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Littelfuse Supplier Production Part Approval Process (PPAP) Manual

November 2013, Revision A

Jun.2014, Revision B

April 2016, Revision C

March 2021, Revision D

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Littelfuse PPAP General Requirements

Littelfuse uses the Production Part Approval Process to confirm that the supplier understands the design specifications and has a process capable of producing product to meet these requirements, during an actual production run, at the quoted production rate. An industry requirement for all automotive suppliers, PPAP is being expanded to include all of our suppliers.

PPAP requirements vary based on the submission level assigned to a supplier and/or part number. The Littelfuse Supplier Development Engineer and/or Supplier Quality Engineer representative, is responsible for designating the submission level. The submission level is generally determined during the PAF RFQ process and/or PAF. Suppliers are expected to apply these same PPAP requirements to all sub-suppliers.

If the parts and PPAP conform to design record requirements, and the capability data is within specifications, the parts and PPAP will be accepted.

The Part Submission Warrant (PSW) will be signed by Littelfuse Supplier Development engineer and/or Supplier Quality Engineer representative, giving the supplier, the approval to run the parts as submitted. If there is no signed PSW, there is no approval from Littelfuse and parts cannot be shipped, unless otherwise is specified by Littelfuse Supplier Development Engineer and/or Supplier Quality Engineer representative (PPAP with interim approval).

Submission Levels

Level 1	Warrant only (and for designated appearance items, appearance approval report) submitted to Littelfuse.
Level 2	Warrant with product samples and limited supporting data submitted to Littelfuse
Level 3	**Default submission level, ~~for all submissions~~ unless otherwise specified. (Refer to PPAP matrix)**
Level 4	This level is reserved for special applications only; it cannot be utilized without the consent of Littelfuse Supplier Development Engineer and/or Supplier Quality Engineer, representative.
Level 5	Only applied to on site review as requested by Littelfuse Supplier Development Engineer and/or Supplier Quality Engineer, representative.

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Change Management Matrix

1) Is it a change?	2) Does it affect customer's significant characteristics?	3) is the technical interface to the customer affected?	4) type of change?	5) Does it affect contract documents (e.g., specifications, customer's drawing, data-sets?	6) Are fitment, form, function, performance, reliability affected?	if customer specific requierements exist, the agreement is obligatory!		PAF	PPAP LEVEL	ROW
	Y	Y/N	ALL	Y/N	Y/N	Change to significant characteritics agreed with the customer for the product, sub-assy., component (electrical/mechanical process,...)?		Y	2	1
y	N	N	Design MC**	Y	Y	e.g., change to design, tooling, ...	Z	Y	2	2
				N	Y	e.g., change to a dimension not included in the Littelfuse specification	Z	N	-	3
						Change to materials	Z	Y	3	4
					N	Change to internal specification or tolerances outside Littelfuse specification	Z	Y	2	5
						Change to internal specification or tolerances but still within Littelfuse specification	-	N	4	6
					N	Change to identification of parts/materials but with unchanged composition	-	Y	4	7
						Change in early man'Fing stages (e.g., pre-drilled dimension for a shaft, water location,...)	-	Y	2	8
			Process Mc	Y	Y/N	e.g., change in process chain, (inc. Supplier, duplicated production lines, ...)	Z	N	2	9
						e.g., changes in checks, checking sequence or other reasons.	Z	N	2	10
				N	Y	e.g., change in hardening parameters, injection temperature, ...	Z	N	2	11
					N	Prod'n-assembly: Change in no. of cavities in tool, progression tools, incremental tool.	I	N	3	12
						Prod'n-assembly: Duplication of production and checking equipment within an existing line	I	N	2	13
						Prod'n-assembly: New of type of machine obtained and installed	I	N	3	14
						Prod'n-assembly: Change to an existing tool, new equipment, new Poka Yoke	-	N	4	15
						Prod'n-assembly: Change in manufacturing stages	-	N	2	16
						Prod'n-assembly: Change in setting parameters, production facilities, injection temperature	-	N	3	17
						Testing: Changes in checks, worsened RPN		N	NP	
						Testing: Change to checking method, RPN Unchanged/improved, same process	I	N	4	18
						Testing: Extended checks with no change to method (e.g., larget sample size)	-	N	4	19
						Testing: Reduction/elimination of check not relevant to the customer (e.g., random sample check)	-	N	4	20
						Transfer of production: Tools moved from one line to another, lines are the same.	-	N	4	21
						Transfer of production: Movement of equipment in a production plant with no change to the process chain.	-	N	3	22
						Transfer of production: Location change: equipment, parallel prod'n (not early mfg stages)	Z	N	3	23
			Logistics	Y	Y/N	Supplier change, new 2nd supplier, supplier has changed sub-supplier	Z	Y	3	24
				N	Y/N	New Carrier or ESP, SLC	I	N	-	25
					Y/N	Supplier and/or Littelfuse packing, shipping, invoicing change	Z	Y	4	26
					Y/N	Internal packing (e.g., plant to plant, within the plant, ...) and suppliers	-	Y	4	27
			Doc Mc	Y	Y/N	Documents adjusted to status of approved /released product	Z	2	3	28
				N		Documents adjusted to status of approved/released product or to correct formal defects.	-	Y	2	29
						Change to documents not product-related (e.g., work instructions, ...)	-	N	-	30
N	Re-Use of tools following 12 or months out of use						Z	N	3	31
	Annual requalification						Y	N	2	32
	Maintenance/overhaul of existing tools/tools subject to rapid wear (e.g., turning too, honing tools)						-	N	-	33
	Replacement of an identical machine or a machine with an equal functionality. Replacement of identical measuring and test devices/equipment. **						-	N	2	34

y	Yes
n	No
np	not permitted
-	Customer Involvement not essential (Note: PPAP documents must be archived in-house)
I	Customer must me informed as ISO/IATF. Para 4.2.3.1 the customer must have 2 weeks to issue findings.
Z	Customer agreement required, execution of PPA procedure
Mc	Modification
ESP	External service provider
SLC	Supplier logistics centre (also applies to warehouse)
RPN	Risk priority number from Process FMEA
*****	or other authorized production documents provided to the customer (e.g., quotation drawing, control plan

Remark:

For distributors, it is their responsibility to receive and approve PPAP from the original manufacturer and then submit to Littelfuse along with their own PSW making sure that there is a cross reference among part numbers: manufacturer, distributor and Littelfuse. Any deviations from this requirement need to be approved by Littelfuse in writing prior to first shipment of parts/material

Littelfuse expects that suppliers and distributors, manage and approve their own suppliers base and maintain evidence of compliance.

Regardless of the submission level, PPAP shall be maintained at least for the length of time the part is active plus one calendar year.

PPAP is also applicable for standard catalog purchased parts, components/off the shelf, i.e., electronic, mechanical and/or other component categories.

Supplier must submit PPAP in English, unless otherwise is specified by Littelfuse Supplier Development Engineer and/or Supplier Quality Engineer, representative

Submission Status

The PSW is reviewed by the Supplier Development Engineer and/or Supplier Quality Engineer representative, as follows:

- **Approval**: Indicates the part meets all specifications and requirements, and the supplier is authorized to ship production quantities.
- **Interim Approval**: Permits shipment of material for production requirements on a limited time or piece quantity basis, when supplier has clearly defined the root cause of the non-conformities preventing production approval and has prepared an interim approval action plan agreed upon by Littelfuse.

  Note 1: For those parts with disposition "Interim Approval", supplier should issue another PSW once the non- conformities have been corrected.

  Note 2: PPAP re-submission is required to obtain a status of approved.

  Note 3: Parts with a status of interim approval are not considered fully "Approved"

- **Rejected**: Prevents production quantities from being shipped because the submission, the production lot from which it was taken and the accompanying documentation does not meet Littelfuse requirements. In such cases, the submission and/or process as appropriate, shall be corrected to meet Littelfuse requirements. The re-submission shall be approved before production quantities may be shipped.

As required, the Supplier Development Engineer and/or Supplier Quality Engineer representative will determine if annual PPAP re-qualification is applicable or not (based on Customer Specific Requirements or other requisites). This requirement must be reviewed and agreed upon during APQP, PAF (Print Acceptance Form) and/or early PPAP stages. When applicable, the annual PPAP re-qualification is separate and in addition to PPAP submissions related to engineering changes.

Annual re-qualification documents may include:

- Full dimensional layout
- Material testing or certifications (such as flammability compliance)
- Environmental requirements
- Reliability testing

Note: No additional Supplier costs or fees ~~and charges~~ associated with this requirement are allowed.

	PRODUCTION PART APPROVAL PROCESS (PPAP)	PPAP Level				
		1	2	3	4	5
1	Design Record	R	S	S	*	R
2	Engineering Change Documents	R	S	S	*	R
3	Customer Engineering Approval	R	R	S	*	R
4	Design FMEA	R	R	S	*	R
5	Process Flow Diagram	R	R	S	*	R
6	Process FMEA	R	R	S	*	R
7	Control Plan	R	R	S	*	R
8	Measurement System Analysis Studies	R	R	S	*	R
9	Dimensional Results	R	S	S	*	R
10	Material, Performance Test Results	R	S	S	*	R
11	Initial Process Studies	R	R	S	*	R
12	Qualified Laboratory Documentation	R	S	S	*	R
13	Appearance Approval Report (AAR)	S	S	S	*	R
14	Sample Product	R	S	S	*	R
15	Master Sample	R	R	R	*	R
16	Checking Aids	R	R	R	*	R
17	Records of Compliance (Substance of Concern & Conflict Minerals)	R	R	R	*	R
18	Part Submission Warrant	S	S	S	S	R

Figure 1 - PPAP Submission Levels from PPAP latest edition by AIAG.

S = The organization shall submit to the customer and retain a copy of records or documentation items at appropriate locations.

R = The organization shall retain at appropriate locations and make available to the customer upon request.

*** =** The organization shall retain at appropriate locations and submit to the customer upon request.

Use of the AIAG Bulk Materials Checklist is an acceptable substitute for a regular PPAP if it is applicable.

The requirements of this manual were drafted to be compliant with AIAG PPAP Standard. Littelfuse has specific requirements and additions to this standard that need to successfully submit a PPAP to Littelfuse. The Littelfuse specific requirements are a must for all Level 3 PPAP submission, unless otherwise specified by Littelfuse Supplier Development Engineer and/or Supplier Quality Engineer representative.

Instructions to complete Littelfuse PPAP Submission

Element 1 – Design Record and Ballooned Drawing

Design Record and/or Specification are engineering requirements for judging the acceptability of a part characteristic. For qualification, every feature of the product as identified by engineering in design record/print or specification~~s~~ must be measured.

Design records are considered as; ~~all~~ Littelfuse and supplier design records.

A ballooned drawing shows the parts or assemblies in a part print with numbered ballooned that point of individual dimensions and requirements of the part. **The numbers on the** ballooned **drawing correlated with the numbers found on the Dimension Result sheet. A** ballooned **drawing must be submitted as part of PPAP for every submission level when there are dimensional results.**

All part requirements on the print must be ballooned and numbered for reference and measurement. These may include:

1. Dimensions and tolerances of parts
2. Visual features (color, texture, etc.)
3. Chemical characteristics (cure time, etc.)
4. Physical and mechanical properties (torque, hardness, plating thickness, etc.)
5. Any other specified requirement that you have the capability to measure or that is described in print notes or referenced specifications.

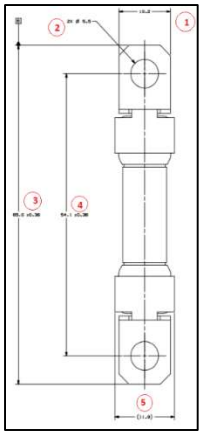


Figure 2 - Example of a ballooned *drawing*

Element 2 & 3 – Engineering Change

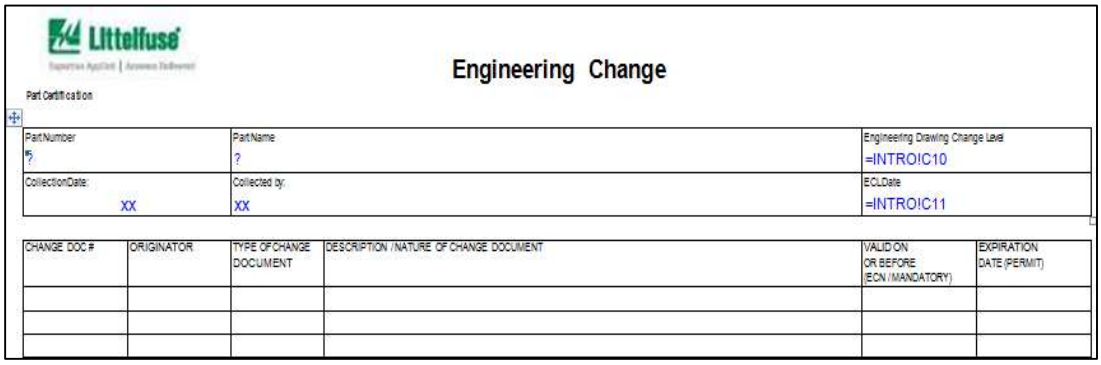
The supplier shall have any authorized engineering change documents not yet recorded in the design record but incorporated in the product, part or tooling.

