

# **Supplier Quality Requirements**

## **Business Sector – Mobility Solutions**

### **Summary & Explanations**



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## 0 Preface

Bosch expects quality from their suppliers for each aspect of cooperation. To support the implementation of a shared quality strategy in a spirit of partnership, quality requirements have been defined based on the standards of the automotive industry.

This manual explains those quality requirements, applicable for supplies to Bosch Business Sector Mobility Solutions for use in the Bosch automotive sector or in Bosch automotive products. It is intended to help achieve the zero defect target.

The requirements apply to all deliveries of products, materials, services and digital goods to Bosch (software, data and IT-Services, in further text collectively referred to as: “product”).

The information contained in this document is provided for informational purposes only. The points explained herein shall not impose any restrictions on any referenced law or regulation, existing or future legal requirements, applicable contracts or on any other requirements or obligations agreed upon between Supplier and Bosch.

For easier readability, this manual uses the short terms “**Supplier**” and “**Bosch**”.

## 1 Requirements for Management Systems

### 1.1 Quality Management System

Following IATF 16949 requirements, Suppliers manufacturing locations have to

- maintain a certified management system in accordance with IATF 16949 or are
- obliged to develop such a system.

Supplier has to provide Bosch with copies of the relevant valid certificate on its own accord. A convenient way to do this is to maintain certificates with the support of Supply On. Further information is available here: <https://www.bosch.com/company/supply-chain/information-for-business-partners/>.

Suppliers of digital goods sign to accomplish and prove requirements by ASPICE, e.g. through self-assessments. The evidences for digital goods have to be provided to Bosch upon request.

Furthermore, Supplier has to ensure that all applicable state-of-the-art, industry specific and / or material field specific requirements (e.g. AIAG, VDA, DIN) are fulfilled.

If a renewed certificate is issued with delay, Supplier has to notify Bosch before expiration of the current certificate, and provide information about the expected date of recertification. After re-certification, supplier has to immediately present the confirmation of a successful re-certification by the certification body.

Supplier has to inform Bosch immediately in the event that any of the above certificates are withdrawn.

### 1.2 Environmental Management System

Supplier has to introduce and develop an environmental management system (EMS) analogous to ISO 14001 or an environmental management system that is appropriate to the specific industry.

### **1.3 Sub-Suppliers Management System**

Supplier has to make sure that its sub-suppliers adhere to the same quality and environmental management system standards.

Supplier has as well to ensure that its sub-suppliers fulfill all applicable state-of-the-art, industry specific and / or material field specific requirements.

Supplier shall take appropriate steps to confirm the effectiveness of the sub-suppliers' management systems.

This principle applies equally to sub-suppliers defined by Bosch (Bosch directed buy).

## 2 Assessments and Audits

To ensure that Bosch requirements regarding management systems or processes are met by Suppliers or sub-suppliers, Bosch may conduct audits or assessments.

Before any audits or assessments, Bosch informs Supplier and assures agreement. In some urgent cases short term planning may be required, e.g. in case of quality issues.

For the audits and assessments Supplier allows Bosch, and if necessary Bosch costumers, access to all involved locations e.g. production locations, commercial areas, test centers, warehouses and adjoining areas as well as to all quality-related documents. Supplier may take all necessary and reasonable measures to safeguard proprietary material.

With appropriate technical equipment and agreed handling conditions, it is also possible to do a remote visit via livestream to reduce efforts for Bosch and Supplier.

Bosch informs Supplier about the result of these audits or assessments. If non-conformities or opportunities for improvements are identified, Supplier

- has to prepare a corrective action plan within the applicable time limit,
- shall implement the corrective actions, and
- shall inform Bosch on its progress as appropriate.

If quality problems originate from a sub-supplier, Supplier shall make it possible for Bosch to conduct an audit or assessment at this sub-supplier, if needed.

If Supplier or a sub-supplier have justified objections against the participation of Bosch at an audit or assessment, Bosch will accept audit results performed by a neutral party (third-party).

The audits / assessments listed in the following chapters are conducted by Bosch. This list is not exhaustive, further audits or assessments may be conducted as needed.

### 2.1 VDA 6.3 potential analysis (P1)

A potential analysis is used to evaluate new suppliers. For existing suppliers the potential analysis is used for new manufacturing locations or the introduction of new technologies.

In the P1 analysis, an estimation is made of the supplier's potential to meet the requirements for the requested products and corresponding processes.

The analysis takes into account the experience and skills of the supplier in developing and manufacturing the scope of requested products and their capability to fulfil customer specific requirements for the product and process implementation.

The assessment is based on existing processes for products manufactured at that specific location (if necessary, similar competitor products).

The result gives a forecastis of the quality capability of the considered supplier / location / technology for the implementation of the product and process. It is used for the preparation of a nomination decision [see VDA 6.3; 2016].

### 2.2 VDA 6.3 Audit

The goal of the VDA 6.3 process audit is to check the conformity of the processes / process steps with the requirements and specifications. Any deviations identified during the audit are documented as audit

findings and evaluated based on the product risk and / or the process risk within the audited organization or in the supply chain. The evaluation considers the resulting risks if the findings indicate that non-compliant products can be expected [see VDA 6.3; 2016].

A process audit can examine the following topics:

- P2: Project management
- P3: Planning the product and process development
- P4: Implementation of the product and process development
- P5: Supplier management
- P6: Process analysis production
- P7: Customer care/customer satisfaction/service

Each process audit is tailored to the specific audit goal. Specialized additional questions, e.g. for heat treatment, may be asked during the audit.

## 2.3 IATF 16949 Compliance Audit

A Compliance Audit IATF 16949 is a system audit to evaluate the compliance of the quality management system with the requirements of IATF 16949.

The goal of Compliance Audits IATF 16949 is to support the development of ISO 9001 QM systems with the ultimate objective of becoming certified to IATF 16949.

Audit criteria of Compliance Audits IATF 16949 are the requirements of IATF 16949 without corresponding requirements of ISO 9001. Following a risk-based approach audit findings are evaluated with reference to product risk and / or process risk. Applying the PDCA-cycle follow-up process for the actions supports the further development of supplier's QM system.

## 2.4 14 Q Assessment

14Q Basics are the fundamental quality enablers to avoid errors in the value stream.

The 14Q Basic assessment questionnaire allows Bosch and Suppliers to check the implementation of the 14Q Basics on the shop floor.

The assessment results in a maturity level. There are four levels, with defined criteria for each level. All criteria have to be fulfilled to reach a certain maturity level.

Further information and the assessment questionnaire is available in the QBasics App (available for iPads only) or on the Bosch purchasing homepage, <https://www.bosch.com/company/supply-chain/information-for-business-partners/>.

### 3 Cooperation for new products

For new products, cooperation between Bosch and Supplier is aligned to Bosch's product development process. One main goal is to assure product quality within the supply chain. Activities to reach this goal are for example:

- Technical discussions
- Confirmation of feasibility
- Preventive Quality (see chapter 4)
- Risk Management (see chapter 4)
- Initial sampling (see chapter 4)
- Safe launch activities (see chapter 4)

#### 3.1 Contract Review & Feasibility Confirmation

As part of contract review, Supplier shall examine upon receipt all technical documents to ensure their implementation. Technical documents are e.g. parts lists (Bill of Material), specifications, drawings, CAD data, packaging specification and standards. Supplier shall immediately inform Bosch of any deficiencies and risks identified during the review as well as of any improvement possibilities.

Bosch expects the Supplier to provide a written confirmation of feasibility before final awarding of the contract. Bosch form can be downloaded ([🔗 https://www.bosch.com/company/supply-chain/information-for-business-partners/](https://www.bosch.com/company/supply-chain/information-for-business-partners/)).

Supplier's confirmation of feasibility shall not replace the internal feasibility analysis, which must be available to Bosch for review purposes. Any documentation used for analysis purposes shall remain with the Supplier.

#### 3.2 Product Development

If the order to Supplier includes development tasks, the requirements shall be defined by the contracting partners, e.g. in the form of a specification sheet.

#### 3.3 Project Management

The Supplier provides project management in the planning phase for processes, products, procedures and other cross-departmental tasks. This is documented by quality management and project management plans and provided to Bosch as evidence.

#### 3.4 Prototypes and Pilot Series

For prototypes and pilot series, the Supplier coordinates the prototypes and pilot series with Bosch and documents respective activities. The pilot series are produced under near-series conditions.

Bosch may request sample parts for prototypes and pilot series. Specific definitions are made on a case-by-case basis.

Prototypes and pilot series parts must be packed separately from the serial deliveries. The packaging units must be clearly marked (e.g. Attention: prototypes / pilot series parts).



## 4 Preventive Quality

As part of project management activities, Supplier initiates and conducts preventive quality activities, such as e.g. feasibility analysis, management of characteristics, reliability checks, risk analysis, FMEA, inspection planning. Furthermore, Supplier maintains and documents a continuous improvement process, e.g. as part of a "lessons learned" process.

This includes a systematic evaluation of experiences e.g. from ramp-up validation and complaints. The information gained from this must be incorporated in the Supplier's QM system standards (e.g. production control plan, FMEA).

Bosch may request and conduct additional preventive quality activities.

