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# Purpose:

This procedure documents the method used to create and approve a controlled set of assembly instructions, i.e., an assembly procedure, or to create and approve a controlled PCB Inspection Master.

# Responsibilities:

Director of Engineering and the Engineering Coordinators have the responsibility to write and maintain the *Creation of Assembly Instructions and Control of Inspection Master Procedure*, EN1016.

The Lead Engineer, Design Engineer, Engineering Technicians, Manufacturing Engineers and Assembly Technicians in conjunction with the Production Department have the responsibility to carry out the *Creation of Assembly Instructions and Control of Inspection Master Procedure*, EN1016.

# Affected Department / Product Group / Support Group:

Engineering, Production, Drafting

# Associated Documents:

* ISO-9001
* PCB Piezotronics, Inc., Quality System Manual
* PCB Piezotronics, Inc., Quality Assurance Manual

# Procedures:

## Creation of Assembly Instructions Procedure

Engineering personnel, with support from Production personnel, are responsible for creating effective assembly procedures, which provide detailed instructions to assemblers as needed to perform the assembly steps identified on product routers. At PCB a procedure is deemed effective when an assembler with 1 year experience, and in compliance with PCB special processes, workmanship standards, and work center-specific processes/standards, can use the Work Packet (Router and BOM) and assembly procedure to consistently and correctly build the product.

1. Identify or create a product router— an assembly procedure must be created in conjunction with at least one product router. See EN1001, The router will specify all assembly and non-assembly operations, high-level instructions, and model-specific information.
2. When a new assembly procedure is required, the engineer creates an initial assembly procedure containing only assembly instructions, using TA088, as a formatting guideline. The initial assembly procedure should follow the format described in this user guide and should align with the assembly operations and their steps on the product router as described in Section 6.1.2.3. If the new assembly procedure will be associated with multiple routers, the procedure should align with all associated routers where practicable.

NOTE: If an existing router and assembly procedure are used to create an initial router and assembly procedure, take the following into consideration:

* + Treat all content as new; do not assume existing content, even the content you did not anticipate changing, is correct.
	+ Try to avoid creating new procedures that are substantially redundant to existing procedures. (However, if you instead revise an existing procedure to fit to a new product, make sure the revision does not conflict with any of the existing items built by the procedure or make the procedure too confusing to follow.)
	+ If the product is part of a “family” of existing products (e.g., it is a -07 when -01 through -06 already exist) make sure the new router and procedure align as appropriate with the routers and assembly procedures used by the other items in the family.
	+ Make sure the new procedure correctly aligns with all referenced procedures.

NOTE: If the new assembly procedure is created first, and then the router, remember that the final router will ultimately be the controlling document (and will additionally contain all non-assembly instructions), so the assembly procedure must align with the router, not the other way around.

1. Product Engineering, Manufacturing Engineering and Production work together using the initial router and assembly procedure to assemble a prototype and gather information that will be used to generate the final router and assembly procedure. This generally includes:
	* Writing down the specific details of all steps—assembly steps for use in the assembly procedure and non-assembly steps, e.g., Welding, for the router or non-assembly procedure/instructions as appropriate.
	* Taking photographs.
	* Making sketches or drawings to clarify ambiguous or complex tasks.
	* Evaluating the necessity for assembly or test fixtures.
2. The Product Engineer, Manufacturing Engineer and Assembly Technician use the information available from the initial router, initial assembly procedure and the other information gathered during the prototype assembly to create an “Effective Assembly Procedure.”
3. The procedure number is determined per DD1045. This number is entered onto the document and controls the document.
4. The assembly procedure is reviewed and approved per DD02, process, and the revised procedure must comply with this user guide EN1016.

## Creation of Inspection Masters Procedure

Engineering personnel are responsible for creating Inspection Masters, when needed, which provide clearly defined cosmetic Accept/Reject criteria that can be used within Sales, Manufacturing and Inspection operations to evaluate acceptability of product during all Manufacturing operations and In Process and Final Inspection.