Suppliers and sub-suppliers of Littelfuse are not authorized to make any change ~~a change~~ to a product and /or process that was previously approved without first receiving written authorization by Littelfuse. Examples of such changes include, but are not limited to: tool moves, changes to manufacturing process / shipping location / plant move, material changes (subsuppliers changes), changes that impact the logistics and deliveries such as ERP and carriers, and others.. Any change must be communicated to Littelfuse. In the **Product / Process Change Notification (PCN).**

If apply, PAF (Print/Spec Acceptance Form) will be generated to assure supplier understands requirements regarding changes through the ECR/GCF and PCN/SPCN (e.g. Introduction of new supplier) process.

Is supplier responsibility:

- Confirm their capability to produce the material/component to design record.
- Notify any concerns regarding design records in SECTION 3 before signing off this form.
- Provides any requested quality documents (e.g. PPAP, IMDS, QMP and others as applicable) as established in this form.



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Engineering Change

Part Certification

Part Number	Part Name	Engineering Drawing Change Level
?	?	=INTRO!C10
Collection Date: xx	Collected by: xx	ECL Date =INTRO!C11

CHANGE DOC #	ORIGINATOR	TYPE OF CHANGE DOCUMENT	DESCRIPTION / NATURE OF CHANGE DOCUMENT	VALID ON OR BEFORE (ECN / MANDATORY)	EXPIRATION DATE (PERMIT)

Figure 3 - Form of the Engineering Change

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Supplier Product/Process Change Notice

Rev B

PCN Information

Supplier Name		**PCN #**	
Supplier Location(s)		**Request Date**	
Contact Name		**Implement Date**	
Phone #		**Product Identification**	
Email			

Category of Change

- ☐ 1. Product Design
- ☐ 2. Assembly / Fabrication Process
- ☐ 3. New Tooling / Mold
- ☑ 4. Manufacturing Site / Location
- ☐ 5. Sub Supplier or material source
- ☐ 6. Material type or component
- ☐ 7. New equipment
- ☐ 8. Changes on critical equipment parameters
- ☐ 9. Others _____

Description of Change & Reasons

Important Dates

- ☑ Qualification Samples avaliable _____
- ☐ Final Qualification data avaliable _____
- ☑ Old product final shipment date _____
- ☐ Last Time order date _____

Method of Distinguishing Changed Product

- ☐ Product Mark
- ☑ Date Code
- ☐ Others

Demonstrated or Anticipated Impact on Form, Fit, Function or Reliability

Supplier Qualification Plan / Results

Littelfuse Requirements

ALL Information Below is to be filled out by Littelfuse

PPAP Required	Yes ◉	No ○	Level _____ Due date _____
Process Audit	Yes ☐	No ☐	
LF Customer Approval	Yes ☐	No ☐	
Appearance Approval	Yes ☐	No ☐	

Additional Requirements _____

Littelfuse Approval Signature	**Signature**	**Date**
LF Procurement Representative		
LF Engineering Representative ***(if needs)***		
LF Supplier Development Representative		

Additional Requirements/Comments:

Figure 4- Form of the Engineering Change

(excel form available in: https://www.littelfuse.com/about-us/supplier-resources.aspx)

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Print/spec Acceptance Form

SECTION 0 – BASIC INFORMATION

Supplier Name Vendor Code		Select type of change		ECO/GCF number	
				DGW Type	Select

Project Description:

Part Number	Drawing No.	Rev.	Part Description	Previous Part Number (If Changed)	Previous Rev.	ECO/GCF Details	Application
						Select	Select
						Select	Select
						Select	Select
						Select	Select
						Select	Select
						Select	Select

SECTION 1 – LITTELFUSE REQUIREMENT

1. PPAP with IMDS Required	Select	Level	3	Due Date		PO#
	(Detailed PPAP requirements refer to Littelfuse Supplier Production Part Approval Process Manual)					
2. Process Audit	Select					
3. LF QMP Updated	Select	(Detailed requirements refer to Littelfuse Quality Management Plan)				
4. DFM Required	Select	Due Date				
5.Technical Review Meeting Required	Select	Due Date				
	(As required based on information in appendix '7.2' for a guideline of what "complex parts" refers to)					
6. Section 3: Supplier Review Checklist Required	Select	(For some updates is not required such as correcting drawing error, adding tolerance missed, etc.)				
7. Sample Required	Select	Due Date		Qty	Select	Specify type of samples
8. Appearance Approval Required	Select	Such as Safe-Launch activities				
9. Additional Requirements						

Purchasing (Printed Name & Date)	Engineering (Printed Name & Date)	Supplier Development Engineer (Printed Name & Date)

SECTION 2 – SUPPLIER RESPONSE (Updated by Supplier)

After reviewing **SECTION 3 – SUPPLIER REVIEW CHECKLIST**

- ◯ Accept Print/Spec as-is
- ◯ Accept Print/Spec with notes (Specify in SECTION 3 recommended information to be added to Drawing / Specification)
- ◯ Cannot accept Print/Spec for the following reasons:

If accept, we (Supplier) declare as below:
All part Prints/Specifications were reviewed in detail and are understood by our team with no further concerns and/or questions. There is clear agreement about the disposition and handling of inventories of the previous material/part version (if change is involved). We will follow quality requirements as stated in this PAF. All costs were evaluated and are acceptable.
In conclusion, we have the ability to develop, manufacture and launch this product within the required schedule and to the quality and cost standards as defined by Littelfuse.

Sales/Project Manager (Printed Name & Date)	Engineering Manager (Printed Name & Date)	Quality Manager (Printed Name & Date)

- Supplier must return this form filled out to Littelfuse Purchasing within three working days. If no feedback is received, Littelfuse understands that the supplier will meet all the requirements as documented in the form including those in the Print/Specification.
- Littelfuse has the right to reject components from a supplier if these are the result of a part or process change which was not previously approved by Littefuse. Supplier is responsible for all costs associated with an unapproved change.
- Originals to be retained by Littelfuse Purchasing

Figure 5 - Print/Spec Acceptance Form - Page 1.

SECTION 3 – SUPPLIER REVIEW CHECKLIST (Updated by Supplier, focus on specific and potential request beyond Print/Spec.)

Supplier Review Dept.	Review Contents	Yes / No / N/A	Comments & Clarify items with Littelfuse	Due Date	Respon sible
Technical Engineering Product Project	Are there other similar components in current production?	Select			
	Is all drawing content well understood including notes, specifications, standards and requirements (i.e. EIA J-STD-002D)?	Select			
	Can safety characteristics in drawing be met?	Select			
	Can all dimension in drawing be met with defined Cpk, SPC and critical characteristics requirements (Unless there is an agreement between Littelfuse and Supplier minimum Cpk is 1.67 for critical characteristics).	Select			
	Can current process and production equipment meet design specifications?	Select			
	Is the raw material available and meets the drawing?	Select			
	Is apprearance requirement clear and understood in order to create own visual aids?	Select			
	Is material free of contaminant agents / sources?	Select			
	Is the packaging defined and agreed and validated with Littelfuse (Ground, airfreight, overseas)? If not, there must be an agreement between Littelfuse and supplier.	Select			
	Are fixtures required to produce this material (i.e welding, machining fixtures and /or gauges) available?	Select			
	Are the parting lines, gates, pin position, flash size, sink or protrusions level, deformation level defined with Littelfuse in a measurable method for the components?	Select			
	Is there any agreement to use regrinding or recycle material?	Select			
	Is there any warranty, reliability or component life agreement?	Select			
	Does the material require special storage/handling method and the shelf life is specified?	Select			
	Are there additional characteristics or features requirements for the component?	Select			
Quality EHS	Is zero defects target defined within your organization?	Select			
	Provide the estimated Internal product yield rate (DPPM or %) per product category.				
	Are you able to measure and test the component based on drawing requirements?	Select			
	Are fixtures required to measure / test this material available?	Select			
	Is there a system in place to keep traceability at component level?	Select			
	Is material in compliance with RoHS/REACH/Halogen free requirements?	Select			
	Are IMDS requirements clear?	Select			
Sourcing Purchasing Buyer	Can raw material be supplied according to Littelfuse requirements?	Select			
	If outsource process is required (i.e. plating, annealing), Is the sub-supplier manufacturing capability and quality assured?	Select			
Production Equipment	Is there any additional equipment to produce this material (Backup equipment)?	Select			
	Is there any additional equipment needed to produce this material (Capacity)?	Select			
	Are there enough operators with required skills to run the process (Certified personnel)?	Select			
Sales Marketing	Is there a MOQ/ MPQ requirement?	Select			
	Can Littelfuse lead times be met?	Select			
	Was the unit cost quoted considering above items?	Select			

- It is highly recommended that the supplier has a cross functional team which at least includes engineering and quality functions to avoid any omission caused by the review of only one person. If there are no concerns, sign in the corresponding department field.
- If there is any change needed to current Print/Specification, approval by Littelfuse Engineering is required
- Originals to be retained by Littelfuse Purchasing

CHI-PUR45-0014 Rev D

Figure 6 - Print/Spec Acceptance Form - Page 2.

Element 4-1 – Design FMEA (if supplier is design responsible)

A Design FMEA is an analytical technique utilized by the design responsible to assure that to extent possible, potential Failure Modes and their associated Causes or mechanism of failure have been considered and addressed prior to releasing the part to production.

DFMEA analyzes the functions of a system, subsystem, or component of interest as defined by the boundary shown on the Block/Boundary Diagram.

Severity, Occurrence and Detection ratings are used when performing FMEA activities. These rating scales must be compliant with the AIAG & VDA guidelines for FMEA (latest edition) and definitions are included in the DFMEA worksheet as well as this handbook.

Action Priority (AP) is based on combinations of Severity, Occurrence and Detection ratings to prioritize actions for risk reductions.

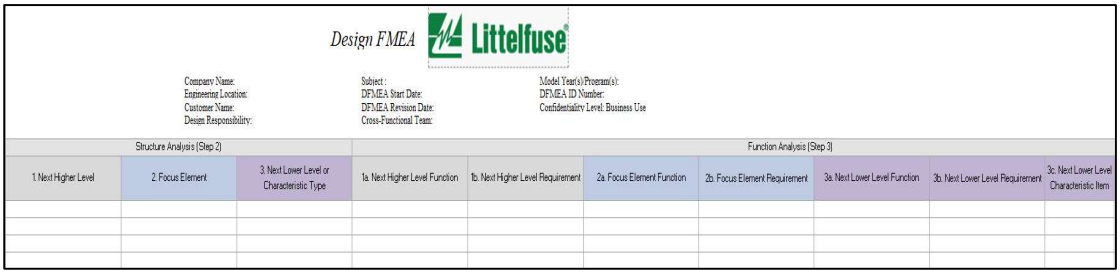
- **Priority High (H):** Highest priority for review and action.
  The team **need** to either identify and appropriate action to improve Prevention and/or Detection Controls or justify and document why current controls are adequate.

- **Priority Medium (M):** Medium priority for review and action.
  The team **should** identify appropriate actions to improve prevention and/or detection controls, or, at the discretion of the company, justify and document why control are adequate.

- **Priority Low (L):** Low priority for review and action.
  The team **could** identify actions to improve prevention or detection controls.

Littelfuse requires that **any severity ranking of 9 or 10 be addressed with a corrective an action plan. In Addition, Littelfuse recommends suppliers to develop continuous improvement activities for the top Action Priority identified**

DFMEA is only required when the part is designed by the supplier. Otherwise, the Design FMEA is the responsibility of Littelfuse.


Design FMEA Littelfuse

Company Name:
Engineering Location:
Customer Name:
Design Responsibility:

Subject :
DFMEA Start Date:
DFMEA Revision Date:
Cross-Functional Team:

Model Year(s)/Program(s):
DFMEA ID Number:
Confidentiality Level: Business Use

Structure Analysis (Step 2)			Function Analysis (Step 3)						
1. Next Higher Level	2. Focus Element	3. Next Lower Level or Characteristic Type	1a. Next Higher Level Function	1b. Next Higher Level Requirement	2a. Focus Element Function	2b. Focus Element Requirement	3a. Next Lower Level Function	3b. Next Lower Level Requirement	3c. Next Lower Level Characteristic Item

Figure 7 - Design AIAG &VDA FMEA example

(excel form available in: https://www.littelfuse.com/about-us/supplier-resources.aspx)

Element 5 – Process Flow Diagram

The Process Flow Diagram depicts the flow of materials through the process.
The Process Flow Diagram must follow the process **from receipt of raw material and receiving inspection, through any warehousing and shipping steps, and include any "Dock Audits" and Final Inspections.** The PFD shall comprehend all potential paths that a part can take in the process, including inspection, containment, rework, scrap, material shipped to sub-contractors and the returning of the material back to the supplier's plant. The Primary process steps must match both the Control plan and the PFMEA.

