Quality lasts when we put it first. Every day in the Volvo Group, we are relentlessly working to improve our processes, products and competences to be best in class in our industry. Equally important is the spirit of true commitment to quality excellence, having a customer-focused approach at heart and a continuous improvement mindset. This is where you as our supplier and business partner come into the picture. We expect and encourage you to adopt the same principles, practices and mindset. Both today, with your unbeatable knowledge of well-known technologies, and your competitive curiosity for tomorrow’s innovations.

Quality lies in everything we do. You are selected to deliver the right products and/or services in terms of Quality, Delivery, Cost, Features, Technology, Sustainability, and Risk Management, known as our “QDCFTSR”. But it is beyond all checklists that we can truly create value for the Volvo Group and be capable of delivering exceptional performance for our customers – now and in the future.

This manual describes the expectations, requirements, formal guidelines and practices expected of you as our supplier for Volvo Trucks, Mack Trucks, Renault Trucks, UD Trucks, Eicher Trucks, Volvo Bus, Nova Bus, Prevost Bus, Volvo Construction Equipment, and Volvo Penta. With this as our common ground, we can develop and maintain a strong, stable, structured, long-term and successful partnership where we proactively and predictively secure zero defects, zero delays and zero waste together.

INTRODUCTION
DELIVERING EXCEPTIONAL PERFORMANCE
FOR OUR CUSTOMERS

ANDREA FUDER
CHIEF PURCHASING OFFICER, VOLVO GROUP
Using this document

1. Safety management
2. Basic requirements
3. Sourcing
4. APQP
5. PPAP
6. Volvo Group specific requirements
7. Production requirements
8. Performance measurements and corrective actions

Organization
This document defines the expectations and working procedures intended to assist suppliers in achieving and maintaining a successful working business relationship with the Volvo Group. This document is organized in eight chapters explaining our main processes.

Key Element Procedures
In addition to this Supplier Quality Assurance Manual, Volvo Group maintains a set of procedures that define specific requirements and expectations in key areas. These Key Element Procedures cover Volvo Group requirements related to the environment, corporate social responsibility, logistics and cost management. The Key Element Procedures are available on the Volvo Group Supplier Portal. Always contact the Volvo Group Buyer or Supplier Quality Engineer* if you have questions related to our procedures and requirements.

* At Volvo Construction Equipment the Supplier Quality Engineers (SQE) is called Supplier Development Engineers (SDE).

Scope
This Supplier Quality Assurance Manual is a joint document recognized and used by the following organizations: Volvo Trucks, Mack Trucks, Renault Trucks, UD Trucks, Eicher Trucks, Volvo Bus, Nova Bus, Prevost Bus, Volvo Construction Equipment and Volvo Penta. Nova Bus and Prevost Bus may be referred to as Volvo Bus North America (VBNA).

To simplify the text in this document, the name Volvo Group refers to this collective group of companies. The word Vehicle may refer to both trucks and buses.

Volvo Group Supplier Portal
Volvo Group Supplier Portal is the web entry point on www.volvogroup.com/suppliers, which enables collaboration between Volvo Group and its suppliers as well as business partners. The portal allows suppliers to access all relevant documents and news needed to collaborate efficiently. Suppliers are responsible for applying for access to Volvo Group Supplier Portal by contacting the Buyer or cmsservices@volvo.com.

Mandatory requirements are highlighted in this format

Text in frame boxes like this provide an overview of the information in the section and may be used as a quick reference.
Suppliers are required to maintain the contact details for key individuals and business information for their organization. To ensure timely and accurate information, authorized suppliers are responsible for maintaining the supplier’s information on Volvo Group Supplier Portal and have the ability to grant access. An authorized supplier contact can add, edit, delete and manage their own employee’s access rights to our system and applications when organizational changes occur.

It is recommended to review the contact information at least every six months. This will help to ensure the effective exchange of important information.

Additional guidelines, communication kits, and templates are posted in the Quality section of the Library on the Volvo Group Supplier Portal. The latest version of this Supplier Quality Assurance Manual is also available there.

**Supplier feedback**

We welcome and encourage feedback concerning this document. Any suggestions, including suggestions for adding additional information or improvements to this document, should be e-mailed to sqam@volvo.com

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1. **SAFETY MANAGEMENT**

PROTECTING THE CUSTOMER

From the founding of Volvo in the 1920’s, quality and safety have been core values of the corporation. Since that time, the commitment to the research and development of new and often unique safety solutions has made the Volvo name synonymous with safety around the world.

Today, Quality, Safety and Care for the Environment continue to be the core values of the Volvo brands and form a foundation for all business practices including the cooperation between the Volvo Group and our suppliers.

The Volvo Group definition of safety not only includes the safety of the immediate user of our products, but also understanding the entire scope of potential impact of our products on society.

The primary objective is to develop products that assist in preventing accidents from occurring or, in the event an accident
1. Safety management

Safety management applies to a part, function or feature when a non-conformance related to the product would create a safety hazard.

1.1 Definition

Safety requirements are determined based on the potential of a feature, product or system to create a personal hazard to any person in contact with the products or effects caused by the product. A Safety Customer Effect is considered when a danger can lead to injuries to vehicle operators, passengers, other travelers, passers-by or maintenance personnel. Suppliers of a safety critical part are categorized as a Safety Part Supplier.

Historically, Volvo Group defined safety critical parts by the feature of the part. Recently, Volvo Group defines a new classification of safety parts based on the use, function or application of the part. There is no single feature or characteristic of the part that defines the part as safety critical, rather the safety critical designation relates to the safe reliable function of the part itself. These parts shall meet all the requirements of a safety critical part with the exception of the requirement to maintain capability of a specific feature.

Suppliers of parts on the list of safety parts will be notified by the presence of a check box on the Part Version Report (PVR) or by notification from the Supplier Quality Engineer (SQE) assigned for the component.

Safety Critical related features are designated by the presence of the symbol [CC] or [1] next to the feature on the drawing or in a specification. If any feature of a part is considered safety critical, the part is considered to be a safety critical part. All of the activities related to safety management are required if any feature of a part is identified as having an impact on safety, and the part is considered safety critical.

1.2 Responsibility

The production of safe, fully conforming products to the Volvo Group companies is the supplier’s responsibility and is part of the supplier’s contractual commitment. Any assistance provided by Volvo Group does not in any way limit the supplier’s responsibility to supply parts that conform to all technical specifications and standards, as well as regulatory, contractual and legal demands.

Suppliers are required to conduct a criticality analysis for features of the product design and production process that could result in a safety effect. For suppliers having design responsibility, special characteristics related to safety must be clearly identified within their design specifications, verification/validation plans, drawings and technical documentation. Suppliers who are design responsible for products impacting safety are required to develop System, Sub-System, Design and Process Failure Modes Effects Analysis to assist in the analysis.

Volvo Group must be notified of any product features or functions where the potential failure mode and associated customer safety effect are assigned a high severity score (9 or 10). (Severity for any features identified by Volvo Group with a [CC] or [1] must have a severity score of a 9 or 10 on the supplier’s FMEA.)

Suppliers are responsible to ensure that all sub-suppliers and contractors are aware of and comply with the requirements related to safety requirements. Tier I suppliers must have procedures and practices to ensure an adequate level of control and requirements are deployed at all suppliers or sub-suppliers whose product or processes could have an effect on safety related features.

VOLVO GROUP MUST BE NOTIFIED IMMEDIATELY IN THE EVENT A NON-CONFORMANCE OR POTENTIAL CUSTOMER RISK IS IDENTIFIED
1.3 Identification of safety characteristics

A safety critical characteristic is identified when non-compliance with the requirement has the potential to lead to a Customer Safety effect.

A new Volvo Group standard for identifying and grading critical characteristics, STD 105-0007 "Special Characteristics Definition and Application" has been released and is effective for all Volvo Group drawings, functional requirements and Technical Requirements. Drawings, Functional Requirements or Technical Requirements developed before 1 Sept 2015 may follow Volvo Group standard STD 105-0001 “Critical Characteristics of Design Products – Identification & Grading”.

The methods used for marking lot/serial numbers on safety critical parts must support identification, traceability and failure investigation through all phases of the product's life. In principle, the serial number or lot number should be applied to the actual part and preferably should be easily visible when mounted on the vehicle. When feasible, the [CC] symbol must be included on the part label. This would apply if the drawing is marked with a [CC] or [1] symbol.

Unless otherwise specified in product documentation, the preferred method for marking is:

- Item serialization
- Bar code (in accordance with Volvo STD 103-0013 or Volvo Group approved alternative)
- Recording of safety critical part or process parameters (preferred)
- Recording OK/not OK is acceptable with evidence of 100% effectiveness

1.4 Production and functional requirements

With regard to dimensional, material, test and functional requirements for product features identified as safety critical [1] or [CC], the following requirements apply and supersede the general requirements. Safety critical characteristics must be clearly identified throughout the manufacturing process and in all associated documentation such as Process FMEA, control plans and work instructions.

Capability requirements for parts identified with [CC], [1] characteristics are described below:

<table>
<thead>
<tr>
<th>Critical Characteristics level [CC], [1]</th>
<th>Capability requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_{pk} \geq 1.67$</td>
<td>- Process appropriate checking frequency</td>
</tr>
<tr>
<td></td>
<td>- On-going Statistical Process Control (SPC)</td>
</tr>
<tr>
<td></td>
<td>- Ppk analysis every 6 months</td>
</tr>
</tbody>
</table>

- Process under statistical control, normally distributed
- Electronic or automated poka yoke
- Effectiveness verified once per shift
- Volvo Group approved action plan for achieving process control and capability

Data records resulting from Statistical Process Control (SPC), automated checking, and inspection results must be available for download upon request by the Volvo Group SQE. The data must include identification of the production lot or serial number information.

In addition to the demands detailed in the table above, the supplier must apply the following requirements on the shop floor:

- Identification of the operations which have a direct or indirect influence on a safety feature
- Clear signs or placards defining the characteristic and potential effects of non-compliance
- Training status and authorization for all operators working on safety feature related workstation
- Rework of EE components is not allowed*

* This requirement does not apply to remanufactured electrical or electronic components.
During the APQP, process audits or PPAP activities, the SQE will verify the evidence of completion and compliance to these requirements for concerned products.

Thorough documentation is necessary in order to:

- Demonstrate that critical components do not have any safety related defects, either from the Volvo Group or supplier
- Demonstrate that both Volvo Group and legal requirements are met
- Limit the number of products subjected to field actions, if any

A copy of the SMA template is available for review on the Volvo Group Supplier Portal.

### 1.5 Safety Management Audit

Suppliers of safety critical components or assemblies must have safety system requirements embedded in their quality management system. Suppliers must be able to demonstrate they have the organization, systems, processes, and competencies to manage the Volvo Group requirements related to safety critical features.

Volvo Group has developed and uses a technical audit to evaluate the Safety Management Systems of suppliers of a safety part or parts. This audit evaluates the presence of an adequate management system and the capabilities to properly manage safety parts throughout the production process.

A supplier that has a safety part without a critical characteristic will be required to complete a Short Safety Management Audit. A supplier who is supplying a part that has been identified as a safety part and contains a critical characteristic will be required to participate in the Safety Management Audit (SMA). The SMA will be conducted during the sourcing process and potential suppliers are required to achieve a passing score prior to the award of business.