The guidelines for creating a new Inspection Master are as follows:

1. Use *Template* QA071.
2. Use ample amounts of appropriately labeled photos or diagrams to clearly document the specific inspection requirement when adding the Inspection Control Method.
3. All Accept/Reject Criteria should be quantified by a measurable Tolerance.

NOTE: For visual criteria, illustrations depicting good and bad boundary samples should be used.

1. Upon completion of a draft Inspection Master, the document should be submitted for approval by appropriate representatives of Manufacturing, Engineering and Sales.
2. The Inspection Master shall be reviewed and approved per QA01.
3. Upon release of the document, it shall be available for general use by accessing its drawing number from TCS on the PCB homepage or the controlled Drafting directory, G:\Drafting-Scanned Originals\Original By DWG-Number.
4. Upon release, the Initiator shall work with the quality department to have this new inspection master added to the TCS web page
5. In the event that a questionable characteristic, not addressed by the current applicable Inspection Master, is discovered during production of a product, it is communicated to the Division Lead Engineer, or delegated Engineering representative. To determine if inclusion of the questionable characteristic into the Inspection Master is warranted, Engineering may consult with the original approvers of the Master. If it is decided to revise an Inspection Master, QA01, is initiated.

# Assembly Procedures Format and Content

## Detailed Guidelines

### PCB Assumptions

Assume the following when preparing assembly procedures for use at PCB:

* Technicians are trained to the PCB special processes, workmanship standards and manufacturing processes (e.g., soldering, epoxying, etc.), and local work center-specific activities required for their work center.
* Technicians are likely to have a wide range of reading comprehension capabilities.
* Technicians may not be familiar with technological terminology or English language idioms (e.g., “kitty-corner”).

### Organization of Assembly Procedures

#### Landscape Orientation

* Use TA088, (instructions within), to set document to landscape orientation.

#### First page content

##### Title

* At a minimum the title should specify the initial or primary model(s) or design and a plus sign (+) to indicate it pertains to multiple models (e.g., 356A01+) but can list all models that use the assembly procedure if required.

##### Revision table

* Update the revision table for procedure number, revision letter, description of change, and ECO number.
* Update the procedure number and Revision letter in the footer to match the number and letter in the table (automated in TA088).

##### Referenced documents list

* Make sure only procedures referenced per Section 6.1.3.1.2 are listed.

##### Table of contents

* After procedure is complete, update table of contents (which is built using the Router Step and Router Last Step paragraph styles).

#### Alignment of Router operations and steps with assembly procedures

* Routers are the controlling document; assembly procedures are subservient to Routers.
* Router step headings in the assembly procedure should match the Router’s assembly steps and should be consistent across all Routers associated with the procedure where practicable. Do not create router headings in procedures that do not correspond to steps on the Routers.
* Align the assembly procedure with the Router’s assembly operations by i) including all of each assembly operation’s router steps and ii) indicating the end of each operation with a horizontal line after the operation’s last step (even if the operation has only one step).

ROUTER STEP

ROUTER STEP

 ROUTER STEP

ROUTER STEP LAST

[Example Router Assembly Operation]

* Apply the Router Step paragraph style to each Router step heading in the assembly procedure, unless the heading is the last step in the operation or when each step indicates a return to the router; in those cases, apply the Router Last Step paragraph style. (This appropriately generates the horizontal lines in the table of contents.)
* Assembly procedures should contain only assembly steps. However, non-assembly steps (e.g., Calibration) may be included if all of the following are true: i) the information (e.g., photos) doesn’t fit on a Router, ii) the information is unique to the model(s) associated with the procedure (and thus can’t be addressed by that function’s standard procedures), and iii) the Router specifically refers the non-assembly Technician to the assembly procedure.

#### Section delineators

##### Delineate end of every Router operation section with a horizontal line

* Apply a bottom border to the last paragraph in each Router operation section.