### 4.1 Management of Characteristics

To assure series quality, supplier performs process planning (work plans, inspection plans, resources, tools, machines, etc.) for all characteristics.

Additionally, Bosch identifies important characteristics (incl. special characteristics) and defines requirements for their inspection and documentation.

Bosch calls this procedure "Management of Characteristics".

The procedure includes

- classification of those characteristics @ Bosch
- communication of those characteristics to the Supplier (via "Important Characteristics List")
- explanation of the form sheets used
- requirements of Bosch for those characteristics with regard to
  - Management in the Supply Chain
  - Inspection planning in the Supply Chain
  - Measurement System Analysis
  - Process Capability Studies
  - Process Monitoring
  - Data Recording
  - Documentation within Control Plan(s)
  - Labeling in documents.

#### 4.1.1 Classification of Characteristics

Bosch classifies characteristics (including potential and confirmed Special Characteristics) with the intent to:

- establish safeguards (quality control loops) for this characteristics in the entire value stream
- install an efficient and effective production control in the entire value stream
- improve product quality in terms of:
  - safety

- compliance with regulatory as well as legal requirements
- functional fulfilment
- create a common understanding of characteristic management in the affected areas (e.g. product view vs. process view)
- minimize manufacturing defects
- ensure that appropriate safeguards are defined for confirmed special characteristics.

Bosch has defined four classes of characteristics:

CLASSIFICATION	EXPLANATION
<b>A</b>	<ul style="list-style-type: none"> <li>• Confirmed special characteristics</li> </ul>
<b>B</b>	<ul style="list-style-type: none"> <li>• Potential special characteristics</li> <li>• Process relevant characteristics</li> <li>• “not functionally robust” and “manufacturing method robust” characteristics</li> <li>• “functionally robust” and “not manufacturing method robust” characteristics</li> </ul>
<b>C</b>	<ul style="list-style-type: none"> <li>• “functionally robust” and “manufacturing method robust” and “not process relevant” characteristics</li> <li>• “not functionally relevant” and “not process relevant” characteristics</li> </ul>
<b>Bosch classification + customer requirements</b>	<ul style="list-style-type: none"> <li>• Customer requirements and Bosch classification (A or B or C) have to be considered [- / C]</li> </ul>

*Table 1: Classification of Characteristics*

For those classes, specific inspection strategies are predefined and have to be implemented for the communicated characteristics.

## 4.1.2 Rules for classes of characteristics

### 4.1.2.1 Rules for characteristics with classification A

Class A applies to **confirmed Special Characteristics**.

For class A characteristics no defective parts are allowed.

Therefore, the predefined inspection strategy is failure sorting by:

- Direct 100% inspection
- In-direct 100% inspection
- Poka Yoke (detection or prevention).

Additionally, for class A characteristics an appropriate Measurement System Analysis (MSA) is required. MSA requirements are defined in chapter 4.2.2.

#### Remarks:

Special Characteristics according to IATF 16949:2016, chapters 3.1 and 8.3.3.3, are product characteristics or production process parameters that may have an impact on

- safety or compliance with official (legal) regulations, (S, G)
- fit, function, performance or further processing of the product (F).

Special Characteristics must be identified by an organization. They have to be measurable or testable and need to be considered during inspection planning as inspection characteristics; they must be secured controlled and monitored) in the relevant manufacturing processes.

They are included in the Control Plan.

Bosch used term “Confirmed Special Characteristics” defines functionally relevant characteristics, which are “not functionally robust” and “not manufacturing method robust” und cannot be manufactured with the required process quality.

In VDA vol. 1, the term "critical characteristics" is used for special characteristics with regard to safety and legal relevance.

The term "production process parameter" used in IATF 16949:2016 refers to process characteristics.

The extension `/C` identifies a special characteristic specified by a customer from Bosch.

The abbreviation PTC “Pass Through Characteristics” identifies potential and confirmed Special Characteristics on purchased parts that are solely ensured with a Supplier inspection.

#### 4.1.2.2 Rules for Characteristics with Classification B

Class B applies to

- Potential Special Characteristics
- Process relevant characteristics
- “not functionally robust” and “manufacturing method robust” characteristics
- “functionally robust” and “not manufacturing method robust”

For class B characteristics, a defined process quality is required.

Therefore, at least one of the following predefined inspection strategies has to be implemented:

- **Process monitoring**
  - Failure prevention
    - In-process control
    - Poka Yoke
    - Statistical Process Control (SPC) incl. regular Cpk-verification
  - Failure detection
    - Process parameter monitoring
    - Regular Cpk-verification
    - Acceptance chart incl. regular Cpk-verification
  - Sampling inspection
- **Failure sorting**
  - Direct 100% inspection
  - In-direct 100% inspection
  - Poka Yoke (prevention or detection).

It is often necessary to define multiple inspection strategies for one characteristic.

Additionally, for class B characteristics an appropriate Measurement System Analysis (MSA) is required. MSA requirements are defined in chapter 4.2.2.

Standard requirements for process capabilities are listed in table 2.

INSPECTION STRATEGY	INSPECTION STRATEGY – DETAIL	MACHINE CAPABILITY	PROCESS CAPABILITY	PROCESS MONITORING	REMARKS
		<i>C<sub>mk</sub></i>	<i>C<sub>pk ST</sub></i>	<i>C<sub>pk</sub></i>	
Process monitoring	Regular Cpk verification	x		x	For initial sampling, either C <sub>mk</sub> or C <sub>pk-ST</sub> is possible.
	SPC incl. regular Cpk verification	x		x	
	Acceptance chart incl. regular Cpk verification	x		x	
	sampling based inspection	x	-	-	

Table 2: Process Capability Requirements for Class B Characteristics

Process capability requirements are defined in chapter 4.2.3.

Remarks:

- A characteristic is "not functionally robust" if the characteristic leads to a failure immediately after the tolerance limit is exceeded, or if the characteristic at the tolerance limit is a large contributor to a failure (expert decision).

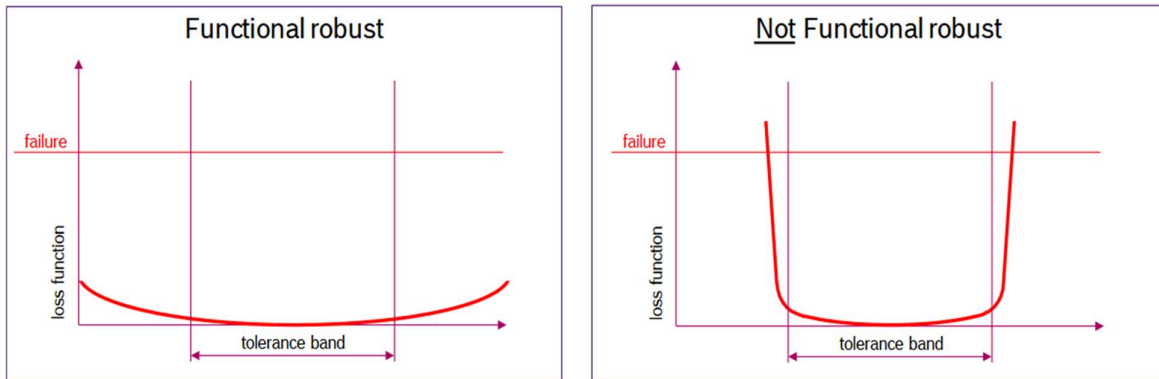


Figure 1: Functional robust / not functional robust

- Product characteristics are "not manufacturing method robust", if there is a high likelihood of exceeding the tolerance for the chosen manufacturing method. That means the product characteristic is failure sensitive for the chosen manufacturing method.

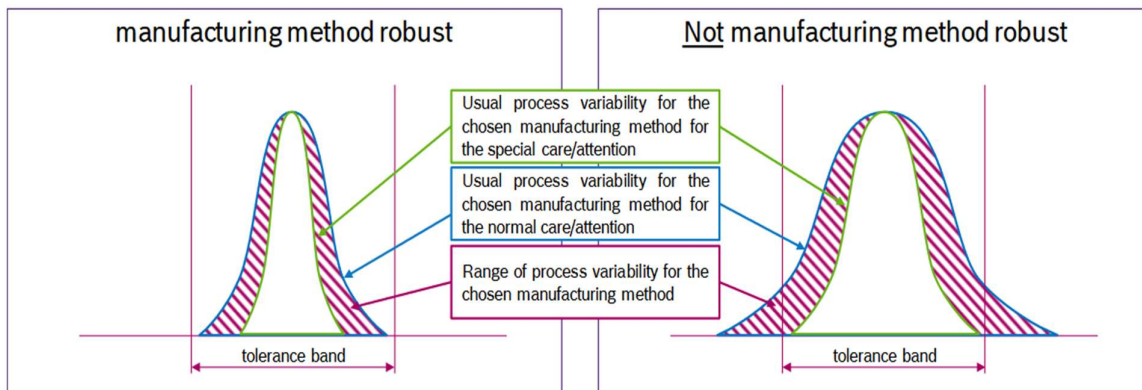


Figure 2: Manufacturing method robust / not manufacturing method robust

- Potential special characteristics are characteristics, which are "not functionally robust" and are "not manufacturing method robust". They are the basis for the identification of confirmed special characteristics.  
Potential special characteristics which are relevant for safety (S) or compliance with official (legal) regulations (G) always become confirmed special characteristics (class A).  
For potential special characteristics which are relevant for fit, function, performance or further processing of the product (F), proof of achieved process quality is necessary. If defined process quality the characteristic becomes a confirmed special characteristic. Otherwise it remains as class B.