The Process Flow can be provided in any format used within an organization.

Process Flow Diagram

Part # xx
Customer Part# xx

Product: xx
Rev Date: 2012-9-1
Prepared By: 2012-9-6

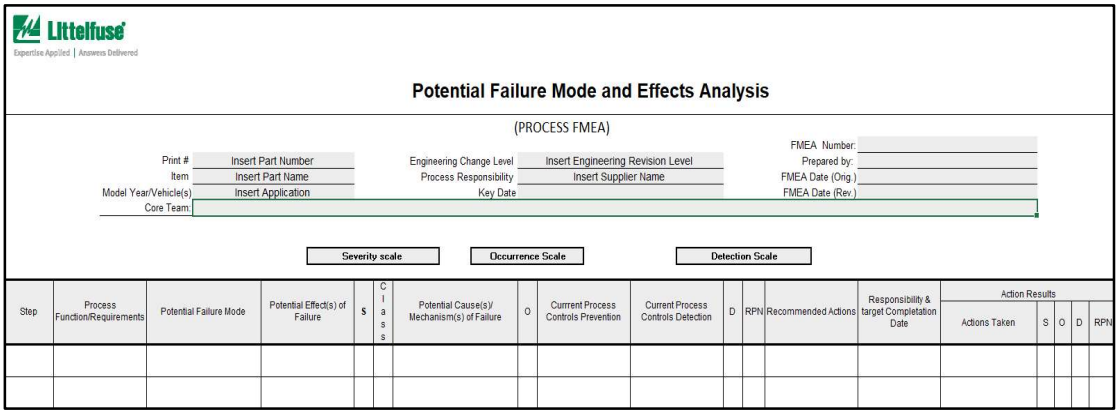
Symbol Instructions

Op-Seq	Rcv	Move	Store/Set	Inspect	Rework	Scrap/Contain	Change over	Operation Description	Class (KPC, QCI)	Significant Product Characteristics (Outputs)	Class (KCC, QCC)	Significant Process Characteristics (Inputs)	Note
Step P1-01							P	Receive the parts		304 COC			
Step P1-02								Check M8 Studs		Correct stud No damage to thread		- Visual inspection - Boundary sample sheet - Check card	
Step P1-03								Any non conforming studs placed into the Reject box					
Step P1-04							P	Warehousing					
Step P2-01							P	Receive the parts		304 COC			
Step P2-02								Check M5 Studs		Correct stud No damage to thread		- Visual inspection - Boundary sample sheet	
Step P2-03								Any non conforming studs placed into the Reject box					
Step P2-04							P	Warehousing					
Step P3-01							P	Receiving the parts		304 COC			
Step P3-02								Check Compression Limiters		Correct limiter		- Visual inspection - Boundary sample sheet	
Step P3-03								Any non conforming limiters placed into the Reject box					
Step P3-04							P	Warehousing					

Figure 8 - Example of a Process Flow Diagram
(excel form available in: https://www.littelfuse.com/about-us/supplier-resources.aspx)

Element 6 - Process FMEA

Format AIAG for reference while transition to AIAG VDA format is complete



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Potential Failure Mode and Effects Analysis

(PROCESS FMEA)

Print #	Insert Part Number	Engineering Change Level	Insert Engineering Revision Level	FMEA Number:	
Item	Insert Part Name	Process Responsibility	Insert Supplier Name	Prepared by:	
Model Year/Vehicle(s)	Insert Application	Key Date		FMEA Date (Orig.)	
Core Team:				FMEA Date (Rev.)	

Severity scale | Occurrence Scale | Detection Scale

Step	Process Function/Requirements	Potential Failure Mode	Potential Effect(s) of Failure	S	Class	Potential Cause(s)/ Mechanism(s) of Failure	O	Currrent Process Controls Prevention	Current Process Controls Detection	D	RPN	Recommended Actions	Responsibility & target Completation Date	Action Results				
														Actions Taken	S	O	D	RPN

Figure 10 - Example of the Process FMEA form
(excel form available in: https://www.littelfuse.com/about-us/supplier-resources.aspx)

Element 6-1 – Process FMEA AIAG | VDA

Process FMEA analyzes the potential failures of manufacturing, assembly, and logistical processes to produce products which conform to design intent. Process-related failures are different than the failures analyzed in the design FMEA.

The process FMEA analyzes processes by considering the potential failure mode which may result from process variation to stablish priority of actions for prevention and as needed, improve controls, the overall purpose is to analyze processes and take action prior to production start, to avoid unwanted defects related to manufacturing and assembly and the consequences of those defects.

Severity, Occurrence and Detection ratings are used when performing FMEA activities. These rating scales must be compliant with the AIAG & VDA guidelines for FMEA (latest edition) and definitions are included in the DFMEA worksheet as well as this handbook.

Action Priority (AP) is based on combinations of Severity, Occurrence and Detection ratings to prioritize actions for risk reductions.

- **Priority High (H):** Highest priority for review and action.
  The team **need** to either identify and appropriate action to improve Prevention and/or Detection Controls or justify and document why current controls are adequate.

- **Priority Medium (M):** Medium priority for review and action.
  The team **should** identify appropriate actions to improve prevention and/or detection controls, or, at the discretion of the company, justify and document why control are adequate.

- **Priority Low (L):** Low priority for review and action.
  The team **could** identify actions to improve prevention or detection controls.

Littelfuse requires that **any severity ranking of 9 or 10 be addressed with a corrective an action plan. In Addition, Littelfuse recommends suppliers to develop continuous improvement activities for the top Action Priority identified.**

PROCESS FAILURE MODE AND EFFECT ANALYSIS (PROCESS FMEA)

PLANNING & PREPARATION (Step 1)

Company Name:	Littelfuse / PCP Automotive Piedras Negras			**PFMEA ID number:**	M4-PRD73-0001-HEV649	**Revision:**	B
Plant Location:	Piedras Negras, Coahuila			**PFMEA Start date:**		**Process Responsibility:**	
Part Number:		**Customer Name:**	N/A	**Model Year(s)/ Program(s):**	N/A	**PFMEA Revision date:**		**Confidentiality Level:**	
Cross funtional team							

STRUCTURED ANALYSIS (Step 2)				FUNCTION ANALYSIS (Step 3)						FAILURE ANALYSIS (Step 4)				RISK ANALYSIS (Step 5)						OPTIMIZATION (Step 6)						
1. Process Item System, subsystem, part element or name of process	2.Process Step Station No. and Name of Focus Element	3. Process Work Element 6M Type		1. Function of the Process Item Function of System, Subsystem, Part element or Process	2.a Function of the process Step	2.b Product Characteristic as applicable	3.a Function of the process work element and process characteristic		3.b Process Characteristics as applicable.	1. Failure Effects (FE)	Severity (S) of (FE)	2. Failure mode (FM) of the process step	3. Failure Cause (FC) the work element	Current Prevention Control (PC) of FC	Occurrence (O) of FC	Current Detection Controls (DC) of FC	Current Detection Controls (DC) of FM	Detection(D) of FC/FM	PFMEA AP	Special characteristics	Prevention action	Detection Action of FC or FM	Responsible Person's Name	Target Completion date	Status	Action taken with pointer to evidence	Completion date	Severity (s)
Op.10: Body drilling	Body drilling	Man		Able to do the Final Fuse Assembly	Drill holes on the body to able apply epoxy	Holes, Diameter and location according with the drawing 909-623	Man			Dimensions on the fuse are out specification	8	Holes disaligment, Not holes, holes diameters out spec & damage body	Man														
		Machine	Drill				Machine	Drill body					Machine	Incorrect or damage drill bit	NA	7	Visual	Visual	8	H		Implement Body Drill Equipment for Body 909-606 (Poka-Yoke Body Position, Body Length)	Implement Gauge Hole inspection and position	Gumercindo Galvan	8/27/2020	Open			
		Material					Material						Material															
		Method	Body drilling process				Method	Aligment and position according WI: M4-PRD30-1013A-HEV649					Method	Not aligment and incorrect position	NA		Visual					Implement Body Drill Equipment for Body 909-606 (Poka-Yoke Body Position, Body Length)	Implement Gauge Hole inspection and position	Gumercindo Galvan	8/27/2020	Open			
		Measurement					Measurement						Measurement															
		M.N (Environment)					M.N (Environment)						M.N (Environment)															

Figure 10 - Example of the Process FMEA VDA form
(excel form available in: https://www.littelfuse.com/about-us/supplier-resources.aspx

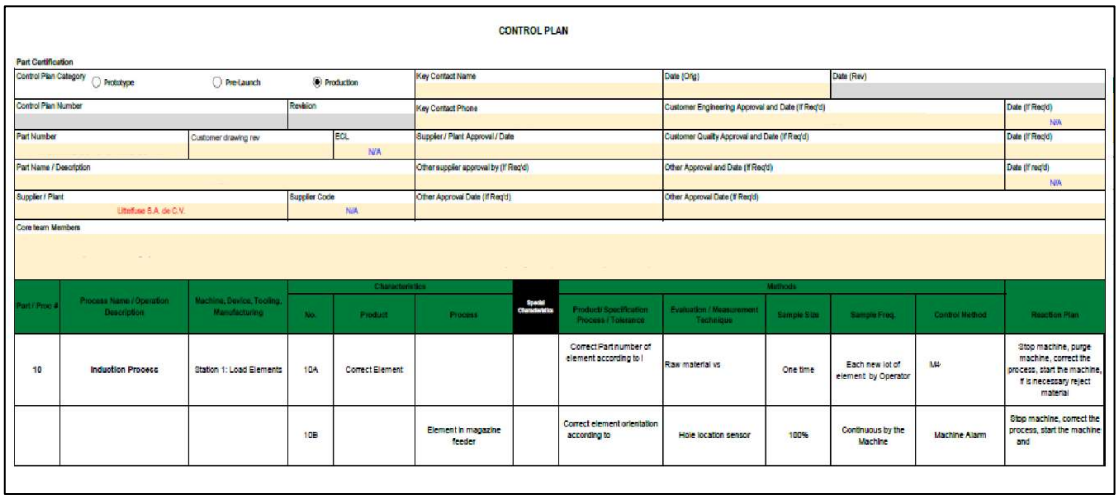
7 – Control Plan

Control plans are written descriptions of the operations, processes, materials, equipment, methodologies, and CTQs for controlling variations in key product or process characteristics integral to the manufacturing process. The supplier shall have a Control Plan that defines all controls used for process control and complies with the Littelfuse specifications. Control plans for "families" of similar parts are acceptable if the new parts have been reviewed for commonality.

The control plan should be developed in stages from proto-type through production. Early planning on the control plan will usually result in a more robust process. **Suppliers should develop a pre-launch control plan early in the development of a new product and submit it to Littelfuse for feedback. A pre- Launch would normally show greater inspection size and frequency.** Littelfuse may also request that you provide specific documents required at PPAP early in the development phase and the most common ones are the PFMEA and a pre-launch Control Plan.

The process flow diagram and design record/specification provide inputs to the Control Plan. All CTQs identified as Process, First-Piece, or Safety Related by the supplier must be listed on the control plan form. The Process Flow, Process FMEA and Control Plan manufacturing steps should match. The control plan cannot be excessively dependent on visual inspection and should target prevention techniques wherever possible.

NOTE: All critical characteristics / CPK / Safety Characteristic must be identified on the control plan.