The target score for the SMA is minimum 90%. Suppliers that achieve a passing score, above 60%, but below 90% will be considered conditionally approved. Suppliers that are conditionally approved are required to develop a detailed action plan with a timeline for achieving the 90% score. This plan must address all audit findings. After achieving a 90% score, suppliers are re-audited periodically to ensure that the SMA systems and processes impacting quality remain in place. Volvo Group reserves the right to conduct an SMA at any time following a major quality spill, recall or when a safety risk is identified.

**NO DEVIATIONS ARE ALLOWED ON SAFETY CRITICAL FEATURES**

### 1.6 Lot traceability requirements

The basic requirements for lot traceability are covered under the section on Production Requirements. The following requirements apply to safety critical parts, components or assemblies and are in addition to the basic traceability requirements. Suppliers shall have an effective system of traceability that ensures delivered product can be traced from a finished product in the customer application back to specific lots, sub-components, parts, blanks and raw material.

In addition to component/materials traceability, the system must be capable of providing the production history of a lot or serial number. This history must include:

- Rework operations or activity
- Product and process special characteristics
- Test records
- Process parameters influencing conformance
- Machine settings influencing conformance
- Maintenance activity of machines, equipment, jigs, gauges and test equipment
- Personnel qualification records for operators performing the work

If product is controlled in lots or batches, a risk analysis related to severity of non-conformance and probability of occurrence must be conducted and used in establishing the lot sizes to minimize the impact of product recall.
The minimum requirement for storage of information related to safety critical parts is ten years after product phase-out or end of production. Any additional applicable legal requirements related to storage must be maintained.

1.7 Pass through parts requirements

“Pass through parts” are defined as parts that are shipped to Volvo Group by a supplier who processes parts from their suppliers, without value added activity or modification to form, fit or function to the safety critical feature. Tier I suppliers assume all responsibility for the quality of “pass through parts” that are considered safety critical. This requirement applies to parts or features identified as safety critical by either Volvo Group criteria or criteria identified by the supplier as having the potential to impact safety.

A Volvo Group on-site SMA will be conducted at the supplier of safety critical “pass through parts”. The Volvo Group safety auditor will conduct the audit focusing on Chapter 1 – “Company Management” and Chapter 4 – “Supplier Chain Management”.

Volvo Group requires tier I suppliers to have an active Safety Management Audit process for their suppliers. For those suppliers who do not have an audit process of their safety critical suppliers, Volvo Group does offer assistance to tier I suppliers in developing a Safety Management Program. This assistance may include conducting a joint audit at a tier II supplier. The tier I supplier is responsible to continue the SMA program and follow up on all action items initiated during the original audit. Volvo Group does not assume responsibility for the supplier’s SMA program, audit results, or follow-up activity. All responsibility for the SMA program and the quality of safety critical parts remain the responsibility of the tier I supplier.
Supplying products and services for the vehicle industry is a fast-paced and demanding business that requires the ability to mass produce complex assemblies and products employing state-of-the-art technologies.

To achieve this level of performance, the vehicle industry and their suppliers have developed specialized processes and systems to support the demands of this type of production while delivering high levels of quality expected by the vehicle customer.

Volvo Group has adopted quality processes and systems where successful application by our suppliers is key to shared success.

The success of our performance is determined by the final customer. Volvo Group’s customers are the businesses and people who rely every day on safe, reliable transport solutions.

We believe that achieving this level of quality and reliability can only be achieved by robust processes and rigorous monitoring.

This requires a customer focus mindset, a continuing search for effective solutions, and opportunities for continuous improvement.

2.1 Performance expectations

The table below defines the target performance levels for Volvo Group suppliers. Our desire is for all Volvo Group suppliers to strive to meet and exceed these target values. All suppliers are expected to have a Zero Defect approach to quality and demonstrate a continuous improvement towards the Zero Defect goal.

For specific products, additional part specific targets may be defined in the Request for Quotation (RFQ).

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Target</th>
</tr>
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</table>
| Field quality | Zero safety issues  
Zero field issues |
| • Warranty  
• Fault Frequency  
• External campaign/recall  
• Quick Solving Process (QSP) / Quality Journal (QJ) (ref 8.8) |
| Zero km quality | Zero production impact  
Zero defects* |
| • Internal campaigns  
• Customer claims (for powertrain)  
• First time through (FTT)  
• Line stop  
• Product audit  
• QPM (ref. 8.4)  
• PPM  
• Supplier First Time Through (for Volvo CE) |
| Problem solving | Zero time lag versus expectations*  
Zero recurrence |
| • QJ/QSP lead time (ref. 8.8)  
• Inspection Report lead time (ref. 8.2)  
• 8D robustness |
| Management system | Zero audit findings without an agreed-upon action plan |
| • Audit compliance |

* Actual targets for a supplier may be modified based on commodity, product technology, function or part criticality. Exceptions must be documented in a Long Term Agreement, or contract.
## 2.2 Management systems requirements

<table>
<thead>
<tr>
<th>Area</th>
<th>Expected level</th>
</tr>
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</table>
- Bus, Penta, VCE: ISO 9001:2015 |
| **Environmental system Volvo Group Supplier Code of Conduct** | - ISO 14001:2015 current certificate  
- Self-assessment  
- IMDS reporting |
| **Supplier Evaluation Model (SEM) Key Element Procedure 1 (General)** | - Preferred: Greater than or equal to 90%  
- Acceptable: Greater than or equal to 60%  
- No stopping parameters |
| **Product Safety Management Program (Applies to suppliers of safety critical components)** | - Approved: Greater than or equal to 90%  
- Conditional: Greater than or equal to 60%  
- No stopping parameters |
| **Index Audit (Applies to suppliers of Index related processes, ref. 3.6)** | - Approved: Greater than or equal to 80%  
- Conditional: Greater than or equal to 60%  
- No stopping parameters |
| **Volvo Group Customer Specific Requirements** | Compliance to:  
- Review of Technical Specification (RTS)  
- Conformity of Production (COP)  
- Part Application Agreement (PAA)  
- Part Handling Review (PHR)  
- Conforming Parts Out Of Tool In Plant Delivery (CPOT-IPD)  
- Digital Shape Model (DSM)  
- ISO 26262 Road Vehicles – Functional Safety |
| **Software (Applies to software suppliers)** | - SPICE CL3  
- Current certificate or equivalent by an accredited 3rd party |
| **Ethics Volvo Group Supplier Code of Conduct** | - Corporate Social Responsibility  
- Self-assessment  
- Preferred: 100%  
- Acceptable: Greater than or equal to 60%  
- No stopping parameters |
| **Logistic evaluation Key Element Procedure 7 (Logistic)** | Materials Management Operations Guidelines/Logistics Evaluation (MMOG/LE) self-assessment level A (Optional for VBNNA and VCE suppliers) |
| **Electronic Data Interchange Key Element Procedure 1 & 7** | 100% Electronic communication |
Awarding business to a supplier is one of the most important decisions made by the Volvo Group. It directly impacts our ability to deliver to our customers, remain competitive, live up to the expectations of what a premium brand stands for, and deliver future developments through projects.

The Volvo Group Global Sourcing Process is designed to ensure that all divisions of Volvo Group have the opportunity to contribute to the selection process and ensures the coordination of these decisions across all Volvo Group locations.

It's the first step in building a strong relationship between the Volvo Group and our suppliers.
Suppliers have an important role to play in the selection process:

- Actively participating in evaluation audits performed by the Volvo Group
- Demonstrating their capability to achieve future quality results
- Responding to action plans to reach the requested level

The following chapter explains the main steps in the process required to become a Volvo Group supplier.

In this section the information that suppliers can expect to receive and the evaluations that are required are further defined.

### 3.1 Quality Management System requirements

All potential suppliers must have a quality system compliant to ISO 9001 as a minimum. Suppliers to the truck brands are required to have a Quality Management System approved to a third party registrar meeting the requirements of IATF 16949. Suppliers are required to have an Environmental Management system compliant to ISO 14001 in place, functioning and also approved by a third party registrar.

### 3.2 Short Supplier Evaluation Model

Typically the first formal contact with a supplier will be a Request for Information (RFI). At that time suppliers will be requested to complete the Short Supplier Evaluation Model (Short SEM).

The Short SEM collects general data about the company, its products and capabilities. Specific quality topics included in the Short SEM are:

- **Quality Systems:**
  - Application and certification by an accredited third party to ISO 9001 or IATF 16949 Quality Management System and ISO 14001 Environmental Management System
- **Quality Performance:**
  - Past performance in quality, reliability and deliveries
- **Reliability:**
  - Practices in place for verification and validation testing that ensures their products will meet the minimum useful life expectations
- **Sustainability & Corporate Social Responsibility (CSR):**
  - CSR self-assessment to evaluate supplier performance and compliance with our ethical requirements

Current Volvo Group suppliers who have not participated in a recent evaluation may be requested to complete a Short SEM or participate in a standard on-site SEM prior to the award of additional business.

Volvo Group routinely monitors all current suppliers based on their performance as measured in the Supplier Scorecard (PPM, QPM, recent audit scores, Inspection Reports, Low Performing Supplier (LPS) status, etc.). Based on these results, Volvo Group may request a new Short SEM to be completed or request further evaluation audits.

### 3.3 Confidentiality agreement

Volvo Group realizes that maintaining an effective supplier/customer relationship may require sharing information, communications, data or technology that is sensitive or confidential. Before receiving a Request for Quotation (RFO), suppliers are required to sign and return a confidentiality agreement. The supplier shall treat all information and data related to the business relationship with Volvo Group in strict confidence and report any intentional or non-intentional breach of confidentiality to Volvo Group management. The Confidentiality Agreement template will be sent by the Buyer.
3.4 Request for Quotation

To be considered for business, suppliers must fully address each section of the RFQ and include all of the requested supporting documents when responding. This includes, but is not limited to:

- Preliminary Advanced Product Quality Plan (APQP)
- Review of Technical Specification (RTS)
- Statement of Work (if requested)
- Documents needed to support the information in the RFQ response

The quality requirements and targets are highlighted in the quality section of the RFQ. Volvo Group may audit the evidence related to the fulfillment of these quality requirements. In the event of where all requirements cannot be fulfilled, suppliers may be required to develop and submit an action plan with the returned RFQ. Suppliers are responsible for all costs associated with the fulfillment of the quality requirements. Some of these requirements may require testing at Volvo Group approved testing facilities. These costs should be included in all RFQ responses.

3.5 Supplier Evaluation Model

The Volvo Group Supplier Evaluation Model (SEM) has been developed based on a history of working with suppliers, lessons learned and “Best in Class” practices. This audit normally takes two to three days, depending on the size of the organization and is required for each supplier manufacturing location that will be shipping to a Volvo Group site. Suppliers must achieve a minimum score of 60% and achieve an acceptable score on all “Stopping Parameters”. The SEM audit is based on the evaluation of 11 criteria:

- Company profile
- Management
- Environment
- Quality
- Logistics
- After market
- Competence
- Product development
- Finance
- Productivity
- Sourcing

3.6 Index audits

The Index audit results are a major consideration in the sourcing decision process. Volvo Group requires all new suppliers, sub-suppliers and sub-contractors using the processes included in the list of technologies to have an Index assessment of their production process prior to supplier selection in the sourcing process. Completion of the Index audit is a requirement for consideration of award of new business. Current suppliers, who provide products covered by any of the technologies listed below, but have not had an Index audit assessment, shall contact the Buyer and SQE to arrange for an audit and approval to ensure continued business with Volvo Group.

Index Audit scores are valid for a period of three years. A new audit is required if there is a process change within the three year cycle. The scoring of the Index Audit is similar to the scoring process used for the SEM or general process audit. Regardless of the score, suppliers are expected to work aggressively to address any concerns or action items identified during the audit.

