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| **Trans-tech RF Ceramics Supplier Quality Manual** |

1. Purpose and Scope
	1. Purpose

The purpose of this manual is to define the basic quality systems and business procedures required for suppliers who currently or potentially manufacture and/or supply production material and / or services to Trans-tech.

This manual also defines quality requirements, business practices and applicable documents for those suppliers, in order to maintain their status as an approved supplier.

This manual, the Commercial Agreement, the Nondisclosure Agreement, and the Trans-tech purchase orders are intended as the agreement on all the terms and provisions. This manual supersedes any prior written or oral agreements concerning any of the subject matter of this manual.

* 1. Scope

This procedure applies to Trans-tech suppliers of Level 1 Materials and Level 4 Services that directly affect the form, fit, function, quality or reliability of the finished product.

1. Acronyms / Terminology and Description / Definition

**Approved**

The supplier status is such that Trans-tech’s Sourcing may buy qualified products from that supplier.

**ASL**

Approved Supplier List

**Certificate of Analysis**

Signed document that provides quantitative data for the items being delivered that certifies that the product conforms to all purchase order requirements and, reference specifications.

**Certificate of Conformance**

Signed document certifying that delivered products conform to all purchase order requirements and reference specifications.

**Disqualified**

The supplier performance has proven unacceptable such that no further orders may be placed.

**Fitness for Use**

Product or service that fits Trans-tech’s defined purpose, under anticipated or specified operational conditions.

**Level 1 Material**

Material used in the manufacture of finished product and directly affects the form, fit, function or reliability of the finished product.

**Level 4 Service**

Service provided by an outside contractor that directly affects the form, fit, function or reliability of the finished product.

**RMA**

Returned Material Authorization: typically a requirement for returning nonconforming products to the supplier.

**SCAR**

Supplier Corrective Action Request: formal request for improvement issued by any member of the team.

**SQE**

Supplier Quality Engineer

**Sub Tier Suppliers**

Suppliers used by an external provider to Trans-tech, i.e., the supplier’s supplier.

**Supplier**

An external provider of goods or services to an organization

1. Associated Documents

Access to Trans-tech documentation can be obtained upon request.

**Trans-tech Documents**

**RFC-WI-0002** RF Ceramics Supplier Qualification and Monitoring

**RFC-F0003** Supplier Procurement Survey

**RFC-SOP-0003** RF Ceramics Supplier Sustainability Specification

**RFC-WI-0005** Green Procurement Supplier Specification

**RFC-WI-0010**  Supplier Product / Process Change Notification Requirements

**RFC-WI-0014** Supplier Audit Protocol

**National and International Standards**

***Referenced in this document and applicable to all suppliers:***

**ANSI/ESD S.20.20** Development of an Electrostatic Discharge Control Program for Protection of Electrical and Electrical Parts, Assemblies and Equipment

**FMEA** AIAG Failure Mode Effects Analysis Manual

**ISO 9001** Quality management systems – Requirements

**ISO/IEC 17025** General requirements for the competence of testing and calibration laboratories

1. Supplier Qualification

Supplier Qualification is performed per **RFC-WI-0002** **Supplier Qualification and Monitoring**. Conformance to these requirements is verified by means of supplier surveys, requested self-appraisals, sample qualification, and if required, on-site assessments performed by Trans-tech.

* 1. Supplier Monitoring

Supplier performance is monitored monthly based on a demerit system that gives equal weight to quality and delivery. The maximum score is 100%. Suppliers that fall below 70% for three consecutive months are placed on probation and an improvement plan is expected. Suppliers that fail to show improvement may be disqualified.

* 1. Supplier Development

Development of Trans-techs’ external providers is achieved by multiple means guided by the principles of engagement, cus-tomer focus, continuous improvement, and data driven decision-making. These tenets drive for quality improvements in all aspects of the supplier-customer relationship from delivery, cost, performance, to customer satisfaction. In addition to the sustaining relationships that drive improvement within the context of on-going qualification and monitoring activities, further development of external providers for some suppliers is targeted by Trans-tech. This may include the active use of the following tools:

* Surveillance audits performed per **RFC-WI-0014** **Supplier Audit Protocol**
1. Supplier Expectations
	1. Corporate Policies and Objectives

It is the policy of Trans-tech that materials and services used in the design and production of Trans-tech products be procured in a professional and ethical manner that results in achieving the lowest total cost of ownership for Trans-tech and for our customers. Further, all purchased materials and services must be in compliance with agreed upon requirements, be delivered on time, and have competitive lead times and prices.