- Process relevance:  
Product characteristics can be defined as process relevant if they
  - have a significant impact on a subsequent process
  - are defined as an indicator of tool wear
  - are defined as an indicator of process behavior.

#### 4.1.2.3 Rules for Characteristics with Classification C

Class C applies to

- “functionally robust” and “manufacturing method robust” and “not process relevant” characteristics
- “not functionally relevant” and “not process relevant” characteristics

Class C characteristics are not listed on the ICL. Class C characteristics are part of the measurement of all characteristics during initial sampling (PPA/PPAP).

Class C characteristics have to be included in the respective layout inspection and functional testing (requalification).

### 4.1.3 Communication & Implementation of Management of Characteristics – ICL

#### 4.1.3.1 Communication & Implementation: Bosch to Supplier

Bosch summarizes Important Characteristics in a document called “Important Characteristics List” (ICL). Bosch communicates the ICL to Supplier during the product development phases, several drafts and versions may be necessary.

For all characteristics contained in the ICL, an inspection strategy for the series production must be defined. This definition must be documented in the control plans, identified with specific markings corresponding to the ICL.

#### Remarks:

Bosch uses two different forms for the communication of the important characteristics. Differences between them are as follows:

- For new projects / in case of major changes Bosch uses a form that contains the characteristics and their classification as explained before. The related rules apply. Results for MSA, capabilities etc. will be requested during initial sampling (PPA/PPAP). Evidence for those requests are part of the initial sampling documentation.

Important Characteristics List - ICL																
Supplier:		Supplier-No.:		Date:												
Part-No.:		Description:		ICL issued by:												
BOM change no.:		BOM change date: (optional)		ICL issue no.:												
DRW change number (+ optional: Index):		DRW change date:		Supplier signature:												
Remarks:																
No.	Product Characteristic	Process Characteristic	Specification					Bosch Customer Special Characteristics	with Bosch Customer agreed Control	Bosch Allocation regarding Functional/ Legal/ Safety-Relevance	Required Process Quality	Pass Through Characteristic	Process Relevance	Characteristic => Status definition	Characteristic => Classification:	specific and / or additional requirements; comments
			Nominal Value	Control Spec. Minimum tolerance	Control Spec. Maximum tolerance	Control Spec. Process tolerance	Unit	SK; GK; FIC; ...	(e.g.: Inspection method, inspection strategy)	S, G, F; not relevant	SG = Zero Failure F = e.g. ppm, Cpk, ...	PTC: -	reason for "process relevance"	examples for status definition: - potential Special Characteristics - Special Characteristics - Inspection Characteristics - ...	A, B, C; + additional customer requirements, if applicable	

Figure 3: Form ICL (new)

2. For existing projects Bosch uses a form which contains explicit requirements for

- Measurement System Analysis
- Process Capability Studies
- Process Monitoring
- Data Recording

within the form.

Supplier needs to record results in the form and submit the filled form as documentation of evidence during initial sampling (PPA/PPAP).

Important Characteristics List - ICL															<CP/IP>				
CP Automotive Purchasing		Supplier: _____		Supplier-No.: _____		Part-No.: _____		Description: _____		Date: _____									
		BOM change no.: _____		DRW change number (+ optional: Index): _____		BOM change date: (optional) _____		DRW change date: _____		issued by: _____									
		Remarks: _____								issue no.: _____									
<div style="display: flex; justify-content: space-between;"> <div> <p>Yellow fields have to be filled by supplier if entry is required.</p> </div> <div> <p>Requirements for Evidence during Initial Sampling Process</p> </div> <div> <p>Requirements for Series Production</p> </div> </div>																			
no.	grid square	important characteristic	values		special characteristic if pass through characteristic	measuring equipment	MSA for measuring equipment				machine capability (n=50)	initial process studies / preliminary process capability (short term n=125)	SPC (incl. C <sub>pk</sub> or P <sub>pk</sub> as defined within specifications)	Process control / process monitoring	C <sub>pk</sub> / P <sub>pk</sub> reporting to Bosch	remarks			
			target	+tol	-tol	S G F IC PTC		REQUIRED	C <sub>pk</sub> ≥ 1,33	C <sub>pk</sub> ≥ 1,33	GRR ≤ 10%	Final Approval	REQUIRED	C <sub>pk</sub> ≥ 1,67	REQUIRED	C <sub>pk</sub> ≥ 1,67	REQUIRED	method: (e.g.: X <sub>bar</sub> , s/R, inspection chart, original value) frequency: _____	other B-safeguards (e.g.: deformation by improper fastening test, SPC, material and structure analysis, etc.)

Figure 4: Form ICL (old) for existing projects

#### 4.1.3.2 Communication & Implementation: Suppliers to Sub-Tier Suppliers

Each supplier has to communicate the requirements for sub-components to the respective sub-tier suppliers.

Sub-tier suppliers have to include relevant characteristics from this subset of the ICL in their control plan and mark them accordingly.

Supplier has to check the implementation at sub-tier suppliers at least during PPA/PPAP evaluation.

## 4.2 Capabilities - general information

Capability studies are carried out in order to statistically describe the behavior of measurement processes, machines and production processes. The results are used to derive a prediction of future behavior.


If it is not possible to verify a product characteristics by means of process capability key figures (e.g. for welding, heat treatment casting, rolling, surface coating), the proof of process capability (process quality) is to be provided through secondary characteristics, or a correlated non-destructive 100% test is to be used.

In cases that exclude such an option, other suitable verification methods must be used to assure for process safety for the specific standard parts (e.g. random spot check frequency, boundary samples).


Standard methods for measurement process capability analysis (measurement system analysis) are described in

-  Bosch Booklet No. 10, Capability of Measurement and Test Processes.

Standard methods for machine and process capability analysis are described in

-  Bosch Booklet 9, Machine and Process Capability.

Standard methods for determining the measurement uncertainty are described in

-  Bosch Booklet No. 8 Measurement Uncertainty.

Standard methods for statistical process control are described in

-  Booklet 7 Statistical Process Control.

Those booklets are available here: <https://www.bosch.com/company/supply-chain/information-for-business-partners/>.

#### 4.2.1 Actions in Case of Non-Capable Processes

It has to be ensured that each non-capable production process only delivers parts that conform to all specifications. This can be achieved either

- by an inspection (e.g. 100%-inspection) using a capable measurement process or
- other adequate measures (e.g. functional testing during successive process steps, risk analysis, decision / approval by management).

If process capability cannot be proven by means of the available inspection equipment, either the equipment has to be replaced with suitable equipment or a further tolerance study of the inspection characteristic has to be carried out. If practical, measurement uncertainty studies have to be carried out in order to optimize capabilities.

In the case of conditionally capable and definitively non-capable measurement processes the tolerance range of the inspection characteristic has to be reduced at the upper and / or lower specification limit by the expanded measurement uncertainty to the range of conformity. If the tolerance range cannot be reduced and Bosch requirements cannot be met, suitable agreements have to be arranged with Bosch.

#### 4.2.2 Measurement process capability (Measurement System Analysis)

The verification of capability has to be provided by means of measurements and tests at the place of operation of the measuring or test systems and through statistical analysis of the results. Statistical analysis is only reasonable for measuring and test systems that conduct a sufficiently large number of similar recurring measurements and tests (e.g. in the production flow) and it is valid for the examined characteristic only. If measurements and tests of different characteristics are done with the same measuring or test system, individual verification of capability is required for each characteristic.

##### 4.2.2.1 Verification of capability for measurement processes for continuous (variable) characteristics

Generally, it is a pre-requisite that the capability criteria according to procedure 1 (type-1 study) are met in order to perform one or more of the procedures 2 – 5.



