eAx solutions GmbH Supplier Quality Manual

Contents

1 Introduction

This document called “Supplier Quality Manual” is created by eAx solutions GmbH (called eAx in this document) in Berlin. Contents are related to our business Quality Policy and represents our objectives in relation with our suppliers (called also “Vendors” in this document) who are considered partners in the business.

1.1 Quality Policy

(note: ref. eAx “Quality Policy” document number: PD-00004 rev. 1)

eAx solutions GmbH commits to its mission and vision as follows.

This mission and vision also include the quality policy.

OUR MISSION

We as eAx solutions GmbH are eager to provide sustainable solutions for our customers by developing and industrializing efficient powertrain solutions for vehicles of tomorrow.

Our Vision

Inspiration

Our passionate team navigates towards growth and new perceptions.

Innovation

Our advanced technologies and intelligent production concepts shaping future transportation.

Identification

Our DNA is driven by people believing in their strength to create next generation mobility solutions.

Quality

We as eAx solutions GmbH provide reliable quality. Our quality vision is based on:

- Customer targets are our targets – the customer defines the quality,
- Quality without compromise – reach and exceed customer expectations,
- Quality by robust processes – Quality is integrated in our processes and products,
- Quality by company – Quality starts at the management level and applies to all employee,
- Quality requires continuous improvement,
- Quality is measurable.

Supplier Quality Vision

It is the objective of eAx solutions GmbH to secure the highest quality, cost effective components and materials, consistently delivered on time. To be able to achieve this objective, eAx will build on a long term, close working relationship with suppliers who adopt the eAx philosophy and approach.

The eAx vision is to be the Quality premium brand of choice, the benchmark to which any objectives are set. Ultimate experience by customer expectations of innovation and reliability.

1.2 Purpose & Scope

The Supplier Quality Manual is issued to current and potential suppliers of prototype, production, and service parts for use on eAx Products. The purpose of the Supplier Quality Manual is to ensure that suppliers fully understand and comply with eAx Quality requirements and our commitment to “Quality” including continuous improvement.

This manual represents the minimum requirement expected of suppliers to eAx in the ever more demanding customer and competitive environments. As you work through this manual you will appreciate that each element is linked to others in the process.

1.3 Lessons learned

This section provides eAx approach on Business maturation troubleshooting. Learning on mistakes and problems is part of each activity. Realising that we are putting measures to make sure that processing knowledge is not lost and used in future projects and activities. It is to be more efficient as a business and provides each time better and more reliable solutions for our customers and partners.

1.3.1 Purpose of this process

A lesson learned is a focus area which has been identified and ideally actioned from one project to the next. Whether a positive learning or an opportunity for improvement, the lessons should be captured throughout the project lifecycle to ensure that challenges previously experienced are avoided.

The Lessons Learned are described as:

“Documented experiences that can be used to improve the future management of projects, programmes and portfolios”.

Lessons learned are typically captured in a Lessons Learned database or register so they can be searched and reviewed later. Lessons learned play an important role in continuous process improvement. The process of lessons learned is required to be implemented in the supply chain. eAx currently adapts various lessons learned registers lead by separate departments within the organisation.

1.3.2 Application of the process

Specific project teams should not wait until the end of an activity to carry out a Lessons Learned review, whether informally or formally as the guidelines below indicate. The danger of waiting

until the end to identify, capture and analyse lessons is that most team members will already be focused on the next project.

Setting up a Lessons Learned log during the project start-up will help to establish the process as a core part of project management. Encouraging its use, and regularly reviewing it as part of the risk management process will also make it more meaningful and relevant to the work of the team. Ongoing capture of learnings “as you go” will also make it a lot easier to incorporate Lessons Learned.

Whatever methodology business wishes to adopt to capture Lessons Learned on their project is acceptable, however a tried and tested process is as follows:

1) At a suitable milestone in the project, the Lessons Learned Manager brings together a cross functional team from the business.

2) Ground rules for this event would be as follows:

a. Everyone is entitled to voice their opinion,
b. Respect each other’s opinions,
c. Be open and honest,
d. Do not instil blame/finger-pointing,
e. Identify what could be done better in the future (where possible),
f. Try not to get too involved in the detail.

3) The team is asked to document (on post-it notes) at least 5 lessons which they believe need to be considered for the next phase of the project or entirely new project (these can be both, things that went well or opportunity areas).

a. It is encouraged that where the team member feels comfortable to do so, they add their initials onto the post-it notes to ensure that they receive feedback from their identified lesson,
b. If they have a proposal for how to resolve the challenge experienced, this should also be highlighted on the post-it:
c. Whilst writing up the lessons learned, the team is asked to consider whether the project/phase had the following:
    i. Clear Scope,
    ii. Clear Objectives/Success Measures,
    iii. Clear responsibilities,
    iv. Plans,
    v. Milestones,
    vi. Regular Reviews,
    vii. Correctives actions when deviating from the plan,
    viii. Clear management of change.

4) The post-it notes are then grouped into pre-determined categories on the walls. Suggestions for these categories are as follows:

a. Resources,
b. Skills,
c. Leadership,
d. Planning,

e. Processes,
f. Customer Relationship,
g. Communication,
h. Budget Management,
i. Decision Making,
j. Scope Management,
k. Supplier Management,
l. Risk Management.

5) The Chair (usually Lessons Learned Manager) would then open up discussion on the lessons raised and take one category at a time to discuss as a group how the lesson could be learned for the next project or phase.

6) Following the review, a Project Coordinator where available would document the lessons into the Lessons Learned Register and pass it back to the Lessons Learned Manager.

7) The Lessons Learned Manager (with relevant colleagues) would assess each lesson in turn and validate the action plan for how to address the lesson. If a new process is required, then these would be requested via the QMS for the Operations Team and Quality to assess and prioritise. If the lesson can be actioned immediately by the project team, then this would be done at the earliest opportunity.

8) An Executive summary would be produced for the Senior Management Team, shared and an output would be generated for all team members who were involved in the lessons learned session to understand the plan behind resolving the issue.

2 Supplier selection and nomination

eAx will assess and approve all suppliers of customised and complex products prior to the issuance of a purchase order. All assessed suppliers must be approved by eAx, regardless of approvals by customers or other entities.

2.1 Vendor minimum requirements

The minimum quality requirement for suppliers of products and services to eAx shall be certification to ISO9001 by recognised authority - accredited certification body. This requirement guarantees the supplier has put in place a reliable quality system to satisfy our basic needs.

Potential suppliers shall provide business details through our “self-assessment form”, and any other required information.

2.2 Supplier audits

Where appropriate, suppliers shall be subject to on-site audit and / or site visit by the eAx Supplier Quality Manager in assistance of purchasing team or other members of eAx technical team. In some instances, eAx will be unable to raise a purchase order until supplier approval has been granted. Scheduled verification audits, site visits and business to business meetings shall be supported when required. During special circumstances on-line audits can be considered as alternative. Supplier can be asked to share data and stream live video to prove content of the audit. Audit will be followed by our “vendor audit form” which can be found as appendix to this Quality Manual.

2.3 Continuous improvements

Where applicable and agreed between eAx and vendor continuous improvement plans should be created and followed. It is important that in long relation between businesses mutual goals are set. Improvements are usually considering in process reliability and efficiency.

