



Ford Motor Company

Customer-Specific Requirements

For use with
AIAG PPAP Fourth Edition
Service PPAP First Edition

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Scope

This Document is applicable to organizations supplying production and service parts to all regions within Ford Motor Company and Joint Ventures. Wherever the term "Ford" is used throughout this document, it refers to "Ford Motor Company" and its Joint Ventures.

The US English language version of this document is the official version.

Any translations of this document shall:

- be for reference only,
- reference the English version as the official language,
- include Ford Motor Company in the copyright statement.

Copies of this document are available from Ford Motor Company at https://web.qpr.ford.com/sta/Phased_PPAP.html through the Ford Supplier Portal and International Automotive Task Force at <https://www.iatfglobaloversight.org/>.

References

Note: unless otherwise noted, all references listed throughout these Ford Specific Requirements refer to the latest edition.

References available through Automotive Industry Action Group, AIAG

The latest copies of **IATF 16949, APQP, CQI, PPAP, S- PPAP, SPC, MSA** and other related manuals are available from AIAG at <https://www.aiag.org/>

References available through Ford

- Ford Engineering CAD and Drafting Standards (FECDS)
<https://azureford.sharepoint.com/sites/C3PNGMethods/FECDS/SitePages/Home.aspx>
- Special Process Assessments and Requirements
https://web.qpr.ford.com/sta/Ford_GTS.html
- Ford Global Technical Service Standards
https://web.qpr.ford.com/sta/Ford_GTS.html
- Ford Motor Company FMEA Handbook, is available in the Document Library via Covisint (subsection Quality Documents)
https://fsp.portal.covisint.com/web/portal/document_library
- Phased PPAP Handbook available through Ford Supplier Portal
https://web.qpr.ford.com/sta/Phased_PPAP.html
- Ford Customer Specifics to IATF 16949 available through Ford Supplier Portal
https://web.qpr.ford.com/sta/Ford_IATF_CSR.pdf

References available through other groups such as International Standards Organization (ISO)

- ISO/IEC 17025 General Requirements for the Competence of Calibration and Testing Laboratories, available through ISO <https://www.iso.ch/iso/en/ISOOnline.frontpage> (search for "17025" in the standards search).

Some hyperlinks within this document may only be accessible on FSP (Ford Supplier Portal) by organizations shipping directly to Ford Motor Company (typically Tier 1).

Lower tier organizations pursuing IATF 16949 registration may need to gain access to FSP (Ford Supplier Portal) through a Tier 1.

Ford-Specific PPAP 4.0 / Service 1.0 Requirements

Introduction

Purpose

No Ford Customer-Specific Requirement for this section.

Applicability

The "authorized customer representative" is the Supplier Technical Assistance (STA) site engineer assigned to the organization site. STA engineers are identified in SIM (Supplier Improvement Metrics) on the Ford Supplier Portal for each organization manufacturing site. Internal suppliers to Ford Assembly Plants (e.g., Powertrain and Stamping Business Unit facilities) should contact their responsible approval activity.

In alignment with PPAP 4.0 and Service PPAP 1.0, an "organization" is the manufacturing site of external suppliers manufacturing production or service parts and products for Ford Motor Company. The sub-tier supplier is the manufacturing facility contracted by the organization to ship product to the organization in support of a Ford Motor Company contract. Special situations may apply where the organization is directed by Ford to contract a particular sub-tier supplier. Please contact the Ford buyer to understand the organization responsibilities where sub-tier suppliers are directed by Ford.

In this document, the terms "organization" and "tier 1 supplier" are interchangeable, both representing the tier 1 site manufacturing production or service parts for Ford Motor Company.

PPAP Submission is required for, but not limited to:

- All new tooled parts
- Design change to an existing part
 - And "running changes" for vehicles in production
- Any change in supplier operating pattern
- Any change in the manufacturing process after PPAP approval
- Any additional or modified production tooling or equipment
- Revised Ford required capacity exceeding verified supplier capacity

Approach

No Ford Customer-Specific Requirement for this section.

SECTION 1 – GENERAL

1.1 Submission of PPAP

Production

The organization shall submit PPAP per Ford's *Phased PPAP*, available at https://web.qpr.ford.com/sta/Phased_PPAP.html, through the Ford Supplier Portal.

Service (FCSD)

- When submitting service PPAP, only select Phase 3 on the Phased PPAP PSW.
- The organization shall submit PPAP per FCSD e-PPAP System available at <https://web.ppap.ford.com/training/>
- Organizations located in Europe shall submit PPAP directly to FCSD STA Engineer

SECTION 2 – PPAP PROCESS REQUIREMENTS

2.1 Significant Production Run

No Ford Customer-Specific Requirement for this section.

2.2 PPAP Requirements

2.2.1 Design Record

For a Design Record to be acceptable, the following conditions must exist:

- Records shall be released and authorized for production and/or service use in the appropriate Ford design system (i.e., Production Authority level in WERS – Worldwide Engineering Release System, Teamcenter).
- Design records shall be authored within corporate data repositories (i.e. WERS, Teamcenter, FordDoc) as required by Ford Product Development Engineering, and records shall fully align (i.e. WERS/CAD/drawing/Ford Purchase Order). *If the PO does not match other records, obtain concurrence.*
- Design records for parts with software should clearly list the software level and strategy number linked to the engineering level.
- When reviewing Design Record requirements, the drawing notes are also to be reviewed by the organization and evidence of conformance provided.
- Supporting product data (as mastered) shall comply with the Ford Engineering CAD and Drafting Standards (FECDS) available via the Ford Supplier Portal
<https://azureford.sharepoint.com/sites/C3PNGMethods/FECDS/SitePages/Home.aspx>

Clarifications of FECDS

- Organizations shall comply with the E108 Branding directive as indicated in both <https://web.purinfo.ford.com/> and the “E-3” Ford Engineering CAD and Drafting Standard (FECDS)
<https://azureford.sharepoint.com/sites/C3PNGMethods/FECDS/SitePages/Home.aspx>

- Organizations shall utilize the DVM-0011-19 - Parts Trademark Compliance Check sheet via the Ford Supplier Portal <https://web.purinfo.ford.com/DocumentHandler1.ashx?type=brandprot&file=compcheck.xls> to verify compliance with E-108 requirements. Include the completed DVM-0011-19 form with the PPAP submission.
- Suppliers to include in the PPAP submission a photograph of the parts showing branding marking meeting E-108 or exemption requirements.
- Where E-108 requirements are not achieved, an approved exemption is required (request form via Ford Supplier Portal <https://web.purinfo.ford.com/>, "E-108"). Include the approved exemption or design guide number in the design record. Also include a copy of the approved exemption or design guide form with the PPAP submission.
- Where tooling is being added, refurbished or modified, branding compliance is to be included and verified to be correct. In the case where tooling is being added, existing tooling is to be reviewed for branding compliance and to be included in the quote for the incremental tooling.
- As part of the design record and where specified by Ford PD, organizations that supply electrical components shall include current Device Transmittal information as defined by the Ford Device Transmittals Engineering Standard (via the Ford Design and Release Engineer).

