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To: Our Valued Suppliers

Subject: Purchased Material Quality

TSI Incorporated is committed to providing our customers with the highest quality products and services. It is therefore essential that the materials and products we purchase from our suppliers also meet those same standards.

As with any relationship, the communication process is the key element that makes all other accomplishments, endeavors, or goals possible.

With that thought in mind, the standards contained within this document have been created as the basic outline for expectations and requirements related to the materials, products or services purchased by TSI Incorporated. These standards have been developed in conjunction with the Quality, Engineering, and Supply Chain departments.

Wherever possible, standard industry documentation, guidelines or practices have been followed or referenced (e.g. American National Standards Institute “ANSI”, International Organization for Standardization “ISO”, National Institute of Standards and Technology “NIST”, etc.).

It is our expectation that the implementation, reference and use of these standards will be embraced and followed by our suppliers.

As with all living documentation, periodic review and update of these standards can be expected as our business world continues to grow and change.

Sincerely,

Adam Truhler

Adam Truhler
Director of Supply Chain

Contents

1 General Information

Applicability

The requirements of this document are applicable to purchased materials for which TSI has design control authority. Items not covered by that definition (i.e. “off the shelf,” etc.) are governed by recognized industry standards for the relevant category / commodity / material / part as applicable.

Quality

TSI Incorporated believes that the implementation and use of a well-defined, clearly documented Quality Management System (QMS) is a core requirement of any successful quality program. We therefore embrace and subscribe to the standards and principles as outlined by the American National Standards Institute (ANSI) / International Organization for Standardization (ISO) / American Society for Quality (ASQ) 9001-2015 documentation.

It is our desire that our suppliers strive to implement and follow the good practices as outlined by those standards. Our common goal must be to ensure the consistent, repeatable, deliverable, quality of purchased materials, products, and services.

To assist in the achievement of these goals, we believe that the use of statistical process control (SPC) techniques will prove to be a significant tool in the advancement of any process, and therefore, we are committed to work with all of our suppliers to help develop such concepts.

By the use of a clearly defined Quality Management System and embracing statistical process control techniques, a company’s ability to control product variation, rework, scrap or defective material costs will be greatly enhanced.

Supply Chain Management

It is our goal to try and involve our suppliers as early as possible in the design phase of new product development. Our intent is to leverage the knowledge and expertise of our suppliers in their chosen field of business. Consistent with that intent, it is our expectation that all TSI documentation (e.g. drawings, prints, purchase orders, etc.) will be carefully reviewed by a supplier prior to their submission of a design concept idea or quotation.

We expect our suppliers to provide feedback to TSI on any design or tolerance issues that could affect their ability to manufacture the product. Feedback on Design for Manufacturability (DFM) issues should be provided as early in the process as possible. This feedback should also include potential cost saving ideas or suggestions that may be applicable.

TSI purchase orders shall contain all the necessary information needed by a supplier to comply with all TSI requirements including required delivery dates. Any shipment of material to TSI must contain paperwork from the supplier which clearly identifies the items included in the shipment and their association to the applicable TSI purchase order.

Fair Margins

The guiding principle for all evaluations, selections or sourcing decision by TSI is based on the desire to obtain items meeting all TSI defined requirements, delivered on time, at the least possible cost, while still affording the supplier a fair margin.

2 Supplier Selection & Approval

2.1 All suppliers to TSI will be selected based on the technical and business needs of our company.

2.2 Dependent upon the type of material or service being provided (e.g. off the shelf, custom design, etc.), different qualification criteria may apply.

2.3 As a key element of any evaluation, the Fair Margins principle will be applied.

2.4 As part of our initial review, a TSI Supplier Survey Form may be sent to the supplier for their completion and return.

2.5 Based upon review of the Survey, an audit by TSI may be conducted at the suppliers' facility to further verify its capabilities as outlined in its survey response.

2.6 Where an audit is conducted at the suppliers' facility, the audit team will usually consist of a representative from Supply Chain Management, Quality and Engineering. However, depending upon workload, priorities, or the technology involved, team size and/or skill composition, may be adjusted.

2.7 Regardless of the method(s) used in evaluating or approving a supplier, TSI Supply Chain or Purchasing will be the primary interface for providing all necessary purchasing information.

3 Supplier Goals & Objectives

3.1 All materials, products or services are derived from some type of a process (e.g. a series of actions or operations conducing to an end). For the purpose of this document, processes should be monitored and controlled consistent with the guidelines below.

3.2 Non-Critical Characteristics or Dimensions

3.2.1 A Cpk of 1.00 or greater, calculated to nominal distribution in relationship to a specified tolerance range, validated to 3 consecutive lots.

Or

3.2.2 A Defective Parts Per Million (DPPM) rate of 2,700 or less, maintained on a 3-lot rolling average.

3.3 Critical Characteristics or Dimensions

3.3.1 A Cpk of 1.33 or greater, calculated to nominal distribution in relationship to a specified tolerance range, validated to 3 consecutive lots.

Or

3.3.2 A Defective Parts Per Million (DPPM) rate of 64 or less, maintained on a 3-lot rolling average.

3.4 All suppliers providing purchased materials or products designed to TSI requirements should evaluate their processes, as a minimum, to the criteria listed above prior to the shipment of any product or material.

3.5 Due to the unique nature of controls, manufacturing processes, or test capabilities associated with a given commodity or category of products provided to TSI, a commodity-specific goal may be established.

3.5.1 Commodity-specific goals must be reviewed and approved by TSI Supply Chain Management.

3.5.2 TSI Engineering and Quality will be consulted regarding any unique category requirements.

3.5.3 Specific instructions or requirements will be communicated to the supplier associated with the applicable commodity or category by Supply Chain Management.

3.6 It is the TSI expectation that all suppliers take a proactive approach to the monitoring and control of their processes and continually seek ways to implement process improvements.