2.4 Exceptions from nomination requirements

Requirement exceptions for suppliers that do not meet the minimum quality certification shall be authorised based on:

a. The supplier is mandated by our customer.
b. The supplier is the manufacturer of a single sourced product mandated by our customer.
c. The supplier is the only distributor of a product mandated by our customer.
d. The supplier provides products or services that have no direct or indirect effect on the products and services we provide to our customer.
e. Supplier can demonstrate that they will meet and maintain our quality requirements.
f. Supplier can demonstrate he achieves requirements of ISO9001.
g. If ordered material is for 'A Sample' purposes, certification may not be required.

Maturation Level	Phase	Tool Maturation Expectation	Process Maturation Level Expectation
PROTOTYPE	A	1. Prototype part from a rapid tooling source	NONE
		2. Part 80% dimensionally correct minimum	NONE
		3. All features included as per drawing/3d CAD model	NONE
DEVELOPMENT	B	1. Mass production tool	1. Not off final prodcution line
		2. Part 80% dimensionally correct minimum	2. Temporary process sequence
		3. All features included as per drawing/3d CAD model	3. Hand re work allowed under concession
		4. Temporary off standard equipment	4. Engineer/ technicain/ team leader build
			5. Location toolmaker/ supplier(vendor)
DEVELOPMENT	B	1. Mass production tool	1. Not off final prodcution line
		2. Part 100% dimensionally correct minimum	2. Temporary process sequence
		3. All features included as per drawing/3d CAD model	3. Handwork only if in agreed production process or concession
		4. Majority Mass production equipment	4. Engineer/ technicain/ team leader build
		5. Grain applied to tool	5. Location toolmaker/ in house
			6. Grain approval (if applicable)
			7. Gloss approval (if applicable)
Production intent	C	1. Mass production tool	1. Off final production line
		2. Part 100% dimensionally correct minimum	2. Mass production process sequence
		3. All features included as per drawing/3d CAD model	3. Handwork only if in agreed production process or concession
		4. Mass production equipment	4. Team leader/ operator build
		5. Grain applied to tool	5. Location - Supplier/ in house
			6. Mass production quality level verification
			7. Mass production TAKT not achieved
Production intent	C	1. Mass production tool	1. Off final production line
		2. Part 100% dimensionally correct minimum	2. Mass production process sequence
		3. All features included as per drawing/3d CAD model	3. Handwork only if in agreed production process or concession
		4. Mass production equipment	4. Operator build
		5. Grain applied to tool	5. Location - in house
			6. Mass production quality level verification
			7. Mass production TAKT achieved

3 General requirements

This section requirements are required and to be fulfilled by all eAx suppliers in the external supply chain.

3.1 Supplier code of conduct

The supplier shall demonstrate compliance with the minimum standard of business behaviours, health, safety and environmental practices, applicable laws and regulations and act in a way that is ethical and corporately responsible.

3.2 Responsibility, authority and communication

The supplier shall:

a. Define the personnel responsible for product quality (across all production shifts) and ensure that they have the following:
   i. Authority to stop production to correct quality problems,
   ii. Organisational freedom and unrestricted access to top management to resolve quality issues
b. Establish a procedure for task and shift handovers that ensures that all necessary information is communicated (verbally and in written form) between the out-going and in-coming personnel.

3.3 Legal regulation items

This section is to make sure that all legislation and legal requirements are considered by eAx vendors.

3.3.1 Regulatory Parts

You must monitor all parts that are required to meet regulations for all type of approval authorities (FMVSS, EPA, EC, etc.) to ensure their compliance. Regulation and significant features be identified on the Control Plan and other released documents (drawings, specifications, etc.) eAx uses feature categories; these are formally named SC/CC (significant characteristic/critical characteristic) to define the category of the parts and features. The regulation and significant feature categories available are:

1. Safety Relevant – 'Category A' (Regulation feature) (CC) (Severity 9-10)
2. Reliability Relevant – 'Category B' (Significant feature) (SC) (Severity 7-8)
3. Attribute Relevant – 'Category C' (Significant feature) (SC) (Severity 7-8)
4. Legislation Relevant – 'Category L' (Regulation feature) (CC) (Severity 9-10)

Qualifying features will be marked on drawings and / or 3D CAD models with appropriate indicators as defined.
Suppliers must notify eAx of the regulatory and compliance items through the PPAP process. This includes all part marking and type approval features on a component or system.
CCC (China Compulsory Certificate) marking certificates should be sent to eAx as part of the PPAP or upon request.
Unless otherwise stated, all parts must be compliant to all relevant worldwide regulations.

3.3.2 Hazardous Materials

All parts or materials shipped to eAx must be compliant to current environmental and Health & Safety regulations. You must ensure that parts with chemical substances are assessed for hazardous materials and when required, must be labelled and accompanied by a safety data sheet. It is required that for components going into road vehicles IMDS (international Material Database System) is used.

3.3.3 Banned Substances, Recyclability, Recovery and Re-use

All parts or materials (Automotive) shipped to eAx must be free from banned substances, recoverable, reusable and recyclable including those detailed on the following directives:

- Directive 2000/53/EC: The End-of-Life Vehicle (ELV)
- Directive 2011/65/EC: The Restriction of the Use of Certain Hazardous Substances (RoHS)

- Directive 2005/64/EC: Type-approval of motor vehicles with regards to their reusability, recyclability and recoverability (RRR)
- Directive 2006/121/EC: Registration, Evaluation, Authorisation and Restriction of Chemical substances (REACH),
- Any other which may apply.

In order to meet the requirements of the ELV Directives, all suppliers must report 100% of the material composition as well as recycled content of all parts and materials shipped to eAx. From January 2015 RRR-ELV Data is to be submitted via the IMDS portal as part of the PPAP.

3.3.4 IMDS

Submit and get eAx approval for IMDS (https://www.mdsystem.com/imdsnt/startpage/index.jsp) submission prior to Interim Part Approval. The International Material Data System is a global data repository for product content in order to comply with End-of-Life Vehicle Directives.

3.4 Lower Tier requirements

It is required that all eAx vendors will transmit requirements of this Quality Manual to their own supply chain. This transmittal will assure that eAx receives same level of confidentiality on every tier within the supply chain.

3.5 Logistics Requirements

When goods are manufactured it is important to deliver them on time and to prevent any environmental or physical damage. Pre shipped goods are assets which belongs to eAx and it is expected that goods will be delivered undamaged, on time and to specification.

3.5.1 Preservation

It is required that goods are preserved to required standard. In example magnetic material goods get rust in time, usually it is agreed that oil preservation or special VCI packaging is required. It is vendor responsibility to make sure that correct agreements about goods preservation are made with eAx to secure material.

3.5.2 Identification

Delivery identification should consider eAx part number, serial number (if applicabel) and description. Goods should be delivered under PO number and with correct information on our “delivery note document”.

3.5.3 Packaging

If special packaging is required, it will be provided by eAx or it will be created by vendor on eAx cost.

If there is no need for special packaging it is vendor responsibility to ensure that goods are securely prepared for shipping to eAx.

3.5.4 Shipping

Shipping should be agreed with eAx prior of raising PO. If eAx is responsible for transport eAx’s standard logistic provider will be used. On some occasions special shipment can be required.

3.6 Goods Inspection

3.6.1 Purpose

You must have a system in place for monitoring outgoing quality and containing non-conforming material. eAx's expectation is to receive conforming material as per purchase order.