Special Process Assessments

- The Organization is responsible to ensure that they and all tiers of suppliers are assessed to the applicable Ford Global Manufacturing Process Standards and Assessments and documented within the web-based Special Process Tracker for both annual and forward model compliance via <https://www.supplierassessments.ford.com/>
- Refer to https://web.qpr.ford.com/sta/Ford_GTS.html on Ford Supplier Portal for all these standards except CQI-xx, which are available through AIAG.

2.2.1.1 Reporting of Part Material Composition

Reporting, Identification and Marking of Materials

- Ford materials reporting requirement and compliance details are specified in Ford's Restricted Substance Materials Standard (RSMS) WSS-M99P9999-A1. The current Ford RSMS package is released each year in the "FAQ" section of IMDS, via: <https://www.mdssystem.com/> "OEM Specific Info".
- Acceptable evidence of material reporting and compliance consists of an approved entry in the GMM Dashboard (<https://www.prp.ford.com/ipca-web/ui/v14/imdsPartSearch/public>) for the part number. The PPAP Approve Column must = "YES" for the given part number. If there are questions Ford Material Compliance Group can be contacted at RSMShelp@ford.com

2.2.1.2 Marking of Polymeric Parts

Design record requirements for material identification and material code parts marking shall comply with the "E-4" Ford Engineering CAD and Drafting Standard (FECDS) via the Ford Supplier Portal

<https://azureford.sharepoint.com/sites/C3PNGMethods/FECDS/SitePages/Home.aspx>

2.2.2 Authorized Engineering Change documents

For Production and Service a Ford authorized change document is a WERS Alert. See [Exception Management Process in Phased PPAP Handbook](#).

2.2.3 Customer Engineering Approval

The organization shall obtain written Ford Product Development Engineering approval of DVP&R and PVP&R of the initial sample parts. The PVP&R shall include the results from both Ford completed and Supplier completed tests. The organization shall conduct the PV testing on parts/products which were produced during Phased PPAP Phase 0.

If the organization requires multiple production streams to meet capacity requirements, additional PV testing needs to be performed on those additional production streams in support of Phase 2 PPAP.

Refer to https://web.qpr.ford.com/sta/Phased_PPAP.html.

2.2.4 Design Failure Mode and Effects Analysis (Design FMEA) if the organization is product design-responsible

Organizations shall meet the requirements of the [Ford FMEA handbook](#) through the [FMA Supplier Site](#) when developing DFMEAs, and PFMEAs (available through Ford Supplier Portal Library Services). [Where Organizations are utilizing the AIAG & VDA FMEA Handbook, Ford will accept the use of the format](#)

Ford PD Engineering approval of DFMEAs

Ford Product Development Engineering authorization is required to create a single DFMEA for a family of similar parts or materials used in similar applications, environments, etc.

Where the organization is design responsible, Design FMEA(s) require Ford Product Development Engineering approval. This includes the approval of all Potential Critical/Significant Characteristics (YCs and YSs) regardless of the location of the special controls in the supply chain (tier 1 through tier N). This is accomplished by use of the Ford Special Characteristics Communication and Agreement Form (FAP03-111-2) available through https://web.qpr.ford.com/sta/Phased_PPAP.html in the SCCAF drop down.

Potential Special Characteristics

For non-design responsible (build-to-print) tier 1 suppliers, the tier 1 supplier confirms that they have reviewed the failure modes with the responsible Ford PD engineer (or FCSD engineer where applicable) and have completed and agreed to the Potential Critical/Significant Characteristics (YCs and YSs) regardless of the location of the special controls in the supply chain (tier 1 through tier N). This is accomplished by use of the Ford Special Characteristics Communication and Agreement Form - SCCAF (FAF03-111-2) available through https://web.qpr.ford.com/sta/Phased_PPAP.html in the SCCAF drop down. Special Characteristics are defined in the Ford FMEA Handbook.

2.2.5 Process Flow Diagram

No Ford Customer-Specific Requirement for this section.

2.2.6 Process Failure Mode and Effects Analysis (Process FMEA)

Organizations shall meet the requirements of the [Ford FMEA handbook](#) through the [FMA Supplier Site](#) when developing DFMEAs, and PFMEAs (available through Ford Supplier Portal Library Services). [Where Organizations are utilizing the AIAG & VDA FMEA Handbook, Ford will accept the use of the format](#)

[In addition to the part FMEA, the supplier shall have foundation FMEA's for the processes used to make the part.](#)

Ford approval of PFMEAs

For all PPAP submission levels (1, 3 and 5), Process FMEA(s) for safety and regulatory (inverted delta) component(s) require Ford Product Development Engineering (or FCSD engineering where applicable) & STA approval. Ford reserves the right to review and approve all organization-developed PFMEAs.

Special Characteristic traceability for build to print organizations

For build to print organizations, the organization shall obtain from Ford, DFMEA information (including potential Critical Characteristics - YCs and potential Significant Characteristics – YSs) to develop the PFMEA and special characteristics (CC, SC, HI and OS, as appropriate). The organization shall document special characteristics on the Special Characteristics Communication and Agreement Form - SCCAF (FAF03-111-2) including where special characteristics are controlled at sub-tier suppliers, and obtain Ford approval. This includes the approval of all Critical/Significant Characteristics (CCs and SCs) regardless of the location of the special controls in the supply chain (tier 1 through tier N). This is accomplished by use of the Ford Special Characteristics Communication and Agreement Form (FAP03-111-2) available through https://web.qpr.ford.com/sta/Phased_PPAP.html in the SCCAF drop down.

This also applies to Ford-directed sub-tier suppliers without a Multi-Party Agreement.

Documentation of Controls for Critical Characteristics

Both build-to-print and design responsible organizations identify in the APQP/PPAP Evidence Workbook the special controls which prevent shipment of any nonconformance to Ford specified Critical Characteristics, regardless of the location of the special controls in the supply chain (tier 1 through tier N). This also applies to Ford-directed sub-tier suppliers without a Multi-Party Agreement.

Characteristic traceability is required from the DFMEA through the PFMEA to the Control Plan and to the process instructions. Such traceability is to be documented on the APQP/PPAP Evidence Workbook available through https://web.qpr.ford.com/sta/APQP_PPAP_Evidence_Workbook.xls.

Ford Supplier Manufacturing Health Chart Requirements

The organization shall assess compliance to Critical to Quality process requirements in accordance with APQP as specified in the Supplier Manufacturing Health Charts located at https://web.qpr.ford.com/sta/Supplier_Manufacturing_Health_Charts.html

2.2.7 Control Plan

Organization shall develop Control Plans in accordance with the AIAG Control Plan Manual, latest edition.