3.7 Repeated failure by a supplier to control their processes to the criteria defined above may lead to their removal from the suppliers list for a specific part or entirely depending upon the circumstances.

3.8 TSI workmanship and cosmetic requirements are documented in the appendix.

4 Supplier Product Verification

4.1 If required or specified via TSI documentation (e.g. drawing, print, purchase order, etc.); product verification sampling data may be required.

4.1.1 Drawings or Prints

4.1.1.1 If specified by a specific Note contained on a drawing or print.

4.1.2 Purchase Orders

4.1.2.1 If identified by the statement “Verification Data Required” placed in the body of a purchase order next to the appropriate part number.

4.1.3 E-Mail / Fax

4.1.3.1 If a written request is received from TSI Supply Chain, indicating “Verification Data Required” is required.

4.2 Upon receipt of documentation from TSI indicating the requirement for verification sampling data, the data must be included with each subsequent delivery of that material or part to TSI.

4.3 All boxes, containers, packages, etc. delivered to TSI containing verification sampling data must be clearly identified.

4.4 Acceptable verification data may be different in format depending upon the type of material or part in question and agreed to by TSI.

4.4.1 Static Materials

4.4.1.1 Characterized by a lack of movement, animation or progression such as covers, enclosures, frames, machined parts, molded parts, shafts, sheet metal, tubing, etc.

4.4.2 Operational Materials

4.4.2.1 Characterized by influencing or causing movement (i.e. exerting force) such as cables, motors, printed circuit assemblies (PCAs), power supplies, etc.

4.5 For those parts classified as static materials and having dimensional characteristics, statistical process control data (ex. distribution charts, histograms, x-bar charts, etc.) with Cpk indices documented should be used.

4.5.1 It shall be the responsibility of the supplier to determine how many dimensional characteristics will be sampled for any specific part number. However, it must be of a quantity which ensures that the material or part delivered to TSI meets all drawing or print requirements.

4.6 For those parts classified as operational materials and having electrical characteristics, a Certificate of Conformance (C of C) indicating completion of all testing should be used.

4.7 Where sampling is specified, it will be in accordance with ASQ (American Society for Quality), “Zero Acceptance Number Sampling Plans” by N. Squeglia, Table 1a, Index Value 1.0, current revision, unless otherwise specified by an applicable TSI drawing or purchase order.

4.8 If during lot sampling a tolerance or test point is found to be outside the specified tolerance limits, then the following actions will take place.

4.8.1 A second sample of the same size will be inspected for the “out of tolerance” condition.

4.8.2 If no additional occurrence of that specific tolerance is found to be outside the specification, then that lot of material is acceptable for shipment.

4.8.3 If a second occurrence of that tolerance is found to be outside the specification, then a request must be made to and approval received from TSI via a signed Deviation Request before any material or parts can be shipped.

4.8.4 All requests for deviation must include the root cause for the out of tolerance condition.

4.8.5 Requests for a deviation should be made to the Strategic Sourcing, Purchasing, or Quality Department.

5 Supplier First Article Process

5.1 When required by TSI Purchase Order, a First Article inspection shall be completed on all parts or materials in accordance with the process listed below.

5.1.1 Complete inspection of all drawing dimensional characteristics and notes on a sample of three parts from the first production run to verify that the manufacturing process is capable of meeting drawing requirements.

5.1.2 Complete electrical or functional test (as applicable) on a sample of three parts from the first production run to verify that the manufacturing process is capable of meeting drawing requirements. A Certificate of Conformance (C of C), accompanying the three parts will be acceptable as evidence of successful completion of testing.

5.2 Where dimensional data is being provided to TSI, the supplier must specify actual measurement data as determined by inspection. At no time are the words “acceptable, completed, passed,” etc. to be used as indicators of a measurement.

5.3 Due to the nature of a specific commodity, TSI Supply Chain may require additional or unique information be provided on the First Article. If so, those requirements will be documented to the supplier via notes on the applicable purchase order or e-mail from Supply Chain. Deviation to the 3-piece requirement may be made at the discretion of Supply Chain due to the size / complexity of the item being evaluated or business cost considerations.

5.3.1 In the case of multiple call-outs (e.g. 4x, 10x, 30x, etc.) for singular dimensions only (e.g. radii, hole diameter, counter-sink diameter, angles, etc.), a minimum to maximum range recorded as a single entry will be permitted on the First Article for each sample.

5.3.2 Any dimension listed on a TSI drawing or specification sheet must be held or met, after secondary operations, unless otherwise specified on the drawing.

5.3.3 In all cases, the device being used to acquire a measurement must be under calibration control and traceable to NIST (USA) standards or the applicable country’s national standards.

5.3.4 Anytime an administrative change or correction is made on a First Article submitted by a supplier (e.g., purchase order number, quantity, location, verbiage, etc.), then the date and initials of the person making the change must be included.

5.4 Where specific material requirements are called out on a drawing or purchase order relating to a regulatory agency such as CE, CSA, UL, etc. (e.g. flammability, manufacturer, materials used, etc.), then Certificates of Conformance (C of C) must be provided by the supplier with each lot delivery.

5.5 After review of the First Article inspection data submitted by a supplier, a First Article Report containing the dispositions and any required actions that need to be taken will be sent to the supplier by TSI Quality or Supply Chain.

5.6 With the exception of the First Article lot itself, no material or products being evaluated by a specific First Article may be shipped to TSI until an approved First Article report has been received from TSI unless otherwise indicated on the applicable purchase order.

5.7 TSI is under no obligation to pay for materials that do not meet the requirements of the First Article process.

6 Part Identification Markings

6.1 If part identification marking is required via a TSI drawing, then the material or part will be stamped or labeled with the following, unless otherwise specified by the drawing. For PCAs, reference section H of the appendix.