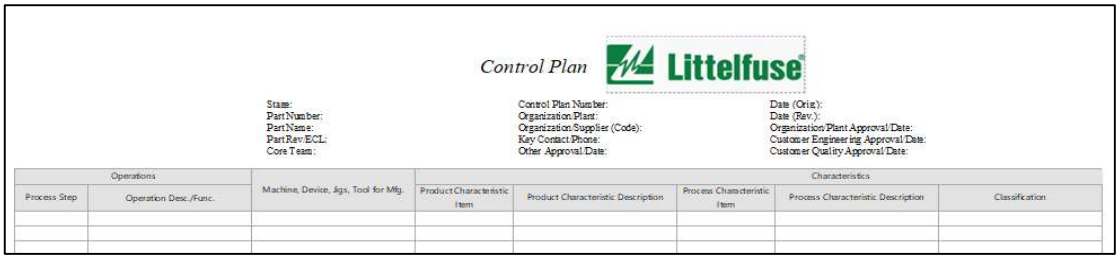
CONTROL PLAN

Part Certification

Control Plan Category: ○ Prototype ○ Pre-Launch ◉ Production			Key Contact Name	Date (Orig)	Date (Rev)
Control Plan Number	Revision		Key Contact Phone	Customer Engineering Approval and Date (If Req'd)	Date (If Req'd) N/A
Part Number	Customer drawing rev	ECL N/A	Supplier / Plant Approval / Date	Customer Quality Approval and Date (If Req'd)	Date (If Req'd)
Part Name / Description			Other supplier approval by (If Req'd)	Other Approval and Date (If Req'd)	Date (If Req'd) N/A
Supplier / Plant: Littelfuse S.A. de C.V.	Supplier Code N/A		Other Approval Date (If Req'd)	Other Approval Date (If Req'd)	
Core team Members					

Part / Proc #	Process Name / Operation Description	Machine, Device, Tooling, Manufacturing	Characteristics: No.	Characteristics: Product	Characteristics: Process	Special Characteristics	Methods: Product/ Specification Process / Tolerance	Methods: Evaluation / Measurement Technique	Methods: Sample Size	Methods: Sample Freq.	Methods: Control Method	Reaction Plan
10	Induction Process	Station 1: Load Elements	10A	Correct Element			Correct Part number of element according to l	Raw material vs	One time	Each new lot of element by Operator	MI	Stop machine, purge machine, correct the process, start the machine, if is necessary reject material
			10B		Element in magazine feeder		Correct element orientation according to	Hole location sensor	100%	Continuous by the Machine	Machine Alarm	Stop machine, correct the process, start the machine and

Figure 11 - Example of the Control Plan form *(excel form available in: https://www.littelfuse.com/about-us/supplier-resources.aspx)*



Control Plan Littelfuse

Stam:
Part Number:
Part Name:
Part Rev/ECL:
Core Team:

Control Plan Number:
Organization/Plant:
Organization/Supplier (Code):
Key Contact/Phone:
Other Approval/Date:

Date (Orig.):
Date (Rev.):
Organization/Plant Approval/Date:
Customer Engineering Approval/Date:
Customer Quality Approval/Date:

Operations		Machine, Device, Jigs, Tool for Mfg.	Characteristics				
Process Step	Operation Desc./Func.		Product Characteristic Item	Product Characteristic Description	Process Characteristic Item	Process Characteristic Description	Classification

Figure 12- Example of the Control Plan VDA form - (excel form available in: https://www.littelfuse.com/about-us/supplier-resources.aspx)

Element 8 – MSA,GR&R

Measurement System Analysis (MSA) is an experimental and mathematical method of determining how much the variation within the measurement process contributes to overall process variability .

MSA is a requirement for qualification. Supplier must submit and follow the following:

- All measuring equipment and gauges are calibrated.
- **A GR&R must be submitted for devices measuring data on CTQs and for each measurement device mentioned on the control plan on all Level 3 submissions**.
- The minimum requirement for Gage R&R is:
  - A Gage R&R study using Total Tolerance samples.
  - % R&R below 10% is acceptable.
  - % R&R between 10% and 30% is marginal acceptable, need an action plan to address and improve the method of measurement.
  - Gages with R&R at 30% or more cannot be used.
  - Number of distinct data categories (ndc) >= 5.
- The **ANOVA** analysis method is recommended to be used to calculate %R&R.
- For visual devices and Go/ No-Go measuring equipment, the Attribute Gage Study shall be performed. At least must be used one out of the following methods:
  - Attribute gage bias report (Analytical method)
  - Gage repeatability and reproducibility report (Attribute hypothesis test method)
- Any equipment or gauge that is not meeting the %R&R should not be used and must have a plan to fix it or replace it.

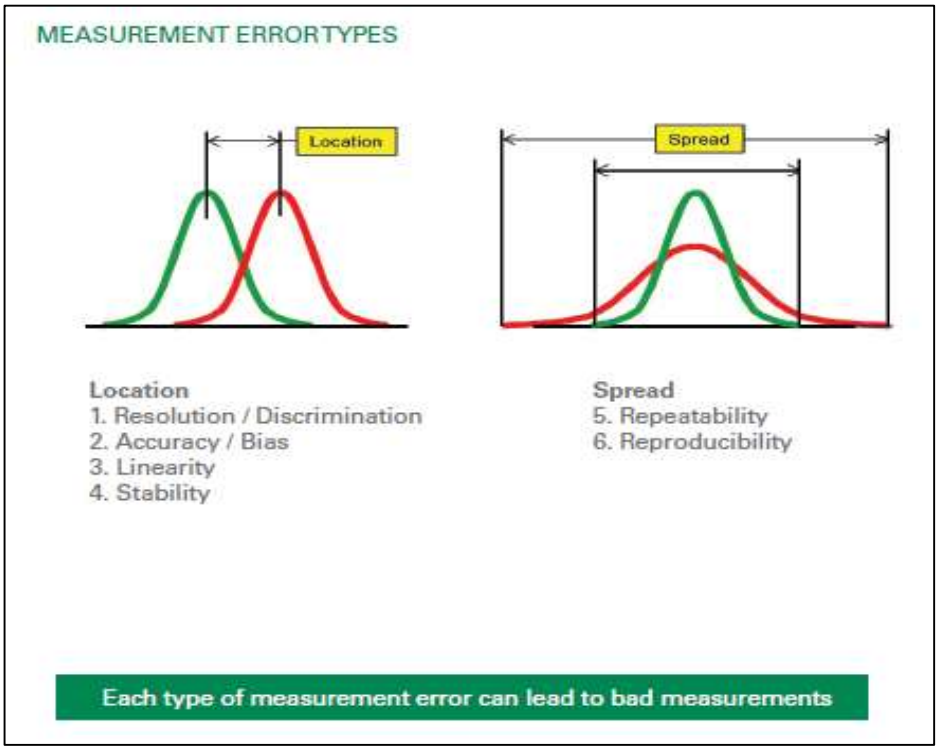


Figure 13 – Measurement Error Types

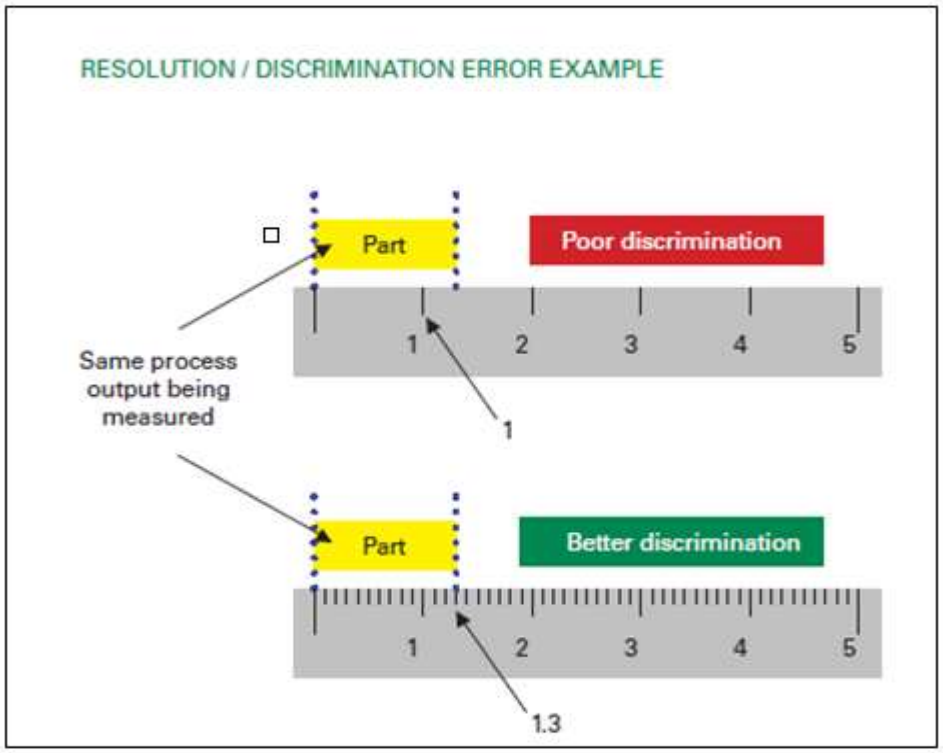


Figure 14 - Example of Resolution/Discrimination Error

GAGE REPEATABILITY AND REPRODUCIBILITY DATA SHEET

ANOVA METHOD

Part Number	Gage Name	Appraiser A
xx	xx	Chunxiang.Yang
Part Name	**Gage Number**	**Appraiser B**
xx	BA02596	Tingting.Liu
Characteristic / **Specification**	**Gage Type**	**Appraiser C**
Thickness / 117 175.5	PCU-203	Fengjuan.Li
Characteristic Classification	**Trials** / **Parts** / **Appraisers**	**Date Performed**
	3 / 10 / 3	2012.06.25

APPRAISER/		PART										AVERAGE	
TRIAL #		1	2	3	4	5	6	7	8	9	10		
1. A	1	138.46	141.89	136.36	138.37	140.68	142.79	139.47	140.96	141.03	135.15		139.516
2.	2	138.45	141.83	136.35	138.32	140.63	142.73	139.35	140.94	141.02	135.21		139.483
3.	3	138.47	141.85	136.34	138.35	140.67	142.75	139.42	140.92	141.13	135.26		139.516
4.	AVE	138.46	141.86	136.35	138.35	140.66	142.76	139.41	140.94	141.06	135.21	X_A=	139.505
5.	R	0.02	0.06	0.02	0.05	0.05	0.06	0.12	0.04	0.11	0.11	r_A=	0.064
6. B	1	138.43	141.86	136.37	138.37	140.68	142.72	139.52	140.95	141.08	135.18		139.516
7.	2	138.47	141.82	136.42	138.45	140.69	142.76	139.42	140.98	141.12	135.51		139.564
8.	3	138.42	141.93	136.45	138.42	140.66	142.82	139.43	140.97	141.12	135.25		139.547
9.	AVE	138.44	141.87	136.41	138.41	140.68	142.77	139.46	140.97	141.11	135.31	X_B=	139.542
10.	R	0.05	0.11	0.08	0.08	0.03	0.10	0.10	0.03	0.04	0.33	r_B=	0.095
11. C	1	138.43	141.93	136.85	138.34	140.63	142.73	139.46	140.92	141.13	135.12		139.554
12.	2	138.41	141.92	136.32	138.39	140.72	142.72	139.42	140.96	141.52	135.20		139.558
13.	3	138.48	141.88	136.29	138.34	140.69	142.74	139.48	140.93	141.06	135.18		139.507
14.	AVE	138.44	141.91	136.49	138.36	140.68	142.73	139.45	140.94	141.24	135.17	X_C=	139.540
15.	R	0.07	0.05	0.56	0.05	0.09	0.02	0.06	0.04	0.46	0.08	r_C=	0.148
16. PART												X=	139.529
AVERAGE		138.45	141.88	136.42	138.37	140.67	142.75	139.44	140.95	141.13	135.23	R_p=	7.522

Anova Table

Source	Resista	Resista	SS	MS	F	Sig
Appraiser		2	0.03	0.01	1.72	
Parts		9	472.47	52.50	6942.92	*
Appraiser-by-Part		18	0.11	0.01	0.79	
Equipment		60	0.45	0.01		
Total		89	473.05			

* Significant at $\alpha = 0.05$ level

Anova Report	Standard Deviation (σ)	% Total Variation	% Contribution
Repeatability (EV)	0.08	3.5%	0.1%
Reproducibility (AV)	0.01	0.6%	0.0%
GRR	0.09	3.6%	0.1%
Part-to-Part (PV)	2.41	99.9%	99.9%
		Gage system O.K	

Note:

Tolerance = 58.50 — Total variation (TV) = 2.42

Number of distinct data categories (ndc) = 39

Gage discrimination acceptable

Figure 15 - Example of a Gage R&R with ANOVA method - form
(excel form available in: https://www.littelfuse.com/about-us/supplier-resources.aspx)

MSA Report

Littelfuse Suzhou Pant					Equipment	59166-503 Auto tester		A	Station 1
P/N		59166-503			Equipment ID:	11473		B	Station 2
Character	Hash Test	Spec	OK:1	NG:0	Equipment Character:	NA		C	Station 3
Character Grade					Times	Parts QTY 50	Station 1-3	Date	9/30/2015

	Record									
Number	A-First Time	A-Second Time	A-Third Time	B-First Time	B-Second Time	B-Third Time	C-First Time	C-Second Time	C-Third Time	Spec
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	1	1	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1
12	1	1	1	1	1	1	1	1	1	1
13	1	1	1	1	1	1	0	1	1	1
14	1	1	1	1	1	1	1	1	1	1
15	1	0	1	1	1	1	1	1	1	1
16	1	1	1	1	1	1	1	1	1	1
17	1	1	1	1	1	1	1	1	1	1
18	1	1	1	1	1	1	1	1	1	1
19	1	1	1	1	1	1	1	1	1	1
20	1	1	0	1	1	1	1	1	1	1
21	1	1	1	1	1	1	1	1	1	1
22	1	1	1	1	1	1	1	1	1	1
23	1	1	1	1	1	0	0	1	1	1
24	1	1	1	1	1	1	1	1	1	1
25	1	1	1	1	1	1	1	1	1	1
26	1	1	1	1	0	1	1	1	1	1
27	1	1	1	1	1	1	1	1	1	1
28	1	1	1	1	1	1	1	1	1	1
29	1	1	1	1	1	1	1	1	1	1
30	1	1	1	1	1	1	1	1	1	1
31	1	1	1	1	1	1	1	1	1	1
32	1	1	1	1	1	1	1	1	1	1
33	1	1	1	1	1	1	1	1	1	1
34	1	1	1	1	1	1	1	1	1	1
35	1	1	1	1	1	1	1	1	1	1
36	1	1	1	1	1	1	1	1	1	1
37	1	1	0	1	1	1	1	1	1	1
38	1	1	1	1	1	1	1	1	0	1
39	1	1	1	1	1	1	1	1	1	1
40	1	1	1	1	1	1	1	1	1	1
41	1	1	1	1	1	1	1	1	1	1
42	1	0	0	1	1	1	1	1	1	1
43	1	1	1	1	1	1	1	0	1	1
44	1	1	1	1	1	1	1	1	1	1
45	1	1	1	1	0	1	1	1	1	1
46	1	1	1	1	1	1	1	1	1	1
47	1	1	1	1	1	1	1	1	1	1
48	1	1	1	1	1	1	1	1	1	1
49	1	1	1	1	1	1	1	0	1	1
50	1	1	1	1	1	1	1	1	1	1