Volvo Group has developed a group of technology-based process audits (Index Audits) that focus on production processes that use technology considered critical to the function of the products. The Index Audit is required for award of business. It may also be used in process improvement or critical problem investigation.
Current Index Technologies:
- Casting (Grey Iron, Ductile, Ferrous, Aluminum)
- Metallurgy (Forging, Heat Treatment)
- Polymers (Plastic and Rubber)
- Steel Mill
- Wiring Harness
- Surface Treatment
- Software
- Safety Management
- Electrical Electronic
- Cleanliness

The Software Index is performed to evaluate a supplier’s maturity in software development. In terms of the scoring and improvement plans, the Software Index follows the common index rules. During the Software Index the supplier’s compliance to Automotive SPICE CL3 is verified. The activities linked with SPICE improvement plan is also verified.

3.7 Corporate Social Responsibility
A Corporate Social Responsibility (CSR) audit will be required of all potential suppliers and will when possible be evaluated as part of the SEM evaluation. The scope will not cover the full sustainability requirements, but focus on major risks. Current suppliers to Volvo Group that have not participated in a recent CSR audit may be requested to participate in an audit. The CSR audit usually takes one full day. It is a risk based audit, and all critical and high risk findings should be closed regardless of audit score.

The CSR audit is an on-site evaluation of supplier’s capability to meet Volvo Group’s Supplier Code of Conduct. The audit is designated to analyze the risk of supplier’s activity with regards to people, planet and profit.

3.8 Final agreement
Once the supplier is selected, all agreements must be signed and returned to the Volvo Group prior to the award of business, including the Purchasing Agreement and Warranty Charter. Templates for these agreements are available in the RFQ package.

Staying competitive in the markets where Volvo Group operates requires regular improvements to existing product and continuous development of new products.

Supporting the introduction of new products requires a well-defined and organized process for project planning and launch.

Volvo Group organizes all new product introductions as projects. Suppliers are required to have an effective project planning process that is capable of supporting the Volvo Group process and timing for project management.

In 2006, Volvo Group adopted the Automotive Industry Action Group (AIAG) guideline for APQP as the standard planning method for suppliers bringing products to production.

Suppliers are expected to develop a detailed Advanced Product Quality Plan for the development of processes used to produce Volvo Group products.
4. Advanced Product Quality Planning

It is always the customer who determines if we are best in class. But before our products reach our customers, the ultimate quality of delivered parts is determined already during the design and development phase of the production process.

Volvo Group expects suppliers to create product launch plans to support:

- Launch of all new components intended for serial production
- Significant changes to existing products or processes
- Development of new manufacturing processes

Recently Volvo Group has made significant changes to the project development cycle, focused on front loading the development activities of a project. To support this, new activities have been added to the supplier requirements or additional emphasis added to existing activities of the project. In this manual you will find the addition of Conforming Part Out of Tool – In Plant Delivery (CPOT-IPD) requirements and more emphasis on the “C build” process. These additional requirements require attention from suppliers supporting product development during a project.

The objective of the planning process is to deliver the project on time, at the right cost and at the highest level of quality. The initial development of the APQP should begin upon receipt of the Request for Quotation (RFQ). This initial plan should be included as part of the RFQ response package. More information on Volvo Group’s expectations on supplier’s project plan, is available on the Volvo Group Supplier Portal. Suppliers are encouraged to develop a plan suited to their specific business.

4.2 Responsibilities in APQP

Volvo Group has learned that successful projects require a high level of a close cooperation and teamwork with the suppliers. A detailed list of the shared roles and responsibilities is available on the Volvo Group Supplier Portal. Here is a short list of the key areas of responsibility:

**Supplier is responsible for:**
- Assigning a dedicated project manager or APQP leader
- Organizing a cross-functional APQP project team
- Developing and executing an APQP Plan to support a successful product launch

**Volvo Group is responsible for:**
- Identifying the Volvo Group project team members
- Assigning a Supplier Quality Engineer (SQE) to support the completion of APQP activities with the project team
- Identifying key milestones and project parameters
4.3 Key Components

All parts used in the vehicle are important to customer satisfaction and the safe, reliable operation of the final product. However, there are some parts that require additional attention. At the start of a project, a cross-functional project team identifies parts that will be subjected to closer control and monitoring. These parts are designated as Key Components. The Buyer will notify suppliers of parts selected as Key Components and any associated requirements. Suppliers of Key Components will typically be expected to participate in APQP and joint steering committee reviews during the project.

Key component selection criteria:

- Safety critical components
- Regulatory or legal requirements
- Parts with critical characteristics
- Supplier designed products
- Complex parts or components
- Parts that holds a vital function in a system
- High value parts or components
- Expensive or long lead time tooling
- Long lead time parts
- Parts with known or potential quality concerns
- Parts that require extensive verification or validation testing
- Parts with features that cannot be verified prior to use by a customer (unchecked characteristics)
- New technical concepts

4.4 APQP reviews

Design responsible suppliers, suppliers of key component parts and suppliers of parts assessed with a risk by the SQE are required to report the project status at established intervals during the project development. As a general rule, these reviews are held prior to the project milestones or drawing revision release. Suppliers should prepare for these project review meetings by completing or updating the APQP review template, their project plan and the project milestone dates. Suppliers can access the APQP review information in the Quality section on the Volvo Group Supplier Portal. The APQP review template is divided into sections for design responsible suppliers and those responsible for production of Volvo Group designed parts.

The initial APQP review meeting (Kick-Off review) should occur within two to four weeks after the award of business. The final review is concurrent to the launch of the product. This review is intended to ensure that all open issues are resolved, that there is adequate capacity to support on-going production needs and a lessons learned has been conducted to improve future APQP activities.

To support these reviews, Volvo Group has developed a checklist designed to document the project status at each review. Information related to the "APQP review" file is available on the Volvo Group Supplier Portal. Suppliers are responsible to complete and maintain the information for each review meeting. The completed form will be used by the joint team as the basis for evaluating the project status.

The illustration on next page demonstrates the relationship between Volvo Group’s Product Development Process (DVP) and the supplier’s project plan:
APQP timing
4.5 Software APQP

The process used for the quality assurance of software is centered around joint reviews similar to those used for product development and production. Software APQP reviews are optional for VBNA suppliers unless requested by the responsible VBNA SQE (VBNA software suppliers are encouraged to use APQP as a project management tool).

Software APQP timing

There are six joint reviews in a normal software development project:
- Kick Off review HW/SW
- Planning review
- Requirements review
- Initial Design review
- Final Design review
- PPAP review
As the majority of software development occurs during the product design phase of the project, most of the reviews occur during this phase. The only exception is the Software (SW) PPAP Review.

The requirements applicable to supplier software projects and quality assurance system are described in a separate requirement document called Quality and Development Process Requirements (QDPR). Supplier delivering software to the Volvo Group shall be certified to level 3 according to an ISO 15504 Software Process Improvement and Capability dEtermination (SPICE) assessment, or have a plan for achieving certification according to the automotive SPICE assessment model (see www.automotivespice.com).

The Production Part Approval Process (PPAP) demonstrates that the manufacturing process used to produce parts for the Volvo Group is fully developed, thoroughly tested, and capable of serial production of parts conforming to the technical specifications.

For the PPAP (as for the APQP) Volvo Group follows the AIAG requirements, using the requirements applicable for trucks and heavy equipment.

Sample parts and the supporting documentation are submitted to show evidence that:

- The design records and specifications have been properly understood and met
- The manufacturing process has the capability to produce conforming parts in the actual production environment
- The manufacturing process has the capacity to support production quantities at a consistent quality level
5.2 Process

Volvo Group uses a four step release process for new part development:

- **A-release**: Creation stage, during which parts and documents are created. The purpose of the A-release is to give early part information to the project organization in order to get feedback regarding the intended new design and/or changes.

- **B-release**: Verification Stage, with the main purpose of the B-release to secure that the parts can be used to build and verify prototype products in an early phase of a project.

- **C-release**: Tooling stage, with the main purpose to release approved parts (and documentation) for orders of series production tooling and/or manufacturing equipment and for the build of pilot series products. The C-release shall also be used (even if no tooling is involved) to secure initial sample ordering in good time.

- **P-release**: Production stage, with the main purpose to communicate in the organization that the concerned part(s) is/are approved for application and assembly in series production conditions and that the part and engineering documentation reflect this condition.

When the design has reached the C-release stage, the Buyer will issue a Sample Order to notify the supplier that a PPAP is required. At this point, the design is considered firm enough that suppliers are authorized to place tooling orders and start the production process design and development. The due date on the sample order is the expected date for delivery of the PPAP documents to Volvo Group. This date will normally be two weeks before the approval by the Volvo Group. Check with the SQE for special situations. Suppliers are responsible to verify that all technical documentation (Part Version Report, Drawing, Technical Requirements, Digital Shape Model, etc.) has been supplied. Any questions regarding the technical document package should be directed to the Buyer. This early release is intended to give suppliers as much time and information as possible to prepare for start of production. This sample order will be amended once the P-documents and specifications are completed.

PPAPs can only be approved based on the P-release of the drawing and document package, unless there is a clear agreement with the SQE and an approved deviation (ref. 7.2).

---

5.1 Reference

Suppliers shall ensure that the PPAP document and sample submissions are in accordance with the requirements of the Automotive Industry Action Group (AIAG) PPAP Manual (latest edition, using requirement as applied to truck and heavy equipment). Suppliers of service parts shall follow the AIAG requirements document Service Production Part Approval Process (Service PPAP) First Edition June 2014. Additional guidelines and a copy of the Part Submission Warrant (PSW) template are available on the Volvo Group Supplier Portal. This requirement is also valid for the Software specific Submission Warranty (SSW).

Volvo Group requires its suppliers to follow the Customer Notification and Submission requirements as specified in the AIAG PPAP Manual that includes but is not limited to:

- Introduction of new components
- Changes to an existing part
- Drawing or specification changes
- Corrections to a prior discrepancy
- Supplier process change
- Material changes or substitutions
- Changes of sub-tier suppliers

VOLVO GROUP REQUIRES PPAP APPROVAL PRIOR TO SHIPMENT OF ANY PRODUCTS FOR USE IN CUSTOMER VEHICLES
The preliminary target date for PPAP submission may be included as part of the RFQ information. Additional information concerning the target date for PPAP submission will be included in the Sample Order. PPAP submission dates must be planned as a milestone in the supplier’s APQP plan. Any issues, delays or changes to the PPAP target date should be communicated to the Buyer and SQE.

The supplier is responsible for the PPAP preparation:

- Suppliers must notify the Buyer and SQE of the proposed shipment date; failure to acknowledge the PPAP order is considered agreement to the due date
- Suppliers (tier I) are responsible for the planning, approval, corrective action, follow-up and retention of PPAPs submitted by sub-suppliers and sub-contractors
- Supplier must indicate to the SQE if this PPAP part has been produced from new, revised or refurbished Volvo Group owned tooling, including our tooling order number as reference
- Cpk studies on special characteristics, identified by [SC] or [CC], must be completed on a minimum of 30 pieces selected at random from the SPR parts
- 100% dimensional evaluation (including evaluation to the Digital Shape Model) is required on five parts selected from the Significant Production Run (SPR)**

* For suppliers delivering small production runs, the requirement for Cpk studies and SPR may be waived with approval by the SQE
**Cpk studies and SPRs are waived for Service Part suppliers

Upon satisfactory completion of all required measurements and tests, the supplier shall complete the required information on the Part Submission Warrant and/or the Software Submission Warrant (PSW/SSW).