Note: Organizations must meet the above requirement by December 31, 2024.

Ford approval of Control Plans

For all PPAP submission levels (1, 3 and 5), Control plan(s) for safety and regulatory (inverted delta) component(s) require the organization cross functional team approval, and approvals by Ford Product Development Engineering & STA. For critical characteristics at a sub-tier level, sub-tier and Tier 1 control plans must identify controls in place to prevent shipment of non-conforming product.

The Control Plan shall include provisions for on-going monitoring of process capability, stability and control; refer to Ford customer specifics for IATF Table A. Ford reserves the right to review and approve all organization-developed Control Plans.

Critical Characteristics and SCCAF

Where Critical Characteristics are identified in the Special Characteristics Communication and Approval form (SCCAF), the physical characteristics (e.g. dimensional or material) leading to the compliance of the Critical Characteristic are identified on the SCCAF with the control method, regardless of the point of manufacture of the Critical Characteristics in the supply chain (tier 1 through tier N). The SCCAF is available through https://web.qpr.ford.com/sta/Phased_PPAP.html in the SCCAF drop down.

This also applies to Ford-directed sub-tier suppliers without a Multi-Party Agreement.

2.2.8 Measurement System Analysis Studies (MSA)

The organization shall successfully complete measurement system analysis of all gages prior to initiating the process capability study.

Where measurement analysis studies are performed using software, the software is to be validated using standard input data sets and checked using corresponding expected output results. Example validation data sets are available on <https://web.qpr.ford.com/sta/Statistics.html> through the Ford Supplier Portal.

The required method for calculating Gauge R&R is by using the Analysis of Variance (ANOVA) method, since the ANOVA method allows identification of the operator to part interaction, whereas the Average and Range or Range methods do not. Refer to the AIAG published MSA manual, and the ANOVA method is available through commercial statistical software packages such as MiniTab. If a commercial software package is not available to the organization, the following template is acceptable as well: https://web.qpr.ford.com/sta/Ford_ANOVA_GR&R.xlsm

The organization shall report gauge R&R as both a percent of study variation and a percent of tolerance ± 2 Total Gauge R&R standard deviations, please reference "Acceptability criteria for Gauge R&R" section for further information.

Guidance for acceptable Gauge R&R analysis

For additional guidance, see the Measurement Systems Analysis and Statistical Process Control manuals from AIAG:

- a) On the range charts, all values should be within the control limits
- b) Gauge R and Rs greater than 10% of tolerance variation may not be acceptable and risks are to be evaluated. Gauge error of more than 30% of tolerance variation is unacceptable

Note:

Resolution: a general rule of thumb is the measuring instrument resolution ought to be at least one-tenth of the range to be measured. Guidance on resolution can be found in the AIAG MSA standard.

For any special situations, please contact your STA site engineer.

Acceptability criteria for Gauge R&R

To help assess the gauge, the organization shall report the value of ± 2 Total Gauge R&R Standard Deviations to understand the 95% prediction interval (uncertainty) of any one measurement. This value can be used in conjunction with engineering judgment to help assess the distance between the edge(s) of the process distribution and the specification limit(s). The organization shall report gauge R&R as both a percent of study variation and a percent of tolerance.

Gauge R&R as a percent of tolerance $< 10\%$ is acceptable (the parts used for the Gauge R&R study must be representative of a production run with all known sources of variation).

If Gauge R&R as a percent of tolerance is greater than or equal to 10% , but less than or equal to 30% , contact the STA site engineer to determine if the Gauge R&R is acceptable.

If Gauge R&R as a percent of tolerance $> 30\%$, it is unacceptable and the organization shall implement a containment actions and a corrective action plan to improve measurement capability until the Gauge R&R requirements are met.

As stated in Ford's IATF 16949 Customer Specific Requirements:

- Variable gauge studies should utilize, at a minimum 10 parts, 3 operators and 3 trials.
- Attribute gauge studies should utilize, at a minimum, 50 parts, 3 operators, 3 trials.

In general, the gauge R&R should use the full range of part to part variation from the process – representing all expected sources of manufacturing variation, while providing enough resolution around the upper and lower specification limits.

Calculation for Gauge R&R with One-sided Tolerance for GD&T Dimensions (e.g. Position, Profile, Flatness, Parallelism, Roundness, Straightness, etc.)

In these cases, calculate the tolerance by taking the upper specification limit and subtracting the lower boundary of zero.

$$\text{Gauge R\&R \% Tolerance} = \frac{6 \text{ Total Gauge R\&R Standard Deviation}}{USL - \text{Lower Boundary Of Zero}}$$

Calculation for Gauge R&R with One-sided Tolerance

Upper specification limit with no lower boundary: In these cases, calculate percent tolerance by dividing 3 Gauge R&R standard deviation by the difference between the upper specification limit and the mean of the data.

$$\text{Gauge R\&R \% Tolerance} = \frac{3 \text{ Gauge R\&R Standard Deviation}}{|USL - \bar{X}|}$$

Lower specification limit with no upper boundary: In these cases, calculate the percent tolerance by dividing 3 Gauge R&R standard deviation by the difference between the mean of the data and the lower specification limit.

$$\text{Gauge R\&R \% Tolerance} = \frac{3 \text{ Gauge R\&R Standard Deviation}}{|\bar{X} - LSL|}$$

Determining Gauge Acceptability for One-sided Tolerances when PPK <1

When PPK is less than 1, the one-sided % tolerance will be artificially high. The team will need to use engineering judgment to assess gauge acceptability. Use +/- 2 Total Gauge R&R Standard Deviations to understand the 95% prediction interval (uncertainty) of any one measurement. This value can be used to help assess gauge acceptability by:

- Comparing the +/- 2 Total Gauge R&R Standard Deviations and the distance between tail of the distribution and the specification limit.
- Comparing the +/- 2 Total Gauge R&R Standard Deviations to the spread of the process (+/- 3 Standard Deviations).
- Use +/- 2 Total Gauge R&R Standard Deviations to compare different gauging methods or technology.

Criteria for Attribute Gauge R&R Study (Measurable Characteristic)

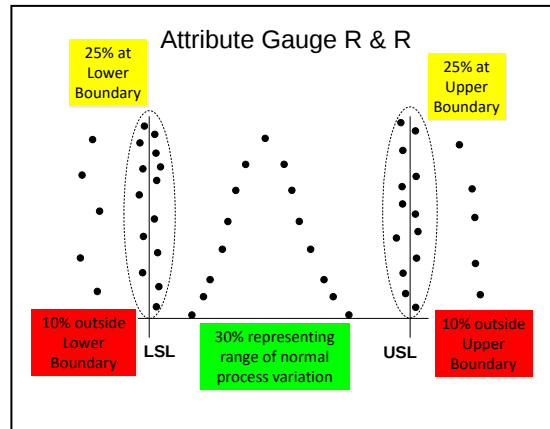
Where attribute gauging is used, the following section applies:

- Gauge must reject all parts that are outside the specification limits
- Rejecting good parts may be acceptable if any throughput or efficiency losses are acceptable to the team.
- All Kappa values should be greater than 0.75. Please note that if the gauge limits are less than the specification limits (Guard Banding) it may be acceptable for the Kappa values to be less than 0.75 if the reduced Kappa values are due to operators rejecting good parts. If the gauge limits are the same as the specification limits then all Kappa values (between appraiser, within appraiser, appraiser to standard) should be greater than 0.75.