Data summary

Attendee	Right ajudgement Times for NG parts	Right ajudgementTimes for OK parts	Right ajudgement Times (Total)	Wrong ajudgement Times	Missing ajudgement Times	Times for ajudgement
A	124	21	145	5	0	150
B	126	21	147	3	0	150
C	124	21	145	5	0	150

Count

Attendee	Effectiveness	Wrong ajudgement	Missing ajudgement	Bias
Station 1	96.67%	3.88%	0.00%	#DIV/0!
Station 2	98.00%	2.33%	0.00%	#DIV/0!
Station 3	96.67%	3.88%	0.00%	#DIV/0!

judgement

Attendee	Effectiveness	Wrong ajudgement Rate	Missing ajudgement Rate	Bias
Station 1	Acceptable	Acceptable	Acceptable	#DIV/0!
Station 2	Acceptable	Acceptable	Acceptable	#DIV/0!
Station 3	Acceptable	Acceptable	Acceptable	#DIV/0!

Symmary: Acceptable

Made by ZJH **Checked by: Huaxia Zhang**

Figure 16 - Example of an Attribute gage study

Element 9 – Dimensional Results

Dimensional results are the measurement results taken off the at least 5 production parts from production tool, mold or set-up. All dimensions (except reference dimensions), characteristics, specifications as noted on the print and print notes should be measured and listed in a convenient format with the actual results recorded.

The supplier shall provide evidence that dimensional verifications required by the design record ~~print~~/specification have been completed and results indicate compliance with specified requirements. **Dimensional measurement must be done on all cavities, mold, tools, or dies.** All dimensions, characteristics, and specifications as noted on the print/specification and notes should be measured and listed in a convenient format with the actual results recorded.

For multiple cavity molds, the minimum number of parts to measure for the dimensional element is at least 3 parts from each cavity unless otherwise is specified or agreed by Littelfuse Supplier Development Engineer and/or Supplier Quality Engineer representative**.** All parts should be the same parts that are submitted as Sample Parts to Littelfuse. All parts should be identified with the corresponding number on the part or the tag.

Any requirement that is non-conforming will result in this requirement being deemed unacceptable. The corrective action is required to be addressed and identified. Any concerns identified in the Dimensional test results should be brought to the attention of Littelfuse Engineering or SDE before submitting PPAP.

The Dimensional Results can be provided in any format used within an organization.

Littelfuse **Production Part Approval**
Dimensional Test Results

ORGANIZATION:	Littelfuse, S. de R.L. de C.V.	PART NUMBER:	
SUPPLIER / VENDOR CODE:		PRODUCT:	
SITE:		DESIGN RECORD CHANGE LEVEL:	
ORDER NUMBER:		ENGINEERING CHANGE DOCUMENTS:	
TEST NUMBER:			

ITEM	Measure Equipment	Dimension	SPECIFICATION / LIMITS		TEST DATE	QTY. TESTED	ORGANIZATION MEASUREMENT RESULTS (DATA)					OK	NOT OK
1	Caliper	73.0	72.50	73.50	16-Feb-21	5	73.00	72.86	73.01	72.98	72.92	X	
2	Vision System 3D	60.0	59.75	60.25	16-Feb-21	5	60.02	59.88	60.03	60.01	59.97	X	
3	Caliper	41.7	41.20	42.20	16-Feb-21	5	42.00	41.71	41.95	41.87	41.91	X	
4													
5													
6													
7													
						Sample	1	2	3	4	5		

Figure 17 - Example of Dimensional Results
(excel form available in: https://www.littelfuse.com/about-us/supplier-resources.aspx)

Element 10 – Material, Performance Test Results

Material Certifications include any material certifications / material test results relating to the part and the base materials from the supplier's internal lab or outside contracted lab. If there is material specifications noted on the design record/specification, you must provide data that shows conformance to those specifications in the PPAP package.

For products with customer-developed material specifications and a customer-approved subcontractor list, the supplier shall procure materials and/or services (e.g. painting, plating, heat- treating) from subcontractors on that list.

Test Results (Performance, Durability) include any performance or durability tests as prescribed in the design record, including drawings and functional and validation specifications. The required level of detail (i.e. summaries vs. charts vs. raw data) shall be as directed by Littelfuse product engineering.

Supplier need attach the detailed Material/Performance report in the "Material, Performance Test Results" sheets or in a spare sheet.

Littelfuse
Expertise Applied | Answers Delivered

Production Part Approval
Material Test Results

ORGANIZATION: Littelfuse, Inc.	PART NUMBER:
SUPPLIER / VENDOR CODE:	PART NAME:
MATERIAL SUPPLIER:	DESIGN RECORD CHANGE LEVEL:
*CUSTOMER SPECIFIED SUPPLIER / VENDOR CODE:	ENGINEERING CHANGE DOCUMENTS:
*If source approval is req'd, include the Supplier (Source) & Customer assigned code.	NAME of LABORATORY:

MATERIAL SPEC. NO. / REV / DATE	SPECIFICATION / LIMITS	TEST DATE	QTY. TESTED	SUPPLIER TEST RESULTS (DATA)	OK	NOT OK
LF Part Number						
Coil element				See attached	OK	
Solder				See attached	OK	
Resin to endbells				See attached	OK	

Figure 18 - Example of Material Performance Test Results
(excel form available in: https://www.littelfuse.com/about-us/supplier-resources.aspx)

Element 11 – Initiall Process Studies (Cpk, Ppk)

Capability or performance shall be determined to be acceptable prior to submission for all special characteristics designated by the customer or supplier. **Common requirement for capability study is 25 subgroups containing at least 100 readings and sampled consecutively from a production run that are sampled randomly unless otherwise specified by Littelfuse.**

Cpk - The capability index for a stable process. The estimate of sigma is based on within subgroup variation (R-bar/d2 or S-bar/c4). If a supplier is submitting a PPAP but not limited to (a) a new part, (b) a part with revised specifications, (c) a part in which the materials, processes, manufacturing location, or production equipment have significantly changed, or (d) a part in which the material suppliers have changed, then the supplier will be asked to report the Cpk.

Ppk - The performance index. The estimate of sigma is based on total variation (all of individual sample data using the standard deviation [root mean square equation], "s"). If the supplier but not limited to (a) has already been manufacturing the specified part, but is a new supplier to Littelfuse, or (b) is an existing supplier to Littelfuse that has been found to have supplied a large number of nonconforming parts, then the supplier will report Ppk.

Short-term studies. The purpose of the initial process study is to understand the process variation, not just to achieve a specific index value. When historical data is available or enough initial data exist to plot a control chart (at least 100 individual samples), Cpk can be calculated when the process is stable. For chronically unstable processes with output meeting specifications and a predictable pattern, Ppk should be used. When not enough data is available (<100 samples) contact the customer responsible part approval activity to develop a suitable plan.

The minimum required Acceptance Criteria for Initial Study:

- Automotive products: Cpk or Ppk of 1.67
- Non-automotive products: Cpk or Ppk of 1.33

If acceptance criteria cannot be attained by the PPAP submission promise date, the supplier shall submit to the Littelfuse for approval a corrective action plan and a modified Control Plan normally providing for 100% inspection until criteria is achieved or customer full approval is received.

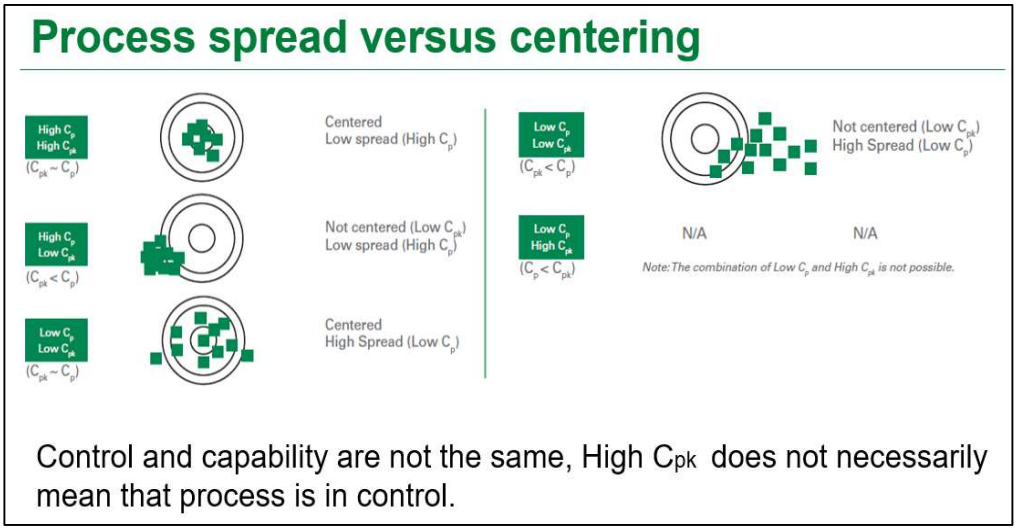


Figure 19 – Process Spread Versus Centering

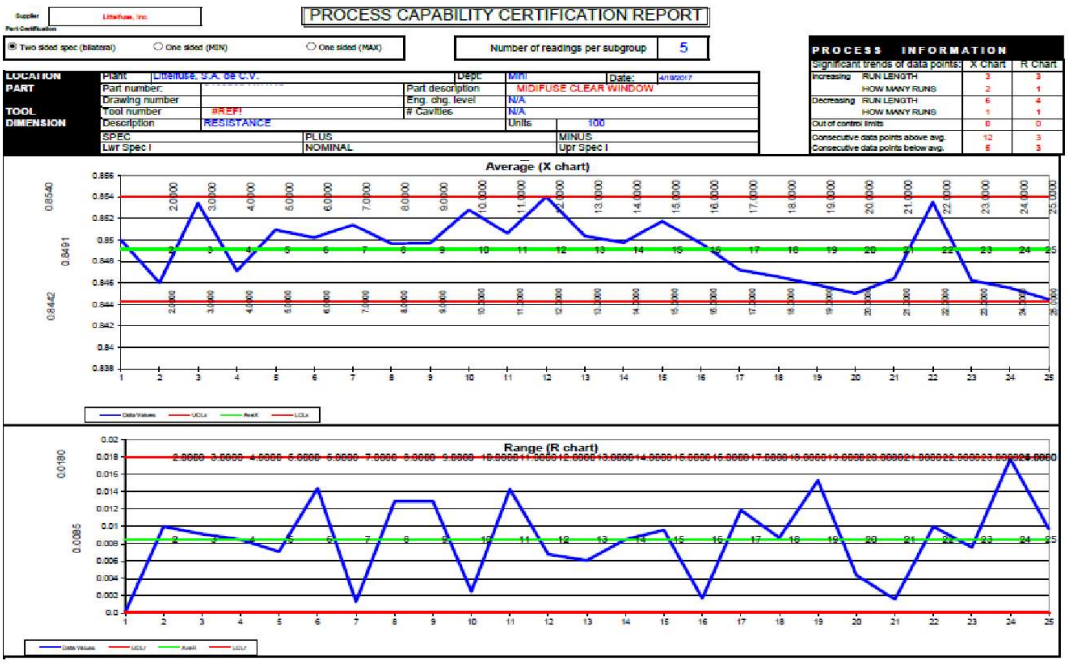


Figure 20 – Example of CPK Chart.

Element 12 – Qualified Laboratory Documentation

If testing is performed in a supplier's internal lab, they must provide a copy of their quality certification. The supplier should also provide documentation of the appropriate laboratory scope. If an external lab is used, send a copy of outside lab certification and the scope of accreditation (Littelfuse prefers that external labs be accredited to known lab accreditation standards such as A2LA and ISO17025 or equivalent).

Figure 21 - Example of a Qualified Laboratory Documentation.

Element 13 – Appearance Approval Report

This requirement is used for more 'print' definition when a specification or design record reference does not exist. Appearance approvals can be used when a specific testing to a known standard or in defining limit samples. This requirement should always be in reference to a specific specification such as color, texture, contrast or paint.