6.1.1 Manufacturers ID or Logo or Initials

6.1.2 TSI Part Number

6.1.3 Revision

6.1.4 Manufacturing Date or Serial Number

6.2 Regardless of the marking technique used, the method chosen must be of a nature to ensure permanency. Acceptable marking techniques include but are not limited to:

6.2.1 Ink Stamping

6.2.2 Stenciling

6.2.3 Laser etching

6.2.4 Silk Screening

6.2.5 Engraving

6.2.6 Metal Stamping (i.e. sheet metal parts only)

6.3 When metal stamping is used, at no time may the stamping alter any feature on the product (i.e. change flatness, push out an edge, etc.).

6.4 Placement of the marking on the part will be at the location specified by the drawing.

6.5 Color of the part marking characters should be of a contrasting color to the finish of the part. Recommended colors are black and white unless otherwise specified on a drawing. White is the recommended color to be used when a dark paint finish (i.e. black, etc) or dark plating (i.e. black anodize, etc) is used. This would also be true for dark colored plastics.

6.5.1 Metal stamped or engraved characters will only be colored if specified by a drawing.

6.5.2 Laser marking should have uniform coloration.

6.6 Unless otherwise specified on a drawing, character height is at the option of the supplier but, a height of 0.12 inches is suggested. However, smaller characters may be used where size and space are limited.

6.7 For parts too small to be stamped or labeled, individual or bulk packaging (i.e. often referred to as “bag and tag”) is acceptable with the required information placed on the packaging.

6.8 For parts which are molded, character height will be 0.12 maximum and raised from .005 minimum to .020 maximum unless otherwise specified on a drawing.

7 Drawings

7.1 Initial drawing release identification will be done at the discretion of the TSI Design Engineer. Numeric revisions will generally be used to identify prototype material. Subsequent releases of prototype material will be in numerical progression (i.e. 01, 02, 03, etc.).

7.2 Production release of drawing revisions will be via alpha characters and start at A. Subsequent revisions of production material will be in alphabetic order (i.e. A, B, C, D, etc.).

7.3 Any change to a production released drawing must be documented and approved via a formal Engineering Change Order (ECO) or a signed and approved Deviation Request from TSI.

7.4 Where a TSI purchase order indicates “production release”, the corresponding drawing or print must be free of any changes or notations *(not documented and approved via an ECO or signed / approved deviation request)* before that supplier can build or ship materials or parts to TSI.

7.5 During prototype evaluation of materials or parts between TSI and a supplier, a red-lined drawing may be used to help facilitate the communication process with regards to potential future changes.

7.6 Drawings may be marked up or redlined by TSI Engineering to request or allow changes from the normal design of a part. If the parts in question are for a production order, an approved TSI deviation must accompany the shipment.

7.7 Any reference to RoHS, RoHS 2, RoHS II, Directive 2002-96-EC, Directive 2011-65-EU, or Directive (EU) 2015/863, should be interpreted as conforming to the latest RoHS directive from the EU.

8 Drawings (Controlled Items; Customer – Regulatory)

8.1 Some materials or parts may be identified by TSI as Customer - Regulatory Designated Items.

8.2 Such drawings will be annotated as follows: in the TSI drawing title block located in the lower right-hand corner on the drawing the designation at the end of the description for the item on the drawing shall be enclosed in double exclamation marks. For example: !!UL!! ; !!CSA!! ; !!MTS!! ; !!OEM!! ; !!IECEx!!, etc.

8.3 Reference example below:

SIGNATURES	DATE	TSI INCORPORATED ST. PAUL, MN			
DRAWN BY: DON ACKER	MAR-17-2016	ASSEMBLY DRAWING AM520 DISPLAY PCA !!IECEX!!			
APPROVED: ANDREW BENTLEY	MAR-17-2016	SIZE B	FSCM NO. 24575	DWG NO. 6008813AD	REV 3
THIS DOCUMENT CONTAINS CONFIDENTIAL AND PROPRIETARY INFORMATION. THE RECIPIENT SHALL NOT USE, REPRODUCE OR DISCLOSE ITS CONTENTS IN WHOLE OR IN PART WITHOUT PRIOR WRITTEN CONSENT OF TSI INCORPORATED		SCALE –		SHEET 1 OF 1	

8.4 Drawings so identified may require additional controls and processes to be observed. In such cases, a further note will be applied to the drawing as listed below:
Part Identified on drawing is a !!CUSTOMER - REGULATORY DESIGNATED ITEM!!
All processes associated with the: procurement & receipt of material, manufacturing, test, shipment and equipment (used in said processes) shall be documented and controlled via a formal Quality Control Plan (QCP). Approved copy of QCP shall be on file with TSI prior to product shipment.
No additions, changes, deviations, substitutions or updates to QCP plan (including Bill of Material and Drawings associated with the plan) shall be made without the prior written approval of TSI.

8.5 For a newly received material or part by a supplier (i.e. first-time material or part associated with drawing is being built by the supplier), then the QCP shall be required from the initial build.

8.6 If the material or part is already being built by a supplier; however, the drawing has been updated via an Engineering Change Order (ECO) to include the notation in paragraph 1.3, then TSI shall indicate the time frame allowed to make said changes accordingly. This shall be included on the applicable purchase order associated with the ECO change notification.

9 Record Retention Requirements

9.1 As defined in section 8, any TSI material or part designated as IECEx shall have all documentation associated with that TSI material or part retained for a minimum of 10 years.