3.6.2 Inspection and Testing

The inspection process should verify that the requirements in the specification are met. All inspection/test points must indicate the result and number of observations made, number and type of defects found (if any) and quantities approved and rejected. You must establish and maintain a system that clearly indicates the status of all material or product from receiving to final inspection.

You may apply for reduction in inspection when historical records indicate no risk of non-conforming material to be produced. This usually is based on SPC (Statistical Process Control) data. You must maintain quality records in sufficient detail to establish justification for the reduction of inspection. You must notify eAx prior to any changes and intention of reduction inspection frequency and you must record changes on Part History form and Control Plan. The Control Plan must be updated and signed by eAx to reflect the changes in part or product processing.

Until sample and/or reduced inspection is agreed, 100% inspection points is required on every sample. To apply for sample and/or reduced inspection volume of sample studies must be agreed with eAx and cannot be below 30 samples. Also, future in-production measurements can be requested to confirm that studies are relevant.

Capability Expectations: Projected Volume	Cpk Safety and Legislation Features	Cpk Non Safety and Legislation Features
<1000 parts	1.33	1.15
>1000 parts	1.67	1.33

3.6.3 Receiving or Incoming Inspection rules

You must ensure that a clear incoming inspection policy exists, monitoring incoming material quality and classifying the inspection regime for all parts received. All incoming inspection and test procedures must be detailed in the Control Plan.

3.6.4 In-process Inspection

You must implement in-process inspection and testing in production areas where key process parameters or product characteristics need to be controlled. All in-process inspection and test procedures must be detailed in the Control Plan. Features not accessible in the finished product assembly condition shall be inspected at the last accessible point in production. Features effected by a sub-sequent manufacturing operation may not be inspected pending approval from eAx's Technical Authority.

3.6.5 Final Inspection

You must implement a final inspection and test process to ensure the finished product meets the dimensional, aesthetic and functional requirements as defined in the Drawing/Specification and the Control Plan. This is usually called EoL (end of the line) testing and contains all important functional and dimensional characteristics. You must ensure that the part or product interface eAx will use is fully conforming with Fit, Form and/or Function rules.

3.6.6 Request for additional inspection

Subject to your agreement, eAx may require additional inspection requirements (temporary or permanent) in response to a particular quality incident or due to an engineering change.

3.6.7 General Recommendations for Inspection

In the following recommendations are provided. However, the supplier is still fully responsible to identify and execute proper inspections. Especially as in some cases, the recommended inspections below could not be sufficient, misleading or having other disadvantages.

3.6.8 Environment Effects

You shall consider the type of environment and conditions in which the part is inspected. You shall ensure that the inspection conditions are optimal in terms of:

- Lighting and illumination
- Observation distance
- Inspection method

These items must be specified on the Control Plan for aesthetically sensitive parts.

3.6.9 Inspection Inconsistency

You shall attempt to eliminate inconsistencies and variability associated with the inspection process. You shall ensure that:

- The inspection criteria are clearly defined,
- The inspection procedure is standardised and documented,
- All inspection personnel are trained and confirmed to the procedure,
- A de-certification / re-certification process is implemented for prolonged periods away from inspection,
- Boundary samples are used where applicable,
- The inspection area is orderly with clear segregation of rejects,
- The inspection area and the inspection method have undergone a complete ergonomic risk assessment.

3.6.10 Inspection Effectiveness

You should regularly review the effectiveness of your inspection process. You should implement a program that monitors customer returns (PPM & Warranty) and inspection audits which then drives improvement into the inspection process.

3.6.11 Non-Conforming Material or Products

You must have a process for controlling non-conforming products. The process must ensure that material or products that are found to be non-conforming are identified, segregated (quarantined), appropriately investigated and/or disposed of. Vendor shall inform eAx about found concerns and if intent to deliver non-conforming product shall raise concession request.

3.6.12 Inspection and Test Records

Inspection and test records, which show clearly whether the product has passed or failed the defined acceptance criteria, are to be maintained.

3.7 Health and safety requirements

Supplier is fully liable and responsible for safe manufacturing and care of employees. It is required that supplier will respect high level code of conduct in relation to people and their health. eAx will be not a part of partnership if in any way human or employment right are violated.

It is required by eAx to communicate and immediately stop processing if any of the products designed by eAx can harm or put anyone in danger.

3.8 Record retention

eAx will require from vendors to record and maintain records for products.

3.8.1 Purpose

You must have a clearly defined document retention policy that satisfies all customer and legal requirements. This policy identifies the retention period of your documents as required by eAx.

3.8.2 eAx Requirements

You must establish a “records retention” policy that complies with the requirements detailed below:

Records retention Document Type	Retention Time	Description
Design Records	Model Life + 15 Yrs	Including all related correspondence drawings, tooling records, selection of safety / special characteristics
PPAP and Part Submission Warrants	Model Life + 15 Yrs	
Change Requests	Model Life + 15 Yrs	
Production Records	Model Life + 15 Yrs	Material / supplier history Production records, control charts, inspection & test results Production Scrap / Reject Notes

Production Permits/Concessions	Model Life + 15 Yrs	
Internal Audit Reports	Model Life + 15 Yrs	Product / Production audit reports Non-conformance reports
Purchase Orders	Model Life + 15 Yrs	PO for sub supplied parts
Calibration Certificates Metrology qualification	3 Years	Results and 'Out of Calibration' Analysis Gauge R&R / MSA studies
Incoming Inspection Reports	1 Year	

These requirements do not supersede any regulatory requirements. All specified retention periods should be considered "minimums".

eAx reserves the right to inspect any records related to parts and services provided. You should maintain a system that will guarantee the safekeeping as in the table. Retrieval of records is expected within 72 hours on request.
In any event where you discontinue business operations, you shall agree to transfer relevant records related to products supplied to eAx.

3.9 Product classification

eAx will state to vendor what kind of component class is requested. There are three (3) main product classes:

A sample – prototype samples – they do not require serial manufacturing requirements stated in this manual. eAx will provide requirement list for this kind of components.

B sample – development parts – they can potentially require APQP and PPAP activities as on some occasions test vehicles will be using components when driven on the road by approved drivers. Legislation, critical and significant characteristics must be considered, risk analysis up to date and continued through DFMEA.

C sample – Serial manufacturing samples – They will require phased approved PPAP and process risk analysis up to date and continued through PFMEA activities.

3.10 Product submission

eAx requires to receive all set of required documentation items and requirements provided on "requirements form" issued with PO. These items shall be provided prior to shipment to eAx to allow SQM and purchasing team to review data and decide on any potential concessions or corrective actions which could be required.

4 Specific product requirements

This section will describe requirements for specific product classes defined earlier in this manual.

4.1 Prototype product requirements (A sample)

Prototype parts are results of design concept. On this phase they will not get into vehicles and do not require all requirements which are necessary when product goes into development or into serial manufacturing.

Minimum requirements for this kind of products are mostly specified in "General requirements (ref: Section 3)" and additionally but not limited to eAx can ask for:

- DV tests (corrosion, mechanical, performance, endurance and similar),
- Dimensional data,
- Prototype manufacturing control plans,
- Process risk matrix,

4.2 Development product requirements (B sample)

These products are going into vehicles and serial manufacturing. This phase is designed to develop product not the process. Biggest requirement on this phase is risk analysis through DFMEA. Boundary diagrams and function diagrams must be provided from A sample and considered in DFEMA. Development phase objectives are to improve product through design but in late stage of the phase DfM (Design for manufacturing) is a key factor to introduce product to serial manufacturing.