It is not uncommon for projects that have no defined appearance requirements to develop them throughout the course of development. This could be as simple as a paint or color application that has developed into an appearance issue based on Littelfuse feedback or Littelfuse customer feedback. Whenever appearance related issues arise that have no defined specification it is in the best interest of both the supplier and Littelfuse to utilize this element and clearly define what is acceptable and what is not acceptable. When non-conformances arise appearance issues can be readily resolved when there is clear definition of acceptance.

Appearance Approval Report must be provided according to AIAG format.

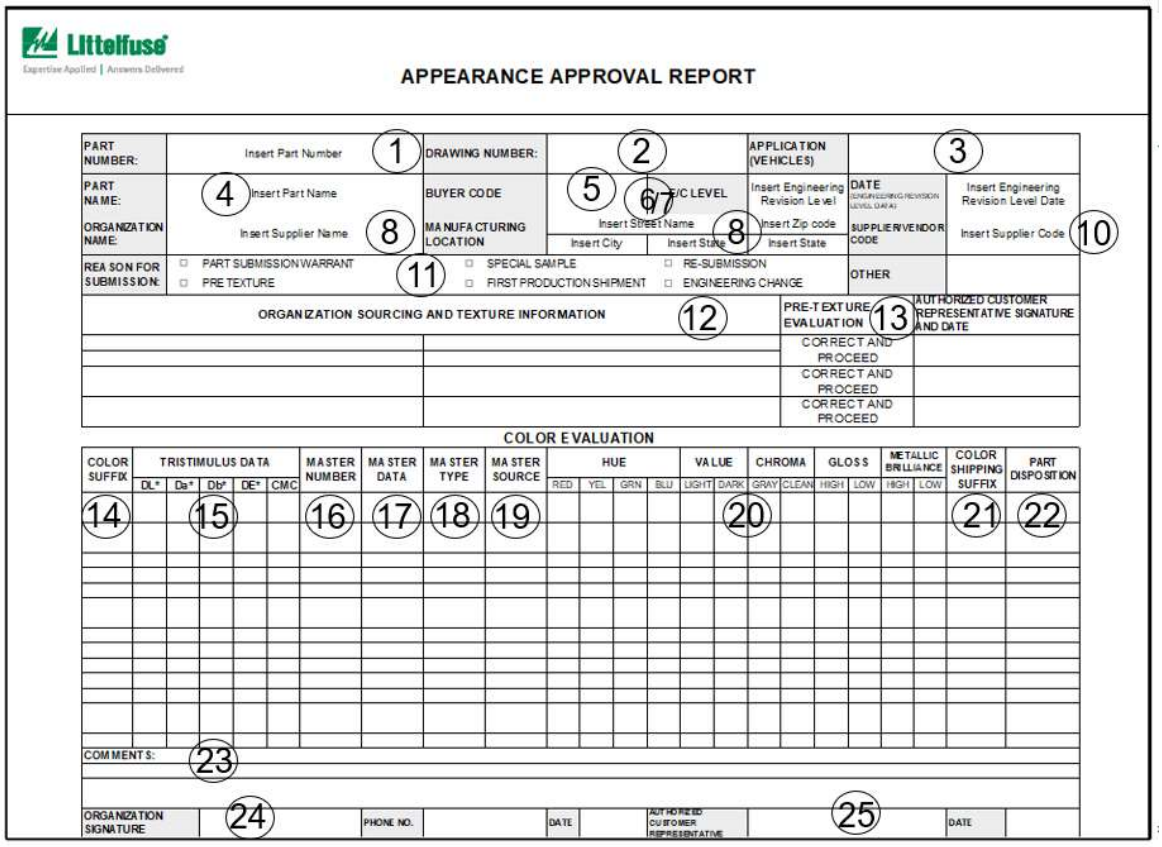


Figure 22 - Example of appearance report
(excel form available in: https://www.littelfuse.com/about-us/supplier-resources.aspx)

Completion of the Appearance Approval Report

1	**Customer Part Number**	Engineering released customer part number
2	**Drawing Number**	Use the number of the drawing on which the part is shown if different from the part number
3	**Application**	Enter the model year(s) and vehicle or other program on which the part is used
4	**Part Name**	Use the finished part name on the part drawing
5	**Buyer Code**	Enter the code for specific buyer of part
6,7	**E/C Level & Date**	Engineering change level and E/C date for this submission
8	**Organization Name**	Organization responsible for submission (include supplier if applicable)
9	**Manufacturing Location**	Location where part was manufactured or assembled
10	**Supplier/Vendor Code**	Customer-assigned code for organization location where the part was manufactured or assembled
11	**Reason for Submission**	Select box(es) explaining the reason for this submission
12	**Organization Sourcing & Texture Information**	List all first surface tools, graining source(s), grain type(s), and grain and gloss masters used to check part
13	**Pre-Texture Evaluation**	To be completed by authorized customer representative (not used by GM)
14	**Color Suffix**	Use alphanumeric or numeric color identification
15	**Tristimulus Data**	List numerical (colorimeter) data of submission part as compared to the customer-authorized master
16	**Master Number**	Enter alphanumeric master identification (not used by Ford)
17	**Mater Date**	Enter the date on which the master was approved
18	**Material Type**	Identify first surface finish and substrate (e.g., paint/ABS)
19	**Material Source**	Identify first surface and substrate suppliers, Exampl:Redspot/Dow
20	**Color Evaluation, Hue, Value, Chroma, Gloss and Metallic Brilliance**	Visual assessment by customer
21	**Color Shipping Suffix**	Color part number suffix or color number
22	**Part Disposition**	To be determined by customer (approved or rejected)
23	**Comments**	General comments by the organization or customer (optional)
24	**Organization Signature, Phone No. & Date**	Organization certification that the document information is accurate and meets all requirements specified
25	**Authorized Customer Representative Signature & Date**	Authorized Customer Representative approval signature

THE AREAS INSIDE THE BOLD LINES ARE FOR CUSTOMER USE ONLY
Refer to AIAG PPAP Manual.

Element 14 & 15 - Sample product and Master Sample

~~The~~ Supplier shall provide sample product as requested by the customer and as defined by the submission request.

Supplier shall retain a master sample for the same period as the production part approval records, or

- Until a new master sample is produced for the same customer part number for customer approval,
- Where a master sample is required by the design record. The master sample shall be identified as such, and shall show the customer approval date on the sample.

Supplier shall retain a master sample for each position of a multiple cavity die, mold, tool or pattern.

Element 16 – Checking Aids

Checking aids (fixtures, gages, models, templates etc.) are specific to the part being submitted, used in inspecting or testing. For this item, supplier shall verify that all aspects of the checking aid agree with part dimensional requirements.

Supplier shall document all released engineering design changes that have been incorporated in the checking aid at the time of qualification submission. Suppliers are not required to submit checking aids with qualification unless otherwise is specified; instead they must retain it for future reference. Measurement system analysis studies, e.g. gage R&R, accuracy, bias, linearity, stability studies, shall be conducted in compliance with customer requirements.

Item #	*Gage #*	*Gage ECL*	*Used for*	*Location(s)/Process Number(s) on Control*
1	3D	A	Measure the size of the material and the product	IQC inspection area
2	LCR	A	Measure the capacitor value & inductor value & resistance value of thematerial	IQC inspection area
3	Paste Gage	B	Measure the paste thickness	SMT SQC Inspection area

Figure 23 - Example of Checking Aid

Element 17 – Littelfuse Specific Requirements

The Littelfuse specific requirements are must for all Level 3 PPAP submit, unless otherwise specified by Littelfuse Supplier Development Engineer and/or Supplier Quality Engineer representative.

Element 17-1 – Storage conditions

Supplier shall provide in PPAP; the storage conditions and period of time for materials such as but not limited to: plating stamping parts, copper strip, chemical, bulk material, glue, flux, alloy wire, molding part, PCB, PCBA, electronic parts.

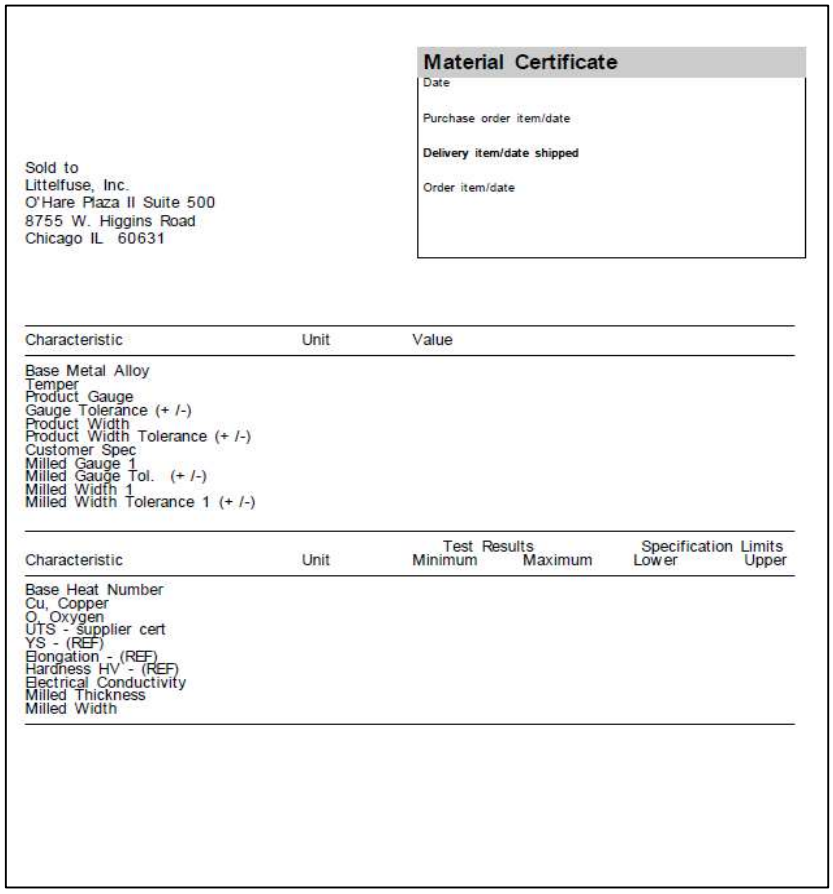
Element 17-2 – Certificate of Analysis / Certificate of Compliance

The purpose is to demonstrate that product has passed performance test, quality assurance test, and meets qualification criteria stipulated on drawings or contracts.

The certificate of compliance must minimally include the following information:

- The specific product or type of product certified
- The qualification standard that the product is judged to meet and data that showing the compliance.
- The date of certification (and if applicable, its expiration)

The certificate of analysis can be provided in any format used within an organization.



Material Certificate

Date

Purchase order item/date

Delivery item/date shipped

Order item/date

Sold to
Littelfuse, Inc.
O'Hare Plaza II Suite 500
8755 W. Higgins Road
Chicago IL 60631

Characteristic	Unit	Value
Base Metal Alloy		
Temper		
Product Gauge		
Gauge Tolerance (+ /-)		
Product Width		
Product Width Tolerance (+ /-)		
Customer Spec		
Milled Gauge 1		
Milled Gauge Tol. (+ /-)		
Milled Width 1		
Milled Width Tolerance 1 (+ /-)		

Characteristic	Unit	Test Results Minimum	Test Results Maximum	Specification Limits Lower	Specification Limits Upper
Base Heat Number					
Cu, Copper					
O, Oxygen					
UTS - supplier cert					
YS - (REF)					
Elongation - (REF)					
Hardness HV - (REF)					
Electrical Conductivity					
Milled Thickness					
Milled Width					

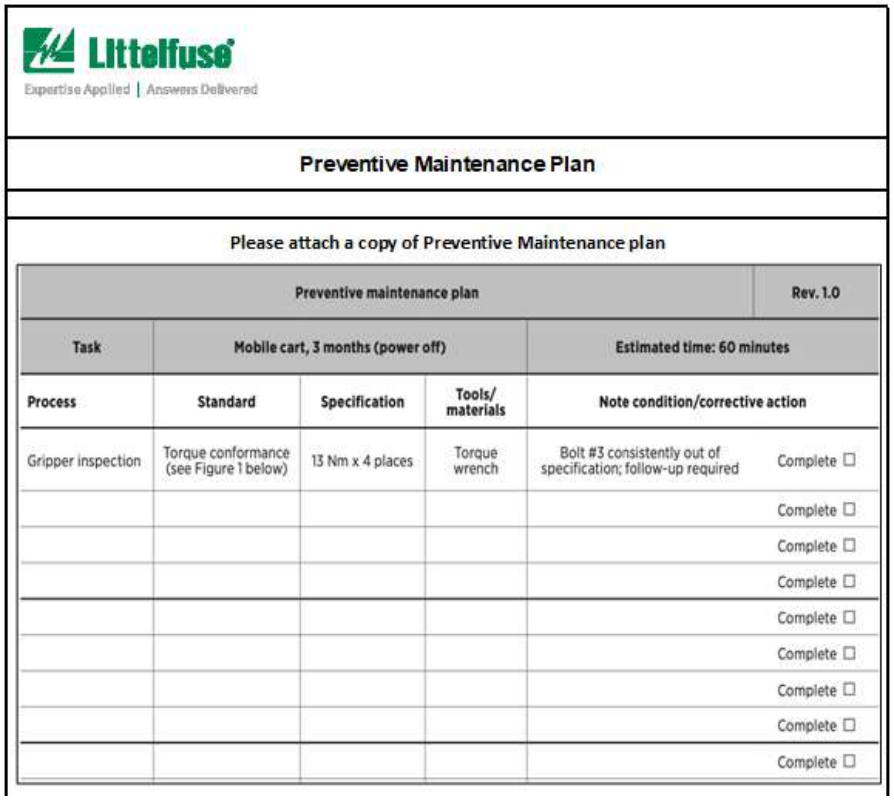
Figure 24 - Example certificate of compliance

Element 17-3 – Preventive Maintenance

Preventive maintenance tends to follow planned guidelines from time-to-time to prevent equipment and machinery breakdown.