Completing the PSW/SSW:

- Suppliers are requested to use the Volvo Group PSW/SSW form that is available on the Volvo Group Supplier Portal
- A separate PSW or SSW shall be completed for each Volvo Group part number unless otherwise specified by the SQE
- The PSW/SSW shall be signed by the authorized supplier representative before submission

The SQE will review all PPAP packages and assign one of the following:

- Fully approved and in compliance with all specifications
- Conditional or interim approval
- Not approved

In the case where interim approval is given, it must be supported with an approved deviation. All deviation requests require review and approval by both the Volvo Group Design Engineer and the SQE. Full approval of the deviation also requires a plan from the supplier that addresses correction of all open issues (ref. 7.2). The form is available in the Quality section of the Library on the Volvo Group Supplier Portal.

The full approval of the PPAP triggers the release of the final funding for tooling. Suppliers are required to upload and update their tooling inventory information on Volvo Group Supplier Portal and submit photographs of the tool and the tooling asset identification for the final release of funds. Volvo Group owned tooling must be identified with the following information:

- “Property of Volvo Group”
- Tool Number (Asset Number)
- Part Number
- Part Name

5.3 Significant Production Run

A Significant Production Run (SPR) is required for all new part introductions and is the basis for the PPAP. This sample run is to be conducted using production tooling/equipment, environment (including production operators), facility, and cycle time.
5.4 Documentation requirements

Suppliers are required to submit a Level 4 PPAP package for all components unless other arrangements have been agreed between Volvo Group and the supplier. The minimum requirements for a Level 4 PPAP include:

- The Production (P) Release of the Volvo Group Drawing
- Part Version Report (PVR)
- Technical Requirements Document
- Dimensional results (including component comparison to the digital shape model)
- Process Flow Diagram
- Process FMEA
- Control Plan
- Material test results
- Performance test results
- Appearance approval report if applicable
- Conformity of Production Certificate (ref. 6.5, if applicable)
- Approved IMDS Report
- Part Submission Warrant (PSW)
- Completed Review of Technical Specifications

Suppliers shall only submit PPAP packages based on the Volvo Group production-released drawings (P-released drawings). Suppliers are required to submit documents according to the order of revision level of the Volvo Group drawings, Part Version Report, and Technical Requirements to ensure that the Production Part Approval has been conducted on the correct revision of the specifications. PPAPs cannot be approved based on supplier’s drawings. The Volvo Group drawing must include reference “balloons” supporting dimensional checks. Actual component comparison to the Volvo Group Digital Shape Model must be submitted with the PPAP package.

An analysis of weight discrepancies including measurement uncertainty will be requested when we have a deviation between the weight documented in the PSW and the weight measured through Volvo Group internal weight quality control.

The SPR also provides a good opportunity to identify and correct potential manufacturing process bottlenecks. To be fully accurate, the capacity calculated from the SPR results should take into account the actual Overall Equipment Effectiveness (OEE) results from the process and include any planned down time.

THE PPAP MUST BE FULLY APPROVED OR HAVE INTERIM PPAP APPROVAL WITH APPROVED DEVIATION BEFORE STARTING SERIAL PRODUCTION
To avoid delays and deviations, suppliers should ensure that these requirements are initiated upon receiving the initial sample order.

Suppliers will be notified via a signed PSW and/or a SSW regarding the status of the PPAP (approval, rejected, or interim approval).

Exception to default PPAP level 4: Upon request from Volvo Group, suppliers may be required to submit a Level 3 PPAP package for Key Components.

### Documentation requirements

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<tr>
<th>Requirements</th>
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<td>4 Design FMEA</td>
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<td>13 Appearance Approval Report (AAR), if applicable</td>
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<td>14 Sample product</td>
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<td>15 Master sample</td>
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<td>18 Part Submission Warrant (PSW)S</td>
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<tr>
<td>19 Picture of sample part (3 views)**</td>
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<td>S</td>
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</tbody>
</table>

S The supplier shall **submit** a copy of the records or documentation and retain a copy at appropriate locations

R The supplier shall **retain** at appropriate locations and make available to Volvo Group upon request

* The supplier shall retain at appropriate locations and submit to Volvo Group upon request

** Volvo Group specific requirement
5.5 Approval of software

The Volvo Group Software Approval Process demonstrates that software developed for Volvo Group is fully specified, thoroughly tested and capable of performing to the functional and non-functional requirements. The software covered by these requirements includes software embedded into component hardware parts, stand-alone software incorporated into a hardware component but having an assigned part number, and software as a standalone product. Supporting evidence in this section is required to verify that all of the software requirements, design records, and specifications have been properly understood and met.

Significant test coverage is required for all new part introductions and is the basis for the Software Approval Process.

Suppliers are required to submit a Software Approval Process document package unless arrangements have been agreed between Volvo Group and the supplier. Suppliers may be requested to submit a request for deviation documenting exceptions.

The minimum requirements for Software Approval include:

- Customer requirements baseline reference
- Requirements traceability matrix
- Software Test Plan (SWTP)
- Software Test and Verification Report (SWTR)
- Software Version Description (SWVD)

Additional guidelines and a copy of the Software Submission Warrant (SSW) template are available on the Volvo Group Supplier Portal.

Software documentation requirements

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Required</th>
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<td>QDPR compliance matrix</td>
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<td>3</td>
<td>Communications plan</td>
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<td>4</td>
<td>Document traceability matrix</td>
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<td>6</td>
<td>Skills and training matrix</td>
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<td>7</td>
<td>Customer requirement baseline reference</td>
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<td>8</td>
<td>Software Requirements Specification (SWRS)</td>
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<td>Software Development Plan (SWDP)</td>
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<td>12</td>
<td>Risk management list</td>
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<td>14</td>
<td>Complexity report</td>
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<td>16</td>
<td>Software Design Description SWDD</td>
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<td>Hardware/Software interface specification</td>
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<td>18</td>
<td>Requirements traceability matrix</td>
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<tr>
<td>19</td>
<td>Node Function Implementation Plan (FIP)</td>
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<td>20</td>
<td>Software Test Plan (SWTP)</td>
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<tr>
<td>21</td>
<td>Software Test Description (SWTD)</td>
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<td>22</td>
<td>Software Test and Verification Report (SWTR)</td>
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<tr>
<td>23</td>
<td>Software Version Description (SWVD)</td>
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<td>24</td>
<td>Software Product Specification (SWPS)</td>
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<td>25</td>
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<td>SPICE certification report</td>
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<tr>
<td>31</td>
<td>SPICE assessment action plan</td>
<td>R</td>
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</tbody>
</table>

S The supplier shall submit a copy of the records and retain a copy at appropriate locations

R The supplier shall retain a copy and make available to Volvo Group upon request
In addition to the specific activities required by Advanced Product Quality Planning, Volvo Group has developed a group of activities that support the process of new part introduction in serial...
These additional requirements have been developed in response to lessons learned in previous projects or to address specific customer needs.

These tasks require close cooperation between the members of the Volvo Group and supplier’s project teams. Suppliers are expected to take active part in these activities. All of the tasks required to support these activities should be included in the supplier’s project plan.

In addition to the requirements described in the AIAG APQP reference manual, Volvo Group requests the planning and completion of the following cross-functional activities:

- Review of Technical Specifications (RTS)
- Product Application Agreement (PAA)
- Part Handling Review (PHR)
- Process audit

### 6.1 Review of Technical Specifications

The goal of this process is to ensure suppliers have a complete understanding of the technical requirements of the product supplied and the capability to meet those requirements. The process is intended to identify potential production constraints and minimize the need for late design changes or design changes after the PPAP order or Tooling Order have been placed. In addition, suppliers are encouraged to suggest improvements that would result in reduced costs or improved quality.

The RTS ensures that all the technical information defining the component has been thoroughly reviewed, clearly understood by the supplier and is feasible to produce. The RTS process also provides the opportunity to collect and incorporate the supplier’s comments and suggestions into the drawings and technical specifications. During the RTS process Volvo Group welcomes supplier suggestions that will improve the quality of the product or reduce the costs associated with either tooling or the product.

Volvo Group has developed a unique system for control of technical documentation including the drawing. This system uses the Part Version Report (PVR) rather than a drawing as the top level document. The PVR contains the part number, drawing number, current revision data, the applicable Digital Shape Model and references to related technical information. The DSM is to be considered as part of the technical information defining the part geometry similar to the 2D drawing, technical regulation, Volvo Group standards, etc. Compliance to the DSM must be confirmed and demonstrated for the purpose of PPAP approval unless prior approval and waiver is granted by Volvo Group Supplier Quality Engineer, reference Volvo Group Standard STD 101-0001.
Suppliers should carefully review the PVR and all of the referenced documents to ensure a thorough understanding of the technical requirements.

The RTS compliance matrix is included with the RFQ documentation, and shall be completed by the supplier and returned together with the rest of the RFQ documentation. As part of this review, suppliers must determine if any of the technical areas included in the Index Audit section of this document apply to their products.

Suppliers must be prepared to prove activities required to ensure that all processes covered by one of the Index technologies are performed by approved sub-suppliers, unless approved by the appropriate Volvo Group Technology Specialist.

After the RTS compliance matrix is submitted and reviewed by Volvo Group, the RTS is signed by both Volvo Group and the supplier. Signing the RTS signifies agreement by all parties that the Technical Requirements, Volvo Group Standards and General Specifications applicable to the part have been received, are understood and are achievable.

The RTS provides a record of specification or production issues discussed during the part launch. Suppliers shall include a copy of this signed RTS with the PPAP documentation package. This ensures that all issues raised during the RTS process are properly addressed during the PPAP review.
6. Volvo Group specific requirements

6.2 Product Application Agreement

The Product Application Agreement (PAA) is a process intended to ensure that suppliers fully understand and accept the installation and operating conditions of a supplier developed component.

THE PAA IS MANDATORY FOR KEY COMPONENTS WHERE THE SUPPLIER IS FULLY OR PARTIALLY RESPONSIBLE FOR THE DEVELOPMENT

This process involves a joint review by the supplier and Volvo Group of the performance requirements and the physical installation of the component in the final application.

By signing the PAA, the supplier agrees with the environment and application in which their product is to be used.

6.3 Part Handling Review

To ensure that the quality of a supplier component is maintained during shipping, storage, handling, testing or installation after transfer of ownership to Volvo Group, the supplier is invited to participate in a Part Handling Review (PHR). The purpose of the PHR is to prevent the possibility of compromising product quality due to improper handling or installation, by sharing information and gaining the supplier’s observations. The PHR is not mandatory, but may be conducted at each Volvo Group facility using the supplier’s component as delivered in the agreed production packaging. The supplier is encouraged to participate in a review of handling, and installation activities from receipt at a Volvo Group facility until shipment to the next facility or customer.

6.4 Special characteristics

While all characteristics of a part are required to conform to specifications, there are a few characteristics that are selected as special characteristics. Volvo Group has recently revised the specifications regarding special characteristics. During the transition, special characteristics may be identified on drawings or technical specifications using either of the following methods.

The selection criteria and guidelines related to special characteristics are based on the Volvo Group standard: STD 105-0007 "Special Characteristics Definition and Application". This standard describes the system currently used by Volvo Group to highlight and grade critical characteristics appearing in drawings and technical specifications. Special characteristics are identified using the symbols [CC] or [SC] next to a feature in a Volvo Group technical document.

Critical Characteristics [CC] refer to special characteristics which affect safety. Significant Characteristics [SC] refer to special characteristics which can affect compliance with regulations (for emission regulations: use STD 105-0004), form, fit, function and performance, or subsequent manufacturing-process steps.