Minimum requirements but not limited to for this phase are:

- DFMEA (living documents with frequent engineering team updates),
- Completed boundary diagrams,
- Completed function diagrams,
- Pre-production control plans with characteristics defined in DFMEA,
- DFM activities,
- Defined tools and equipment,
- Draft process flow,
- Defined volumes,
- APQP tracked activities

4.3 Serial manufacturing product requirements (C sample)

Serial manufacturing product requires fully approved and signed PPAP. What PPAP elements are required for this samples will be described by eAx in requirements sheet provided with contract and purchase order. See APQP and PPAP sections for more information related to serial manufacturing products.

4.3.1 Measurement System Analysis (MSA)

The supplier shall:

a. Define the metrological requirements and the metrological function in accordance with ISO10012
b. Ensure that the personnel nominated to perform product verification activities are trained and competent in the use of the monitoring / measuring equipment
c. Ensure that the monitoring / measuring equipment used to perform product verification activities is calibrated and traceable to international or national measurement standards
d. Have personnel available who are trained and competent in measurement systems analysis techniques
e. Validate the measurement system by performing statistical studies related to a representative range of tolerances and features (including tightest tolerance measured) to analyse the variation present in the results of each type of monitoring / measuring and test equipment system. The participants in the study shall be representative of those using the measurement systems on a day-to-day basis
f. Perform product feature specific statistical studies to validate the measurement system where Conformance Control Features have been identified and communicated to the supplier by eAx
g. Monitor and maintain the capability of measurement equipment over time to ensure it performs as initially validated

h. Perform a review of measurement capability when tolerances, personnel or environmental conditions have changed
i. Record the results of statistical studies in a study report to identify how the study was undertaken and the conclusions

4.4

4.5 Catalogue (standard or of shelf) product requirement

Catalogue parts are usually: DIN/ISO products, screws, washers, seals, plugs and similar. For such products it is required to receive CoC (Certificate of conformity) as a minimum. On some occasions eAx can ask for sample measurement data or ask vendor to assure single source of manufacturing and IMDS records.

Items masked with (CC) or (SC) characteristics cannot be considered as catalogue standard parts due to process control requirements and legislation.

5 APQP (development and serial production products)

Advanced Product Quality Planning

5.1 Purpose

eAx recommends the use of APQP as a Quality Project Management process. It enables us to monitor the progress of component supply from initial creation through to production.
eAx uses the SDA (Supplier Development Audit) process to monitor the APQP from conception through to completion. The audit activity is managed solely by the New Product SQA Team and will take place at three key points throughout the project to measure / mitigate risk.

5.2 Overview

A major element of the APQP process is a timing plan which allows us to monitor your production preparation planning against your actual achievement.
We will advise you if we require you to follow the APQP process. If requested, you should create an APQP timing plan for each critical component. However, with our approval, it may be more appropriate to create a simple report if it is limited to a small number of components.
Once created, the timing plan is agreed with eAx and fixed. We will then request that your progress is reported against this on a frequent basis. Gaps to plan should be highlighted to both your senior management team and to your eAx contact as soon as they occur to enable the appropriate activity to mitigate risk.

5.3 Nominated Contacts

eAx will designate one person for each supplier to manage APQP which will be an engineer from the New Model SQA team.
You must nominate one member of staff (typically a project manager) who will be responsible for managing the APQP activity and ensuring that the status is communicated to eAx.

5.4 Process

5.4.1 Kick-Off

It is expected that you start planning activities at the beginning of the development process, filling an eAx APQP timing plan and submit it to eAx for review. If you have your own planning format you can send this provided it contains all the elements in the eAx timing plan.

5.4.2 Timing Plan Guidance Notes

Detailed below are key headings from the APQP timing plan, and an overview of both eAx's and your responsibilities for each section.

5.4.3 Initial Review

An SDA audit (Supplier Development Audit) will be held during the early phase of development where you present the completed timing plan. eAx will review it with you and try to identify and resolve any areas of concern. Once both you and eAx are satisfied, this timing plan is fixed.

5.4.4 Frequent Submission

You must send us the timing plan frequently with the latest status. If a Launch Readiness Review is scheduled the plan will be reviewed at the same time. Either you or eAx may request that a face-to-face meeting is held to get further explanation for certain items, or to resolve any highlighted concerns.

6 PPAP

Production part approval process

6.1 Purpose

To provide the evidence that all customer engineering design record and specification requirements are properly understood by the organization and that the process has the potential to produce product consistently meeting these requirements during an actual production run at the quoted rate.

6.2 Submission Requirements

You must submit a PPAP package to eAx in the following situations:

- B Sample Build, C Sample Build, SoP and post SoP (see table for Maturation Levels),
- Start of production of off-tool / off-process parts,
- Engineering change, i.e. new part number or issue level,
- Change of manufacturing process,
- Change of optional material or construction method,
- Change or additional manufacturing location,
- Tool refurbishment or replacement,
- After prolonged interruption of production (> 2 years),

You are not permitted to ship parts for products onwards until you have a signed PSW from SQM.
PPAP activities follow the guidelines available through AIAG for PPAP, unless otherwise noted within this manual.

6.3 Submission level

The submission level determines what documents and samples are required in the PPAP submission, as shown in the table below.
Generally, submission should be to level 3 wherever possible (PSW level), unless otherwise agreed by eAx. This should be agreed using PPAP Submission Requirements form.

Maturation Level	Phase	Tool Maturation Expectation	Process Maturation Level Expectation
PROTOTYPE	A	1. Prototype part from a rapid tooling source	NONE
		2. Part 80% dimensionally correct minimum	NONE
		3. All features included as per drawing/3d CAD model	NONE
DEVELOPMENT	B	1. Mass production tool	1. Not off final prodcution line
		2. Part 80% dimensionally correct minimum	2. Temporary process sequence
		3. All features included as per drawing/3d CAD model	3. Hand re work allowed under concession
		4. Temporary off standard equipment	4. Engineer/ technicain/ team leader build
			5. Location toolmaker/ supplier(vendor)
DEVELOPMENT	B	1. Mass production tool	1. Not off final prodcution line
		2. Part 100% dimensionally correct minimum	2. Temporary process sequence
		3. All features included as per drawing/3d CAD model	3. Handwork only if in agreed production process or concession
		4. Majority Mass production equipment	4. Engineer/ technicain/ team leader build
		5. Grain applied to tool	5. Location toolmaker/ in house
			6. Grain approval (if applicable)
			7. Gloss approval (if applicable)
Production intent	C	1. Mass production tool	1. Off final production line
		2. Part 100% dimensionally correct minimum	2. Mass production process sequence
		3. All features included as per drawing/3d CAD model	3. Handwork only if in agreed production process or concession
		4. Mass production equipment	4. Team leader/ operator build
		5. Grain applied to tool	5. Location - Supplier/ in house
			6. Mass production quality level verification
			7. Mass production TAKT not achieved
Production intent	C	1. Mass production tool	1. Off final production line
		2. Part 100% dimensionally correct minimum	2. Mass production process sequence
		3. All features included as per drawing/3d CAD model	3. Handwork only if in agreed production process or concession
		4. Mass production equipment	4. Operator build
		5. Grain applied to tool	5. Location - in house
			6. Mass production quality level verification
			7. Mass production TAKT achieved

6.4 Additional conditions

Samples must be manufactured entirely using serial production tooling, process, rate, personnel, location to the Maturation Level required unless otherwise agreed. (see Maturation Levels).
The reason for your submission should be made clear in the documentation, with the Maturation Level.
Where production involves multiple identical tools / cavities / dies, samples are required from each tool, with measurement values and capability given for parts from each tool.
eAx may request examples of dismantled assemblies and measurement reports for sub-components.
eAx may request examples of uncoated parts for dimensional inspection.