The primary goal is to avoid or mitigate the consequences of failure of equipment. This may be by preventing the failure before it actually occurs which Planned Maintenance and Condition Based Maintenance help to achieve. It is designed to preserve and restore equipment reliability by replacing worn components before they actually fail. Preventive maintenance activities include partial or complete overhauls at specified periods, oil changes, lubrication, minor adjustments, and so on. In addition, workers can record equipment deterioration so they know to replace or repair worn parts before they cause system failure. The ideal preventive maintenance program would prevent all equipment failure before it occurs.

The preventive maintenance program can be provided in any format used within an organization.



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Preventive Maintenance Plan

Please attach a copy of Preventive Maintenance plan

Preventive maintenance plan					Rev. 1.0
Task	Mobile cart, 3 months (power off)			Estimated time: 60 minutes	
Process	Standard	Specification	Tools/ materials	Note condition/corrective action	
Gripper inspection	Torque conformance (see Figure 1 below)	13 Nm x 4 places	Torque wrench	Bolt #3 consistently out of specification; follow-up required	Complete ☐
					Complete ☐
					Complete ☐
					Complete ☐
					Complete ☐
					Complete ☐
					Complete ☐
					Complete ☐
					Complete ☐

Figure 25 - Example of Preventive Maintenance Plan
(excel form available in: https://www.littelfuse.com/about-us/supplier-resources.aspx)

Element 17-4 – Operator Work Instructions

Work instructions should be very detailed on "how" to accomplish a specific job, task or assignment.

Work instructions present a sequence of steps to execute a task or activity. The format is typically text, but a visual depiction of the steps can also constitute work instructions.

A work instruction promotes consistency in execution of work and it is useful when having a frequent turnover of part time helpers.

The work instructions can be provided in any format used within an organization.

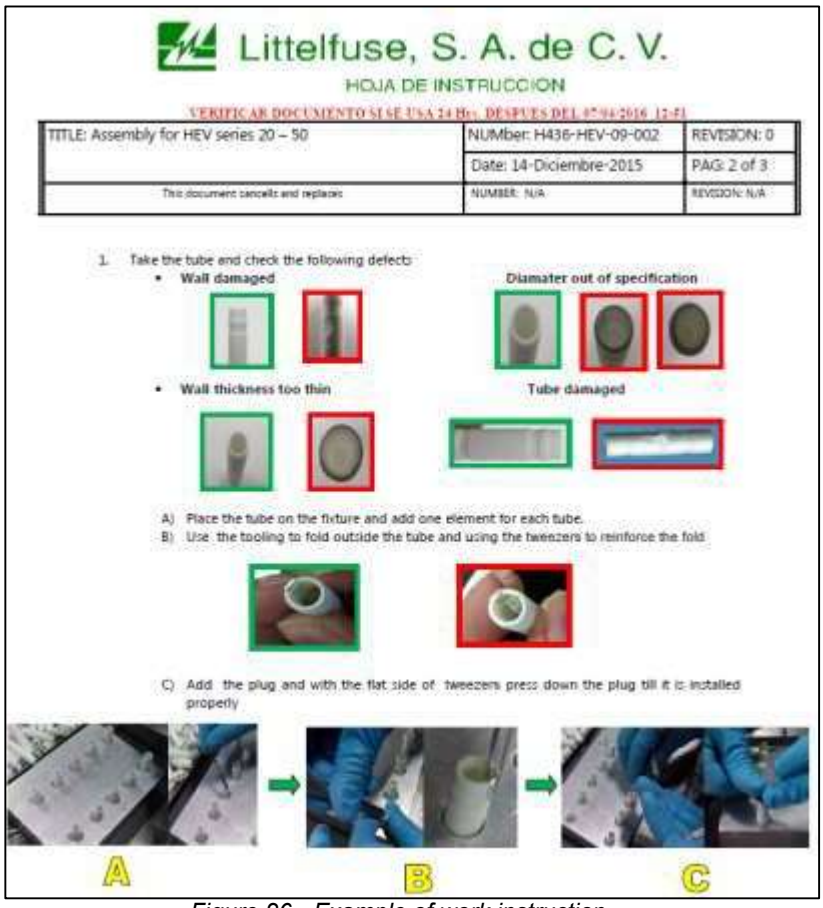


Figure 26 - Example of work instruction.

Element 17-5 – SLC (Safe launch control) Control Plan and S/O

When a new part number has been designed and has been moved into the production phase, Littelfuse requires establishing a pre-launch control plan & procedure in which 100% of the parts manufactured during 1st PO# are contained and inspected.

Please refer to AIAG APQP & control plan manual section 3.7 Pre-launch control plan.

Element 17-6 – IMDS

The IMDS (International Material Data System) is an active tool that aids suppliers in the automotive supply chain to register material data for all components.(the materials they are made from , and the basic substances those materials consist of).

Suppliers must provide the IMDS to Littelfuse thru ID# 2426, and then fill out the PSW format. The module ID#, Version# and date transmitted to Littelfuse must be included.

IMDS report must be also attached on the Littelfuse PPAP format, on section “IMDS”.

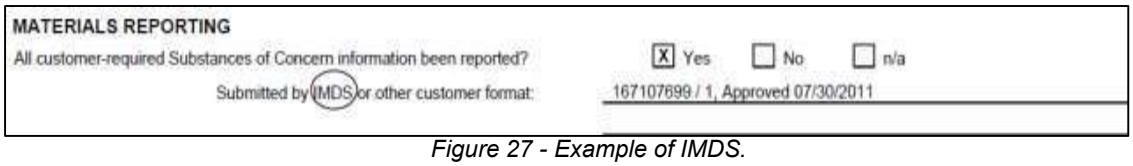

MATERIALS REPORTING
All customer-required Substances of Concern information been reported? [X] Yes [ ] No [ ] n/a
Submitted by IMDS or other customer format: 167107699 / 1, Approved 07/30/2011

Figure 27 - Example of IMDS.

Element 17-7 – Packing Standard

Purpose is approving the packaging method and material for supplied product. Make sure the package meet all facility related requirements, prevent of shipping and handling defects and addresses any Hazmat related concern. Attach the product package standard / WIs / SOP in this sheet and take the picture at least includes:

- A picture of the part in the packaging position with label A picture of the outside carton with label
- A picture of any dunnage for the container.
- A picture of the final unit load in the shipping configuration.

The Packing Standard can be provided in any format used within an organization

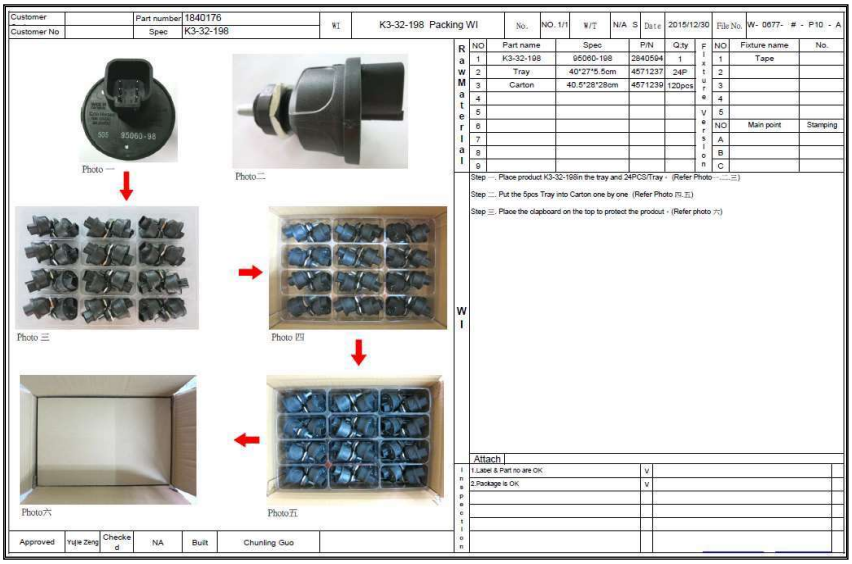


Figure 28 - Example of packing standard sheet.

Element 17-8 – Inspection Plan

The purpose is to approve and record the outgoing inspection requirements, e.g. the inspection items, inspection sample size, inspection gauge etc. Attach the final product outgoing OQC inspection WI / SOP in this sheet.

The Inspection Plan can be provided in any format used within an organization.

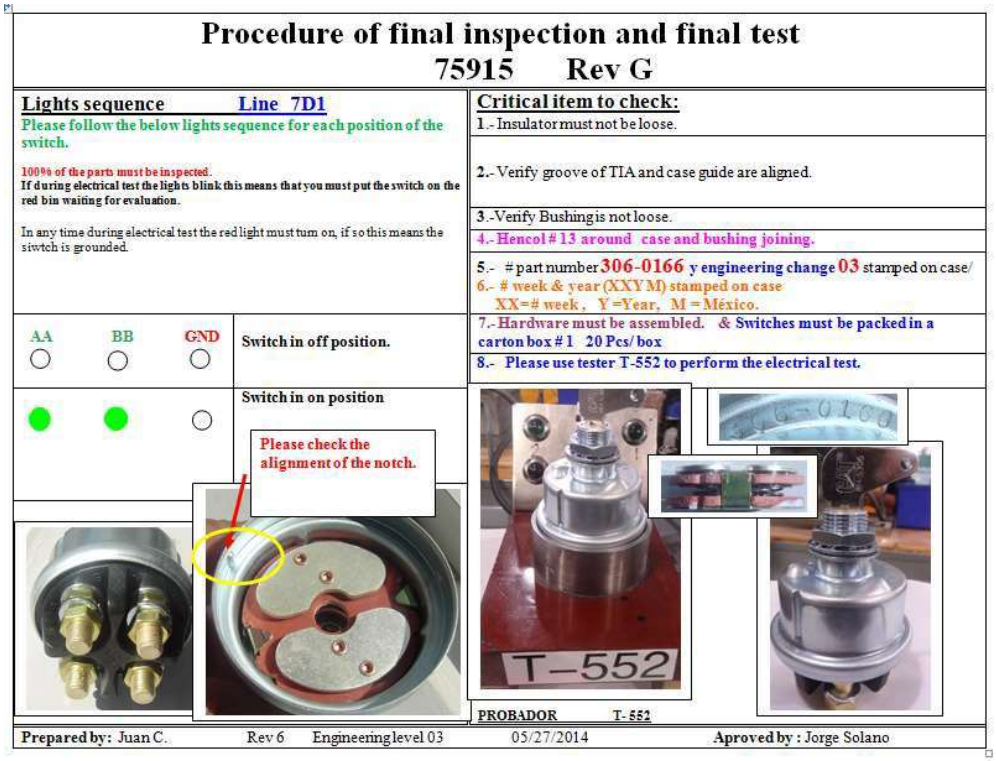


Figure 29 - Example of inspection plan.

Element 17-9 – ISO 9001 / IATF 16949 Certificate

Suppliers must demonstrate compliance with ISO 9001/ IATF 16949 by maintaining a third-party certification issued by a certification body that demonstrates the accreditation mark of an IAF member.
For more details of IAF members visit:
https://www.iaf.nu/articles/IAF_Members___Signatories/4

intertek
Total Quality. Assured.

CERTIFICATE
OF REGISTRATION

This is to certify that the management system of:

LITTELFUSE S. DE R.L. DE C.V.

Libramiento Venustiano Carranza No. 2501, Colonia Lomas de la Villa, Piedras Negras, Coahuila, Mexico, 26090

has been registered by Intertek as conforming to the requirements of:

IATF 16949:2016

The management system is applicable to:

Design and Manufacture of Circuit Protection Devices, Switches and Accessories

Permissible exclusions include: None

IATF Certificate Number
0277040

Certificate Number:
2004-0100

Certificate Issue Date:
25 October 2017

Certificate Expiry Date:
24 October 2020

Colin Moldoveanu
President, Business Assurance

Intertek – 4700 Broadmoor, Suite200
Kentwood MI 49512, USA

Figure 30 - Example of IATF certificate.