Procedure 1:

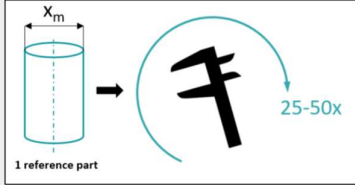
PROCEDURE	EXPLANATION	CAPABILITY CRITERION
Procedure 1 (type-1 study)  Systematic measurement error and repeatability  	Verification of the capability of a measurement process in terms of location and variation of measured values within the tolerance field of this characteristic (as a test process for a particular characteristic).  Measurement of master part incl. handling and clamping min. 25x ( $cgk \geq 1,67$ ) or standard 50x ( $cgk \geq 1,33$ ).	Compliance with specified minimum values for Cg and Cgk.  The following limits apply: 1. $Cg \geq 1.33$ and 2. $Cgk \geq 1.33$

Table 3: MSA Procedure 1

Remarks:

- Procedure 1 has to be used before procedure 2 or 3, respectively. If there are several measuring systems that are identical in construction and if capability according to procedure 1 was already proven for one of these systems, it must be decided whether procedure 1 is required for the other measurement systems as well.
- Same measurement position on part must be assured for all measurements (stable condition of master part)

Procedure 2:

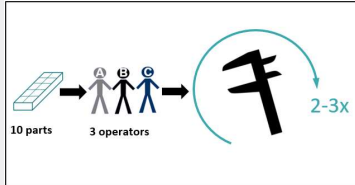
PROCEDURE	EXPLANATION	CAPABILITY CRITERION
Procedure 2 (type-2 study)  Repeatability and reproducibility (gage R&R) with operator influence  	Verification of the capability of a measurement process (as a test process for a particular characteristic) in terms of its variation behavior using measurements of serial parts.  Measurement of 10 serial parts for 2-3 runs by a minimum of 3 operators, incl. handling and clamping (random measuring sequence).	Compliance with the specified limiting value for the variation %GRR of the measurement process.  The following limits apply: 1. $\%GRR \leq 10\%$ : measurement process is capable 2. $10\% \leq \%GRR \leq 30\%$ : measurement process is conditionally capable 3. $\%GRR \geq 30\%$ : measurement process is not capable

Table 4: MSA - Procedure 2

Remarks:

- If operator influence is possible, measurement process capability must normally be verified with procedure 1 together with procedure 2 (type-2 study).
- Ensure same measurement position on part for all measurements (position marks)
- Ensure serial inspection conditions incl. all handling and clamping steps for each measurement
- Finish the first run for all parts / operators before starting with the 2nd run
- Use different measuring sequences in both runs (mix parts)
- A type-2 study resulting in a non-capable measurement process is not necessarily due to the measuring system. For example, it may also be caused by the inhomogeneity of the characteristic of the production parts. An appropriate analysis is required.

Procedure 3:

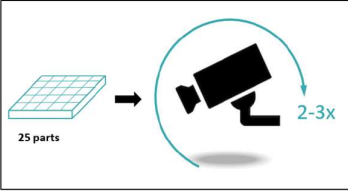
PROCEDURE	EXPLANATION	CAPABILITY CRITERION
Procedure 3 (type-3 study)  Repeatability and reproducibility (gage R&R) without operator influence  	Verification of the capability of a measurement process (as a test process for a particular characteristic) in terms of its variation behavior using measurements of serial parts without operator influences.  Measurement of 25 serial parts for 2-3 runs incl. handling and clamping (random measuring sequence).	Compliance with the specified limiting value for the variation %GRR of the measurement process.  The following limits apply: <ol style="list-style-type: none"> <li>1. <math>\%GRR \leq 10\%</math>: measurement process is capable</li> <li>2. <math>10\% \leq \%GRR \leq 30\%</math>: measurement process is conditionally capable</li> <li>3. <math>\%GRR \geq 30\%</math>: measurement process is not capable</li> </ol>

Table 5: MSA Procedure 3

Remarks:

- If operator influence is not possible, the capability must be verified with procedure 1 together with procedure 3 (type-3 study).
- If possible ensure same measurement position on part for all measurements (position marks)
- Ensure serial inspection conditions incl. all handling and clamping steps for each measurement
- Finish the first run for all parts before starting with the 2nd run
- Use different measuring sequences in both runs (mix parts)

Procedure 4:

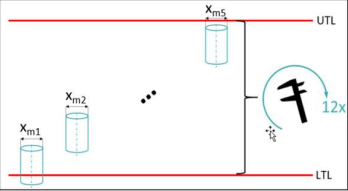
PROCEDURE	EXPLANATION	CAPABILITY CRITERION
Procedure 4  Linearity  	Verification of a sufficiently linear relation between the values of a physical quantity to be measured and the corresponding measured values determined by the measuring system. This procedure determines whether the systematic measurement error of the measuring system is within the acceptable limits regarding the measuring range relevant for the measurement.  Measurement of 3-5 master parts for 12 runs incl. handling and clamping (random measuring sequence)	Maximal systematic deviation from reference: <ol style="list-style-type: none"> <li>1. <math>\leq 5\%T</math> = capable</li> <li>2. <math>\leq 10\%T</math> = conditionally capable</li> </ol>

Table 6: MSA Procedure 4

Remarks:

- The linearity of a measuring system is generally tested by the manufacturer and subsequently as part of its regular calibration. An additional check as part of a capability study is usually not required. However, special applications can require proving sufficiently linear behaviour of the measuring system (e.g. adjustable response curve, logarithmic scale).

Procedure 5:

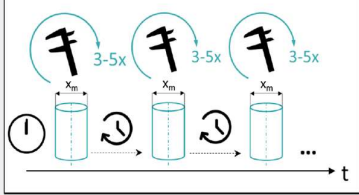
PROCEDURE	EXPLANATION	CAPABILITY CRITERION
<p>Procedure 5</p> <p>Stability</p> 	<p>Validation of consistently correct measurement results by monitoring the long-term behavior of a measurement process and corresponding evaluation of the stability of the measuring system (similar to an <math>\bar{x}s</math>-SPC control chart whereas a measurement process is not controllable in terms of a SPC process).</p> <p>Measurement of a master part (stability part) in an appropriate sampling interval. 3-5 measurements per check incl. handling and clamping. Documentation of values in <math>\bar{x}s</math>-chart</p>	<p>The stability of a measurement process is evaluated by means of the stability- (<math>\bar{x}s</math>-) chart.</p> <p>All values (usually the mean values) are within the control limits and vary unsystematically (randomly). There are no indications of instability.</p>

Table 7: MSA Procedure 5

Remarks:

- Preconditions: cgk and %GRR capable, active maintenance plan for equipment
- Procedure 5 is additionally intended for measurement processes with presumably insufficiently stable long-term behaviour
- If the measurement process is shown to be stable according to the stability chart over a long period of time, the sampling interval may be increased.
- If a measurement process is shown to be stable according to a greater number of subsequent stability charts, stability monitoring may be completed. The following examples are typical criteria that do not allow for completion:
  - abnormalities during control of inspection, measuring and test equipment or calibration;
  - customer requirement for stability monitoring;
  - no further validation of the quality requirements for this characteristic;
  - function-critical and/or process-critical characteristic (e.g. a special characteristic, risk part);
  - changes of measurement setup.

If in doubt, the stability monitoring has to be continued.

#### 4.2.2.2 Verification of capability for measurement processes for discrete (attributive) characteristics

Procedures 6 and 7 are intended for the verification of the capability of test systems for the assessment of discrete (attributive) characteristics.

##### Procedure 6:

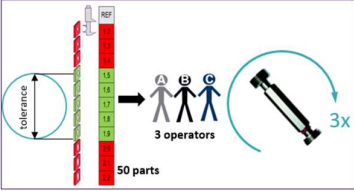
PROCEDURE	EXPLANATION	CAPABILITY CRITERION
<p>Procedure 6</p> <p>Test decisions for discretized continuous characteristics</p> 	<p>Verification of the capability of a test process regarding unambiguous test decisions when testing discretized characteristics.</p> <p>3 operators in 3 runs inspecting 50 parts (randomized) and documenting ok / nok-results. The values are sorted by size. The range of values with inconsistent results is determined. This range should have a maximum of 10% of the tolerance.</p>	<p>The following limits apply:</p> <ol style="list-style-type: none"> <li>1. <math>\%GRR \leq 10\%</math>: measurement process is capable</li> <li>2. <math>10\% \leq \%GRR \leq 30\%</math>: measurement process is conditionally capable</li> <li>3. <math>\%GRR \geq 30\%</math>: measurement process is not capable</li> </ol> <p>(corresponding to procedures 2 and 3)</p>

Table 8: MSA Procedure 6

##### Remarks:

- Precondition: 50 parts covering the tolerance range +/- 10%
- Finish first run for all parts / operators before starting with the 2nd run
- Use different measuring sequences in both runs (mix parts)
- Ensure traceability of parts (marking)
- Add representative number of serial inspectors to MSA-study
- If the measurement process is not capable / conditionally capable, the process has to be improved by taking suitable measures (e.g. instruction of test personnel, correct handling, changes of construction, alternative test equipment). If the result of a repeated test is negative again, procedures 1 - 3 must be used.

Procedure 7:

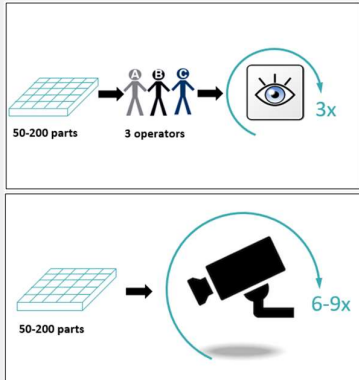
PROCEDURE	EXPLANATION	CAPABILITY CRITERION
<p>Procedure 7</p> <p>Test decisions for discrete and discretized continuous characteristics</p> 	<p>Verification of the capability of a test process regarding unambiguous test decisions when testing discrete or discretized continuous characteristics.</p> <p>Minimum 3 operators in 3 runs inspecting a randomized reference lot (inspection automat 6-9 runs, all cameras included). Documentation of ok / nok-results</p>	<p>The capability is classified by means of the parameter <math>\kappa</math> "kappa"):</p> <ol style="list-style-type: none"> <li>1. <math>\kappa \geq 0.9</math> test process is capable</li> <li>2. <math>0.9 &gt; \kappa \geq 0.7</math> test process is conditionally capable</li> <li>3. <math>\kappa &lt; 0.7</math> test process is not capable</li> </ol> <p>The minimum of all determined <math>\kappa</math> - values is relevant for the final classification of the test process.</p>

Table 9: MSA Procedure 7

Remarks:

- Preconditions:
  - Reference standard (limit sample catalogue)
  - Defined test process (test procedure, workplace setup and trained employees)
  - Reference lot available (reflecting requirements of limit sample catalogue)
- Inspection has to happen under the same conditions as in the serial production (inspection place, cycle time, aids & inspection catalogue...)