Parts for Attribute Gauge R&R Study

- 25% of the parts should be near the lower specification limit (on both sides of the specification).
- 25% of the parts should be near the upper specification limit (on both sides of the specification).
- 30% of the parts should represent the expected process variation.
- 10% of the parts should be outside the upper gauge specification limit and beyond the 25% of the parts near the specification as described above.
- 10% of the parts should be outside the lower gauge specification limit and beyond the 25% of the parts near the specification as described above.

Graphic
representing
the data
distribution for
Attribute
Gauge R&R



Depending on the characteristic, the above parts should be independently measured with a variable gauge (such as a CMM or other known standard) so that the physical measurement of each part is known.

Note: When measuring a true attribute that cannot be measured with a variable gauge, use other means such as experts to pre-determine which samples are good or non-conforming.

Gauge R&R for tires

All tire tier 1 suppliers must follow the 10x10 Gauge R&R methodology for tire uniformity defined by Corporate Engineering Test Procedure CETP 04.04-E-414, Gauge R&R for Tire Uniformity at Low Speed (available from the Ford tire Product Development Engineer). The results are to be reported for both the clockwise and counter clockwise directions separately.

Gauging must use production intent holding fixtures such that the part is held the same way as installed in the vehicle or Powertrain. See the AIAG published Measurement Systems (MSA) Analysis manual for guidance on other MSA approaches.

2.2.9 Dimensional Results

Dimensional results are to be documented on the “Prototype or Production Measurement Results” section of the APQP/PPAP Evidence Workbook, GD&T sheets, checked (ballooned) print or other method of recording the results acceptable to the STA engineer.

At least 5 parts are to be measured and individual results from all Ford specified dimensions are to be recorded. For production streams involving multiple cavities, tools etc., the supplier ensures parts are measured from every cavity, tool etc.

The Annual Dimensional Layout requirement (see IATF 16949 customer specifics) shall be included in the Control Plan.

2.2.10 Records of Material / Performance Test Results

2.2.10.1 Material Test Results

[Reference 2.2.3 for for sign-off requirements.](#)

2.2.10.2 Performance Test Results

[Reference 2.2.3 for for sign-off requirements.](#)

2.2.11 Initial Process Studies

No Ford Customer-Specific Requirement for this section

2.2.11.1 General

The organization shall successfully complete measurement system analysis of all gages prior to initiating the process capability study.

Designation of characteristics for demonstration of process capability

Where the part does not have any Ford-designated special characteristics (CC, SC, or HI – see the Ford FMEA Handbook), the organization shall select part characteristics for which process capability is to be demonstrated, and include the selected characteristics in the Control Plan. The selection of these tier 1 supplier designated part characteristics is to be included in the special characteristics approval process, recorded on the SCCAF and may be identified in the PFMEA Transfer Form in the SCCAF document.

This also applies to Ford-directed sub-tier suppliers without a Multi-Party Agreement.

Demonstration of process capability (Capability Index)

The organization shall demonstrate process capability per 2.2.11.3 of AIAG PPAP latest edition using the P_{pk} process capability index.

Where process capability index calculation software is used, it is to be validated using standard input data sets and checked using corresponding expected output results. Example validation data sets are available on <https://web.qpr.ford.com/sta/Statistics.html> through the Ford Supplier Portal.

Critical Characteristics require controls which prevent the shipment of non-conforming product, regardless of the location in the supply chain (tier 1 through tier N) of the manufacture of the physical characteristic(s) associated with the Critical Characteristic and are recorded in the APQP/PPAP Evidence Workbook.

Statistical process control on product characteristics without continuous manufacturing process controls is not appropriate or sufficient for Critical Characteristics.

Note: Process capability demonstration is not required for Operator Safety (OS) Special Characteristics.

Demonstration of initial process capability (Calculation of P_{pk})

The P_{pk} index of the initial process study must be calculated using a data set that is statistically stable, in control and normally distributed or of the expected distribution (see note 1 below). Stability, control and normality are determined using a data set of at least 25 subgroups and a subgroup size of at least 5 for a minimum of 125 measurements using rational sampling methods (see the AIAG SPC manual). Subgroups are to contain measurements from consecutive parts evenly spaced throughout the population being evaluated (minimum 300 parts).

The process capability for each special characteristic is determined using the data from the 125 piece sample. Exceptions to the minimum number of parts are to be aligned with the Site STA and the rationale for exception/comments are to be documented in the PPAP package. Until the organization can determine process capability utilizing data from a 125 piece sample, 100% inspection or mistake proofing integrated into the process is required. Later demonstration of process stability and acceptable capability will remove the need for 100% inspection.

The initial process study data set of 25 subgroups is to be developed to include the full range of expected variation of the manufacturing process (e.g., the actual manufacturing environment, including all tools, all cavities, all streams, all shifts, expected operating patterns and variation in environmental conditions.)

Note 1: If the data collected are not statistically stable, in control and normally distributed, special causes are to be eliminated and if still not normally distributed, the data should be matched to the expected distribution, such as Weibull, as appropriate, before calculation of P_{pk} . See https://web.qpr.ford.com/sta/Expected_Process_Distributions.pdf for a sample list of manufacturing processes and corresponding distribution types for guidance. Calculation of P_{pk} for non-normal distributions typically requires a statistical software package. Please contact your STA site engineer for guidance. For guidance on stability and control, see the Statistical Process Control (SPC) reference manual.

Note 2: Critical Characteristics require controls which prevent shipment of any nonconforming product, regardless of the location in the supply chain (tier 1 through tier N) of the manufacture of the physical characteristic(s) associated with the Critical Characteristic.

Note 3: The subgroup size of 5 should be considered a minimum for most situations. Where a process is highly automated and part to part (within subgroup) variation is small, larger subgroups may be necessary. Please contact your STA site engineer for guidance.

Note 4: For homogeneous processes, such as extrusion, it is recommended to measure 125 parts or samples which are evenly spaced throughout the population being evaluated.

Note 5: For bulk materials, process capability is typically not demonstrated, contact your STA site engineer for advice.

Note 6: The process capability requirement for both “initial process capability” (Phase 1 and Phase 2) and “final process capability” demonstration with PPAP Phase 3 is $P_{pk} > 1.67$.