9.2 Specific records are:

9.2.1 All documents contained in the Quality Control Plan Package.

9.2.2 Process Flow Map.

9.2.3 PFMEA (Process Failure Mode Effect Analysis).

9.2.4 Quality Control Plan:

9.2.4.1 Customer Order Receipt & Review.

9.2.4.2 In-coming material receipts inspections.

9.2.4.3 Raw material lot identification & traceability.

9.2.4.4 Manufacturing process & test.

9.2.4.5 Equipment used (maintenance & calibration records).

9.2.4.6 Shipment Records (Declaration of Conformity).

9.2.4.7 Sub-contractor Qualification (if applicable).

9.2.4.8 Training Records for all individuals associated with processes.

9.2.5 Corrective and Preventative Actions.

9.2.6 TSI generated reports on Quality and Delivery including any Quality Alerts.

10 Quality Control Plans

10.1 Where Quality Control Plans are required per Section 7a, then the following guidelines shall apply.

10.1.1 Quality Control Plan Packages should include:

10.1.1.1 Process Flow Map.

10.1.1.2 Process Failure Mode Effect Analysis (PFMEA).

10.1.1.3 Quality Control Plan.

10.2 If a supplier does not already have a standard format or does not have familiarity with such documents, then TSI Supply Chain may be contacted for example (*preferred*) formats.

10.3 Where a supplier needs additional assistance with the creation, implementation or documenting of such process / plans, TSI Supply Chain may be contacted for assistance.

11 Material Delivery Requirements

11.1 General

11.1.1 Under no circumstances shall a supplier knowingly ship materials or parts to TSI which do not meet or conform to the requirements as defined by a drawing, print or bill of material.

11.1.1.1 Where discrepant or nonconforming materials or parts are discovered by a supplier, then a signed & approved Deviation Request from TSI must be received prior to the shipment of any such materials.

11.1.1.2 All requests for a deviation by a supplier should be made (in writing) to the appropriate TSI Supply Chain Representative.

11.1.1.3 The request must contain the applicable TSI: purchase order number, part number, part description, revision, part manufacturing date and deviation quantity. In addition, the request must include the specific details as to the cause for the discrepancy or nonconformance.

11.1.1.4 A copy of the deviation containing the final disposition (accepted or rejected) will be returned to the supplier by TSI Quality or Supply Chain.

11.2 Delivery Performance

11.2.1 Suppliers are expected to maintain a 97% (i.e. 30000 DPPM), or better, on-time delivery performance. Repeated failure may result in the removal from the TSI approved supplier list.

11.2.2 Parts will be accepted up to 5 days prior to the purchase order delivery date. The applicable Supply Chain Representative may return product if it is received more than 5 days early. Early shipments will be treated the same as a late shipment.

11.2.3 TSI will pay premium freight costs only when requested by TSI.

11.3 Shipping Documentation

11.3.1 All containers or packing slip(s) will include the part number, revision, quantity per box, purchase order number and total quantity of cartons in the shipment.

11.3.2 Packing slips or paperwork without a purchase order number will hold up receipt of orders and may delay payment of invoices.

11.3.3 Reference the Packaging section of the appendix for additional requirements.

11.4 Return Material Authorization (RMA)

11.4.1 Nonconforming material will be returned to the supplier via a debit memo for credit.

11.4.2 Repaired product can be returned to TSI only with a purchase order provided by TSI.

11.4.3 Requests for an RMA number should be satisfied within 48 hours.

Appendix

A General

A.1 This section establishes the general rules regarding workmanship guidelines for materials or parts supplied to TSI where specific directions or notes are absent from TSI drawings.

A.2 For the purpose of this document unless otherwise noted, while other standards may be applicable, the primary nationally recognized standards organizations referred to are:

A.2.1 American National Standards Institute (ANSI)

A.2.2 Military Standards (MIL)

A.2.3 National Institute of Standards and Technology (NIST)

A.2.4 Interconnecting and Packaging Electronic Circuits (IPC)

A.2.5 Cosmetic Specifications of Injection Molded Parts (SPI)

A.2.6 American Welding Society (AWS)

A.3 In the event of a conflict regarding the guidelines in this document or other specified documentation, the following order of precedence shall apply:

A.3.1 TSI drawing or print

A.3.2 Requirements on Purchase Orders

A.2.3 Workmanship guidelines as contained herein.

A.3.3 Relevant nationally recognized or published standards

A.4 Some TSI drawings may call out specific external standards. In those cases, the requirements on the drawing take precedence over the workmanship guidelines contained in this document.

A.5 TSI may institute a “gold standard” inspection requirement, where parts produced are compared to a pre-approved part that meets our inspection requirements.

B Cosmetics

B.1 Surface Identification and Viewing. Cosmetic Defect examples located in Table 2, Starting on page A17.

B.2 All inspections of a TSI part regarding cosmetic requirements will be performed consistent with the steps outlined in this document.

B.3 Surfaces may be identified on TSI drawings as A, B, or C for cosmetic purposes. Reference A16, Table 1.

For reference only: the intended TSI cosmetic surface designations are defined as:

Surface	**A – Surface**	**B – Surface**	**C – Surface**
Definition	a surface that is *directly* viewable by the end customer during normal use or operation	a surface that is *indirectly* viewable by the end customer during normal use or operation	a surface that *is not* viewable by the end customer during normal use or operation

B.3.1 If surfaces are designated on a drawing as A, B, or C, but do not correspond to the definitions listed here, the cosmetic requirements specified in this document are still to be maintained to the A, B, and C standards.

B.3.2 If a drawing does not designate A, B, or C surfaces, all surfaces should be treated as A – Surfaces.

B.3.3 If surface designations are called out along with an external standard, those designations should be understood to refer to the definitions specified by that standard.

B.4 Lighting Intensity

B.4.1 All cosmetic acceptability of quality decisions will be made under normal lighting conditions (i.e. 100 – 120 foot-candles) in white fluorescent light.

B.5 Viewing Distance

B.5.1 All viewing will take place with direct overhead lighting. Parts under inspection will be held at normal arms-length.