#### 4.2.2.3 Repetition of capability studies

During use in production, the capability of the measurement process must be ensured at all times.

The following criteria are typical examples that may make a new analysis of the measurement process and a new verification of capability necessary:

- after interventions in the measurement process (e.g. after exceeding control limits), the stability chart shows a significant difference compared to the status before the intervention;
- after adjusting the measuring system or components of the measuring system (e.g. individual measuring instruments during control of inspection, measuring and test equipment);
- upon restart after maintenance work where substantial disassemblies, modifications or replacements of crucial parts were necessary (e.g. measuring sensor, displacement transducer);
- upon start-up of new, overhauled or repaired measuring systems;
- in case of (later) tolerance reduction of the characteristic to be measured;
- in case of technical changes of the measuring system (e.g. setup, software);
- in case of parameter changes that may change the capability of the measurement process;
- if basic conditions of the measurement process are changed that may influence the capability of the measurement process (e.g. workflow, measurement strategy);
- after changes of the operating personnel (e.g. new staff members in case of procedure 2);
- in case of completions or significant changes of the reference standard (limit sample catalogue);
- if it is suspected that the measuring system does not work properly;
- if necessary before, and definitely after relocation of the measuring system.

In doubt, the measurement process analysis has to be repeated and the capability must be verified again.

### 4.2.3 Process Capabilities

A successfully completed suitability study of the measuring equipment is a prerequisite for conducting process capability studies.

TYPE OF EVIDENCE	REQUIREMENT	COMMENTS
Machine capability index, short term study	$C_m \geq 1,67$ $C_{mk} \geq 1,67$	sample size $n \geq 50$ ( $n \geq 100$ recommended) (sequential parts)
Preliminary process capability (= short term = ST) Stabile process	$C_p\text{-ST} \geq 1.67$ $C_{pk}\text{-ST} \geq 1.67$	Sample size $n \geq 125$ (25 samples with 5 parts each)  In contrast to the long-term study, the parts that are to be examined can be taken from the production process directly one after another, unless a sufficient amount of parts is available.
Preliminary process performance (= short term = ST), instable process (characteristics with varying mean values)	$P_p\text{-ST} \geq 1.67$ $P_{pk}\text{-ST} \geq 1.67$	Sample size $n \geq 125$ (25 samples with 5 parts each)  In contrast to the long-term study, the parts that are to be examined can be taken from the production process directly one after another, unless a sufficient amount of parts is available.
Process capability index	$C_p \geq 1,33$ $C_{pk} \geq 1,33$	Long term study, stable process
Process performance index	$P_p \geq 1,33$ $P_{pk} \geq 1,33$	Long term study, instable process

Table 10: Standard values for capability indices

If fewer than the required minimum number of parts are available, this is to be documented and the reduced number is to be taken into account by raising the standard values.

The standard values are to be increased by the following amounts:

NUMBER OF PARTS:	CM / CMK	CP-ST / CPK-ST / PP-ST / PPK-ST	CP / CPK / PP / PPK
124 TO 100	–	–	0,33
99 TO 50	–	0,33	0,67
49 TO 25	0,33	0,67	1,00

Table 11: Increasing the capability index in accordance with the number of sample parts

A copy of the detailed results of the capability test must be attached with the sampling documentation.

#### 4.2.4 Repeating of the Evidence of capability

The following criteria are typical examples that may make a new verification of capability necessary:

- Specification changes of the manufactured characteristic;
- increased occurrence of unexpected process results and/or defective parts;
- Intervention in the manufacturing process (for example, after exceeding control limits) lead to process results, which differ significantly from the results prior to the intervention (for example, verifiable on the basis of a control chart);
- Commissioning of new, overhauled or reconditioned production equipment (for example, after maintenance, in which extensive dismantling, rebuilding and/or replacement of essential components were required);
- technical changes (for example design, software), changes of process parameters (for example, settings) and/or boundary conditions of the manufacturing process (for example, processes, environment);
- Relocation of production equipment.

When in doubt, the analysis must be repeated and the capability has to be proven again.

Process changes may lead to non-comparable conditions before and after the change. It is possible that the previous random samples and validation intervals are also no longer adequate.

#### 4.2.5 Calculation of new SPC control limits

New control limits are only calculated after process changes have been proven effective, e.g.:

- Technical improvements
- Reduction or elimination of previously observed changes of averages
- Reduction of internal process variation

Otherwise, the control limits remain constant.

#### 4.2.6 Acceptance chart incl. regular Cpk-verification

Requirements for Acceptance chart incl. regular Cpk-verification are successfully completed suitability study of the measuring equipment, machine capability analysis (resp. short-term capability analysis) and initial long-term process capability analysis and the inner variation small enough compared to the tolerance ( $\sigma^*$ ) e.g.  $T/\sigma^* \geq 10$ .

A successfully completed suitability study of the measuring equipment is a prerequisite.

#### 4.2.7 Sampling inspection

The inspection strategy "Sampling inspection" is only suitable for discrete features, if the process behavior is such that inspection of a single part can safely detect the failure (e.g., hole missing).

A successfully completed suitability study of the measuring equipment is a prerequisite.



#### 4.2.8 Poka Yoke (Prevention)

As opposed to the detection Poka Yoke the prevention Poka Yoke is no measurement equipment. Therefore, a successfully completed suitability study of the measuring equipment is not necessary. A suitable method for Error proofing has to be implemented.

#### 4.2.9 In-process control / Process parameter monitoring

Successfully completed suitability study of the measuring equipment, analyzed and described cause-effect relationships between process parameters and product characteristics, taking into account disturbance and control variables.

### 4.3 Control Plan

The production control plan (PCP) is a documented description of the systems and processes for product control purposes. It contains all the process steps, from receipt of goods to delivery, including tests that accompany the process, outsourced processed and the substitute, rework and alternative processes.

Control plans have to be developed for each production location and all products supplied.

The production control plan provides evidence that

- the information from the FMEAs was taken into account during the planning and implementation of production
- a transparent / reproducible documentation of the product / process characteristics is assured
- monitoring and control of the inspection and production processes is assured.

Typical process steps that require process monitoring and control are:

- Goods receipt checks / incoming inspection (including identity / quantity checks)
- Production, assembly and test steps in the production flow
- On-going series production tests and product audits
- Logistics processes that impact the product / packaging quality (e.g. repackaging / picking)
- Set-up procedures, such as machine adjustment, tool changeover, provision of parts

Family control plans are acceptable for bulk materials and similar parts provided the product family parts are produced using a common production process.

The following items have to be included in the control plan:

- activities / measures used for monitoring and control of the manufacturing process, including verification of job set-ups (control method)
- first-off / last-off part validation, as applicable

- all items from the ICL – i.e. special characteristics and other important characteristics that have to be marked as follows:
  - special characteristics:
    - with letter(s) as noted on the ICL (e.g. F, G, S, /C or combinations)
  - other important characteristics:
    - with letters: ICL
- methods for monitoring the control of special characteristics, both for those identified by Bosch and / or for those identified by the supplier
- defined reaction plan for occurrences when nonconforming products are detected or when the process becomes statistically unstable (not controlled) or not statistically capable

Further information that has to be included in the control plan:

- general header data
- Part / Process step no.
- Process name / Operation description
- Product characteristics / Process characteristics
- Specification / Tolerance
- Machines / jigs / fixtures / tools for manufacturing, incl. measurement equipment (including identifiers, as appropriate)
- Inspection method
- Sample size / frequency
- Error proofing
- corrective action(s)
- requalification (layout inspection and functional testing)

A copy of the control plan is part of the PPA/PPAP documentation.

## 4.4 FMEA

### 4.4.1 Basic Information

Failure Mode and Effects Analysis (FMEA) is a team-oriented, systematic, qualitative and analytical method intended to:

- Evaluate the potential technical risks of failure of a product or a process
- Analyze the causes and effects of those failures
- Document preventive and detection actions
- Recommend actions to reduce risk

The FMEA is used for analyzing the technical risks to reduce failure and improve safety in the products and processes.

DESIGN-FMEA	PROCESS-FMEA
<p>The Design FMEA (DFMEA) analyzes the failure possibilities that may be created during the design phase of the product. It shall assure that, to the extent possible, potential Failure Modes and their associated Causes or mechanisms of failure have been considered and addressed prior to releasing the part to production.</p> <p>The Design FMEA (DFMEA) analyzes the functions of a system, subsystem or component of interest as defined by the boundary shown on the block/boundary diagram, the relationship between its underlying elements, and to external elements outside the system boundary. This enables the identification of possible design weaknesses to minimize potential risks of failure.</p>	<p>The process FMEA analyzes the design of processes in terms of quality from the receipt of goods to the delivery to the customer.</p> <p>The process FMEA (PFMEA) analyzes the potential failures of manufacturing, assembly and logistical processes to produce products which conform to design intent.</p> <p>The overall purpose is to analyze processes and take action prior to production start, to avoid unwanted defects related to manufacturing and the consequences of those defects.</p> <p>Process-related failures are different than the failures analyzed in the design-FMEA.</p> <p>The process FMEA analyzes processes by considering the potential failure modes which may result from process variation, to establish priority of actions for prevention, and as needed, improve controls.</p>

Table 12: FMEA terminology

Application of FMEA is mandatory.