Demonstration of process capability for both “Initial” and “Final” Process Capability (Acceptance Criteria)

Acceptable levels:

$$P_{pk} \geq 1.67$$

Demonstration of process capability (When the P_{pk} data set requirements are not met)

If part size or other factors prevent the collection of 25 subgroups covering the expected variation of the manufacturing process, the process capability is not defined and 100% inspection or mistake proofing integrated into the process is required. Later demonstration of process stability and acceptable capability will remove the need for 100% inspection.

Inverted Delta parts

For parts designated as inverted delta (parts with Critical Characteristics), the organization shall prevent the shipment of non-conforming product to Ford.

Note: this is typically accomplished by using error and/or mistake proofing techniques integrated into the organization's manufacturing and material handling processes.

Parts without inverted delta designation

An error proof approach is recommended for all parts, not just parts designated as inverted delta.

Process Capability and Special Characteristic Evidence

Process capability demonstration data and special characteristic linkage evidence are recorded on the APQP/PPAP Evidence Workbook https://web.qpr.ford.com/sta/APQP_PPAP_Evidence_Workbook.xls and included in the PPAP submission. The special characteristics identified in the SCCAF (in the APQP/PPAP Evidence Workbook) must be traceable to the special characteristics controls in the Control Plan.

Special Characteristics and associated process control methods for Ford parts are to be approved and recorded in the SCCAF in the APQP/PPAP Evidence Workbook, regardless of the tier where the physical characteristics are being controlled (tier 1 through tier N).

This also applies to Ford-directed sub-tier suppliers without a Multi-Party Agreement.

2.2.11.2 Quality Indices

No Ford Customer-Specific Requirement for this section.

2.2.11.3 Acceptance Criteria for Initial Study

Acceptance Criteria for Heat Treated Components (applicable to all tier level suppliers):

Case depth, longitudinal induction pattern, surface hardness, core hardness, microstructure and any other product characteristic indicated on the part drawing and any other product characteristic indicated in the applicable product standard shall be tested. All heat treat product testing shall be conducted after final part processing that may impact heat treat product conformance to the heat treat specification (e.g. Final grinding that removes outer surface hardened layers). Samples shall be collected from the extreme locations as indicated below:

- Batch furnaces (including pushers): 8 corners and center of the load (minimum 9 samples per CQI-9 volumetric method for TUS)
- Continuous furnaces: across the belt at the beginning, middle and end of the production run (samples collected shall represent qualified work zone height)
- Induction: per spindle at set up and 3 consecutive parts from the start, middle and end of the 8 hours run (10 parts minimum)

At the minimum, hardness or required product characteristics (e.g. tensile, bend) shall be tested on 30 parts collected in total as indicated above. Sampling using multiple batch or lot is recommended but not required for PPAP validation. Destructive testing involving extensive sample preparation (such as case depth, microstructure, longitudinal induction pattern, tensile strength...) shall be performed on a minimum 9 parts that best represent process extremes, as indicated above. The study will be judged acceptable if all individual readings fall within a safety band that is defined at 90% specified tolerance with no readings at specification limits allowed.

Hardness readings may not be rounded to an integer to avoid inadequate measurement discrimination. Rockwell hardness values shall be reported to first decimal place. The study shall be judged acceptable if no readings are reported at the specification limits.

Acceptance Criteria for Heat Treat process validation and PPAP sign-off, requires the following:

1. Sample collection and compliance to product specification per requirements described above.
2. Initial and ongoing compliance to heat treat process requirements defined in latest revision of AIAG CQI-9 including pyrometry requirements such as SAT, TUS, Instrumentation and Thermocouple requirements as well as requirements of all applicable CQI-9 Process Tables.
3. Production Control Plan shall include all requirements specified above in items 1 and 2. Supplier shall ensure that the Production Control Plan for heat treat processes are in conformance to the applicable Process Table(s) in CQI-9. Control Plan shall be used to control ongoing heat treat process and product conformance to the specification.

Heat Treat SME shall be contacted to review supplier conformance to pyrometry described in item 2 and any issues related to product specification conformance.

2.2.11.4 Unstable Processes

No Ford Customer-Specific Requirement for this section.

2.2.11.5 Processes With One-Sided Specifications or Non-Normal Distributions

No Ford Customer-Specific Requirement for this section.

2.2.11.6 Actions To Be Taken When Acceptance Criteria Are Not Satisfied

The modified control method shall include techniques to incorporate mistake proofing methods or 100% product inspection integrated into the manufacturing process to prevent the shipment of non-compliant product to Ford facilities. Visual or statistical control methods are not permitted in this situation.

Note: examples of mistake proofing methods include the modification of manufacturing processes to detect and prevent the errors which lead to non-conforming product (e.g., poka-yoke), or a gauge to ensure product compliance to specification where the process does not meet the capability requirements. This is not the addition of a temporary manual inspection process at the end of the line.

The organization shall continue to determine sources of variation, improve the process with permanent corrective actions, and improve the process to meet the capability requirements.

100% Inspection required / selected

Wherever a 100% inspection is used, the organization shall use the gauge error (independent of whether the Gauge R&R met the acceptance criteria) to identify modified product acceptance criteria (typically tighter tolerances and often referred to as “guard banding”) to prevent the shipment of non-conforming product to Ford Motor Company.

The following are examples of measurement equipment mistake proofing methods For Variable Gauges

Two sided tolerances:

Tolerances used for 100% inspection gauges can be reduced by the extent of the gauge R&R as a percent of tolerance of the gauge(s) being used in the 100% inspection methodology. The typical practice is to remove half the gauge R&R as a percent of tolerance from the upper specification limit and the other half from the lower specification limit.

Example:

A variable gauge is used to check a product characteristic of 600 microns +/- 40 microns (this equates to 80 microns specification tolerance spread).

Additionally, this variable gauge has a gauge R&R as a percentage of tolerance of 20%.

The upper limit compensated for gauge capability would be 632 microns $(600+40- 80 \times 0.2/2)$

$(\text{Upper Specification} - (\text{Specification tolerance spread} \times (\% \text{ tolerance Gauge R\&R})/2))$

and the lower limit compensated for gauge capability would be 568 microns $(600-40 + 80 \times 0.2/2)$

$(\text{Lower Specification} + (\text{Specification tolerance spread} \times (\% \text{ tolerance Gauge R\&R})/2))$.

This example assumes the gauge error is equally distributed. Continue process variation reduction efforts until a P_{pk} greater than 1.67 is achieved.

One-sided tolerances:

For a "less than" tolerance specification (e.g. length less than 20 mm) subtract three gauge R&R standard deviations from the tolerance specification.

For a greater than tolerance specification (e.g. plating thickness greater than 10 microns) add three gauge R&R standard

deviations to the tolerance specification.

"Greater than" example:

A variable gauge is used to check the length of a product characteristic. The product specification is greater than 150 microns. The gauge R&R standard deviation is 2 microns.