The special characteristic symbols ([1], [2] or [3]) defined in STD 105-0001 “Critical Characteristics of Design Products – Identification & Grading” may still be present on some Volvo Group drawings or other documents. These indications are valid and the characteristics shall fulfill the requirements stipulated in STD 105-0001. If the [1], [2], or [3] are present, the rules governing [CC] [SC] should be applied by the following guide: [1] equals [CC] requirements, [2] or [3] equal [SC]. Symbols from STD 105-0007 and STD 105-0001 are not used together in the same document.

For all features identified as a special characteristic, the following requirement applies:

Additional information is available in the Quality section of the Library on the Volvo Group Supplier Portal.

THE PAA IS MANDATORY FOR KEY COMPONENTS WHERE THE SUPPLIER IS FULLY OR PARTIALLY RESPONSIBLE FOR THE DEVELOPMENT

The PAA is designed to anticipate and prevent problems related to the integration of supplier designed parts into a system or a sub-system. The process provides an opportunity for the supplier to review the performance of their product in the final application.

The PAA is designed to anticipate and prevent problems related to the integration of supplier designed parts into a system or a sub-system. The process provides an opportunity for the supplier to review the performance of their product in the final application.
Volvo Group specific requirements

6.5 Legal requirements and Conformity of Production

Legal Requirements and Conformity of Production (COP) refer to individual components or systems that are directly connected to vehicle regulations. The vehicle approval in several countries is linked to valid component type approval at our suppliers, since Volvo Group uses them to obtain system and vehicle approval. Therefore, concerned suppliers must be well acquainted with the regulations and legal requirements that apply to their components, both as used within a vehicle and on a standalone basis (such as a service part) on a worldwide level, in order to obtain the type approval of the supplied component.

Volvo Group requires suppliers to follow the regulation to obtain their approvals as well as follow all valid regulations related to COP during the part’s lifetime. By conducting business with the Volvo Group, all suppliers agree to comply with any and all such regulations. Each time the supplier changes the authority approval (new extension, new amendment level or whatever the reason), the supplier will provide that information to Volvo Group six months in advance, since the system and, potentially, vehicle certificates are impacted. Any update of a certificate from authority to supplier, the supplier is required to immediately send a copy of that signed document to the Volvo Group.

Volvo Group will, during APQP/PPAP, endeavor to confirm that the suppliers have a system in place to record and document their own process of COP, so the COP approval continues to be valid, although

<table>
<thead>
<tr>
<th>Critical Characteristics level [CC], [1]</th>
<th>Significant Characteristics level [SC], [2], [3]</th>
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<tbody>
<tr>
<td>Process under statistical control, normally distributed</td>
<td>Process appropriate checking frequency</td>
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<td>On-going SPC**</td>
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<td>Ppk analysis every six months</td>
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<td>Process not under statistical control or capability not achieved</td>
<td>Electronic or automated poka yoke</td>
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<td>Effectiveness verified once per shift</td>
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<td>Volvo Group approved action plan for achieving process control and capability</td>
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<td>Cpk ≥ 1,67</td>
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<td></td>
<td>Cpk ≥ 1,33 / 1,67*</td>
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<td>Process appropriate checking frequency</td>
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<td>On-going SPC**</td>
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<td>Compliance to capability requirement</td>
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<td></td>
<td>Electronic Components</td>
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<td></td>
<td>Data records resulting from SPC, such as control charts or electronic data, must be stored and available upon request.</td>
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</table>

The requirements related to special characteristics are also applied to all parts classified as Safety Critical or Conformity of Production (COP). The specific application and any additional requirements related to Safety and COP are detailed in the relevant sections of this document.

In addition to the special characteristics identified in Volvo Group drawings or technical documents, suppliers must identify any special characteristics related to their product. Suppliers should communicate any special characteristics identified along with their standards for selecting and ranking critical or key characteristics and the methods used for identification on drawings. Suppliers shall also define any special considerations for handling, assembly, application, capability or use required to ensure safe, reliable performance of the product.

* Electronic Components

** Data records resulting from SPC, such as control charts or electronic data, must be stored and available upon request.
ultimately it is understood that this responsibility rests solely with the supplier. Volvo Group will always require, and all suppliers conducting business with Volvo Group agree, that if a supplier is in a non-conformity situation during COP testing that Volvo Group is immediately informed by such supplier, and further that such non-conformity is promptly corrected. By conducting business with Volvo Group our suppliers agree that the Volvo Group may at any time inspect the supplier’s ability to monitor its COP system.

Parts that have the potential to impact compliance, legal regulations or features, such components are identified using the symbols [2R] or [3R]. These symbols appear on Volvo Group drawings or are stated within the related Volvo Group technical specifications controlling the part. The determination [2R] or [3R] grading is based on an assessment of how seriously the consequences of non-compliance with the requirements for the characteristic in question, will impact Volvo Group's compliance with the legal or governmental requirement. This assessment will in no way relieve any supplier of the responsibilities described previously.

Volvo Group standard STD 105-0004 defines the guidelines for grading characteristics. This standard generally applies to components intended for POWERTRAIN applications (engines, transmissions and drive axles), but may apply to any component of a vehicle.

All parts with features designated as [2R], [3R] are also considered “Key Components” and are subjected to the same level of control. The designation of [2R] or [3R] differentiates the degree of significance of the characteristic in question.

It is mandatory for [2R], [3R] parts to be inspected or tested and the necessary documentation (inspection results, test reports, certificates) to be kept at the supplier for a period of time consistent with the documentation retention policy. All inspections or tests required to ensure compliance to [2R], [3R] regulation must be included in the control plan. A summary of the results from inspections or tests must be communicated to the Volvo Group at regular intervals. Conformance to COP process requirements must be respected during the entire product lifetime. No changes to product or process are allowed without formal approval from Volvo Group. No deviations are allowed on features designated as [2R].

When characteristics for regulatory compliance are identified the following requirement applies:

<table>
<thead>
<tr>
<th>COP Characteristics level 2R</th>
<th>COP Characteristics level 3R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_{pk} \geq 1.33$</td>
<td>$C_{pk} \geq 1.33$</td>
</tr>
<tr>
<td>On-going SPC*</td>
<td>Inspection completed to control plan**</td>
</tr>
<tr>
<td>Ppk analysis conducted every 12 months</td>
<td>Ppk analysis conducted every 3 years</td>
</tr>
<tr>
<td>Machine or process 100% automated checking surveillance</td>
<td>Machine or process 100% automated checking surveillance</td>
</tr>
<tr>
<td>Action plan for achieving process control and capability</td>
<td>Action plan for achieving process control and capability</td>
</tr>
</tbody>
</table>

* Data records resulting from SPC, such as control charts or electronic data, must be stored and available upon request.
** Inspection results must be recorded, maintained, stored and available upon request.

In the event of non-conformance of an identified characteristic or component escaping the supplier’s location, the following actions must take place immediately:

- Notify the Plant Supplier Quality (SQP) at the affected Volvo Group facilities and the SQE
- Containment at supplier, Volvo Group facilities and in transit
- Short term corrective action
- Begin cause analysis
- Develop an action plan to recover full conformance

ALL [2R], [3R] FEATURES MUST BE MEASURED AND THE RESULTING DOCUMENTATION MAINTAINED
6.6 Cleanliness requirements

Technology and performance enhancements to the vehicles require improved cleanliness of certain components. These components are required to meet a cleanliness requirement. The cleanliness requirement will be specified on the part drawing or in the Technical Requirements document.

When required, cleanliness testing must be performed using the flushing method as defined in the Volvo Group standard STD: 107-0002. Alternative testing methods must be approved by Volvo Group Product Development. Suppliers are required to perform cleanliness testing at intervals that demonstrate adequate control of the cleaning process.

<table>
<thead>
<tr>
<th>Cleanliness Requirements STD 107-0002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max number of particles/cm²/Nc</td>
</tr>
<tr>
<td>Particle Sizes ≤ µm</td>
</tr>
<tr>
<td>Wetted surface cm² Ac</td>
</tr>
</tbody>
</table>

In addition, a Cleanliness Audit in accordance with Volvo Group Standard STD: 107-0003 may be required by the SQE. The SQE will provide the appropriate information if a Cleanliness Audit is required.

Even when cleanliness is not specified on the PVR, drawing, Technical Requirements or standards, parts shall be delivered free from dirt, machining chips, burrs, or rust.

6.7 Prototype parts and CPOT-IPD

To support design verification testing, or early build trials, suppliers may be required to deliver prototype parts. By the Volvo Group definition, prototype parts are any parts that are built on a production process other than the final PPAP approved process. Prototype parts may be requested at different times during the product design cycle.

The requirements for the respective levels of prototype parts are:

- Prototype parts to the A or B documentation release:
  Parts are expected to be fully conforming to Volvo Group dimensional specifications
- Prototype parts to the C documentation release:
  These prototype parts are designated as Conforming Part out of Tool (CPOT), with the purpose to ensure the production intent tooling is capable of producing parts conforming to the drawing and technical specifications early in the APQP Process Development phase

CPOT prototypes shall meet the following requirements:

- Be geometrically and functionally correct based on agreed drawing release
- Produced on serial intent tooling when specific tooling is required
- Be verified by the supplier for conformance to all dimensions and features according to the agreed technical specification
- Be produced by the production supplier
- In cases where specialized tooling is required, the parts may be manufactured at the tool maker’s location (the CPOT pick up point shall be equal to the regular pick up point for serial production).

The appearance requirements for CPOT may be waived based on agreement between the Volvo Group and supplier during the RTS process (e.g. no chroming, no graining).

Suppliers are required to develop a prototype control plan to support the production, inspection and testing activity of parts manufactured according to the release stage of their technical documentation. The prototype control plan should include all...
product features and characteristics of the product and include any additional requirements from a Measurement Point plan (MP), or a Dimensional Control Plan (DCP) the supplier may have received from Volvo Group Engineering for some components. The objective of this control plan is to ensure that the parts produced are fully conforming to the specifications.

Prototype parts, where the part or any of the features of the part fall under the requirements for Conformity of Production, Safety Critical or special characteristics, must meet the requirements as defined in the related section of this manual. The section of the capability requirements chart “Process not under statistical control or capability not achieved” shall be applied. All special features must be clearly identified in the prototype control plan.

Prior to shipment, suppliers of prototype parts are required to complete:

- **A- or B-release level prototypes:**
  100% measurement/verification evaluation prior to shipment

- **C-release level prototype (CPOT):**
  Measurement/verification of 100% of the characteristics/dimensions/features on 5 pieces of the shipment
  Measurement/verification of 100% of any applicable Special Characteristics of all parts of the shipped quantity ([SC], [CC], [2R], [3R], [1], [2], [3])

All exceptions to these requirements (number of samples/features measured) must be agreed prior to the “Signing” of the RTS and must be documented in the RTS. Exceptions for functional requirements must be identified in the Verification Report as “RTS not measured” characteristic. The evidence of inspection, verification and measurements must be recorded in a Verification Report and copies of the records forwarded to Volvo Group prior to shipment.

For any prototype parts not achieving full compliance to the technical specification, shipment is not authorized unless approved by Volvo Group Engineering and supported by an approved deviation.

Shipments of prototype parts must be clearly identified using an orange label with the word PROTOTYPE. CPOT parts must be marked using a red label including CPOT-IPD. The label must be prominently displayed on the exterior of the shipping skid or container. Specific details related to shipment guidelines, the prototype identification label and documentation requirements can be obtained by visiting the Volvo Group Supplier Portal or by contacting the Buyer that placed the order for those prototype parts (Prototype order or Quantity order).