6.5 PPAP Sample Submission

6.5.1 Sample Parts ID and Delivery

Sample submissions must always be handled separately from production shipments.
Samples must always be delivered with a separate delivery note. This must be clearly marked “PPAP samples”.
Packaging used for shipment of samples must also be marked with a Trial Parts Submission label.
Sample parts must be individually numbered, in an area that cannot be seen on the finished vehicle, to ensure they can be matched to the correct inspection reports.

6.5.2 Documentation

The basic documentation requirements are shown in the table in RFQ document. When you are ready to submit, you should request a sampling coordination meeting, where the requirements can be agreed in more detail.

You must use the eAx format Part Submission Warrant for PPAP submission. You may use your own document formats for the other sections, provided that all relevant information is present.
You are responsible for all test results and dimensional checks. If you do not have suitable test facilities in-house, you are responsible for arranging testing with an accredited sub-contractor.
Documents may be issued in one of two ways:

a) Uploaded electronically via the eAx shared location data management and file transfer system.
b) If for an exceptional reason the documents cannot be uploaded onto the file location, electronic copies are to be sent via email to the SQM contact.

   Note: Documents to be provided as soon as possible but not less than 5 working days before despatch of parts.

PPAP parts received without paperwork cannot be assessed and will be returned.

6.5.3 Variant / family sample submission

In certain instances, agreed on an individual basis prior to shipment, the sample submission can be based on a similar part. In these cases, the first part will have full documentation, and family or variant parts will have limited documentation identifying the differences from the first part. In each case, the extent of the parts and documentation requirements must be agreed with eAx prior to shipment.

6.5.4 Split Submission

In certain instances, agreed on an individual basis prior to shipment, the sample submission can be split into two stages, as follows:

a) Stage 1: Samples manufactured in serial conditions, with initial test results, which have not been proven to meet all requirements, where long-term tests are being started; then:
b) Stage 2: Submission of missing test results.

A QN (Quality Notification) to supply parts may be applied (raised) for at stage 1 with approval submission at stage 2.

6.6 eAx Response

Trial Build/Volume shipments of production parts must not start until a PSW has been approved and returned by eAx SQM and if appropriate a concession request has been approved by eAx SQM.
PPAP approval will be assigned one of three levels:

6.6.1 Full Approval (Green)

Samples are approved and trial build/volume shipments may start.

6.6.2 Conditional Approval (Yellow)

Samples are temporarily approved, and trial build/volume shipments may start.
Reasons for issuing conditional approval include:

- Incomplete paperwork
- Incomplete testing, where initial testing has given enough confidence for conditional approval.

- Non-critical specifications have not been met, but a plan has been set up to meet these specifications.
- Appearance of the part needs further improvement, but they are temporarily acceptable.
- Production tools and methods have not been used for all operations.
- Parts Maturation is not at production level.

A close out plan shall be provided to eAx with a defined close out date. That plan may be covered by potentially raised Quality Notification which refer to conditionally approved Part Submission Warrant.

You must resubmit PPAP once the relevant items have been corrected.

6.6.3 Rejected (Red)

Samples are not accepted and trial build/volume shipments may not start. You **must** re-manufacture or rework parts and resubmit PPAP.

7 Concession process

It is eAx policy not to accept parts that do not meet the requirements of applicable drawings and specifications. However, Concessions may be granted for time-limited or quantity-limited deviations.
You may request a Concession by submitting a Concession request form to eAx at least two days prior to the scheduled shipment. eAx expects you to use the Concession request form at the end of this guide. The Concession form must contain:

- Details of the deviation.
- The quantity of parts and serial numbers (if applicable) the concession will cover.
- The reason for the Concession request.
- How the concessed parts will be identified.
- The corrective action proposed.
- The potential effect to eAx if the Concession is not granted.

In certain cases, eAx may request a formal report.
The Concession form must be submitted and approved prior to the shipment of parts. Any parts shipped under an approved Concession must contain a copy of the signed Concession form. If the Concession is denied, you must not ship parts covered by the request.
The above applies equally to sub-components: eAx must agree to any requests for Concessions from sub-suppliers.
The process below details the stages and responsibilities of the Concession process.

8 Non-conformity of the product

Suppliers shall maintain a documented process which specifies how non-conforming product is identified, quarantined, and reacted to.

For non-conforming products supplied to eAx, including those that reach a eAx customer, the Supplier must endeavour to implement containment and corrective actions in as short a time as possible and is liable for all costs to correct the non-conformance.

eAx will inform the supplier of non-conforming product that is highlighted at any stage of eAx's process flow including, but not limited to, goods inwards inspection, manufacturing or assembly use, engine testing and subsequent use in service.

eAx will formally notify the supplier of a non-conformance by issuing a report. eAx Supplier Quality Manager will determine if a full respond report is required from the Supplier in response to the non-conformance and communicate this requirement directly to the Supplier. When raised, the Supplier will address the following through the report:

- Problem statement
- Containment Action across the full supply chain
- Root Cause of Escape Analysis
- Root Cause Problem Analysis
- Identification and implementation of Corrective Action
- Definition and implementation of Preventive action reports shall be processed to the following timescales by the supplier:
- Supplier has 48 hours to acknowledge receipt and respond with the outcome of containment action.
- Supplier has 21 calendar days to respond with a detailed corrective action,
- Supplier has 28 calendar days to respond with the 8D completed in full.
- Supplier will submit on or before the agreed verification date, evidence of the implemented corrective/preventive action. This evidence will allow the eAx Supplier Quality Manager to close the non-conformance report.

Records of supplied non-conforming product are retained by eAx and considered by eAx during supplier evaluation exercises.

Supplier Request for Non-conformance – Concession

A Supplier shall not knowingly ship product that deviates from the drawing, specification limits, or design intent without prior written authorisation from eAx. If such a condition exists, the Supplier may submit a request to the eAx Supplier Quality contact, in writing, to allow shipment of the product with an approved Concession. This must include the proposed corrective action to eliminate the cause and prevent recurrence.

It is the responsibility of the Supplier to submit written request for Concession using the eAx Concession form to the eAx Supplier Quality Engineer, no later than 48 hours before the delivery due date. It remains the responsibility of the supplier to ensure product is delivered on time to the purchase order schedule regardless of the outcome of any submitted Concession request.

The cost of shipping, inspection, and testing to determine the potential acceptability of product subject to a Concession request will be charged to the Supplier. eAx's approval of a deviation/Concession is specific to the products for which it has been submitted and approved and shall not to be construed as a permanent engineering change.

The Supplier must begin work immediately on corrective action. In all cases, the Supplier shall fully contain all product suspected of being non-conforming. In addition, non-conforming product may be returned to the Supplier at Supplier expense, or the Supplier may be required to sort any suspect product already shipped to eAx or be charged back for the cost of sorting by eAx.