##### Identifying sections of text unique to different versions (options) of a model

* If an entire Router step is unique to an option, identify the option in parentheses in the Router step heading, e.g., “POT CONNECTOR (W option only)”. If consecutive Router steps are unique to an option, identify the option in parentheses in each of the relevant router headings. Click to view Example 1.
* If part of a Router step section provides additional steps that pertain only to some versions:
	+ Try to write the procedure so all unique steps are kept together.
	+ Identify the section’s start and end with notes (e.g., “NOTE: The following steps pertain only to sensors with the W option.” and “End of steps that pertain only to sensors with the W option.”) and apply *italics* to the steps between the notes. Click to view Example 2.
* If part of a Router step section presents alternate steps, use bulleted paragraphs (i.e., apply “List 1 Bullet” or “List 2 Bullet” paragraph style) to identify each alternative and make sure each alternative directs the reader back to the appropriate point in the procedure or Router. Click to view Example 3.

### Content of Assembly Procedures

#### Text

##### Steps

* Each numbered step should describe an observable single action with a clear stopping point.
* A step can also describe a series of actions if they need to be performed serially to produce an observable result.
* Each step should be followed by the next logical action.
* All actions required to complete the assembly, especially those critical to maintain quality, need to be described.

##### Document references

* Ideally, an assembly procedure should not specifically reference another assembly procedure; all assembly procedures needed to build an assembly should be listed on the assembly’s BOM(s).
* Non-specific references to other documents such as BOMs, procedures, drawings, etc. are OK (e.g., “Refer to the BOM to identify the cable assembly procedure.”).
* When an assembly procedure is designed as a reference for other assembly procedures, it can be specifically referenced by those assembly procedures. (These reference procedures are typically not listed on any BOMs.) Example reference procedures:
	+ **TA3143, Element Inspection**
	+ **TA3225, Standardize Voltage Amplifiers With A Capacitor**
	+ **TA2816, Standardize Sensitivity And Trimming Amplifiers With On Board Capacitor**
	+ **29625, Pressure/Force Spot Weld Procedure**
* Assembly procedures should only reference special processes/workmanship standards when it is necessary to distinguish between two or more similar processes/standards, e.g., Alcohol Wash (TA1051 or TA1061).
* To the extent practicable, avoid specifying model-specific information (e.g., resistor values) in assembly procedures; instead specify the information on BOMs or Routers, as appropriate.

##### Redundancy

* Avoid redundant information within one assembly procedure, between different procedures, and between assembly procedures and other external documents. When redundancy is used (e.g., to assemble different versions of a model if each version requires different images), the person making a revision must make sure all redundant information is properly updated.
* If text between different assembly procedures is redundant and the text cannot be provided as a separate procedure, make sure the redundant text is consistent in all procedures. Be aware that repeating text in multiple procedures typically results in variance over time because the text is not linked.
* Do not repeat text from core competency procedures, (I.E. verbiage on how to clean a solder iron tip; as per TA1004).
* Except for router steps, do not repeat information from routers.

##### Terminology

* Focus on accurately describing actions—use a library of defined verbs where available—at appropriate points in the procedures, and on consistent usage of nouns.
* Be consistent—use the same (generic) terms used on assembly instruction, routers and BOMs as much as practicable.
* Provide just enough detail to enable any properly trained technician to perform procedure correctly and completely on first use without needing to seek clarification or assistance.

##### Notes

* Insert a Note, Warning, or Caution as a separate, non-numbered paragraph at the same indent level as the number of the step that precedes it, and begin line with “NOTE:” in all caps or “WARNING” or “CAUTION” in all caps and bold text.
* Use Notes to give supplemental information, provide an explanation, identify the source for an input to the procedure, or describe a consequence of a step.
* Use Warnings and Cautions before their associated step; Warnings indicate a danger to personnel and Cautions indicate potential damage to equipment or product. Warnings/Cautions should contain the action required to avoid the injury or damage, the reason for the Warning/Caution, and the consequences of ignoring the Warning/Caution.
* Use Notes within a router step section to indicate the beginning and end of additional text unique to a different version of a model, as described in Section 6.1.2.4.