Prototype parts must be clearly identified with the part number, the part version and marking that allows the part to be identified as a prototype after installation, in the production environment and on vehicles. The intention is to insure that prototype parts can be easily differentiated from PPAP approved P-release parts. Prototype specific identification should be appropriate to the part and agreed between the supplier and Volvo Group Engineering.

Suppliers will receive a PPAP sample order, a tooling order for production tooling (depending on the business arrangement), and a specific purchase order defining the quantity of CPOT parts required for the current issue.

CPOT-IPD (In Plant Delivery) is the date defined by the project, when CPOT parts are required to be delivered and received at the respective Volvo Group facility. The exact “In Plant Delivery” date will be communicated in the purchase order for the CPOT parts.

Acceptance and use of CPOT parts by Volvo Group does not imply production approval. Compliance to the CPOT requirements does not replace the requirements for conducting the PPAP. Demonstration of process capability is not required for CPOT parts, however, the CPOT process provides an excellent opportunity to evaluate capability of the tooling prior to the SPR.

Unique requirements related to prototype parts specific to a Volvo Group facility, business unit or region are available on the Volvo Group Supplier Portal or by contacting the Buyer.
6.8 REACH compliance and IMDS reporting

REACH is a regulation of the European Union, adopted to improve the protection of human health and the environment from the risks that can be posed by chemicals, while enhancing the competitiveness of the EU chemicals industry. REACH stands for Registration, Evaluation, Authorisation and Restriction of CHemicals. This regulation went into effect on 1 June 2007.

To comply with the regulation, companies must identify and manage risks linked to the substances they manufacture and market. For substances listed on the Candidate list which are manufactured or imported in quantities of 1 tonne or more per year per company, manufacturers and importers need to demonstrate that they have appropriately identified and managed the associated risks by means of a registration dossier, which must be submitted to the European Chemicals Agency (ECHA).

Companies established outside the EU are not bound by the obligations of REACH even if they export products into the European Union. The responsibility for fulfilling the requirements of REACH, such as pre-registration or registration lies with the importers established in the European Union, or with the “Only
6.9 Pre-launch control plans

Suppliers are expected to use pre-launch control plans to increase the level of quality controls applied during ramp up and early production stages of new part launches. A pre-launch control plan is defined by increased frequency, levels of inspection and increased controls during the early stages of production. The purpose is to protect the customer from problems until process controls can be refined and start-up problems can be identified and resolved. The level of controls within the control plan should be adjusted once the production process has been stabilized and process control can be assured. Additional information regarding Volvo Group expectations and requirements for control plan development can be obtained from the SQE.

Suppliers may be required to implement a separate inspection activity at process start-up that is independent of the inspections and controls required by the control plan. The purpose is to verify the effect of the control plan, and determine the capability of the production process. The application of this additional control may be required by the SQE for early production when a supplier’s performance indicates that current controls are not adequate to identify and address problems prior to reaching the customer.

Shipments of products that have been through additional process controls should display prominent notification on each shipping unit (box, package or skid).

6.10 Service parts requirements

Customers of Volvo Group products expect the same quality on service parts, including repair and maintenance, as they expect from the original equipment. Volvo Group requires that the criteria of this manual apply fully to the production and delivery of service parts or products. This includes, but is not limited to, the planning for product realization (APQP), approval process for new or changed parts (PPAP), changes to production process (PPCN), safety parts requirements, and responsiveness to corrective action requests.
6.11 Functional safety requirements

The process used for ensuring functional safety is centered on Functional Safety Joint Reviews that to a large degree are coordinated with the Software APQP reviews.

There are six Functional Safety Joint Reviews in a normal development project:

- FSJR0 Project Planning
- FSJR1 Component Development Start
- FSJR2 Detailed Safety Requirements
- FSJR3 Initial Design
- FSJR4 Final Design
- FSJR5 PPAP

The functional safety requirements applicable to supplier projects are described in a separate requirement document called Functional Safety Quality and Development Process Requirements (FS-QDPR). This FS-QDPR is based on the automotive functional safety standard ISO 26262. ISO 26262 standard is mandatory for development of safety related electronics and software.
6.12 System- or organizational changes

Volvo Group has experienced disturbances to production or deliveries as a result of changes at our supplier’s facilities. It is required that suppliers notify Volvo Group of pending changes to systems (ERP/MRP), ownership, management, or management structure.

Suppliers should notify the Buyer or SQE when these types of changes are pending. While notification of these types of changes is not required under the PPAP and PPCN requirements, suppliers are invited to use the PPCN form to notify Volvo Group of pending changes.

7. PRODUCTION REQUIREMENTS
SUPPORTING PROCESSES

While the production operations ultimately determine the quality of product, ensuring consistent quality also depends on the capability of supporting processes.

The processes described in this section do not directly determine or improve product quality, but failure of these processes has the potential to adversely affect product quality.
7.1 Product or Process Change Notification

In accordance with the IATF 16949 standard, the PPAP guidelines, and Volvo Group Purchasing conditions, a supplier cannot implement a change to a product or production process after PPAP approval, without prior approval from the Volvo Group.

All proposed changes to the product, production process, material or suppliers after PPAP must be submitted to Volvo Group for approval using the Product or Process Change Notification (PPCN) process. Requests for change must be submitted at least 12 weeks prior to the introduction of the change.

The purpose of this requirement is to prevent quality and delivery issues resulting from unapproved, untested changes or modifications after PPAP approval. This applies, but is not limited to, the following cases:

- Transferring of the production line: partly or totally; to a new or existing location, plant or building
- New production layout or changes to production line
- Change of a sub-tier supplier
- Changes of a process at a contract supplier, (surface treatment, machining, etc.)
- Packaging changes or repackaging operations
- Change at sub-tier suppliers that affect fit, form or function of the product
- Renewal of non-consumable tooling
- Change to the raw material
- Outsourcing all or part of production to a sub-tier supplier
- Request for change to product design including dimensions, tolerance, function, appearance

The supplier desiring a change shall submit a completed Product or Process Change Notification (PPCN) form to the Buyer with a copy sent to the SQE as soon as the modification project is known, and at least 12 weeks prior to the intended start of production. Some components or commodities may require a longer time to achieve full approval of changes (eg. electronics). As a general rule, suppliers should notify the Volvo Group of required changes as early as possible and obtain agreement on the implementation timing. Suppliers may be required to submit additional information to support evaluation of the proposed change [Product Validation Testing, Dimensional or Functional Reports]. The PPCN form is available on the Volvo Group Supplier Portal.

Since Volvo Group functions as a global company with manufacturing functions on most continents, suppliers must be prepared to support the impact of a change request at all impacted Volvo Group facilities. Suppliers making a process or product change must be capable and willing to provide information and resources required to secure product quality and uninterrupted deliveries.

Any proposed changes to suppliers that affect fit, form or function of the product must be submitted to the Buyer for approval as a PFA and an updated PPCN form. After receipt by the Volvo Group, the request is submitted to a team for analysis. Based on the impact on Volvo Group and the
risk associated with the change, the PPCN may have one of the following decisions:

- Authorize the supplier modification
- Ask to adapt the content of the supplier modification
- Ask the supplier to delay the implementation until extra actions/verifications are performed (actions include, but are not limited to, audits, safety stock, testing, etc.)
- Ask the supplier to cancel the proposed modification

Once approved by Volvo Group, suppliers will be notified by an official letter. Upon receipt of the approval letter, suppliers should implement the modification project according to the agreed implementation plan.

The level of PPAP documentation required to support the introduction of the change will be determined by the SQE. Authorization to start shipping (with the changes implemented) is only granted via the return of the signed PSW and/or SSW following PPAP approval.

### 7.2 Requesting deviations to specifications

In the case where the supplier wishes to request a deviation to supply parts that do not fully comply with Volvo Group requirements, the supplier must inform Volvo Group and request approval. The request must be approved prior to shipment.

Suppliers to Volvo Group Trucks and Volvo Penta may request a deviation using the Global Deviation Request form, available in the Quality section of the Library on the Volvo Group Supplier Portal. The completed form is submitted by email to the functional mailbox address listed on the deviation form with a copy to the SQE or if agreed to the Volvo Group Plant Supplier Quality (SQP). Suppliers to VBNA must complete the template and follow the process defined as specific for Nova Bus in the Library on the Volvo Group Supplier Portal.

Requests for approval are reviewed by the Volvo Group responsible Design Engineer and the SQE. If the deviation is approved, the supplier will be e-mailed a copy of the notice of approval.

All shipments made under a deviation shall be identified on the exterior of the shipping container. Specific labeling type shall be agreed between the supplier and the SQP(s) at each affected Volvo Group facility and/or the SQE, and shall include the deviation approval number.

In addition to the agreed labeling, the supplier shall inform the affected SQP(s) about the first delivery of material under deviation (shipment date, delivery note numbering). Shipments under deviation may be subjected to additional inspection upon arrival at the Volvo Group facility.

Suppliers requesting a deviation must complete an 8D response identifying the cause, corrective action, and measures taken to prevent recurrence.

**VOLVO GROUP WILL NOT APPROVE DEVIATIONS TO SAFETY CRITICAL [CC] CHARACTERISTICS, REGULATORY REQUIREMENTS CHARACTERISTICS OR ELECTRONIC COMPONENTS**

### 7.3 Lot traceability

Lot control and traceability should be established to limit the size and impact in the event of the need for product recalls or campaigns. The control system must be capable of linking production quantities to production processes to support root cause analysis activity.

When lot control is utilized, the system must establish and maintain one-to-one relationship between a lot/batch traceability number and a certain quantity of produced parts. If a traceability number, other than the serial number, is used for identifying serialized parts, a one-
to-one relationship between the traceability number and the serial number must be maintained.

The extent of definition and control shall be based on risk analysis of the product and the potential impact to customers. Suppliers are responsible to ensure that the lot traceability system maintains its integrity through the entire supply chain, including raw material, purchased components/products, and sub-contracted operations.

7.4 First In First Out inventory control
Suppliers are responsible to have inventory control systems that positively identify and control obsolete material to prevent inadvertent shipment to the Volvo Group. Where feasible, suppliers shall maintain First In First Out (FIFO) inventory management practice. The system for FIFO control must ensure controls extend to rework/repair, test activity and off-site (sub-contract) processes.

7.5 Sub-tier supplier requirements
Volvo Group Trucks requires that all sub-tier suppliers are third party registered to ISO 9001. Volvo Group strongly encourages our suppliers to support IATF 16949 certification of their sub-tier suppliers. Suppliers have full responsibility for the quality assurance and corrective action of products delivered from sub-tier suppliers for use in Volvo Group products.

Volvo Group reserves the right to have access to sub-tier suppliers and processes that could have significant impact on final product quality. This will generally concern technical processes like surface treatment, heat treating, forging, casting etc. Please check with your SQE to determine if your sub-tier or contract suppliers would fall into one or more of these categories. Access to sub-tier suppliers or approval of sub-tier suppliers by a Volvo Group Technical Specialist, does not change or reduce the supplier’s responsibility for quality of products supplied by those sub-tier suppliers.

Volvo Group requires suppliers to use the Production Part Approval Process (PPAP) and that this requirement is applied to sub-tier suppliers of products to be used in Volvo Group products. Suppliers have the responsibility for managing the PPAP at their suppliers and maintain evidence of compliance. “Catalogue Parts” may be eligible to have this requirement waived. Exemption requires a formal waiver from Volvo Group prior to shipment of parts exempted from this requirement. Contact the SQE for additional information related to obtaining a waiver for this requirement.