B.6 Viewing Technique (unless otherwise specified)

B.6.1 Hold parts under inspection roughly 30 degrees from the horizontal plane.

B.6.2 Part is in direct line with the eyes.

B.6.3 Rotate the part about the vertical axis from left to right.

B.6.4 View the part under inspection for approximately 10 seconds.

B.7 If cosmetic imperfections are noted that are not explicitly covered by the requirements of this document, the part should be judged by an applicable external standard.

C Cables / Harnesses

C.1 All cable / harness assemblies will be manufactured in accordance with **IPC/WHMA-A-620**, Class II, (current revision), unless otherwise indicated on a TSI drawing or print.

C.2 Contact strip length will be in accordance with contact manufacturers' specifications.

C.3 All assembly procedures will be in accordance with the component manufacturers' specifications using recommended tooling unless otherwise specified on a drawing.

D Coatings

D.1 All painted surfaces must be complete with no voids or bare spots showing. Surfaces where no paint is needed, for cosmetic reasons, may be specified on the drawing.

Surface	A – Surface	B – Surface	C – Surface
Requirement	All painted surfaces shall be uniform in appearance relative to both texture and color.	All painted surfaces shall be uniform in appearance relative to both texture and color.	Some light scratching is allowed as long as paint seals the entire surface of the underlying material.

D.2 All plated parts shall be uniform in coverage with consistency of finish per **ASTM or MIL standards**, except where racking points are indicated on engineering drawings or where plugged holes or masked features are specified.

D.3 For all coated parts, the installation of fasteners (i.e. self-clinching standoffs, captive fasteners, etc.) should take place after coating whenever possible. However, if due to manufacturability issues a fastener is installed prior to coating, it is the responsibility of the supplier to ensure that the original fastener specification (before coating) has not been changed or compromised (after coating).

D.4 Any dimension listed on a TSI drawing or specification sheet must be held or met, after secondary operations.

E Machining

E.1 Geometric tolerances shall be interpreted pursuant to ANSI standard **ASME Y14.5**, current revision.

E.2 External and internal threads, unless otherwise specified on a drawing, will have unified thread form per **ANSI** standards. If a class is not specified, **class 2 (i.e. 2A for external and 2B for internal)** will be used. All threads (external and internal) will be verified with go / no-go gages in accordance with ANSI standards. All threads will be verified after plating.

E.3 When ring gages are unavailable or cannot be used for external threads, alternative inspection methods (e.g. 3 wire measurement for pitch diameter, major and minor diameters, etc.) may be used. Alternative inspection methods may also be specifically requested.

F Packaging

F.1 All parts delivered to TSI should be free from contaminants, dirt, foreign material, grease, machining chips, etc. Parts that are subject to corrosion should be protected by a means suitable to their intended use, which may include rust inhibitor, plating, cleanroom packaging, or some other specified method as needed. However, care must be taken to ensure that non-metallic parts or portions of a part are not affected.

F.2 All parts shall be packaged in a manner to protect them during handling, transit, and storage. Internal packaging or cushioning may be used as applicable; however, no material handling technique or packaging material shall be used that is known or is subsequently proven to introduce hidden or obvious defects to the material it is protecting.

F.3 Bulk items such as nuts, bolts, screws, etc. may be placed in bags or containers without individual protection provided that the items cannot be damaged during handling or transportation.

F.4 Painted or plated parts should be individually wrapped or protected to prevent all surfaces from nicks, dents or scratches during handling or transportation.

F.5 Electrostatic sensitive parts such as printed circuit assemblies, etc. should be in an approved and sealed ESD bag.

F.5.1 An approved ESD bag shall be one that is printed or stamped with the symbols and requirements as outlined in the standard, ANSI/**ESD S20.20 S8.1 (Association Standard for the Protection of Electrostatic Discharge Susceptible Items – Symbols – ESD Awareness)**.

F.6 Mechanical shock sensitive devices such as electronic components, etc. should be packaged to separate and restrict movement.

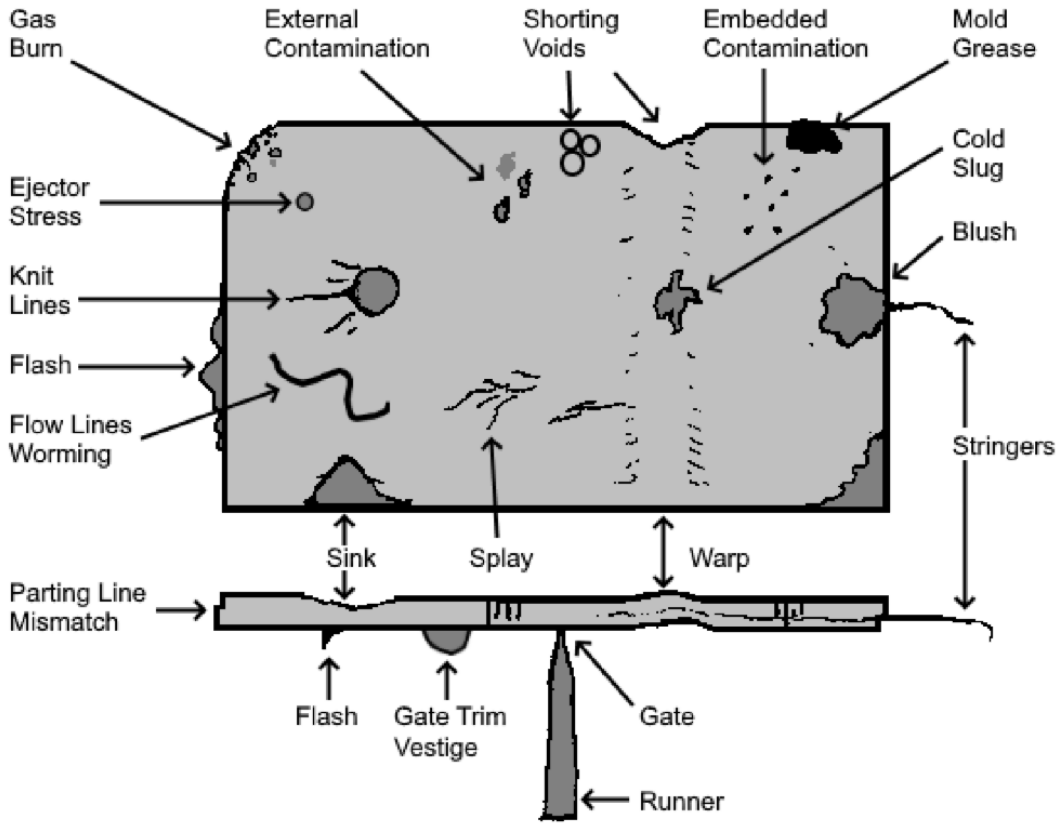
F.7 All containers or packaging should be free from hazards such as staples, insecure banding, protruding nails, etc.