Element 17-10 – Sub-contractors PPAP

Sub-contractors PPAP's must be in compliant with the AIAG PPAP standard.

Element 17-11 – Conflict Mineral Report

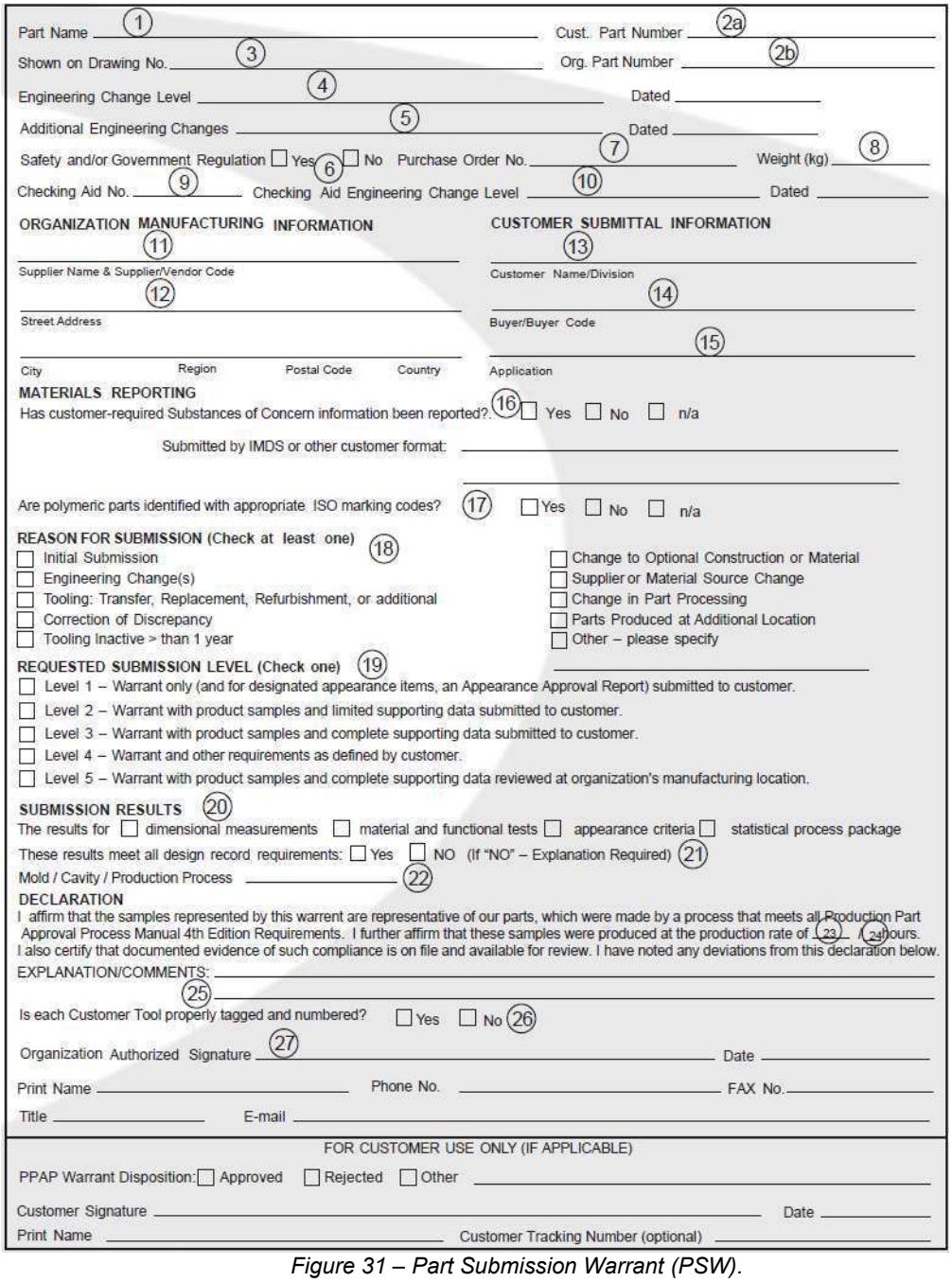
Littelfuse takes seriously allegations that metals mined in conflict regions throughout the world, including the Democratic Republic of the Congo, may be making their way into the supply chain and that profits from this illegal mining may be fueling human rights atrocities. Littelfuse expects our suppliers to comply with the Electronic Industry Code of Conduct and to only source materials from environmentally and socially responsible suppliers. Littelfuse has procedures in place to help ensure that our suppliers comply with these expectations. In support of this, Littelfuse expects our suppliers to continuously monitor both direct and indirect supply chains to avoid procurement of materials from conflict regions, and to be forthright in sharing compliance information with Littelfuse. Littelfuse suppliers must:

- Comply with all national and other applicable laws and regulations, and require their suppliers do the same (including labor agencies);
- Adopt sound human rights practices and treat workers fairly with dignity and respect.
- Provide a safe and healthy working environment for their workers.
- Conduct business operations in a way that protects and sustains the environment.
- Maintain management systems that measure, improve, and communicate their company's labor, health & safety, environmental performance, and uphold the highest standards of ethics.

For more details of Conflict Mineral Report, contact: pec-cmrt@littelfuse.com

Element 18 – Part Submission Warrant (PSW)

The purpose of the Part Submission Warrant (PSW) is to document the submission and the approval or rejection of purchased parts prior to production. It is critical to make sure the PSW is filled out correctly, and contains accurate and legible information. A sample of the part submission warrant described above can be found below.



Part Name (1) Cust. Part Number (2a)
Shown on Drawing No. (3) Org. Part Number (2b)
Engineering Change Level (4) Dated
Additional Engineering Changes (5) Dated
Safety and/or Government Regulation ☐ Yes (6) ☐ No Purchase Order No. (7) Weight (kg) (8)
Checking Aid No. (9) Checking Aid Engineering Change Level (10) Dated

ORGANIZATION MANUFACTURING INFORMATION
(11) Supplier Name & Supplier/Vendor Code
(12) Street Address
City Region Postal Code Country

CUSTOMER SUBMITTAL INFORMATION
(13) Customer Name/Division
(14) Buyer/Buyer Code
(15) Application

MATERIALS REPORTING
Has customer-required Substances of Concern information been reported? (16) ☐ Yes ☐ No ☐ n/a
Submitted by IMDS or other customer format:
Are polymeric parts identified with appropriate ISO marking codes? (17) ☐ Yes ☐ No ☐ n/a

REASON FOR SUBMISSION (Check at least one) (18)
☐ Initial Submission
☐ Engineering Change(s)
☐ Tooling: Transfer, Replacement, Refurbishment, or additional
☐ Correction of Discrepancy
☐ Tooling Inactive > than 1 year
☐ Change to Optional Construction or Material
☐ Supplier or Material Source Change
☐ Change in Part Processing
☐ Parts Produced at Additional Location
☐ Other – please specify

REQUESTED SUBMISSION LEVEL (Check one) (19)
☐ Level 1 – Warrant only (and for designated appearance items, an Appearance Approval Report) submitted to customer.
☐ Level 2 – Warrant with product samples and limited supporting data submitted to customer.
☐ Level 3 – Warrant with product samples and complete supporting data submitted to customer.
☐ Level 4 – Warrant and other requirements as defined by customer.
☐ Level 5 – Warrant with product samples and complete supporting data reviewed at organization's manufacturing location.

SUBMISSION RESULTS (20)
The results for ☐ dimensional measurements ☐ material and functional tests ☐ appearance criteria ☐ statistical process package
These results meet all design record requirements: ☐ Yes ☐ NO (If "NO" – Explanation Required) (21)
Mold / Cavity / Production Process (22)

DECLARATION
I affirm that the samples represented by this warrent are representative of our parts, which were made by a process that meets all Production Part Approval Process Manual 4th Edition Requirements. I further affirm that these samples were produced at the production rate of (23) / (24) hours. I also certify that documented evidence of such compliance is on file and available for review. I have noted any deviations from this declaration below.
EXPLANATION/COMMENTS:
(25)
Is each Customer Tool properly tagged and numbered? ☐ Yes ☐ No (26)
Organization Authorized Signature (27) Date
Print Name Phone No. FAX No.
Title E-mail

FOR CUSTOMER USE ONLY (IF APPLICABLE)
PPAP Warrant Disposition: ☐ Approved ☐ Rejected ☐ Other
Customer Signature Date
Print Name Customer Tracking Number (optional)

Figure 31 – Part Submission Warrant (PSW).

Completion of the Part Submission Warrant

PART INFORMATION	
1	**Part Name** and **2a. Customer part number**: Engineering released finished end item part name and number.
2b	**Orig. Part Number:** Part Number defined by the organization, if any.
3	**Shown on Drawing Number:** The design record that specifies the customer part number beingsubmitted.
4	**Engineering Change Level & Date:** Show change level and date of the designrecord.
5	**Additional Engineering Changes & Date:** List all authorized engineering changes not yet incorporated on the drawing but which are incorporated in the part.
6	**Safety and/ or Government Regulated:** "Yes" if so indicated on part drawing, otherwise "No".
7	**Purchase Order Number:** Enter this number as found on the purchase order.
8	**Part Weight:** Enter the actual weight inkilograms to four decimal places.
9/10	**Checking Aid No.** Enter the checking aid number, if one is used for dimensional inspection, and, Its Engineering Change Level and Approval Date.
ORGANIZATION MANUFACTURING INFORMATION	
11	**Organization Name & Supplier Code:** Show the code assigned to the manufacturing location on the purchase order.
12	**Supplier Manufacturing Address:** Show the complete address of the location where the product was manufactured.
CUSTOMER SUBMITTAL INFORMATION	
13	**Customer Name/Division:** Show the corporate name and division or operations group.
14	**Buyer Name: and Buyer Code:** Enter the buyer's name andcode.
15	**Application:** Enter the model year, vehicle name, or engine, transmission, etc
MATERIALS REPORTING	
16	**Substances of Concern:** Enter "Yes" "No" or "n/a". IMDS/other customer format: Circle either "IMDS" or "Other customer format" as appropriate. If submitted via IMDS include: Module ID#, Version #, and Creation Date. If submitted via other customer format, enter the date customer confirmation was received.
17	**Polymeric parts Identification:** Enter "Yes" "No" or "n/a".
REASON FORSUBMISSION	
18	**Check the appropriate box.** Add explanatory details in the "other" section.
REQUESTED SUBMISSION LEVEL	
19	Identify the submission level requested by your customer.
SUBMISSION RESULTS	
20	Check the appropriate boxes for dimensional, material tests, performance tests, appearance evaluation, and statistical data.
21	Check the appropriate box. If "no", enter explanation in "comments" below.
22	**Molds / Cavity / Production Process:** For instruction, see paragraph 2.2.18
DECLARATION	
23	Enter the number of pieces manufactured during the significant production run.
24	Enter the time (in hours) taken for the significant production run.
25	**Explanation/Comments:** Provide any explanatory details on the submission results or any deviations from the Declaration. Additional information may be attached as appropriate.
26	**Customer Tool properly tagged and numbered:** Are customer-owned tools identified in accord with ISO/IATF 16949 and any customer-specific requirements, answer "Yes" or "No". May not be applicable to OEM internal suppliers.
27	**Organization Authorized Signature:** A responsible supplier official, after verifying that the results show conformance to all customer requirements and that all required documentation is available shall approve the declaration and provide Title, Phone Number, and Fax Number.
FOR CUSTOMER USE ONLY	
Leave blank.	

Element 18 – Part Submission Warrant (PSW) Bulk Materials. (if applicable)

The minimum submission requirement for bulk material is the PSW and the bulk material check list.

For bulk material PPAP only, please refer to AIAG production part approval process manual item F.3 bulk materials requirements check list.

Examples of bulk materials include, but are not limited to: adhesives and sealants (solder, elastomers) chemicals (rinses, polishes, additives, treatments, color/pigments, solvents), coating (top coats , undercoats,primers,phosphates, surface treatments), polymers (rubber, plastics, resins and their precursors).

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Bulk Materials Requirements Checklist **Project:**

	Required / Target Date	Primary Responsibility		Comments / Conditions	Approved by / date
		Customer	Supplier		
Product Design and Development Verification					
Design Matrix					
Design FMEA					
Special Product Characteristics					
Design Records					
Prototype Control Plan					
Appearance Approval Report					
Master Samples					
Test Results					
Dimensional Results					
Checking Aids					
Engineering Approval					
Process Design and Development Verification					
Process Flow Diagrams					
Process FMEA					
Special Product Characteristics					
Pre-launch Control Plan					
Production Control Plan					
Measurement System Studies					
Interim Approval					
Product and Process Validation					
Initial Process Studies					
Part Submission Warrant					
Elements to be Completed as Needed					
Customer Plant Connection					
Customer Specific Requirements					
Change Documentation					
Supplier Considerations					
Storage conditions and warranty period					
Packaging solutions					
Operating manual					

Plan agreed to by: Name / Function	Company / Title / Date

Figure 32 – Bulk Materials Requirement Checklist