Once a part is approved, changes at sub-tier suppliers that affect fit, form or function must be documented and approved by Volvo Group using the Product Process Change Notification process.

7.6 Packaging
In support of the Volvo Group commitment to protecting the environment, Volvo Group has developed a process for returnable packaging and integrated logistics system. Suppliers are expected to package components according to packaging instructions that are agreed to and approved between Volvo Group and the supplier before shipment to Volvo Group. Suppliers are required to provide appropriate storage and protection for Volvo Group packaging while under their control.

7.7 Warranty
Responding to field warranty claims remains a top priority at Volvo Group. When Field Failures are determined to be the result of a supplier’s product, suppliers will be notified through receipt of a warranty claim. It is expected that suppliers will fully participate in the investigation, root cause analysis and corrective action when field failures are identified. Suppliers should have an established process for the handling, analysis, investigation, reporting and
corrective action of customer field returns. Volvo Group has developed and conducts a warranty specific process audit of supplier’s capability to manage customer field returns.

If the non-conformance is generated by a supplier, a Volvo Group warranty department may call the responsible supplier for immediate correction or replacement of products. The conditions defining response and responsibility are included in the Purchasing conditions, purchasing agreement and/or warranty charter. A copy of the warranty charter is included as part of the Request for Quotation.

7.8 Laboratory requirements

Compliance to ISO/IEC 17025 may be used to demonstrate the organization’s in-house laboratory conformity to this requirement, but it is not mandatory. Compliance to ISO/IEC 17025 is a requirement for suppliers delivering Electrical Electronic (EE) components.

7.9 Record retention

<table>
<thead>
<tr>
<th>Document type</th>
<th>Examples</th>
<th>Maintenance interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPAP documentation</td>
<td>Drawings, process flow charts, control plans, FMEAs, PSWs,</td>
<td>Duration of production and service activity plus 1 year</td>
</tr>
<tr>
<td></td>
<td>manufacturing instructions, etc.</td>
<td>(unless otherwise specified by Volvo Group)</td>
</tr>
<tr>
<td>Quality records</td>
<td>Inspection records, functional test results, material certifications,</td>
<td>3 years from date of production</td>
</tr>
<tr>
<td></td>
<td>torque, records other test results (cleanliness etc.)</td>
<td></td>
</tr>
<tr>
<td>Quality system documents</td>
<td>Internal quality system audits, product audits, management reviews</td>
<td>3 years from date of creation</td>
</tr>
<tr>
<td>Product safety related records</td>
<td>Inspection records, test results, material certifications, torque</td>
<td>10 years after product phase-out or end of production</td>
</tr>
<tr>
<td></td>
<td>records, traceability records</td>
<td></td>
</tr>
<tr>
<td>Conformity of Production parts</td>
<td>Inspection records, test results, material certifications, torque</td>
<td>10 years from date of product manufacture</td>
</tr>
<tr>
<td></td>
<td>records</td>
<td></td>
</tr>
</tbody>
</table>

The above time periods shall be regarded as minimum. Retention periods longer than those identified above may be specified by an organization in its procedures.

These requirements do not supersede regulatory requirements.
Volvo Group recognizes that the performance of the supply base has a direct and immediate impact on organizational performance. In response to this, Volvo Group has developed a system for the measurement and evaluation of supplier performance. The indicators resulting from this process are compiled every month and are reviewed and evaluated at all levels of the Volvo Group organization. These measurements are available for review on the Supplier Scorecard on the Volvo Group Supplier Portal.
Even under ideal conditions and careful preparation, problems may occur. In addition to performance, Volvo Group measures a supplier based on their cooperation in aggressively seeking to resolve problems. Suppliers are evaluated on the promptness of the initial response when notified of a problem, the timeliness of subsequent actions, and the effectiveness of actions taken to resolve the problem.

Volvo Group invites suppliers to work as partners in the problem solving process.

### 8.1 Non-conforming material

It is in the interest of both Volvo Group and the supplier, to identify and address non-conforming parts as quickly as possible. Suppliers shall take all necessary actions to respond to non-conforming product that reach a Volvo Group facility (production site, warehouse etc.). Every effort is taken to investigate and document non-conformances and to notify the supplier immediately.

Volvo Group has developed guidelines for determining the quantity of parts charged as non-conforming related to a specific IR. Any questions regarding the quantity rejected related to a specific IR and the effect on a supplier’s PPM and QPM (ref. 8.4) scores should be directed to the “Issuer” noted in the IR.

All costs (sorting, handling, shipping, rework and inspection report costs) associated with addressing a non-conformance will be the supplier’s responsibility. These costs may include any secondary costs incurred by Volvo Group resulting from a non-conformance, such as the costs associated with tear down, reassembly, re-testing, and logistics support.

Under normal circumstances, suppliers are expected to respond immediately to any non-conformance and ensure that all receiving plants are protected within 24 hours. Suppliers are required to notify Volvo Group immediately if it is suspected that non-conforming material has been shipped to a Volvo Group facility.

Depending on the type of non-conformance and material status, supplier parts may be sorted, reworked or adjusted. Supplier approval is requested before any rework or adjustment will be performed, except in circumstances where support of production need requires immediate action. Suppliers should be prepared to take any or all of the following actions after non-conforming material are identified at a Volvo Group facility:

- Expedited replacement of non-conforming material
- Provide resources to perform required sorting or rework
- Provide third party sorting resources
- Authorize Volvo Group to begin third party activities on the supplier’s behalf
- Provide instructions and acceptance criteria required to support inspection, sorting, or rework
- Provide product specific gauging

Volvo Group has agreements with third party sorting companies who are capable of providing sorting activities on behalf of the supplier. All costs associated with these third party activities are the supplier’s responsibility. Suppliers have the option to use this service or to contract a third party to do sorting or rework on their behalf. Third parties selected by the supplier must be approved by Volvo Group prior to starting any sorting or rework at a Volvo Group facility.

If not used by Volvo Group under deviation, after rework or after repair, non-conforming parts or material will be “returned to supplier” or “scrapped at Volvo Group” based on supplier’s direction.
8.2 Corrective action response

Volvo Group uses the 8 Disciplines (8D) process as common problem solving process for quality issues. Each time a non-conformance or a defect has been documented, the causes for the problem must be investigated and reported in the 8D connected to the IR. Suppliers should submit their corrective action response in the system as soon as possible, and no later than the due time.

In addition to the cause and corrective action conducted during the 8D process, suppliers should conduct root cause analysis for all major issues. Root cause analysis requires evaluation of the weaknesses within the organization processes or systems that allowed the problem to occur. Root cause generally requires management action to address the underlying systems or processes.

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<tr>
<th>AN 8D RESPONSE IS REQUIRED FOR ALL NON-CONFORMANCE</th>
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</table>

It is of vital importance that the supplier starts the problem solving process upon notification. It is critical that appropriate actions occur immediately to contain the problem and avoid any further disturbances to production or potential quality hazard. When notified of a non-conformance suppliers are requested to react in accordance with the following timeline:

- **Immediately**: Acknowledge receipt of IR and initiate containment activities.
- **24 Hours**: Begin containment activities to include sorting internally, in-transit and at Volvo Group facilities, (third party allowed). Problem analysis started. Identify other Volvo Group sites at risk.
- **48 Hours**: Containment completed and short term corrective action fully implemented.
- **10 working days**: Cause analysis complete for both occurrence and non-detection, permanent corrective action defined and implemented. (Timing starts after confirmation and acceptance of non-conformance.)
- **20 working days**: Effectiveness of permanent corrective action checked and recurrence prevented.

If the resolving time lasts longer than 20 days, the supplier must reach an agreement with either the SQE or the concerned SQP.

<table>
<thead>
<tr>
<th>8D submission response timing</th>
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</thead>
<tbody>
<tr>
<td><strong>Activity</strong></td>
</tr>
<tr>
<td>Problem identified</td>
</tr>
<tr>
<td>Containment completed</td>
</tr>
<tr>
<td>Root cause analytics and actions completed</td>
</tr>
<tr>
<td>Effectiveness verified</td>
</tr>
</tbody>
</table>

In addition to correction of the documented problem, suppliers shall apply the lessons learned to all similar products or processes (horizontal deployment). Permanent countermeasures for all defect categories should be implemented for all parts and processes.

8.3 Supplier scorecard

Volvo Group maintains a scorecard of the quality and delivery performance for each supplier that delivers parts to a Volvo Group facility. The measurements on this scorecard are regularly reviewed to track supplier performance and identify negative trends. This information is available for supplier review over the Volvo Group Supplier Portal. It is recommended that suppliers review this information on a regular basis. Regular review of their performance data allows suppliers to take action to address problems and trends before Volvo Group is required to take action with the supplier.

The scorecard is a tool for monitoring supplier performance. The scorecard is made available to suppliers to allow them to be proactive in addressing production quality issues. The scorecard can also assist in reviewing performance for negative quality trends.
The supplier’s performance is calculated for a calendar month and the scorecard is updated during the first half of the following month. Information about the latest update can be found under “information/sources”. The scorecard shows information for the prior three months, with the ratings calculation based on a three month rolling average. Information for other periods is available using the “View Performance Breakdown” page.

In addition to performance information, the scorecard contains important information related to:

- Supplier address and company structure
- SEM Audit Results
- Purchasing Contracts
- Quality Certificates
- Environmental Certificates
- REACH Compliance
- Supplier quality and delivery performance
- EDI Capability
- Supplier sales to Volvo Group
- Volvo Group Buyers
- Volvo Group SQEs
- Supplier contact persons for Volvo Group cooperation

The information in the scorecard provides a picture of how Volvo Group views the supplier ability and capability. The information in the scorecard is routinely used in making sourcing decisions.

To access this information, suppliers should contact the Volvo Group Buyer.

8.4 PPM and Quality Performance Measurement

PPM measurement is calculated as the number of non-conforming parts identified divided by the number of parts delivered, normalized over one million parts. PPM performance visible on the supplier scorecard shows PPM for the past three months.

The Quality Performance Measurement (QPM) has proven to provide a better indicator of supplier performance than by using PPM alone. QPM is a key indicator of supplier performance that reflects the impact that delivery of non-conforming parts has on the Volvo Group over the prior three months. The QPM is calculated and updated on the supplier scorecard on the second week of each month.

The QPM measurement includes the PPM, the actual number of parts rejected, the number of Inspection Reports written and the value of rejected parts compared to the value of parts delivered compensates for anomalies inherent in the PPM calculation. Example: If a supplier had 1 part from a shipment of 10 pieces rejected during a three month period, the resulting PPM for that period would be 100 000. The related QPM for this same three month period would be:

\[
\text{PPM: } 20 + \text{NCp: } 5 + \text{IR: } 0 + \frac{\text{V/V: } 20}{\text{QPM: } 45}
\]
8.5 The Volvo Group process audit

Volvo Group routinely conducts process audits as a prevention activity as well as to support corrective actions. Process audits may be performed under any of the following circumstances:

- During APQP
- During production ramp up
- New supplier evaluation
- Introduction of a new process
- Move production to a new location
- Poor quality performance
- After a major incident

In addition to the situations listed, the production processes of components that have been identified as critical to the safe, reliable function of a vehicle may be subjected to annual audits. These audits are to ensure that the production processes used during the “Significant Production Run” remain unchanged and capable of delivering consistent quality products.