The specification compensated for gauge error would be greater than 156 microns ($150 + 3 \times 2$) (Specification + 3 x gauge R&R standard deviation).

"Less than" example:

A variable gauge is used to check the length of product characteristic. The product specification is less than 150 microns. The gauge R&R standard deviation is 2 microns. The specification compensated for gauge error would be less than 144 microns ($150 - 3 \times 2$).

If business reasons exist to deviate from the recommendations listed above, contact STA to obtain concurrence.

Continue process variation reduction efforts until an acceptable process capability is achieved.

2.2.12 Qualified Laboratory Documentation

The internal or external laboratory shall be in compliance with the latest ISO/IEC 17025 (or national equivalent), however, accreditation is not required.

2.2.13 Appearance Approval Report (AAR)

All parts/products having appearance criteria shall be reviewed and approved by Ford Design Quality and approval recorded on the Appearance Approval Report (AAR) as specified in the Global Decorative Component Approval Process (GDCAP). The completed Appearance Approval Report (form CFG-1002) shall accompany all PSW submissions.

NOTE 1: Appearance items are: all interior, exterior, luggage compartment, and select under-hood components which are visible to the customer. AAR sign-off ensures compliance with Ford Color Harmony Requirements, including the Global Decorative Component Approval Process (GDCAP).

NOTE 2: Visual “match-to-master” is the specified requirement for AAR sign-off. Numeric evaluations should only be used for on-going statistical process control after visually acceptable parts/products are attained.

NOTE 3: MCDCC (Material Color / Durability Compliance Certification must also be approved by Ford for final AAR sign off.

For additional information, visit: https://web.gpr.ford.com/sta/Phased_PPAP.html

“Ford Color Harmony Requirements (includes GDCAP – Global Decorative Component Approval Process and the Regional Design Quality Contact list)”

The AAR used to be a hand written document CFG-1002-F1, but now only the electronic version is used (eAAR). There is a online document and a sticker (AAR label) that is placed directly on the part.

This is done through GCMS (global color management system):

Visit: <https://www.gcms.ford.com/GCMSUiWeb/authenticatePre.do>

The latest GDCAP v5.3 PDF contains the most up to date information, and can be found on the Global Phased PPAP site >> under the Ford Color Harmony tab.

There is a checklist of mandatory items on **appendix A3b** within the **GDCAP v5.3 PDF**. Once a supplier gets the eAAR approved by DQ (Design Quality), DQ will printout a AAR sticker label. these labels are printed at the Ford facility by DQ at the time of the appearance approval review. **Appendix A4** within the **GDCAP v5.3 PDF** shows the labels – most parts would get (a) regular label.

2.2.14 Sample Production Products

No Ford Customer-Specific Requirement for this section.

2.2.15 Master Sample

No Ford Customer-Specific Requirement for this section.

2.2.16 Checking Aids

No Ford Customer-Specific Requirement for this section.

2.2.17 Customer- Specific Requirements

Customer specific requirements in this section are required for Service PPAP.

Labeling Requirements

- Organizations supplying FCSD North America are required to provide a sample label to FCSD North American STA's for service products. Organizations supplying FCSD Asia Pacific, FCSD Europe and FCSD South America are required to follow local practices – contact your regional FCSD STA engineer for details.
- Organizations supplying FCSD North America are required to provide a copy of the part screen information from Direct Data Link (DDL) to FCSD North American STA's for service products, e.g. "GPMA" from DDL. Organizations supplying FCSD Asia Pacific, FCSD Europe and FCSD South America are required to follow local practices – contact your regional FCSD STA engineer for details.

Packaging

- **Packaging:** All organizations supplying service parts to North America shall comply with FCSD (Ford Customer Service Division) Packaging and Shipping requirements. The Packaging and Shipping Guidelines can be accessed at: <https://web.pkginfo.ford.com/> through the Ford Supplier Portal. All other regions shall comply with local requirements; contact your regional FCSD STA engineer for details.
- **Rust:** All organizations supplying service parts to North America shall comply with FCSD (Ford Customer Service Division) rust policy. The Packaging and Shipping Guidelines can be accessed at: <https://web.pkginfo.ford.com/> through the Ford Supplier Portal. Organizations supplying FCSD Asia Pacific, FCSD Europe and FCSD South America shall comply with local requirements, contact your regional FCSD STA engineer for details.
- **Service Kits with Packaged Chemical Components:** FCSD (Ford Customer Service Division) Package Material Specification L1794 (Labeling Instructions for Kits with Chemical/Regulated Components) will be specified on the individual service kit's packaging specification. The L1794 requires the chemical component tier 1 supplier and/or FCSD Contract Packager to develop the appropriate warning label for these products. The FIR # (FIR #: "Ford Internal Reference Number" also known as Toxicology Number) must be included on the tier 1 supplier developed warning label for the packaged chemical components, e.g. greases, lubricants, adhesives, solvents, butyl tape, etc. The L1794 label Package Material Specification can be found at: <https://packagematerialspecifications.cdis1.com/specs/L1794.pdf> through the Ford Supplier Portal.
- **Dry Friction Materials:** A unique FCSD developed toxicology label or a generic toxicology label will be specified on individual dry friction service part's packaging specifications. The generic label for brake and clutch parts will be L1853. The Package Material Specification for L1853 can be found at <https://packagematerialspecifications.cdis1.com/specs/L1853.pdf> through the Ford Supplier Portal. Uniquely developed toxicology labels will have their own label number specified on the parts packaging specification. The generic labels are used whenever a FIR # (FIR #: "Ford Internal Reference Number" also known as Toxicology Number) has not yet been established, otherwise, the unique labels will include the applicable FIR #.

2.2.17.1 Copy of GPMA Screen from 3270

- Upload copy into FCSD ePPAP system

2.2.17.2 Pictures of Ford owned tools with correct Ford Identification

- Upload copy into FCSD ePPAP system

2.2.17.3 Pictures of Parts (3 views / close up of E-108 branding)

- Upload copy into FCSD ePPAP system

2.2.17.4 E-108 Branding Deviation if unable to meeting branding requirements

- See Section 1, element 2.2.1 above

2.2.17.5 Operator Work Instructions

- Upload copy into FCSD ePPAP system

2.2.17.6 Sample AIAG Shipping Label

- Upload copy into FCSD ePPAP system

2.2.17.7 Tier 2 PSW's

- Upload copy into FCSD ePPAP system

2.2.17.8 Copy of IMDS

- See Section 1, element 2.2.1.1 above

2.2.18 Part Submission Warrant (PSW)

Please Note: The below information also applies to Section 5 - Part Submission Status

Per Ford requirements, where Part Submission Warrant (PSW) is referenced, electronic PSW (ePSW) is the default Production warrant submission process. Exceptions to the ePSW process that may require use of the paper PSW submission include SREA, Directed Tier 2, Capacity Uplift, and Bulk material related PPAPs. See Phased PPAP Handbook https://web.qpr.ford.com/sta/Phased_PPAP.html available through the Ford Supplier Portal for PPAP level and PSW submission requirements.