Any parts shipped to eAx that have been approved for deviation/Concession shall be clearly identified as such externally on the box, container, or other packaging and on shipping documentation. Inside of each box shall contain a copy of the approved Concession document.

Product accepted under Concession will be recorded as such at eAx goods receiving inspection. These records are retained and considered by eAx during supplier evaluation exercises.

Prior to PPAP sign off, if product supplied under eAx approved Concession is subsequently found to be unfit for use during prototype manufacture, assembly or testing at eAx, the product may be returned to the supplier for further investigation. A replacement part may be required at a cost and timescale agreed by both parties. This will not affect the supplier's quality rating.

Control of Salvaged/Repaired Product
Salvage/repair is defined as additional operation that is not part of the PPAP approved production process flow, which is undertaken to bring a non-conforming product into an acceptable technical condition but not back to the initial drawing intent/requirements.

Instructions for salvage/repair, including re-inspection requirements, shall be approved by eAx prior to the Supplier performing the salvage/repair. All salvage/repair operations shall be documented via Concession and must be approved by eAx's Supplier Quality Manager prior to product being shipped to eAx, in line with the requirements detailed above.

9 Product and process Maturation

9.1 Purpose

Part maturation (part maturity) level serves two purposes:
1. For eAx to communicate the requirement for both tooling and process maturity at each build phase throughout a project's lifecycle.

2. For suppliers to confirm to eAx, their expectation of actual tool and process maturity for any given build phase.

9.2 Matrix

Maturation Level	Phase	Tool Maturation Expectation	Process Maturation Level Expectation
PROTOTYPE	A	1. Prototype part from a rapid tooling source	NONE
		2. Part 80% dimensionally correct minimum	NONE
		3. All features included as per drawing/3d CAD model	NONE
DEVELOPMENT	B	1. Mass production tool	1. Not off final prodcution line
		2. Part 80% dimensionally correct minimum	2. Temporary process sequence
		3. All features included as per drawing/3d CAD model	3. Hand re work allowed under concession
		4. Temporary off standard equipment	4. Engineer/ technicain/ team leader build
			5. Location toolmaker/ supplier(vendor)
DEVELOPMENT	B	1. Mass production tool	1. Not off final prodcution line
		2. Part 100% dimensionally correct minimum	2. Temporary process sequence
		3. All features included as per drawing/3d CAD model	3. Handwork only if in agreed production process or concession
		4. Majority Mass production equipment	4. Engineer/ technicain/ team leader build
		5. Grain applied to tool	5. Location toolmaker/ in house
			6. Grain approval (if applicable)
			7. Gloss approval (if applicable)
Production intent	C	1. Mass production tool	1. Off final production line
		2. Part 100% dimensionally correct minimum	2. Mass production process sequence
		3. All features included as per drawing/3d CAD model	3. Handwork only if in agreed production process or concession
		4. Mass production equipment	4. Team leader/ operator build
		5. Grain applied to tool	5. Location - Supplier/ in house
			6. Mass production quality level verification
			7. Mass production TAKT not achieved
Production intent	C	1. Mass production tool	1. Off final production line
		2. Part 100% dimensionally correct minimum	2. Mass production process sequence
		3. All features included as per drawing/3d CAD model	3. Handwork only if in agreed production process or concession
		4. Mass production equipment	4. Operator build
		5. Grain applied to tool	5. Location - in house
			6. Mass production quality level verification
			7. Mass production TAKT achieved

9.3 Expectations

Each build phase has a minimum requirement for part maturity in line with the testing requirements.

Any deviations from this must be agreed with eAx SQA and Engineering prior to order placement.

9.4 Application

At the point of generating APQP plans to support a project the Part Maturation Level should be defined. If this information is based upon a theoretical release date of the data from eAx it should be fully confirmed once this information is available.

The parts maturation level should be confirmed on the PSW prior to submission.

10 Definitions & acronyms

Acronyms and Glossary of Terms
There are several Acronyms used within eAx both standard within Automotive and some specific to the organisation. This glossary will evolve over time. Those which have been identified with their definitions are as follows:

10.1 A

AC – Alternating Current
An electric current that reverses its direction many times a second at regular intervals, typically used in power supplies.

ACB – Angular Contact (Single Row) Bearing

AIAG – Automotive Industry Action Group
The Automotive Industry Action Group (AIAG) is a not-for-profit organisation where OEMs, suppliers, service providers, government entities, and individuals in academia have worked to drive down costs and complexity from the automotive supply chain

APM – Association for Project Management
The chartered body for Project Management

APQP – Advanced Product Quality Planning
IATF Definition: Product quality planning process that supports development of a product or service that will satisfy customer requirements' APQP serves as a guide in the development process and also a standard way to share results between organisations and their customers; APQP covers design robustness, design testing and specification compliance, production process design, quality inspection standards, process capability, production capacity, product packaging, product testing and operator training plan, among other items

ASIL – Automotive Safety Integrity Level
Automotive Safety Integrity Level (ASIL) is a risk classification scheme defined by the ISO 26262 - Functional Safety for Road Vehicles standard

AWD – All Wheel Drive

10.2 B

BAU – Business as Usual
An organisation's normal day-to-day operations

BCA – Build Corrective Action
Documentation of an action required by the build team to resolve an issue. Documentation usually provided by Engineering and largely within Prototype build phases

BEV – Battery Electric Vehicle
A battery electric vehicle *(*BEV*), pure* electric vehicle*, only*-electric vehicle *or all*-electric vehicle *is a type of* electric vehicle *(EV) that uses chemical energy stored in rechargeable* battery *packs. BEVs use* electric *motors and motor controllers instead of internal combustion engines (ICEs) for propulsion.*

BCR - Build Concern Report

BoM – Bill of Materials
A bill of materials or product structure is a list of the raw materials, sub-assemblies, intermediate assemblies, sub-components, parts, and the quantities of each needed to manufacture an end product

10.3 C

CAE – Computer Aided Engineering
Computer-aided engineering (CAE) is the broad usage of computer software to aid in engineering analysis tasks. It includes finite element analysis (FEA), computational fluid dynamics (CFD), multibody dynamics (MBD), durability and optimisation

CAD – Computer Aided Design
CAD*, or computer-aided design, is technology for design and technical documentation, which replaces manual drafting with an automated process*

CCAR – Concerns and Corrective Action Register
Concerns and Corrective Action Register is a document used to record an issue, its containment and corrective action. It is used as a response to a defect. In simple words, it means an action/actions adopted to eliminate the problem from occurring again. A corrective action should address the root cause of the issue and provide a permanent fix

CDB – CIM Database
eAx PLM system developed by the Company Contact

CCW – Counter Clock Wise
In the opposite direction to the way in which the hands of a clock move round; anticlockwise.

CET – Cold Environment Testing
Cold Environmental testing is carried out to meet cold start drivability and environmental testing requirements for vehicles and components

CoF – Coefficient of Friction
A coefficient of friction is a value that shows the relationship between two objects and the normal reaction between the objects that are involved. The coefficient of friction is dimensionless and it does not have any unit. It is a scalar, meaning the direction of the force does not affect the physical quantity.

CRB – Cylindrical Roller Bearing
CRB's are bearing in which cylinders are used as the rolling elements as opposed to balls in ball bearings. As such, the rollers have a greater (linear) contact area with the outer ring and are distribute loads across a broader surface.