F.8 Any package weighing more than 35 pounds should be marked with a “Heavy” label.

G Molded Plastics

G.1 The diagram below provides examples of some of the most common types of defects that can occur with the injection molding process.

G.2 The reference illustration below shows common injection-molded plastic defects. For further clarification, see the latest revision of **SPI AQ-103, Cosmetic Specifications of Injection Molded Parts**.



Surface	A – Surface	B – Surface	C – Surface
Requirement	No defects permitted per inspection method specified in section B of the appendix.	Slight blush, flow lines, and knit lines are acceptable. Knit lines must not show signs of cracking.	Blush, ejection marks, knit lines, flash, flow lines, sink, splay, and gate trim vestige are allowed, provided there is no functional impact on the finished assembly.

G.3 Surface Classification

G.3.1 Color Matching

G.3.1.1 Decisions regarding color matching are made by comparison to known standards using a spectrophotometer, color meter or suitable color matching light booth.

G.3.1.2 In the absence of a TSI supplied color standard, the creation of such standards shall be developed based upon the material manufacturers color chip set.

G.3.2 Gloss

G.3.2.1 Determination of gloss is to be made using a suitable gloss meter. When gloss cannot be measured by a gloss meter, judgment shall be made by eye against gloss standards provided or approved by TSI. All evaluations by eye shall be under standard viewing conditions as further defined in SPI AQ-103.

G.3.3 Finish & Texture

G.3.3.1 Judgment as to the conformance of surface finish is to be made by comparing a part to a **SPI Mold Finish Guide** plaque. Comparison is by eye unless otherwise specified.

G.3.3.2 Judgment as to the conformance of surface texture is to be made by comparing a part to a **SPI Mold – Tech Texture** plaque. Comparison is by eye unless otherwise specified.

G.3.4 Adhesion

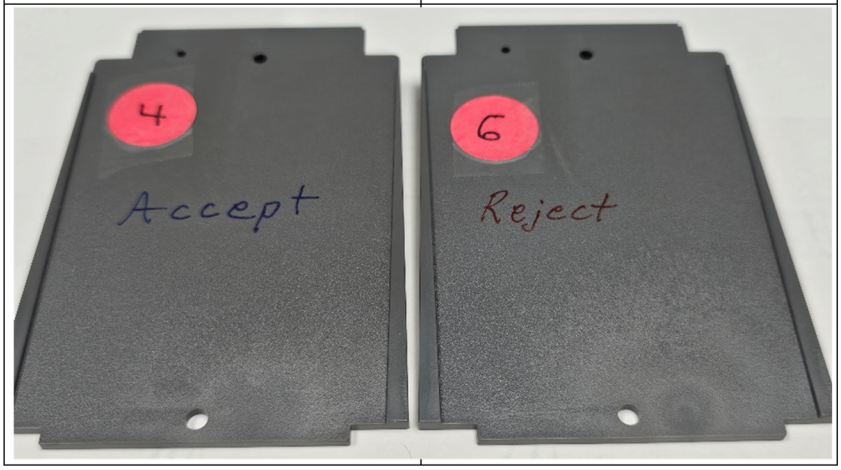
G.3.4.1 Adhesion requirements pertain to printed, painted or other decorative finishes applied to the surface of a plastic part.

G.3.4.2 The applied finish must withstand a tape test, whereby, a piece of pressure sensitive tape (Scotch number 610 or equivalent adhesive strength) is applied across the finished surface. It is then removed by rapidly pulling the tape at a 90-degree angle to the part surface. Upon removal, there should be no evidence of finish coat on the tape.