New projects should follow the current AIAG & VDA FMEA process and tools (Failure Mode and Effects Analysis – FMEA Handbook First Edition - Issued June 2019).

Existing FMEAs developed using the previous AIAG 4th Edition FMEA “Product and Process FMEA” or VDA Edition, may remain in their original form for subsequent revisions.

The organization should thoughtfully plan the transition from their current FMEA process(es) and methods to the current AIAG & VDA FMEA process and tools. When practical, existing FMEAs used as a starting point for new programs should be converted to reflect the new rating scales, analytical methods, and format. However, if the team determines that the new program is considered a minor change to the existing product, they may decide to leave the FMEA in the existing format.

Foundation and family FMEAs are recommended to be created and used as a basis for new analyses. These optional practices provide the greatest opportunity to leverage past experience and knowledge and ensure that knowledge is accumulated over product lifecycles and that prior negative performance issues are not repeated (lessons learned).

Supplier ensures that the FMEA is checked for necessary updates following:

- Changes to the operating conditions
- Changes to requirements (law, norms, customer, state of the art)
- Changes to the product / process / production location
- after complaints and incidents (both external and internal)
- after negative findings due to product monitoring and lessons learned
- after negative findings from process observation
- after negative findings in development- and / or manufacturing network.

Special Characteristics (see Chapter 4.1) have to be marked with abbreviations or symbols in the Process FMEA (Special Characteristics column).

Further information on the implementation of the FMEA can be found in:

-  Booklet 14 of the BOSCH series of publications.

(Booklets are available here: <https://www.bosch.com/company/supply-chain/information-for-business-partners/>.)

#### 4.4.2 Cooperation between Bosch and Supplier

To ensure successful cooperation, a discussion and agreement between Bosch and Suppliers about severity evaluations is useful for newly developed parts and / or new processes or changes. To support this, meetings between organisations to exchange relevant information about failure effects and severity evaluation may take place.

Additionally, Bosch reserves the right to hold FMEA discussions in order to evaluate remaining risks in order to decide about further risk mitigation.

Specific failure descriptions are a prerequisite:

- Specific and precise failure descriptions related to manufacturing, assembly and logistics are required as basis.
- Failure descriptions might not be included or different to those in the D-FMEA.

The following chart shows the context of severity evaluation:

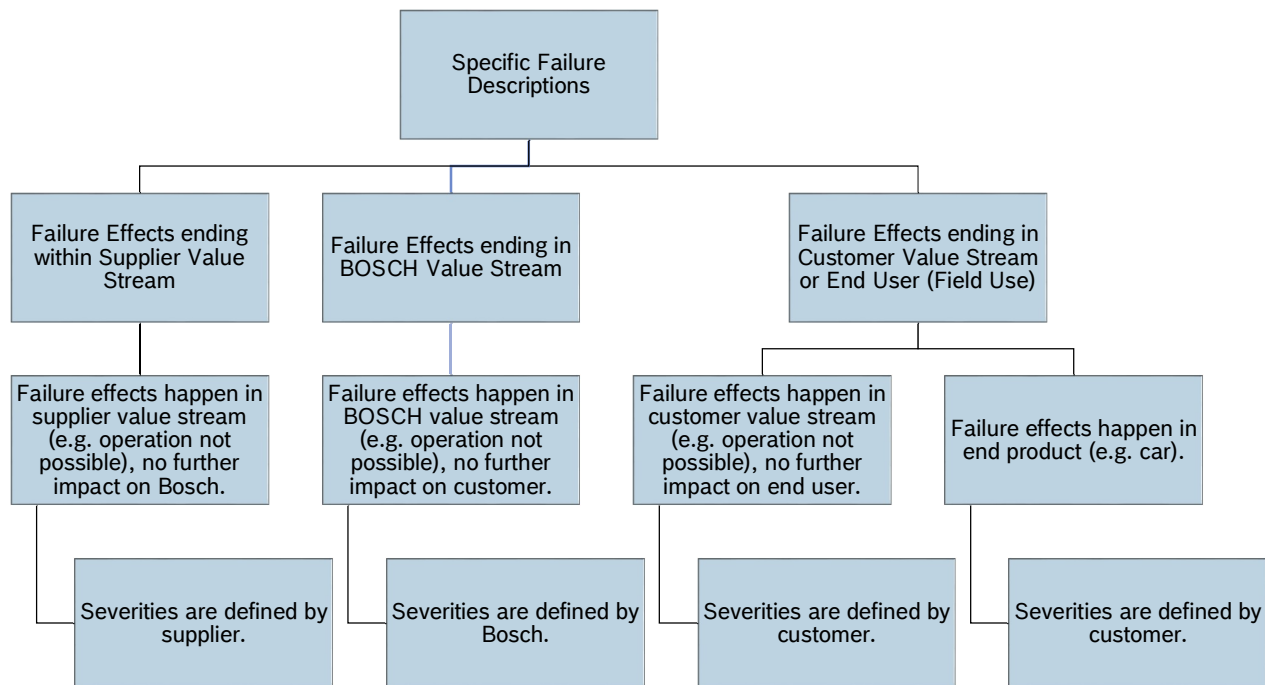


Figure 5 Definition of Severities

Severity evaluation of 9 or 10 does not automatically require „Special Characteristic“ for this failure. For the definition of Special Characteristics, various other criteria than severity (S) apply.

## 4.5 Process release

Bosch may participate in Supplier's internal process releases. The goal is to ensure that quality requirements in relation to product and process can be met by the serial process at the Supplier site. The process release may be combined with the PPA/PPAP evaluation.

If Bosch participates during the process release, a positive overall result is a prerequisite for a positive PPA/PPAP evaluation. If non-conformities or opportunities for improvements are detected, Supplier

- has to prepare a corrective action plan within the applicable time limit,
- shall implement the corrective actions, and
- shall inform Bosch on its progress as appropriate.

## 4.6 Heat Treatment

Heat treatment represents a core process in the manufacturing chain of a component. Deviations in the heat treatment and side processes usually have a massive impact on the quality and reliability of the products.

For this reason, a special focus is placed on the approval of heat treatment processes at suppliers or their subcontractors. Bosch heat treatment experts are always involved to design and validate the processes in

accordance with Bosch requirements. These requirements correspond to the automotive requirements (e.g. CQI9) as well as the lessons learned experience of Bosch.

The drawing, heat treatment order spec and test specification specify the required component properties and the heat treatment processes.

Basic sampling requirements in the context of process approval are extended testing on selected parts as defined. Testing of the components is performed in accordance with the specification. If technically possible, a temperature uniformity survey (TUS) is performed. Furthermore, a Bosch heat treatment expert performs a heat treatment audit. The ramp-up to series production as well as the scope of tested parts in series production are defined in consultation with the Bosch heat treatment expert. Heat treatment processes are always released part-specific and furnace-specific.

The procedure for releasing heat treatment processes is described in detail in the Bosch Norm N67W 0.2, <https://www.bosch.com/company/supply-chain/information-for-business-partners/>.

## 4.7 Run@Rate

Supplier performs a Run@Rate (performance test) as part of the internal PPA/PPAP process.

Duration of Run@Rate covers the production of volume that corresponds to 2 days' production at Bosch, but no less than 4 hours.

Deviations from this period may be possible in consultation with Bosch.

Bosch may either check the results or may participate in Supplier's performance test. Process performance (contractually agreed weekly capacity) and quality capacity of the complete production process is evaluated under series production conditions (e.g. tool, systems, clock time, personnel) as part of a Run@Rate (performance test) on the Supplier side.

## 4.8 Ramp-up validation (Launch Management)

Bosch expects a secure ramp-up. Supplier ensures this with necessary measures even without being specifically requested to do so by Bosch.

In addition, Bosch can agree with the Supplier on measures for securing the ramp-up (Early Production Containment); these may include for example additional tests or increasing the test frequency for a particular period until previously defined criteria are reached (exit criteria).

## 4.9 Production Process and Part Release - Procedure / Sampling

Production Process and Part Release procedure (PPA/PPAP) must be performed in line with VDA Volume 2 (current edition) or AIAG PPAP manual (4<sup>th</sup> edition) requirements. Supplier is obliged to conduct a complete PPA/PPAP and document the results as evidence for the fulfillment of the requirements.

Bosch requests documents and samples as evidence for the PPA/PPAP and adds specific sampling requirements, if needed. Preferably, the documents are transferred electronically via eSIR.

Additionally, Bosch may request samples and accompanying results / evidence to evaluate maturity and fulfilment of requirements during the development of products.

