects** (examples include improvements to Equipment Uptime/Downtime, First Pass Yield, Rework reduction, Scrap improvement, On-Time Delivery)
- **Non-manufacturing process improvement projects** (examples include Customer Service, Accounting, Purchasing, Warranty returns, Quality Control)
- First Solar is committed to developing a steady and healthy supply chain, and so are willing to engage with suppliers to develop best practices across supplier sites and to share First Solar methods of improvement.
- Suppliers are expected to present and discuss their Continuous Improvement process and results with First Solar.

2 Appendix A

2.1 FIRST SOLAR FORMS / DOCUMENTS

- First Solar Supplier Quality Systems Audit: FS-4-310-500-W2
- First Solar Advanced Supplier Readiness:
 - Modules –FS-2-310-000-W24
 - BoS – Advanced Supplier Readiness Forms
- First Solar Supplier Deviation Request: FS-4-310-000-W160
- First Solar Supplier Change Request: FS-4-310-000-W23
- First Solar Barcode Labeling: FS-3-600-000-W9
- First Solar Supplier Reliability Assurance Compliance Framework: FS-2-210-010-W10
- First Solar CofA Portal Search and Data Entry Procedure: FS-3-310-000-W101
- Control Plan Template
- Process Failure Mode Effect & Analysis (FMEA) Template
- Supplier Qualification & Test Plan Template
- Problem Solving Guide & Template (8D)

Electronic copies are available upon request from your First Solar Supplier Quality representative.

3 Appendix B

3.1 FIRST SOLAR ACRONYMS

- ASR – Advanced Supplier Readiness
- CIP – Continuous Improvement Plan
- CMS – Change Management System
- CoA/CoC – Certificate of Analysis, Certificate of Compliance
- ETA – Engineering Test Authorization
- FMEA – Failure Mode and Effects Analysis
- ISO – International Organization for Standardization
- MSA – Measurement System Analysis
- M&TE – Measurement and Test Equipment
- NCP – Non-Conforming Product
- PIP – Performance Improvement Plan
- Q&TP – Qualification & Test Plan
- QCR – Quality Concern Report
- SCR – Supplier Change Request
- SDR – Supplier Deviation Request
- SPC – Statistical Process Control
- SQCI - Supplier Quality Continuous Improvement
- SQE – Supplier Quality Engineer