Table 1: Cosmetic Disposition Definitions

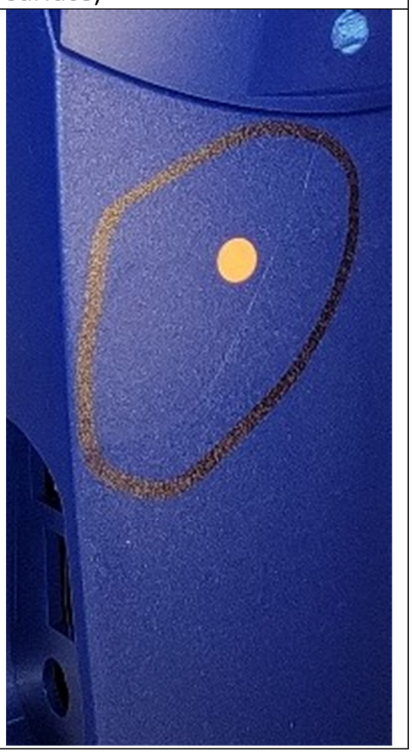
Defect	Class A	Class B	Class C	Class D
Abrasion	None allowed	1 at .25 in^2.	1 at .50 in^2.	Acceptable
Blush	None allowed	None allowed	Acceptable	Acceptable
Burrs	None allowed	None allowed	None allowed	Acceptable
Cold Slug	None allowed	None allowed	None allowed	None allowed
Crazing	None allowed	None allowed	None allowed	None allowed
Debris Contamination	None allowed	None allowed	None allowed	None allowed
Delamination	None allowed	None allowed	None allowed	None allowed
Discoloration	None allowed	None allowed	Acceptable	Acceptable
Drag Marks	None allowed	None allowed	None allowed	None allowed
Flash	None allowed	None allowed	None allowed	None allowed
Flow, Knit, Weld Lines	None allowed	None allowed	Acceptable	Acceptable
Gas Marks	None allowed	None allowed	Acceptable	Acceptable
Gate [Height]	Flush or below, as design-specified	Flush or below, as design-specified	Flush or below, as design-specified	Flush or below, as design-specified
Gouge	None allowed	3 at .039 in^2.	10 at .039 in^2.	Not visible
Marbling	Acceptable	Acceptable	Acceptable	Acceptable
Orange Peel	None allowed	None allowed	Acceptable	Acceptable
Parting Line	None allowed	None allowed	Acceptable	Acceptable
Pin Push	5 at .02 in^2.	10 at .02 in^2.	20 at .02 in^2.	Acceptable
Pitting	5 at .02 in^2.	10 at .02 in^2.	20 at .02 in^2.	Acceptable
Scorch	None allowed	None allowed	None allowed	Acceptable
Scratch	None allowed	1 at .5 in. x .02 in.	2 at 1.0 in. x .02 in.	Not visible
Shorts	None allowed	None allowed	None allowed	Acceptable
Sink	Acceptable	Acceptable	Acceptable	Acceptable
Splay	None allowed	None allowed	None allowed	None allowed

Table 2: Cosmetic Disposition Examples

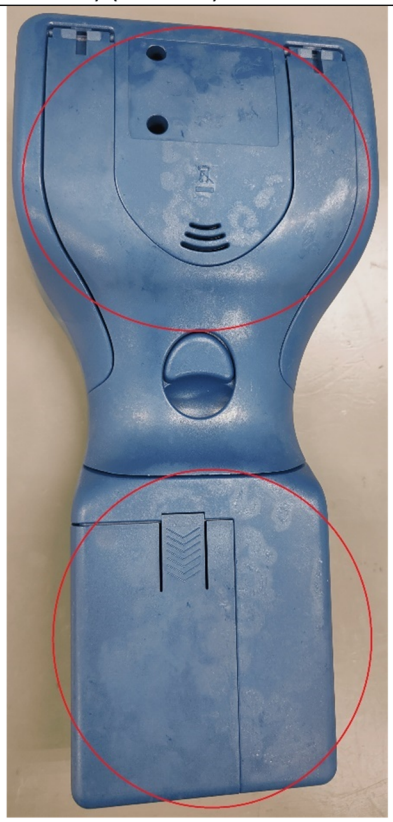
Blush (6009040), B-Surface	Blush (6009040), B-Surface
	

Short (1317471) 'ACCEPT'	Short (1317471) 'REJECT'
(NONE)	
Splay (6002022) 'ACCEPT'	Splay (6002022) 'REJECT'
(NONE)	

Gouge (1317573) 'ACCEPT'	Gouge (1317573) 'Reject' (A-surface)	Gouge (1317573) 'Reject' (A-surface)
(NONE)		

Scratch (6001466) 'ACCEPT' (A-surface)	Scratch (6001466) 'Reject' (A-surface)
(NONE)	

Blush (6012006) 'ACCEPT' (A-surface)	Scratch (6012006) 'Reject' (A-surface)
(NONE)	

Discoloration (S7000097) 'ACCEPT' (A-surface)	Discoloration (9306) 'Reject' (A-surface) (1 – Front)	Discoloration (9306) 'Reject' (A-surface) (2 - Back)
(NONE)		

H Printed Circuit Assemblies

H.1 All printed circuit assemblies (PCAs) will be manufactured in accordance with IPC Standards (i.e. Interconnecting & Packaging Electronic Circuits) unless otherwise indicated on a TSI drawing or print.

H.2 Specific acceptance criteria will be governed by **IPC-A-610 (current revision) Class II** unless otherwise specified on the applicable drawing.

H.3 Clarification to the First Article inspection process regarding printed circuit assemblies.

H.3.1 The use of a Certificate of Conformance regarding the First Article process indicates that three distinct actions have been performed and successfully completed.

H.3.1.1 Components used (i.e. Manufacturer) have been validated to TSI Bill of Material.

H.3.1.2 Component orientation has been validated to TSI drawing specifications.

H.3.1.3 Electrical testing (ICT / Functional / etc.) has been completed when specified on a drawing or within a relevant specification.

H.4 In addition to the Certificate of Conformance, a supplier should include their internal First Article paperwork with the certificate when submitting the First Article to TSI.

H.5 After successful completion of the First Article process by a supplier, every future shipment of material to TSI must contain a Certificate of Conformance specific to that delivery.

H.6 COMPONENT AUTHENTICITY / VALIDATION / VERIFICATION (Counterfeit)

H.6.1 All components used on a TSI PCA will be governed by the following criteria:

H.6.1.1 All components must be new and meet the published specifications of the original component manufacturer.

H.6.1.2 Components <u>may not</u> have been previously installed or used on any device.

H.6.1.3 Components <u>may not</u> be: reclaimed, recoated, re-harvested, repackaged, resurfaced, or reused.

H.6.1.4 Components purchased direct from a manufacturer may be used with no further validation for date codes up to 5 years old. Any date code older than 5 years from point of use should be validated prior to use.