* + 1. Confidentiality

Both parties (the Supplier and Trans-tech) will hold in confidence any and all data or information which is received from the other party which is marked CONFIDENTIAL or PROPRIETARY, if disclosed in documentary form, or identified as CONFIDENTIAL or PROPRIETARY at the time of disclosure, if disclosed in other than documentary form. Should conditions of the effort warrant such an action, the parties will enter into a separate Non-Disclosure Agreement, providing mutual protection regarding the data exchanged between them.

* 1. Regulatory Agency Compliance

It is the supplier’s responsibility to ensure that their product is in compliance with all applicable regulatory agency and product safety requirements, and claims including that stated in supplier published product advertising, catalogues and data sheets. The supplier must be prepared at all times to substantiate compliance by providing copies of test reports and making records available for review if requested.

* 1. Sustainability

All requirements set forth in **RFC-SOP-0003 RF Ceramics Supplier Sustainability Specification** apply.

**5.3.1 Banned and Restricted Substances**

Refer to **RFC-WI-0005 Green Procurement Supplier Specification** for all materials restrictions and reference to Trans-tech banned and restricted substances.

* 1. Risk Management Policy

The supplier shall have an up-to date Risk Management Policy ensuring that in the event of disaster or inability to perform the supplier has a plan to take necessary action in order to minimize and or eliminate such risk from Trans-tech.

* + 1. Banned and Restricted Substances

Refer to **RFC-WI-0005 Green Procurement Supplier Specification** for all material restrictions and reference to Trans-techs’ banned and restricted substances.

* 1. Notification of Product Quality or Delivery Issues
		1. Non-Conforming Product

Delivery of product to Trans-tech not meeting Trans-tech specifications or supplier's internal manufacturing specifications for measurements requires:

* Supplier to review non-conformance through a cross functional Material Review Board (MRB) to determine acceptability of shipping material to Trans-tech. Additionally, the supplier must inform Trans-tech of any critical defect detected that warrants a MRB, even if the MRB determines the product is not acceptable to ship to Trans-tech. The defects are identified based one the supplier’s critical defects list.
* Issuance of a Non-Conforming Material Report (NCMR) to the Trans-techs’ Supplier Quality Engineer specifying nature of non-conformance, associated data with non-conformance, and supplier's MRB explanation of why supplier believes the non-conformance will not impact Trans-techs’ product performance, quality or yield.
* Approval of the NCMR by the Trans-tech Quality Department prior to any shipment of such material from the supplier to Trans-tech.

Suppliers may generate a waiver or deviation request in accordance with **RFC-WI-0010 ‘Supplier Product / Process Change Waiver and Supplier Alert Notification Requirements’** and supporting **RFC-F0021 ‘Trans-tech Supplier Change Notification Form’** as follows:

• For a planned product or process change affecting a limited quantity of product or till a certain date

• For a planned variation from a documented requirement

• For a change that occurred inadvertently and will only affect a limited quantity of product

In all cases, the supplier shall submit the completed form with relevant supporting data to the Trans-tech Supplier Quality Engineer for review and disposition prior to shipment of the material.

* + 1. Product / Process Changes

The Supplier shall have a process to manage and track changes in accordance with RFC-WI-0010 Supplier Product / Process Change Notification (PCN) Requirements

When submitting a Process Change Notice, the supplier shall provide a process map that clearly highlights the process changes that are being proposed. In case of non-conformance to the Trans-tech PCN process, the external provider will be responsible for all costs incurred by Trans-tech (or its subcontractors) related to such non-conformance.

* 1. Product Identification

The Supplier shall have a manufacturing control system such as a route card, run card, control software, etc, used for the identification of products with regard to: type, lot or serial number, and their status during all stages of production and test.

* 1. Product Traceability

The external provider shall have a system for ensuring finished product traceability back to the subassembly, component and raw materials. Traceability shall be achieved by means of date code, lot and/or serial number.