CSC – Concentric Slave Cylinder
The CSC is a hydraulic cylinder with an integrated release bearing which eliminates the clutch lever and the conventional release bearing. It is connected to the master cylinder via the hose. The CSC is in direct contact with the clutch cover diaphragm, increasing the efficiency of the hydraulic system.

CUV – Cross-over Utility Vehicle
A CUV — also called crossover *— is a type of* vehicle *with unibody construction.* CUV's *are often based on a platform shared with a passenger* car*; as a result they typically have better interior comfort, a more compliant ride, and superior fuel economy, but less off-road capability than truck-based SUVs.*

CW – Clock Wise
In a curve corresponding in direction to the typical forward movement of the hands of a clock

10.4 D

DfA – Design for Assembly
IATF Definition: Process by which products are designed with ease of assembly considerations (e.g. if a product contains fewer parts it will take less time to assemble, thereby reducing assembly costs)

DfM – Design for Manufacturing
IATF Definition: Integration of product design and process planning to design a product that is easily and economically manufactured

DFMEA – Design Failure Mode Effect Analysis
See FMEA

DfSS – Design for Six Sigma
IATF Definition: Systematic methodology, tools and techniques with the aim of being a robust design of products or processes that meets customer expectations and can be produced at a six-sigma quality level

DC – Direct Current
DC is used in reference to voltage whose polarity never reverses.

DCNB – Drawn Cup Needle Bearing
Drawn cup needle roller bearings are complete bearing units consisting of a thin-walled, drawn outer cup and a needle roller, available in full complement or cage assembly.

DGBB – Deep Groove Ball Bearing
The Single Row radial ball bearing has a single row of balls and can handle radial and thrust loads.

DRAC – Double Row Angular Contact Bearing
The raceways of the inner and outer ring of angular contact ball bearings, shifted against each other, were designed for bearings which have to bear combined loads in the axial and radial direction. In comparison to a single row angular contact type, the double row enables axial loads can be applied in one direction only. For this reason, a second opposing bearing must always be used.

DV – Design Validation
Validation of a design through testing, whether through analysis, on a rig or in a vehicle

DVP – Design Validation Plan
The Design Verification Plan is a tool that documents the plan that will be used to confirm that a product, system or component meets its design specifications and performance requirements

10.5 E

ECR – Engineering Change Request
An engineering change request (ECR) is used to describe a problem and suggested technical enhancement to a component or system. An ECR form initiates the change process. Upon a Production design release being made, all changes must go through formal change management

EDS – Electric Drive System (may also mean Electrical Distribution System)
Motor and inverter part of the EDU

EDT – Enhanced Durability

EDU – Electric Drive Unit
Electric unit to drive the axle – includes motor, inverter and transmission

EM – Electric Motor
An electric motor is an electrical machine that converts electrical energy into mechanical energy.

EPCR – External Project Change Request
For any change to work scope, whether additional cost is being charged to the customer or not, an ePCR documents the request which has been received and is a log of any change to the original contract. If the change does incur cost, then the ePCR provides a breakdown with the invoice schedule associated. The customer should issue a PO once the ePCR is signed, but the ePCR itself if enough to invoice against

ERP – Enterprise Resource Planning
Enterprise resource planning (ERP) is business process management software that allows an organisation to use a system of integrated applications to manage the business and automate many administrative functions

ESO – Engineering Sign Off
Technical sign off for drawings/ technical documents and reports. Final Engineering Sign Off is the authority for the product to be handed from Engineering to Manufacturing

ETRS – Engineering Time Release Schedule
Document to track the release of parts (drawing and procurement) to achieve stock in plant dates to support build

ELV – END of LIFE VEHICLE

EC - European Commission

EPA - Environmental Protection Agency

10.6 F

FiT – Failure in Time
The term FIT (failure in time) is defined as a failure rate of 1 per billion hours. A component having a failure rate of 1 FIT is equivalent to having an MTBF of 1 billion hours.

FMEA – Failure Mode and Effects Analysis
AIAG Definition: Failure Mode and Effects Analysis (FMEA) FMEA is an analytical methodology used to ensure that potential problems have been considered and addressed throughout the product and process development process. Part of the evaluation and analysis is the assessment of risk. The important point is that a discussion is conducted regarding the design (product or process), review of the functions and any changes in application, and the resulting risk of potential failure Developed with a global team of OEM and Tier 1 supplier subject matter experts, there is now a harmonised VDA and AIAG approach to FMEAs within the industry – this is industry standard

FTA – Fault Tree Analysis

IATF Definition: Deductive failure analysis methodology in which an undesired state of a system is analysed; fault tress analysis maps the relationship between faults, subsystems, and redundant design elements by creating a logic diagram of the overall system

FMVSS - *Federal Motor Vehicle Safety Standards*

10.7 G

GD&T – Geometric Dimensioning and Tolerancing
GD&T is a precise language of engineering symbols that clearly communicate the design intent of the part. The result is an improvement in communication and part quality

GR – Goods Receipt
Upon parts being received into stores, they are checked against original purchase order, inspected and goods receipted into the business to trigger the invoice to the supplier

GVM – Gross Vehicle Mass
Maximum operating mass of a vehicle as specified by the manufacturer

GVW – Gross Vehicle Weight
Maximum operating weight of a vehicle as specified by the manufacturer

10.8 H

HARA – Hazard Assessment Risk Analysis
At the concept phase of ISO 26262 is the Hazard Assessment Risk Analysis. This process provides an automotive specific risk-based approach for determining risk classes. Potential hazards are identified and categorised and safety goals related to the prevention or mitigation of these potential hazards are formulated

HCU – Hydraulic Control Unit
The Hydraulic Control Unit generates and regulates hydraulic pressure

HDA – Hybrid Drive Assembly
The same as HTM.

HET – Hot Environment Testing
Hot Environmental testing is carried out to meet hot start drivability and environmental testing requirements for vehicles and components

HEV – Hybrid Electric Vehicle
A hybrid electric vehicle is a type of hybrid vehicle that combines a conventional internal combustion engine system with an electric propulsion system.

HIL – Hardware in the Loop
Hardware-in-the-loop simulation, or HWIL, is a technique that is used in the development and test of complex real-time embedded systems. HIL simulation provides an effective platform by adding the complexity of the plant under control to the test platform

HSD – High Speed Durability
High performance vehicle circuit durability *testing, often carried out using Nürburgring duty cycle or on other high-speed proving grounds*

HTM – Hybrid Transmission Module
The hybrid transmission module enables electrification of a standard automotive transmission and contains the electrical motor.

HV – High Voltage
For automotive high voltage is usually considered any voltage above 60V.

10.9 I

IC – Inner Clutch
On a nested design of dual clutch, the smaller diameter clutch pack.

ICE – Internal Combustion Engine
An internal combustion engine is a heat engine in which the combustion of a fuel occurs with an oxidiser in a combustion chamber that is an integral part of the working fluid flow circuit

ID – Inner Diameter
The dimension internal to the component i.e. bearing or shaft.

IPVR – Internal Project Variation Request
For any overspend outside of the project budget, an iPVR must be submitted to the business to agree the overspend ahead of a Purchase Order being generated. It can also be used to document scope creep, regardless of whether there is a cost associated, it provides details of the contractual variance and can be used to update the formal contract with the customer

IR – Inner Ring
The inner component of a bearing

ISIR – Initial Sample Inspection Report
Initial Sampling Inspection Report is a report about the VDA-specific procedure to release first samples, produced under serial conditions

IMDS - international Material Database System
https://www.mdsystem.com/imdsnt/startpage/index.jsp

10.10 K

K0 – Clutch Zero
Designation of a clutch between ICE and P2 EM in a hybrid vehicle layout.