Volvo Group reserves the right to perform process audits whenever it is deemed necessary. Suppliers will be given reasonable advance notice of a pending audit. A copy of the process audit template used by Volvo Group in conducting the audit is available for review on Volvo Group Supplier Portal.

One or more process audits may be required during the development and launch phases of the introduction of a new product or process. The SQE will communicate this requirement to the supplier during the development of the APQP activities. In addition to audits conducted by Volvo Group, suppliers are expected to routinely conduct internal audits of their production processes. Records of any findings from internal audits and actions taken in response to findings should be available for review during the Volvo Group process audit.

### Measurement criteria:

<table>
<thead>
<tr>
<th>Parts Per Million</th>
<th>Non-conforming parts</th>
<th>Inspection Reports</th>
<th>Volume value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPM</td>
<td>Points</td>
<td>NC parts</td>
<td>IRs raised</td>
</tr>
<tr>
<td>1-100</td>
<td>0</td>
<td>0</td>
<td>0-1</td>
</tr>
<tr>
<td>101-500</td>
<td>5</td>
<td>1-5</td>
<td>2</td>
</tr>
<tr>
<td>501-2000</td>
<td>10</td>
<td>6-25</td>
<td>3-4</td>
</tr>
<tr>
<td>2001-5000</td>
<td>15</td>
<td>26-250</td>
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<tr>
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<td>20</td>
<td>251-</td>
<td>9-12</td>
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<td></td>
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</tr>
</tbody>
</table>

### Explanation of terms:

- **Parts Per Million:**
  The number of parts rejected, divided by the number of parts delivered multiplied by 1 million
- **Inspection Report:**
  The number of IRs issued to a supplier during the three month window
- **Non-conforming parts:**
  Refers to the total number of parts returned during the months being evaluated.
- **Volume value:**
  The percentage calculated by dividing the cost of returned material for a three month period by the total value of products delivered during that same time period. This calculation compensates for the situation where suppliers may have a large number of rejects of very low value products while successfully supplying high value products but at a lower volume.

### Formula for calculating QPM:

\[ QPM = \text{PPM points (T/R type reports)} + \text{NCp points (T/R type reports)} + \text{IRs Created points (T/R/A/P type reports)} + \text{Vol val points (T/R type reports)} \]
8.6 Continuous improvements

Suppliers are expected to use the lessons learned from each incident to improve production process, product design, or underlying business systems. The goal is to eliminate the possibility of similar incidents, not only by making procedural and process adjustments on the manufacturing floor, but by removing the environment that allowed the issue to surface. Lasting improvement requires correcting the systems and strategies that support the production process.

In addition to responding to identified non-conformances, suppliers should use statistical data to continually evaluate and refine their processes. This evaluation should include analysis of quality out of control indications, high PPM, scrap, downtime, and warranty failures. The clear objective of this analysis must be reduction of variation with the finished product. The supplier shall have ongoing, active improvement projects that target two or three of the largest problem areas and be able to demonstrate a positive trend in reducing incidents and repeat occurrences.

8.7 Supplier improvement programs

Volvo Group monitors supplier performance on a monthly basis. When any of the monitored measurement parameters indicate negative performance trend or significant abnormality, the supplier is considered for elevation into a supplier improvement program.

There are different variants of supplier improvement or supplier development programs being used by Volvo Group, depending on the problem and specific situation for each supplier.

Suppliers may be notified of the potential inclusion in any supplier improvement program by a warning letter sent to the supplier’s Quality department. The letter will include the reason or reasons a supplier is being considered for entry.

A supplier can be placed in a supplier improvement program based on performance for an individual part number, multiple part number bases or organizational performance.
8. Performance measurements and corrective actions

Release

Probation Period
(Case by Case Approach)

Monitoring of Volvo Group supplier performance indicators

- WARNING
  - Send warning letter

- No Actions

- OK?

Level 1

Examples of actions
- Management Review
- Firewall at Supplier
- Process audit/SMA
- Establish action plan
- Definition of Exit Criteria

- Supplier
  - Director level
  - Volvo
  - SQE
  - SQ&D manager
  - Buyer
  - Purchasing manager

Level 2

Examples of actions
- Management Review
- Firewall by third party (at suppliers expense)
- New business on hold
- Prepare business case for backup solution
- Update/Redefine Control Tower

- Supplier
  - Top Management
  - Volvo
  - SQE
  - SQ&D manager
  - Buyer
  - Purchasing manager

- OK?

Level 3

Examples of actions
- Top Management Review
- Firewall by third party (at suppliers expense)
- Keep new business on hold
- GSC/Panel Committee Decision
- Initiate Phase Out Supplier Switch

- Supplier
  - Top Management
  - Volvo
  - SQE
  - SQ&D manager
  - Buyer
  - Purchasing manager

OK?

YES

NO

OK?

YES

NO

OK?

YES

NO

NO

OK?

NO

PHASE OUT
8.8 Field quality issues

It is in Volvo Group’s and our supplier’s best interest to solve customer quality issues as quickly as possible. Therefore, when a customer quality issue is identified as potentially related to supplier delivered parts, the supplier may receive a notification letter regarding the pending investigation. If it is determined that a formal investigation and problem solving activity is required, suppliers will be invited to join a formal Kick-Off meeting. During this meeting the scope of the problem is defined, the plan for investigation, and the timing for resolution is presented. Suppliers are invited to participate in the investigation and expected to provide all needed support required for timely resolution of the problem.

When Volvo Group detects an issue in the field and assess that a purchased part is either directly or indirectly involved, Volvo Group will request supplier support in order to investigate the case and fine tune the problem description (1D phase).

Volvo Group expects the following outcome from the pre-investigation:

- Parts analysis
- Initial cause analysis
- Estimated failure occurrence
- Proposed containment action

Following the pre-investigation Volvo Group will decide the most appropriate solving process. A field quality issue could be resolved using either the Quick Solving Process (QSP) or Quality Journal (QJ) process. Both processes follow the 8D methodology:

The QSP is applied when the failure is related (directly or indirectly) to a supplier part that is found to deviate from the technical specifications for the part (e.g., manufacturing process deviation)

- The solving process will be led by the supplier and Volvo Group will monitor progress of the implementation and verification of the solution
- An 8D report is required for all QSP
- Expected solving lead time is the same as for Inspection Reports (ref. 8.1)

The QJ process is applied for critical and complex cases where the problem is determined to be related to Volvo Group design or process where a supplier part or product is involved

- The supplier will be notified by an official letter of the opening of a QJ
- The QJ will be led by Volvo Group, the supplier is expected to take an active part in the cross-functional work
- Expected solving lead time is communicated in the QJ notification letter

Other solving processes, based on PDCA or DMAIC methodologies, are also used in some parts of Volvo Group.
Glossary

8D  8 Disciplines, a problem solving method
AIAG  Automotive Industry Action Group
APQP  Advanced Product Quality Planning
[CC]  Critical Characteristic
CG  Concept Gate
COP  Conformity of Production
Cpk  Capability Analysis Index
CPOT-IPD  Conforming Part Out of Tool-In Plant Delivery
C Builds/P Builds  Physical build to confirm product design and verify production solution, based on C/P release
DCP  Dimensional Control Plan
DG  Development Gate
DVP  Product Development Process
ECHA  European Chemicals Agency
EDI  Electronic Data Interchange
EE  Electrical Electronic
EG  End Gate
E-Library  A library of documents and procedures on the Volvo Group Supplier Portal
ERP  Enterprise Resource Planning
Fault Frequency  Measure of product failures occurring on product after delivery to customer
FDG  Final Development Gate
FIFO  First In First Out
FIG  Final Industrialization Gate
FMEA  Failure Modes Effects Analysis
IATF  International Automotive Task Force
IDM  Identity Manager
IMDS  International Material Data System
Index Audit  An audit conducted on a technology related production process
IR  Inspection Report
Key Element Procedure  A series of guideline procedures for companies doing business with Volvo Group
MP  Measurement Point Plan
MRP  Material Resource Planning
OEE  Overall Equipment Effectiveness
OR  Only Representative
PAA  Part Application Agreement
PHR  Part Handling Review
Poka Yoke  A Japanese term for error proofing
PPAP  Production Part Approval Process
PPCN  Product or Process Change Notification
Ppk  Performance Analysis Index
PPM  Part Per million
Product Audit  Audit of samples taken from production process
PSW  Part Submission Warrant
PVR  Part Version Report
QDCF  Quality Delivery Cost Feature
QDCFTSR  Quality Delivery Cost Feature Technology Sustainability Risk Management
QDPR  Quality and Development Process Requirements
QJ  Quality Journal: Volvo Group internal problem solving process for field failure issues
QPM  Quality Performance Measurement
QSP  Quick Solving Process: Problem solving process for field issues related to manufacturing processes (not design)
REACH  Registration, Evaluation, Authorization and Restriction of Chemicals
RFQ  Request for Quote
RG  Release Gate
RTS  Review of Technical Specification
[S]  Significant Characteristic
SEM  Supplier Evaluation Module
Service PPAP  Service Production Part Approval Process
SMA  Safety Management Audit
SOW  Statement of Work
SPC  Statistical Process Control
SPICE (CL3)  Software Process Improvement and Capability dEtermination (Capability Level 3)
SPR  Significant Production Run
SQE  Supplier Quality Engineer
SQP  Plant Supplier Quality
SREC  Supplier Request for Engineering Change
SEM  Supplier Evaluation Module
SSW  Software Submission Warrant
Stopping Parameter  Issue in SEM where failing score eliminates supplier from consideration for business
STD  Standard
SW  Software
SWTP  Software Test Plan
SWTR  Software Test and Verification Report
SWVD  Software Version Description
TR  Technical Requirements
VBN  Nova Bus and Prevost Bus
VCE  Volvo Construction Equipment
### Revision record

<table>
<thead>
<tr>
<th>Edition</th>
<th>Revisions description</th>
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<tr>
<td>01-2009</td>
<td>First release</td>
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<tr>
<td>03-2019</td>
<td><strong>Key changes:</strong></td>
</tr>
<tr>
<td></td>
<td>● Replace ISO/TS 16949 with IATF 16949</td>
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<tr>
<td></td>
<td>● Replace KEP 5 &amp; 6 with Volvo Group Supplier Code of Conduct</td>
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<tr>
<td></td>
<td>● Addition of QCDFTSR acronym and definition</td>
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<tr>
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<td>● Expanded definition of safety critical parts</td>
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<td>● Digital shape model compliance added to customer specific requirements</td>
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<td>● Cleanliness audit added to index audit list</td>
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<tr>
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<td>● Sustainability audit requirement added</td>
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<tr>
<td></td>
<td>● Revise the software and safety reviews and graphic</td>
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<tr>
<td></td>
<td>● DSM, COP and RTS requirements added to PPAP documentation documentation</td>
</tr>
<tr>
<td></td>
<td>● Functional safety Requirements added</td>
</tr>
</tbody>
</table>

### Concluding words

“Together with our suppliers and partners, we are on an exciting journey. The transport industry is entering disruptive times. Change is coming faster with shorter development cycles than ever seen before.

By being part of transforming the society and the transport solutions, strategic partnerships are of utmost importance. Collaboration and co-creation is a prerequisite to meet the future customer and market demands, thus, your competence and knowledge will be a key competitive advantage for the Volvo Group.

With a base of some 51,000 suppliers around the world, we partner to leverage from each other’s strengths for the benefit of everyone – including our customers and society as a whole.

I hereby thank all of our suppliers and partners who are part on our journey and mission in driving prosperity through transport solutions.”

ANDREA FUDER  
CHIEF PURCHASING OFFICER, VOLVO GROUP