* 1. Quality Plan

Trans-tech being a leader in the wireless industry will continuously strive to improve Quality and provide world-class products to our customers. To ensure we are able to meet and maintain this objective, Trans-tech expects the elements in this section to be present with its suppliers. In the event the supplier does not have an element of this plan, Trans-tech will at its discretion, decide if we want to work and assist the supplier develop the missing element. The Quality plan may be reviewed by the Trans-tech Supplier Quality Engineer prior to a supplier being qualified. For existing suppliers, Trans-tech Quality Engineers may work with the supplier to document and/or develop an acceptable Quality Plan.

The requirement of the Quality Plan is one of the most critical steps in becoming an approved supplier to Trans-tech. Trans-tech will not accept the cost of excessive testing and poor quality, and will not pay the cost of our suppliers doing extensive testing or the resulting poor yields and escapes. The intent is to emphasize process capability improvement and controls and/or monitoring that will have the greatest impact on quality and reliability and ultimately zero defects, zero repeat issues and low cost of ownership goals.

The Quality Plan will normally consist of the following elements as a minimum; additional requirements may be requested by Trans-tech:

* + 1. Quality System

Suppliers are expected to have an effective quality system in place that assures consistent on-time delivery of conforming product.

* System should be based on **ISO 9001**.
* Calibration and Testing Laboratories shall comply with **ISO/IEC 17025**. The parameter and/or equipment applicable to the laboratory service being provided must be within the scope of accreditation.
* **ANSI/ESD S.20.20** certification is required for assembly and/or test suppliers where applicable.

**Note:** Where present, the above certifications shall be registered by an accredited third party certification body.

* + 1. Process Controls

The supplier shall plan and carry out manufacturing processes under controlled conditions that shall include:

* The use and development of Control Plans.
* The use of documented work instructions available at point of use.
* The use of suitable equipment supported by a preventive maintenance program for key process equipment
* The use of equipment for test, inspection and measurement of Trans-tech product. This equipment shall require Gage reproducibility and repeatability (R&R) studies to demonstrate the capability of the equipment and measuring process. These studies shall be performed using the ANOVA method outlined in the **AIAG Measurement System Analysis (MSA)** manual. All such equipment with > 10% error needs to be reported to Trans-tech.
* Adherence to Trans-tech workmanship standards.
* Trans-tech strongly recommends the use of statistical tools such as Statistical Process Control (SPC) and capability studies (see section 5.11). The supplier shall initiate a reaction plan for characteristics that become incapable or unstable.
* A production scheduling system that supports Trans-techs’ delivery expectations.
	+ 1. Purchasing

The supplier shall have a defined process for its purchasing process that includes:

* The use of approved sub tier suppliers for the procurement of materials and/or services that directly affect the form, fit, function or reliability of Trans-tech products.
* A supplier development program that emphasizes the flow down of the requirement set forth in this manual to sub tier suppliers.
* The generation of purchasing information that clearly describes the product being purchased.
* The implementation of verification activities to ensure that incoming product meets specified purchase requirements.
	+ This shall include a method of traceability to the original material and/or component manufacturer, and methods to identify and address potential counterfeit materials/components.
* Sub tier supplier performance monitoring.
	+ 1. Failure Mode and Effect Analysis (FMEA)

It is strongly recommended that the supplier develop a Process or Product FMEA and use those results to determine the appropriate test and inspection points as well as appropriate control methods. FMEA items with severity ranking of 9 or 10 must be acted upon immediately. Other than that, actions must be taken on the top three highest ranked risk items. In the case where 2 or more risk items have the same RPN, priority should be given to those with highest severity. Additional information can be found in the **AIAG** **FMEA manual**.The supplier may also use **TT-F0779 Process FMEA Template.**

* + 1. Reliability

Suppliers shall have a qualification process for their products, processes and/or components that ensure quality, reliability and fitness for use. This process must be followed for new products as well as product or process changes. This process must also include on-going reliability testing that gathers and monitors reliability data on qualified production products and processes.

Suppliers may be requested to provide these reports on an as-needed basis.

* + 1. Corrective Action and Failure Analysis

Trans-tech will use a Supplier Corrective Action Request (SCAR) as the trigger to engage the supplier for a request for containment, root cause analysis, corrective action and verification. All responses from supplier need to be in an 8D or equivalent format. The supplier should have a formal process with evidence that key personnel have been trained. Failure Analysis capabilities and support needs to be identified in the Quality Plan.