##### Item (bubble) numbers (item x) and adjectives usage

* Use item numbers only as needed to clearly identify items in the procedure. Typically, item numbers are used for zero quantity (consumable) materials/items (e.g., epoxy, wire, etc.) or to distinguish between similar items (e.g., two different housings).
* Use item numbers to refer to unmodified/unassembled items only.
* Avoid using item numbers in both text and callouts; text only is preferred.
* Use generic (i.e., not part numbers or changeable detailed descriptions) adjectives such as “’ribbon’ wire” as needed to differentiate between similarly-named items (e.g., types of wire).

##### Fixture numbers

* Identify fixtures using “F” numbers (e.g., “F1”), if available; otherwise, use generic descriptive text tied either to the fixture’s function or the BOM description.

##### Usage of bold, italics, all caps, underscore, etc.

* Use *italic* text only to indicate additional text for different versions of a model, as described in Section 6.1.2.4.2.
* Use ALL CAPS text to reference text on a labeled item (e.g., ON/OFF switch).
* Use underscore to indicate emphasis (e.g., “Do not disconnect wire at this time.”).

##### Use of Numbers/Units

* Use engineering units, when appropriate, to indicate settings, parameters, or expected outputs (e.g. set pressure to 40psi).
* When a setting or parameter is non-critical use “approximately” to indicate as such.
* When a setting or parameter is critical a tolerance value should be specified.

#### Images

##### When/How to use images

* Generally, use images to reinforce or clarify text, not replace it.
* To the extent practicable, keep image on the same page as the text with which it is associated. If the image is on a different page, make its cross-reference a hyperlink.
* Insert images “in line” with text.

##### Type of image to use

* Select type of image (photo, drawing, animation, video) based on its ability to accurately depict what needs to be illustrated, not the ease/availability of obtaining the image.
* Avoid reusing existing pictures, drawings, etc. if they are close but not exact representations of the information to be shown.
* Use exploded view/final assembly images in assembly procedures only if the images are current, accurate, and valid for all models associated with the procedure.

##### Quality of image

* Make sure photos are clear and in focus—they can be zoomed in digitally.
* Make sure all aspects of modeled images, especially placement/location of parts, are accurate.
* If it is difficult to discern perspective from an individual “zoomed in” photo, accompany it with a second, “zoomed out” photo to show perspective.

##### Captions, Numbering and Cross References

* Use Word’s referencing capability to insert captions below figures and above tables.
* Insert cross-references to figures and tables (and router step headings as appropriate); apply underline and blue color to reference (the X-ref character style is available to do this) when it refers to an item on a different page.

##### Callouts

* Use the first Word callout shape style (Rectangular Callout), as shown in the template—it works with any light or dark background.
* Make sure all callouts point to the proper locations.
* It can be helpful to lock a callout’s anchor to the paragraph that contains the image to keep the callout with the image if the paragraph moves.

#### Using separate source data files

* An assembly procedure may use data (e.g., images, spreadsheets, graphs, charts, etc.) from a separate file. If the separate file contains information that would need to be revised when the assembly procedure is revised, the file can be archived with the procedure by providing it to Drafting in a folder that also contains the procedure’s MS Word file. The folder should be named with the assembly procedure number.