H.6.1.5 Components purchased from a Tier 1 Distributor may be used with no further validation for date codes up to 5 years old. Any date code older than 5 years from point of use should be validated prior to use. Note a Tier 1 Distributor is defined as an entity that purchases direct from the component manufacturer.

H.6.1.6 Components purchased from a broker or any other source not defined by item D or E, must be validated prior to use regardless of component date code.

H.6.2 All component validations will be done on a 3-piece sample from the lot being considered for purchase via an independent failure analysis lab. Analysis to encompass de-cap of components for validation of die to original component manufacturer (i.e. counterfeit verification) and the absence of any obvious manufacturing defect.

H.6.3 Solder-ability testing must be included in the analysis report.

H.6.4 The 3-piece component sample (including any component stickers and packaging slips) will be sent to TSI Supply Chain Management for review.

H.6.5 A copy of the analysis results will be provided to TSI Supply Chain Management for review and approval. TSI Supply Chain may be contacted for recommendations relating to available failure analysis labs.

H.7 Return / Repaired PCAs/PCBs

H.7.1 Defective PCAs encountered are returned to a supplier through a MR (Material Review) process.

H.7.2 Any item returned would have a defect label attached to the part identifying the issue.

H.7.3 Supplier may test the part (i.e. ICT or functional, etc.) if one exists and then determine if a repair is feasible.

H.7.4 If the PCA/PCB can be repaired, it may be returned to use with the next shipment of assemblies to TSI.

H.7.5 Any repair done to a PCA/PCB will be in accordance with and governed by **IPC Standards** (i.e. **IPC 7711B / 7721B; IPC A-610**, etc.), current revisions.

H.7.6 Due to functionality or timing issues, a request (i.e. e-mail) will be submitted to TSI Continuation Engineering regarding the addition of repair wires prior to use.

H.7.7 If no test exists for a PCA, a visual inspection may be completed for a manufacturing defect (i.e. solder bridge, unsoldered leg, etc.). If a defect is found, the PCA/PCB may be repaired and returned for use with the next shipment of assemblies with the original repair tag still attached, if present when returned to the supplier.

***NOTE**: For any technical questions arising by a supplier concerning the repair of PCAs or PCBs, the applicable TSI Quality / Supplier Quality Engineer should be contacted.*

H.7.8 For any “no defect found” PCAs/PCBs returned to a supplier, the applicable TSI Buyer / Purchasing Agent will be contacted for *disposition instructions* concerning those assemblies

H.8 PCA Traceability / Marking Requirements

H.8.1 This requirement applies to all PCAs where design control resides with TSI.

H.8.2 PCAs delivered to TSI will have a readable bar code label attached.

H.8.3 The label will contain the following information unless otherwise indicated on applicable TSI drawing:

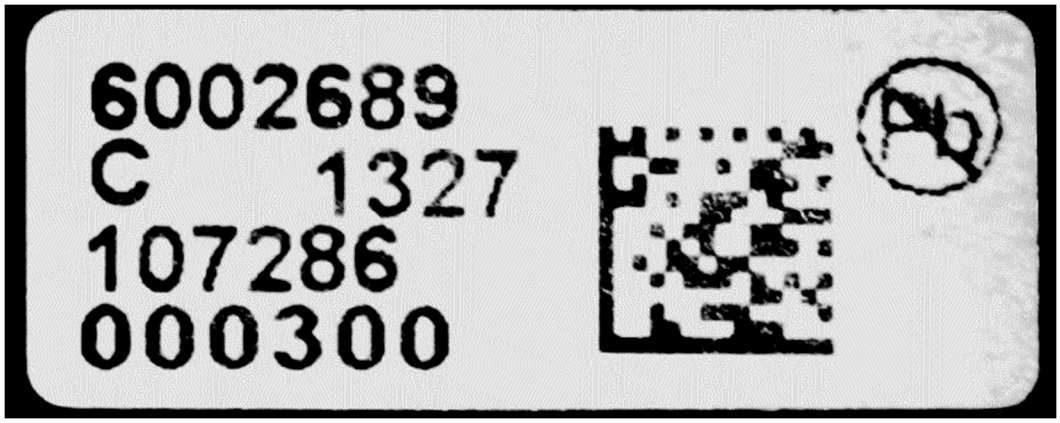
H.8.3.1 TSI Part number.

H.8.3.2 Revision Level / Manufacturing date (i.e. year / week, etc.).

H.8.3.3 Unique Identifier (i.e. job / serial number, etc.).

H.8.3.4 Lead or Lead-Free Symbol.

EXAMPLE: (*2D Data Matrix is the preferred format*)



I Sheet Metal

I.1 Geometric tolerances shall be interpreted pursuant to ANSI standard **ASME Y14.5**, current revision.

I.2 Die marks are the straight lines parallel to a bend appearing on the outside or inside surfaces of a formed part that are made by a brake die.

Surface	**A – Surface**	**B – Surface**	**C – Surface**
Requirement	Die marks are not allowed.	Die marks are not allowed.	Die marks are allowed if there is no pitting, galling, or embedded particles.

I.3 Dimensions on a TSI drawing or specification sheet must be met, after secondary operations.

J Welding

J.1 Spot welds will be verified visually for:

J.1.1 Uniformity

J.1.2 Completeness

J.1.3 Separation (i.e. lifting)

J.1.4 Burn-Through

J.2 Spot weld diameter and center-to-center spacing will be verified to drawing requirements.

J.3 All other welds will be visually verified for:

J.3.1 Uniformity

J.3.2 Completeness

J.3.3 Pitting

J.3.4 Spatter

J.3.5 Cracks

J.3.6 Burn-Through

J.4 Weld length and spacing will also be measured to verify drawing requirements have been met.

J.5 Any dimension listed on a TSI drawing or specification sheet must be held or met, after secondary operations.

J.6 Regardless of the type of weld, burn marks / residue are not permissible.