Requirements, notes and explanations in relation to sampling requirements and required evidence are listed below:

- Cover sheet for PPA report**  
 (VDA Volume 2, current version)
- Additionally, if needed:**
- Part Submission Warrant (PSW)** (AIAG 4<sup>th</sup> edition, PPAP)
- see as well "others"**
- Based on the current production and documentation status, the cover sheet must be completed in full (reference number, designation revision level, tool no., number of nests, production machine/line, etc.) and must be signed by the Supplier's quality representative.
- The change numbers / version numbers of the bill of materials must also be specified on the cover sheet used (VDA cover sheet: "Remarks" field, AIAG cover sheet (Part Submission Warrant): either in the field provided or in a remarks field).
- Self-assessment for product, process, and, if applicable, software**
- With the self-assessment the Supplier confirms that the product and production process meet all requirements in accordance with the defined criteria and that an internal release has been implemented (for an example see VDA Volume 2).

### Deliverables of the product development

- Technical Specifications**
- Supplier must confirm by reference on the cover sheet that he has all the technical specifications (including for the components) at his disposal (note: in principle the bill of material (BOM) is the leading document).
- Deviations/change requests must be announced, discussed and clarified with BOSCH in a timely manner prior to sampling.
- Design changes approved by Bosch in advance must be submitted together with the sampling documents.
- As evidence Supplier must provide a copy of the BOM.
- Design, engineering approvals**
- If Supplier has responsibility for development, supplier must provide proof of the relevant releases according to requirements.
- (in case of development responsibility)
- Approved design changes**
- Supplier shall provide any authorized engineering change documents not yet recorded in the design record but incorporated in the product, part or tooling.
- Material Data via IMDS**
- Suppliers have to fulfill N2580 – for further details see <https://www.bosch.com/company/supply-chain/information-for-business-partners/>.
- Supplier must enter the part-specific data in the "International Material Data System" (IMDS Supplier Code for Robert Bosch GmbH: #202) if no other agreement has been reached.
- The respective IMDS-ID-No. must be entered on the cover sheet.
- Conventions for the entry must be adhered to (German designation, English designation, RB reference number). The reference number must be specified without blanks or separators (e.g.: 1234567890).

**Design FMEA**

- If supplier has responsibility for development, a copy of the cover sheet for the completed Design FMEA must be attached with the documents. Bosch has a right to inspect the FMEA documents.
- The cover sheet must contain details of the designation, reference number (including the edition) and the change history of the documents.

**Deliverables of the production process development**
**Process flowchart**

- Supplier shall submit a process flow chart (production and test steps, including logistics processes) that clearly describes the process and its steps in full, from receipt of goods to delivery to Bosch.
- The process flow chart must be aligned with the process FMEA and the production control plan.
- The process flow chart must include outsourced process steps.

**Process FMEA**

- At a minimum, a copy of the cover sheet for the completed process FMEA must be included in the sampling documents. The cover sheet must contain a reference number, including the document status and the designation. Bosch has a right to inspect the FMEA documents.

**Control Plan**

- Supplier shall submit a copy of the control plan. For details of the content see chapter 4.2.

**Deliverables of the validation of the product**

- For the purpose of providing proof of the product characteristics, all requirements contained in drawings and specifications are to be tested and documented.
- All characteristics are to be marked clearly and must be listed separately with nominal values, tolerances and actual values (note: in the case of CAD drawings, details of the reference points test sections and test surfaces are required).
- Unless otherwise agreed, the measurement results include:
  - all characteristics of the technical documents, listed in the Bill of Material (BOM) (e.g. drawings, test/order specifications, standards) for initial samples.
  - for sampling after change, all changes to the previous specification.
- The measurement results also include proof of properties that can only be determined on the raw material itself (e.g. thickness of the original sheet metal material).
- Measured values outside of the tolerance (deviations) are to be clearly marked.

**Geometry**

- ---



<b>Material</b>	<ul style="list-style-type: none"><li>▪ In addition to the results of the material check, Supplier has to provide a certificate of conformity 3.1 (EN 10204) with results for chemical and physical (mechanical and structural) properties of the material (reference to Bosch material order specification / norm mandatory).</li><li>▪ Certificate of conformity has to be checked, approved and acknowledged by Supplier (with regard to Bosch material order specification / norm).</li></ul>
<b>Function</b>	<ul style="list-style-type: none"><li>▪ ---</li></ul>
<b>Haptic</b>	<ul style="list-style-type: none"><li>▪ ---</li></ul>
<b>Acoustic</b>	<ul style="list-style-type: none"><li>▪ ---</li></ul>
<b>Odour</b>	<ul style="list-style-type: none"><li>▪ ---</li></ul>
<b>Appearance</b>	<ul style="list-style-type: none"><li>▪ Decorative surfaces (e.g. graining – see also VDA Volume 16 "Decorative surfaces of accessories and functional parts in the exterior and interior areas of automobiles")</li></ul>
<b>Surface</b>	<ul style="list-style-type: none"><li>▪ Technical surfaces: For surface-coated components, complete systems composed of a substrate (if required) and surface coating are approved according to customer requirements (e.g. assurance of adhesion, resistance, roughness, free of grease, etc. according to the customer drawing)</li></ul>
<b>Reliability</b>	<ul style="list-style-type: none"><li>▪ Reliability indicators, e.g. service life, overload etc. see VDA volume 3 Part 02 "Reliability Assurance of Car Manufacturers and Suppliers"</li></ul>
<b>Technical cleanliness</b>	<ul style="list-style-type: none"><li>▪ Generally: The cleanliness analysis is to be carried out and documented in accordance with VDA19 or ISO 16232.</li><li>▪ Special requirements, for example defined by a limit value definition („Prüf-werteblatt“) and a definition of the method of the particle extraction and analysis („Prüfmethodenblatt“) have to be considered.</li></ul>
<b>Resistance to electrostatic discharge (ESD)</b>	<ul style="list-style-type: none"><li>▪ ---</li></ul>
<b>Electrical safety / high-voltage safety</b>	<ul style="list-style-type: none"><li>▪ ---</li></ul>

**Electromagnetic compatibility (EMC)**

- ---

**Deliverables of the validation of the production process****Assurance of special characteristics according to technical specifications and agreed characteristics (e.g. poka-yoke, 100% inspection, process capabilities, etc.)**

- Proof is to be provided for the validation of characteristics listed on the ICL (for details see chapter 4.1 “Management of Characteristics”).
- Requirements for capability indices are listed in Table 10 and Table 11.
- Proof of validation is required for each machine, nest, mold and / or die.
- A copy of the detailed results test must be attached to the sampling documentation.

**Laboratory qualification**

- If Supplier uses an external laboratory for investigations, it is necessary to ensure and verify that the laboratory is accredited according to ISO/IEC 17025 (or a comparable national standard).

**Samples incl. documentation**

- Samples for PPA/PPAP release (initial samples) are products and materials that were completely produced with standardized resources under standard conditions as part of the PPA/PPAP.
- Other samples are products and materials that were not completely produced under standard conditions. Other samples may not be used for the PPA/PPAP.
- Deliveries of samples for PPA/PPAP release (initial samples) must be clearly marked on the packaging and on the delivery paper.
- The revision level must also be clearly visible on the delivery papers for all parts for which a revision level is listed on the bill of materials (BOM).
- It must be possible to clearly assign the documented measurement results to the samples (sample marking/ numbering).
- If not otherwise agreed, 5 samples per cavity / form are submitted.
- Where appropriate the identification should also indicate whether the parts are from single-cavity mold or multi cavity mold tools.
- It must be possible to clearly assign the documented measurement results to the samples (sample marking/ numbering).
- A reference to family samples is possible.

**Tooling List**

- It must be specified how many tools (molds, forming dies) devices etc. used to manufacture the respective product or how many cavities a multi-cavity mold (e.g. injection molding) contains.

**General deliverables****Compliance with legal requirements**

- Supplier must confirm compliance with legal requirements (e.g. environment, safety, recycling, country-specific certificates).
- A sentence as confirmation is sufficient (example: "We herewith confirm that we comply with legal requirements.")

**PPA status of Supply chain**

- The PPA/PPAP status of the supply chain is to be attached to the PPA/PPAP documents.
- The "Component Supply Chain Chart" form is to be completed for documentation purposes, <https://www.bosch.com/company/supply-chain/information-for-business-partners/>
- Releases for all materials and (sub) components (including customer / Bosch directed buy) used in the supplied product must be attached to the sampling documents.

**Master Sample**

- Supplier must retain a master sample analogous to the documentation of the PPA/PPAP procedure. The master sample must be marked as such.
- Unless otherwise agreed, the same retention period applies as for documents.

**Inspection and Test Equipment List**

- Supplier submits a product-specific list of the measuring devices used for the initial sampling and the serial production.

**Confirmation of agreed Capacity**

- As part of process validation under standard conditions, a verification is done under series conditions that the required quality and unit volume can be assured in accordance with the contractually agreed maximum capacity. This can be a one-day production or an agreed deviating time-period.

**Capability Study Test Equipment / Measurement System Analysis (MSA)**

- Supplier submits evidence for the capability of all measurement systems listed in the production control plan.
- Requirements for measuring system capabilities are described in chapter 4.2.2 ff.
- In cases where test equipment capability verification cannot be provided, calibration certificate or adequate capability studies may be sufficient.