## Assembly Procedures Checklist

* Verify title is appropriate. It does not have to list all models; it can use the initial (main) model and a + sign.
* Verify Revision table is correct and correct assembly procedure number is shown in table and footer.
* Verify Referenced Documents Section lists all documents referenced in the body of the procedure.
* Make sure all assembly steps from all associated Router(s) are accounted for in the assembly procedure and all are defined with the Router Step or Router Last Step paragraph style, as appropriate.
* Make sure the table of contents lists all Router steps and has bars after the last step of each Router operation.
* Make sure the end of each Router operation section in the procedure is marked with a horizontal bar.
* If the assembly procedure applies to multiple sensor versions, make sure the version-specific information is properly delineated and the procedure clearly indicates how each path proceeds to the next step.
* Make sure all figures and tables are referenced and numbered properly, their captions are descriptive and unique for each figure or table
* Where practicable, make sure figure or table is on the same page as the text that references the figure or table. If figure or table is on a different page, make sure its cross-reference is formatted as a hyperlink.
* Make sure all callouts are lined up correctly.
* Make sure step numbering is correct throughout document.
* Make sure each procedure has a logical flow, i.e., each step is followed by the next logical action and all actions required to complete the assembly are described.
* Check for consistent use of terminology; widgets are always widgets, not thingamajigs or anything else.
* Check image quality. Make sure photos are clear, not blurry, and are accurate for all models that use the procedure. Make sure drawn images are accurate and unambiguous for all models that use the procedure.
* Check for and remove unnecessary redundancy. If redundant information is used, make sure all redundant text in procedure and other related external documents is consistent.
* Check spelling, punctuation, grammar. (It can be helpful to read text aloud; if it doesn’t sound right or is difficult to say, you probably need to change something.)
* If you are revising a procedure, do not assume existing content is correct—be prepared to verify all content.
* Verify that all parameters are used appropriately and include units as necessary.

# Referenced Documents:

EN1001, [TA088](file:///R%3A%5CTCS%5CTA%5CForms%5CTA088%20Standard%20Operating%20Procedure.doc), [DD1045](file:///R%3A%5CTCS%5CDD%5CUser%20Guides%5CDD1045%20Users%20Guide%20-%20Creating-Closing-Reviewing%20Document%20Numbers%20and%20ECO%20Numbers.doc), [DD02](file:///R%3A%5CTCS%5CDD%5CProcess%20Maps%5CDD02-ECO%20Process%20Map.htm), [QA071](file:///R%3A%5CTCS%5CQA%5CForms%5CQA071%20Visual%20Inspection%20Master%20template.xls), [QA01](file:///R%3A%5CTCS%5CQA%5CProcess%20Maps%5CQA01%20-%20Document%20%26%20Data%20Control%20of%20TCS.htm), [TA1051](file:///R%3A%5CTCS%5CTA%5CUser%20Guides%5CTA1051%20Heated%20Ultrasonic%20Cleaning.DOC), [TA1061](file:///R%3A%5CTCS%5CTA%5CUser%20Guides%5CTA1061%20General%20Workmanship%20Cleaning.DOC), [TA3143](file:///G%3A%5CUsers%5CDRAFTING%5CTA_Procedures%5CTA3000%5CTA3143.doc), [TA3225](file:///G%3A%5CUsers%5CDRAFTING%5CTA_Procedures%5CTA3000%5CTA3225.doc), [TA2816](file:///G%3A%5CUsers%5CDRAFTING%5CTA_Procedures%5CTA2000%5CTA2816.doc), [29625](file:///G%3A%5CUsers%5CDRAFTING%5CMaster%5C29%2C000%5C29625.doc), [27281](file:///G%3A%5CUsers%5CDRAFTING%5CMaster%5C27%2C000%5C27281.doc), [QA020](file:///R%3A%5CTCS%5CQA%5CForms%5CQA020%20Material%20Disposition%20Report-Deviation%20Notice.doc)/[QA020i](file:///R%3A%5CTCS%5CQA%5CForms%5CQA020i%20Material%20Disposition%20Report-Deviation%20Form%20Instructions.doc)

# Unusual Conditions:

1. Regarding assembly procedures, for special projects that are a simple modification of a standard product, the assembly instructions for the standard product shall suffice as adequate means of documentation. These procedures are to be used as a guideline for assembly and exceptions are to be noted on the product router. It is ultimately the Operation Manager and lead engineer’s decision whether a unique set of assembly instructions needs to be generated for any product.
2. The Manufacturing Deviation Notice, per QA020, takes precedence over the Assembly Procedure.

Reference Examples Storage

Example 1: All steps under the router heading are unique to one version:

Return to Section 6.1.2.4.2.

Example 2: Some steps under the router heading are unique to one version AND the unique steps provide additional actions:

Return to Section 6.1.2.4.2.

Example 3: Part of router heading step is unique to one version AND the unique steps provide alternative actions:

Return to Section 6.1.2.4.2.