The initial response (3D) needs to be provided within 1 business day of the receipt of samples. The root cause analysis and corrective action plan (5D) shall be provided within 10 business days of the receipt of samples. The actual deployment and verification (6D though 8D) may take longer based on the complexity of the problem.

* + 1. Document Control System

Trans-tech requires suppliers to have a document control system in place. Suppliers must ensure that the latest Trans-tech specifications, work instructions, and other related documents are maintained in this system.

* + 1. Internal Quality Audits

Suppliers shall perform internal quality audits in accordance with documented procedures and control plans. The supplier shall review audit results, plan corrective action and perform follow-up verification of corrective action effectiveness.

The supplier will publish the frequency of internal audits performed in the supplier facility in the Quality Plan. Periodically, the supplier may be requested to share details of the internal audits and follow-up items with the Trans-tech Supplier Quality Engineer.

* + 1. Resource Management
			1. Human Resources

Suppliers shall ensure that personnel performing work affecting product quality or the quality management system are competent on the basis of appropriate education, training, skills, and experience.

* + - 1. Work Environment

Suppliers shall determine and manage the aspects of the work environment necessary to achieve conformity to product requirements. Examples of aspects may include, but are not limited to: temperature, humidity, cleanliness and electrostatic discharge protection.

Suppliers who handle ESD sensitive parts are expected to establish and maintain an ESD management system in accordance with **ANSI/ESD S20.20** (see section 5.8.1).

* + 1. Problem Resolution, Escalation and Key Contacts

The external provider shall define who has authority for resolving quality, technical and supply issues and the escalation process to the next level of management in the event that a decision can not be reached at any level.

The external provider is expected to designate a key contact person and furnish their name, daytime phone number, pager/mobile number, and email address. This individual will be the owner for taking action on quality alerts and ensuring all reports and corrective action request are rendered to Trans-tech in a timely fashion. The external provider will be responsible for assuring the availability of this individual or an available back-up to Trans-tech at all times.

* 1. Reports

When requested, all shipments must be accompanied by a certificate of conformance and/or certificate of analysis traceable back to the delivered items.

The supplier may be requested to provide periodic reports or summary reports of inspection or test results. The Trans-tech Supplier Quality Engineer may review the metrics and reporting formats and frequency. Additionally the supplier may be requested by the Trans-tech Supplier Quality Engineer to provide periodic summary reports of FA and evaluation results on SCARs / RMAs. These will need to be in the format prescribed by the Trans-tech Supplier Quality Engineer.

* + 1. Calibration Reports

For calibration service providers, calibration reports must include evidence of conformance to requirements. Calibration shall be performed in accordance with manufacturer’s specifications unless otherwise noted on the purchase order. The calibration report shall include as a minimum the following information:

* Equipment identification, including the measurement standard against which the equipment is calibrated
* Any out-of-specification readings as received for calibration/verification
* A statement of conformity to specification after calibration/verification
* Revisions following engineering changes
	1. Supplier Self-Assessment Survey

**RFC-F0003 Supplier Procurement Survey** needs to be completed by the supplier during the initial supplier evaluation and will be kept on file by Trans-tech. This form will also be used as the template for on-site audits performed by Trans-tech. An updated survey may be requested by the Trans-tech Supplier Quality Engineer if deemed necessary.

* 1. Capability Indices

The supplier shall establish a procedure to assure that critical Cpks are **≥** 1.33. This procedure may be reviewed by the Trans-tech Supplier Quality Engineer. For those critical Cpks which are < 1.33 for two consecutive quarters, the supplier will have documented improvement plans that shall be made available to Trans-tech upon request.

* 1. Control of Trans-tech Owned Product or Equipment

Secondary materials (such as carrier tape, trays, packaging, etc.) and consigned material provided or specified by Trans-tech shall be verified to meet Trans-techs’ requirements and fit for use before being accepted.

Custom equipment and/or tooling purchased by Trans-tech shall remain the property of Trans-tech. All Trans-tech-owned equipment and tools will be marked with Trans-techs’ control numbers prior to shipment to the supplier.

Trans-tech owned equipment, tools, test correlation parts, secondary materials, and/ or consigned material shall be controlled, stored, handled and maintained in a manner that protects them from loss and damage.