K1 – Clutch One
Designation of a clutch in a dual clutch transmission between ICE/EM and Transmission.

K2 – Clutch Two
Designation of a clutch in a dual clutch transmission between ICE/EM and Transmission.

KO – Kick Off
At the beginning of a project and at the beginning of each subsequent phase within a project, a Kick Off should be held by Programme Management to bring the project team together to outline the project's objectives, deliverables, team structure and governance. The Project Management Plan (PMP) should be the leading document for this review

10.11 L

LH – Left **H**and

Definition of a direction for a thread whose helix moves upward when the screw is inserted vertically from above in a fixed mating thread and turned clockwise. Also applies to helical gears.

LIC – Latest Indicated Cost
Based on cost breakdown of parts, formed both by formal quotation and estimate, the latest indicated cost provides the most up to date measure of piece price and tooling cost information

LOP – List of Open Points
This is a document used to capture all open actions across a programme, it should also capture the owner and date that the action is due to complete

LV – Low Voltage
For automotive low voltage is usually considered any voltage below 60V

10.12 M

MRD – Material Requirement Date
The date in which parts are required in plant in order to achieve build requirements

MSP – Microsoft Project
Planning software largely used by Programme to determine the project plan, interdependencies and resource loading

10.13 N

N/A – Not Applicable
It is used to indicate when information in a certain table cell is not provided, either because it does not apply to a particular case in question

NB – Needle Bearing
A needle roller bearing is a special type of roller bearing which uses long, thin cylindrical rollers resembling needles. This type of bearing cannot react an axial/thrust load.

NPI – New Product Introduction
The way in which a new product is developed, within eAx this is governed via the PEP process

NVH – Noise, Vibration and Harshness
Largely objective but some subjective measures for assessing noise, vibration and harshness, either at a component level, system level or full vehicle level

10.14 O

OBS – Organisational Breakdown Structure
Organisation is the management structure applicable to the project, programme or portfolio and the organisational environment in which it operates. The structure details who reports to whom, the details of the hierarchy and the reporting structure.

OC – Outer Clutch
On a nested design of dual clutch, the larger diameter clutch pack.

OD – Outer Diameter
The dimension external to the component i.e. bearing or shaft.

OR – Outer Ring
The outer component of a bearing.

10.15 P

PCD – Pitch Circle Diameter
Pitch Circle Diameter may refer to: The effective distance between the gears of a gearset; The bolt pattern of a wheel; The bolt circle on a flange etc.

PCR – Project Change Request
See EPCR

PVR –Project Variation Request
See IPVR

PEP – Product Execution/Enhancement Process
APQP term for defining the new product introduction process. In the case of eAx, it is the full serial production lifecycle from initial lead through to start of production and all of the gateways and milestones which govern this process

PFMEA – Process Failure Mode Effect Analysis
See FMEA

PLM – Product Lifecycle Management

PMP – Project Management Plan
APM Definition: A project management plan is a collection of baselines and subsidiary plans that include: Baselines for scope, schedule, and cost. Management plans for scope, schedule, cost, quality, human resources, communications, risk, and procurement

PO – Purchase Order
A purchase order (PO) is a commercial document and first official offer issued by a buyer to a seller indicating types, quantities, and agreed prices for products or services. It is used to control the purchasing of products and services from external suppliers and should be preceded by a Purchase Requisition which is the authorisation to the Purchasing department to raise the Purchase Order

PP – Pilot Production
Production line set up usually during engineering or manufacturing development, to test new methods, processes, and systems.

PPAP - Production Part Approval Process
AIAG Definition: Production Part Approval Process (PPAP) is the industry standard that ensures engineering design and product specification requirements are met. Through the PPAP guideline, suppliers and customers understand the requirements to obtain part approval of supplier manufactured parts. Applicable to all parts and commodities, application of these principles reduces delays and non-conformances during part approval

PR – Purchase Requisition

Precedes a Purchase Order and is the document used to authorise Purchasing to raise a Purchase Order. It is approved by the budget holder/s ahead of a PO being raised

PSW – Part Submission Warranty
A procedure by which the supplier of a part or subsystem gives evidence to the customer that he is able to satisfy the requirements of Delivery date, Quality, Process Capability and Production Rate

PV – Product Validation
The final step prior to going to full production is to perform the design verification tests on a sample for the pre-production lot. This validates that using the production equipment, tooling, and material provides a product that meets the design specification and durability targets

PVP – Product Validation Plan
The plan which governs product validation and documents what testing is required

Q

QMS – Quality Management System
A quality management system (QMS) is a set of policies, processes and procedures required for planning and execution (production/development/service) in the core business area of an organisation (i.e., areas that can impact the organisation's ability to meet customer requirements)

10.16 R

RASIC – Responsible, Approve, Support, Inform, Consult
RASIC (responsible, approves, supports, is informed, is consulted) is a tool or document used to establish the roles of key resources for activities related to a project **RfI –** Request for Information
RFI responses explore how a vendor might solve a problem or fill a requirement

RFoB – Rear Face of Block
Defines the mounting interface position of an ICE

RfQ - Request for Quotation
RFQ responses provide the cost of meeting a specific need

RH – Right Hand
A screw thread whose helix moves downward when the screw is inserted vertically from above in a fixed mating thread and turned clockwise. Also applies to helical gear geometry

RRR - reusability, recyclability and recoverability

REACH - Registration, Evaluation, Authorisation and Restriction of Chemicals

10.17 S

SiP - Stock in Plant
Parts physically delivered to stores to support build activity

SoC – State of Charge

State of charge (SoC) is the level of charge of an electric battery relative to its capacity

SoP – Start of Production

10.18 T

TM – Transmission
Also known as gearbox. Provides torque / speed multiplication / reduction from the input to the output.

TPM – Total Productive Maintenance
IATF Definition: A system of maintaining and improving the integrity of production and quality systems through machines, equipment, processes, and employees that add value to the organisation

TPMLM – Technically Permissible Maximum Laden Mass
The maximum laden mass of the vehicle including any trailer being towed

TRB – Taper Roller Bearing
Tapered roller bearings are rolling element bearings that can support axial forces (i.e., they are good thrust bearings) as well as radial forces. **TT –** Tooling Trial
Verifies that all tooling processes work

10.19 V

VDA – Verband der Automobilindustrie
The German Association of the Automotive Industry or VDA is a German interest group of the German automobile industry, both automobile manufactures and automobile component suppliers

VP – Validation Prototype
Final Prototype build for validation purposes

VCI - https://en.wikipedia.org/wiki/Volatile_corrosion_inhibitor

10.20 W

WOT – Wide Open Throttle
100% demand

WBS – Work Breakdown Structure
A WBS shows the work required to create the products/ elements of a project plan. It can be used as a way of defining the project scope and tasks required to achieve the deliverables

10.21 0-9

8D
Eight disciplines (8Ds) problem solving is a method developed at Ford Motor Company used to approach and to resolve problems. Focused on product and process improvement, its purpose

is to identify, correct, and eliminate recurring problems. It establishes a permanent corrective action based on statistical analysis of the problem and on the origin of the problem by determining the root causes