See Ford PSW Completion and Submission Practices in the appendix.

PSW and Capacity Analysis Report (CAR) Verfication

The organization shall have supporting evidence from the CAR form to support the Average Purchased Part Capacity (APPC) and Maximum Purchased Part Capacity (MPPC) entries on the PSW form.

Sub-tier Supplier Advanced Product Quality Planning as defined in the latest release of the AIAG published Advanced Product Quality (APQP) manual. Effective December 31st, 2024, the use of the APQP Manual 3rd Edition is required.

The organization shall include evidence of organization approval of sub-tier part approval submissions in the PPAP submission package to Ford. Ford reserves the right to review the detailed sub-tier supplier part approval submission data for the sub-tier supplier components included in the Ford specified end item. Where Critical Characteristic controls are implemented at the sub-tier supplier, the PPAP submission package must show evidence that the sub-tier Critical Characteristic controls are effective in preventing the shipment of non-conforming product.

- Tier 1 Suppliers to Ford must require their sub-tier suppliers to use Advanced Product Quality Planning (APQP) to plan for production part approval
- Tier 1 Suppliers to Ford must use a production part approval process for their sub-tier suppliers. The Tier 1 Suppliers shall include the approved sub-tier supplier part approval submissions with each phase of PSW submission to Ford.
- For each New Tooled End Item (NTEI), where sub-tier suppliers are used to support the manufacture of the NTEI, the organization shall:
 - Manage the sub-tier supplier readiness using the principles defined in the latest release of the AIAG published Advanced Product Quality Planning (APQP) manual
 - Track sub-tier supplier component readiness using APQP, in support of each applicable deliverable and expectation in Ford's APQP/PPAP Readiness Assessment (Schedule A)
 - Report sub-tier supplier component readiness to Ford in support of each deliverable in Ford's APQP/PPAP Readiness Assessment (Schedule A) throughout the Vehicle or Powertrain program
 - Include the final Schedule A with the PSW submission to Ford for each NTEI, including sub-tier supplier readiness, and retain in the PPAP record

These requirements also apply to Ford-directed sub-tier suppliers without a Multi-Party Agreement.

Post Job 1 PPAP submissions, including Functional Trials

The organization is not to ship production quantities to the Ford facilities until after PPAP and functional trial approval or functional trial waiver are obtained from all affected Ford plants.

The functional trial approval or functional trial waiver is obtained after PPAP approval, and is managed by Plant Vehicle Team (PVT at VO plants), Local Vehicle Team (LVT), or the locally defined approver at Powertrain plants. Contact the PVT, LVT, or the Powertrain plant for instructions.

For PPAP submissions during a vehicle launch, the launch builds constitute the "functional trials" and therefore provide approval to ship parts subject to plant releases.

Family of parts on a single PSW

Organizations are permitted to submit multiple part numbers (same family of parts) on a single PSW, with prior concurrence by the STA site engineer, with all part specifics (e.g., prefix, base, suffix) clearly noted on the PSW or on an attachment to the PSW.

Ford PSW Completion and Submission Practices in the appendix for a summary of submission practices and methods for notifying the appropriate Ford system of completion of the PSW.

The organization must allow for STA approval timing ahead of the sample promise date.

PSW submissions with service and production parts

Where the same part is being submitted for PPAP approval for production and service application (Ford Customer Service Division – FCSD) the organization enters the service part number (if different from the production part number) above the production part number in parentheses, shown in the image below. The organization should contact FCSD STA to determine if this situation applies.

PPAP Submission Warrant	
	(6F2Z-14630-BAA)
Cust. Part Number	6F2T-14632-BM

2.2.18.1 Part Weight (Mass)

No Ford Customer-Specific Requirement for this section.

SECTION 3 – Customer Notification and Submission Requirements

3.1 Customer Notification

Change Notification (*PPAP – section 3*)

Organizations contracted by Ford are required to obtain Ford approval per the Ford SREA Process (Supplier Request for Engineering Approval) prior to implementation of any organization-initiated or sub-tier supplier-initiated change. The notification requirements of section 3 in PPAP 4.0 are met by following the SREA process; (the SREA requirements and process are available on <https://web.srea.ford.com/default.aspx>, Ford Supplier Portal).

Where the same part has a production and service application, any associated tier 1 supplier-initiated change is submitted via the production SREA process.

Service Part Deviation (SREA) Process

A web based SREA tool is available via <https://web.srea.ford.com/> for parts that are not used in production and are covered by warranty.

Service-Unique parts released by FCSD Engineering (Ford Customer Service Division) and not common with production parts (e.g. components, service chemicals, etc.) or past model parts no longer used for Ford production, but still produced for service, should be processed via the FCSD Service Part Deviation SREA process found via <https://web.srea.ford.com/> or <https://web.purinfo.ford.com/> through the Ford Supplier Portal. Contact your local FCSD STA engineer for further details.

3.2 Submission to Customer

No Ford Customer-Specific Requirement for this section.

SECTION 4 – Submission to Customer – Levels of Evidence

4.1 Submission Levels

No Ford Customer-Specific Requirement for this section.

SECTION 5 – Part Submission Status

5.1 General

Please Note: Reference Customer Specifics in section 2.2.18 – Part Submission Warrant (PSW)

5.2 Customer PPAP Status

No Ford Customer-Specific Requirement for this section.

5.2.1 Approved

For PPAP level 3, 5, and priority parts, Ford Product Development engineering should review and approve the PPAP submission (full submission and interim) prior to STA, to review the PD requirements of PPAP first, unless STA and PD review the submission as a team.

5.2.2 Interim Approval

A WERS alert must be approved and authorized for interim PSW approval. The approved and authorized alert is the authorization to ship parts.

5.2.3 Rejected

No Ford Customer-Specific Requirement for this section.

SECTION 6 – Record Retention

Ford Customer-Specific Requirement for this section.

Appendix A – Completion of the Part Submission Warrant (PSW)

Reference PPAP Sections 2.2.18 Part Submission Warrant (PSW) and Section 3 Customer Notification and Submission Requirements.

See Ford's Phased PPAP for instructions on PPAP and PSW submission requirements, available through https://web.qpr.ford.com/sta/Phased_PPAP.html, Ford Supplier Portal

Tool Tagging

Customer tool tagging/numbering is not applicable to Ford internal suppliers such as Powertrain and Stamping Business Unit.

Requirements for tagging/marking of Ford owned tooling at tier 1 supplier or sub-tier supplier locations are available through <https://www.fsp-wlp.ford.com/gtc/docs/supptooltagging.pdf>

Appendix B – Completion of Appearance Approval Report

No Ford Customer-Specific Requirement for this section.

Appendix C – Production Part Approval, Dimensional Results

No Ford Customer-Specific Requirement for this section.

Appendix D - Production Part Approval, Material Test Results

No Ford Customer-Specific Requirement for this section.

Appendix E – Production Part approval, Performance Test Results

No Ford Customer-Specific Requirement for this section.

Appendix F – Bulk Material – Specific Requirements

No Ford Customer-Specific Requirement for this section.

F.1 Introduction

No Ford Customer-Specific Requirement for this section.

F.2 Applicability

No Ford Customer-Specific Requirement for this section.

F.3 Bulk Materials Requirements Checklist (see 2.2)

No Ford Customer-Specific Requirement for this section.

F.4 Design Matrix

No Ford Customer-Specific Requirement for this section.

F.4.1 Introduction

No Ford Customer-Specific Requirement for this section.

F.4.2 Design Matrix – Elaboration

No Ford Customer-Specific Requirement for this section.

F.5 Design FMEA

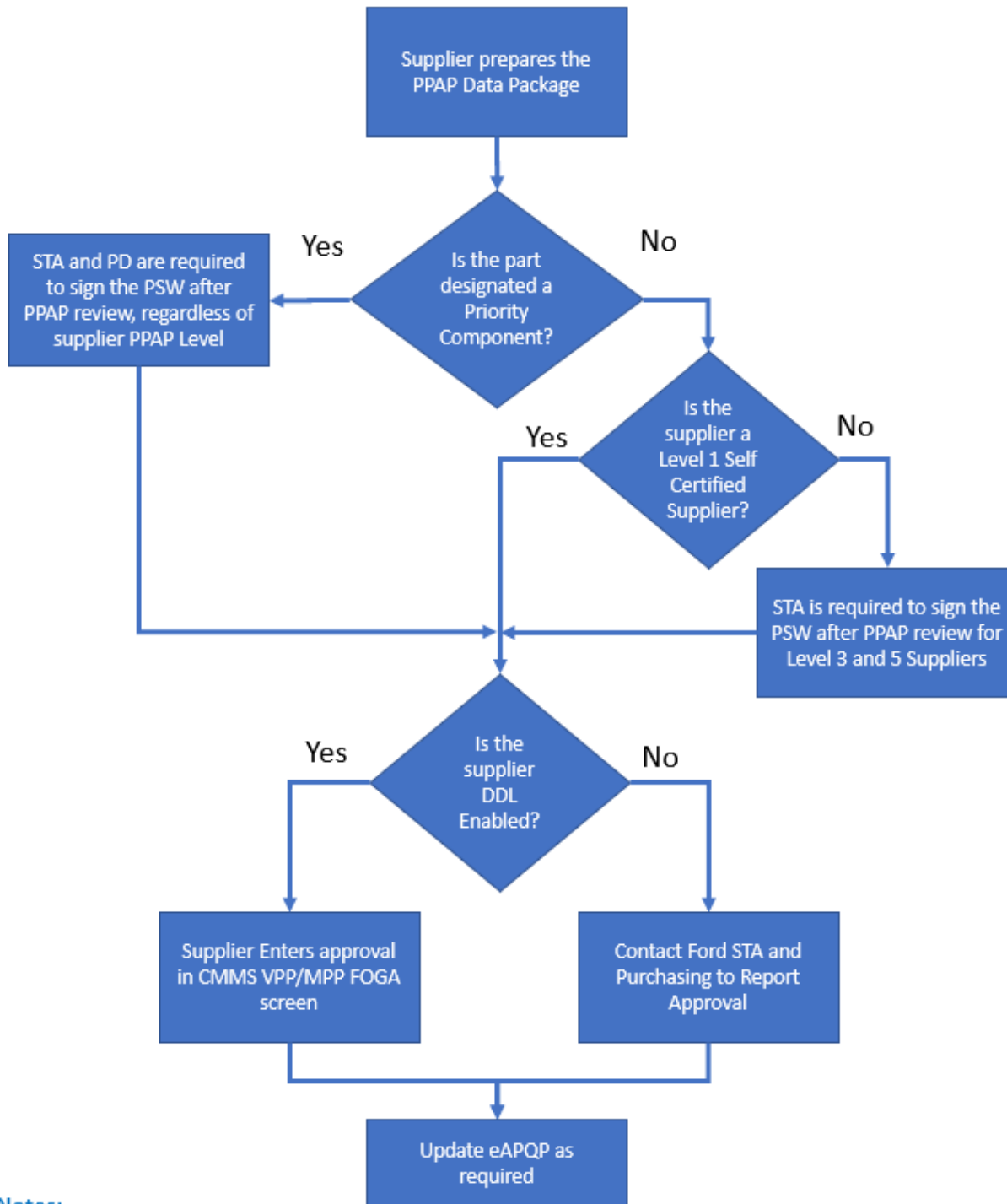
No Ford Customer-Specific Requirement for this section.

Appendix G – TIRES – Specific REQUIREMENTS

The tire tier 1 suppliers to Ford shall meet the "Ford Motor Company - Phased PPAP Requirements for Tires" defined by Ford, available through Ford Supplier Portal https://web.qpr.ford.com/sta/Phased_PPAP.html (under Global Phased PPAP tab) or the tire STA site engineer.

The Ford Tire PPAP requirements are also referenced in the current version of the "Ford Functional Specification - Tire Casing" (Ford Tire FS) that is released by Ford Product Development. All engineering requirements defined in the Ford Tire Functional Specifications must be met to comply with Tire PPAP requirements. The Ford Tire Functional Specifications are available from the Ford tire Product Development engineer.

Ford PSW Completion and Submission Practices



Notes:

1. In all cases, the Supplier is required to maintain the completed PPAP data package on file.
2. Self Certifying Supplier status is recorded in SIM

Records Of Revision

Sections updated	Date updated
1. Added link to Supplier Assessments, Special Process Tracker, for Special Process Assessment requirement 2. Added existing Ford Manufacturing Health Chart Requirements to this document (already required in other Ford STA documentation) 3. Added clarification of Control Plan expectations for sub-tier critical characteristics 4. Updated Level 3 and 5 PPAP Approval Requirements 5. Administrative updates to outdated references and links	February 2025
1. Acceptance of AIAG & VDA Handbook format for DFMEA & PFMEA 2. Added Acceptance Criteria for Heat Treated Components 3. Interim PSW Approval Requirements 4. AIAG APQP Manual 3rd Edition and Control Plan Manual 1st Edition requirement, effective Dec 31, 2024 5. Administrative updates to outdated references and links	September 2024
1. Updated clarification for capability studies with quantity of parts less than 125. 2. Updates for Gauge R&R Requirements 3. Administrative updates to outdated references and links.	May 2023
1. Administrative updates to outdated references and links. 2. Updated process flow chart for PSW submission. 3. Integrated of Service – PPAP First Edition 4. Formatting alignment	October 2020
1. Updates and clarifications from previous revision	June 2013