**Part history**

- All changes to the product and production process must be documented in the part history.

**Evidence of suitability of the employed load carriers including storage**

- Supplier verifies that the provided storage and the load carriers used for the product to be delivered will not cause any damage.
- This is verified by a copy of the packaging data sheet agreed between the Supplier and Bosch.
- Additional proof may be provided, for example, by transportation trials with a correspondingly positive result.

**Documentation of agreements regarding the about diagnosis and analysis process**

- see VDA Volume “8D - Problem Solving in 8 Disciplines” / VDA Volume “Field Failure Analysis”

**Complaint hand-ling (e.g. 8D)****Field failure Analysis****Documentation about agreements about Requalification (Layout inspection and functional testing)**

- see chapter 4.4 “Control Plan” and chapter 7 “Requalification Check (Layout Inspection and Functional Testing)”

## Others

### **Documentation for heat-treated parts**

- The documentation of the heat treatment of the parts should be provided as explained in the following rows:
  - 1. Cover sheet of CQI9 self-assessment of related heat treatment process:
    - A copy of the cover sheet of the conducted CQI9 self-assessment has to be added to the documentation.
  - 2. Heat treatment query:
    - Filled heat treatment query has to be added to the documentation
  - 3. If 100% non-destructive tests demanded: test installed and suitable?
    - In case a non-destructive 100% check is required: proof of suitability for the check must be provided (e.g. MSA, GRR, ckg). Remark: See also ICL requirements
  - 4. Heat treat at sub-supplier: Incoming inspection at Bosch supplier
    - If a sub-supplier is used for the heat treatment, a confirmation is necessary that an incoming inspection at the Bosch supplier is done after heat treatment (proof by respective steps in control plan).
  - 5. Cover sheet of process related heat treatment audit for this part / part family
    - Signed coversheet of the heat treatment audit and the respective current actual open-point-list (OPL) have to be added to the documentation.
    - Overall rating green or yellow, provided that all release relevant measures (see coversheet) have been completed in OPL.
  - 6. Results of defined checks (e.g. surface hardness, core hardness, CHD, microstructure, ...)
    - Inspection certificates have to be added to the documentation.
    - Inspection amount according N67W0.2 (<https://www.bosch.com/company/supply-chain/information-for-business-partners/>) and after consultation with Bosch heat treatment expert.

### **Part Submission Warrant (PSW) (AIAG 4th edition, PPAP)**

- Based on the current production and documentation status, the cover sheet must be completed in full (reference number, designation revision level, tool no., number of nests, production machine/line, etc.) and must be signed by the Supplier's quality representative.
- The change numbers / version numbers of the bill of materials must also be specified on the cover sheet used (VDA cover sheet: "Remarks" field, Part Submission Warrant: either in the field provided or in a remarks field).

**Deliverables for software**

<b>SW-release</b>	<ul style="list-style-type: none"> <li>SW-release (e.g. Appendix 6 "Cover sheet for the PPA report software")</li> </ul>
<b>Definition of scope of the SW product</b>	<ul style="list-style-type: none"> <li>e.g. Share of in-house development of organization</li> <li>Integrated software without in-house development (re-use, directed part SW, 3rd-party SW, FOSS)</li> <li>Use of legacy software, re-use of software that does not fully meet customer quality requirements</li> <li>Additional points in which the fulfilment of customer quality requirements for this software scope cannot be verified or only to a limited extent.</li> </ul>
<b>Reference to contractually stipulated quality requirements</b>	<ul style="list-style-type: none"> <li>List of applicable standards, e.g. coding guidelines (MISRA, etc.), code metrics (cyclomatic complexity, number of code lines, etc.), test coverage (specification of test levels and degrees of coverage, etc.).</li> </ul>
<b>Documentation of technical SW specifications (functional and non-functional)</b>	<ul style="list-style-type: none"> <li>The technical SW specification contains the agreed scope of contract volume incl. agreed changes.</li> <li>The degree of detail of the documentation must aligned between the Supplier and Bosch.</li> <li>Evidence can also be provided in the form of a reference to the agreed software specification, approved customer document, or similar documentation.</li> </ul>
<b>Implementation of the requirements from 6.3 and 6.4, especially the Special Characteristics</b>	<ul style="list-style-type: none"> <li>The type of evidence must be aligned between Supplier and Bosch.</li> <li>In addition to the general requirements, this may include:             <ul style="list-style-type: none"> <li>Traceability of Functional Safety requirements (ISO 26262) up to testing</li> <li>Evidence of the fulfillment of the agreed requirements concerning security</li> <li>Evidence of the fulfillment of the legal and official requirements in the agreed area of application</li> <li>Failure analysis concept for SW components</li> </ul> </li> </ul>
<b>Documentation of FOSS (free and open-source software)</b>	<ul style="list-style-type: none"> <li>Documentation of the FOSS modules used incl. the license terms and customer approvals</li> </ul>
<b>List of known errors</b>	<ul style="list-style-type: none"> <li>---</li> </ul>

**Documentation of development tools**

- This includes the documentation of the configuration of the development tools used in the creation of the executable software and the verification of the status at the time of the SW approval.
- Examples of development tools (incl. parameterizations):
  - Compilers
  - SW libraries
  - Hardware configuration
- Documentation of the version management tools (e.g. Doors, CVS, etc.) is not required here.

**Documentation of testing tools**

- This includes the development-accompanying documentation of the test tools used at the time at the respective software creation and verification of the status at the time of the SW approval of the test implementation.

**Documentation of version management**

- Documentation of the product baseline, configurations and change history with respect to the software modules and components used. Documentation of compatibility with hardware variants.

**Documentation of a process evaluation (e.g. VDA Automotive SPICE®)**

- The minimum scope is a self-assessment by the organization for the relevant project.
- In addition, an assessment can be made by the customer and/or an external assessor.
- Documentation of the implementation of the project-specific actions derived from the self-assessment / assessment and evidence of the effectiveness is provided.

#### 4.9.1.1 Evaluation of Initial samples / Result

Bosch evaluates the initial samples and related documentation, as requested. The result is documented on the cover sheet (based on VDA Volume 2 and / or AIAG PPAP manual) and communicated to Supplier. Supplier has to follow-up any defined corrections / activities in a timely manner within the defined validity / timeframe.

The same applies to an evaluation after a change.

## 5 Marking of Products, Parts, Samples and Packaging

Supplier marks products, parts, samples and packaging according to the agreements reached with Bosch. Markings on the packaged products have to remain legible during transport and storage.

It is as well necessary to comply with all rules and notes arising from the current version of the Bosch supplier logistics manual. For further details see <https://www.bosch.com/company/supply-chain/information-for-business-partners/>.

### 5.1 Marking of Samples and after Release

The samples shall be packed in accordance with the packaging specification. If there is no packaging specification yet (e.g. for samples during product development), the sample packaging must be agreed in advance between Supplier and Bosch.

Deliveries of samples for PPA/PPAP release (initial sample) must be clearly marked on the packaging and on the delivery paper.

The revision level must also be clearly visible on the delivery papers for all parts for which a revision level is listed on the bill of materials (BOM) (use orange label per package / smallest unit).

A copy of the cover sheet has to be added to the package.

At least the first three deliveries after the start of a series and after a change must be marked accordingly.



## 6 Traceability / FIFO

Traceability is required for all parts produced for Bosch. Based on their traceability the parts can be pinpointed, isolated, filtered out and reworked as necessary in the event of a defect in order to minimize the impact on the customer.

To assure this, Supplier follows the first in / first out (FIFO) principle and ensures the traceability of the products it supplies.

If a defect is found, it is necessary to ensure that the faulty parts / products / batches and related production data are identified within a working day. This also applies to traceability among sub-suppliers.

Supplier must outline the traceability system / concept to Bosch during the contract negotiations within the offer or in technical discussions. If necessary, further details must be agreed with Bosch.

The minimum requirements are as follows:

**Traceability** must be assured for every delivery for

- all components, materials and modules
- all process parameters which have impact on distinctive characteristics and test characteristics

The **batch size** must not be greater than the volume produced

- either in a single shift or
- a single day and
- the volume of 50,000 units / batch must not be exceeded. If necessary, further definitions will be agreed between the Supplier and Bosch.

**First in / first out** principle

- shall be observed in every process step.

**Mixing of parts:**

- Parts shall not be mixed when making the transition from once process step to another.

The **smallest packaging unit**

- contains a maximum of two separate batch numbers.

The following **production data** have to be provided within one day on request:

- Production data, changed conditions (man, material, machine, method)
- Records in relation to the production line (e.g. line, machine, tool, nest, measurement system)
- Records in relation to the components, parts or materials used in each production step
- Records in relation to the key process conditions for each production step
- Records in relation to reworking and repairs, prompt return of the reworked parts to the original production batch.

**Marking:**

- An appropriate marking system shall be used by the Supplier in its production and its function will be explained on request.

- For deliveries to Bosch, the format and the type of marking shall be approved by Bosch on the basis of a proposal from the Supplier.
- The MAT label is mandatory for electronic components and optional for other parts.

Further details are defined in Bosch supplier logistics manual, [🔗 https://www.bosch.com/company/supply-chain/information-for-business-partners/](https://www.bosch.com/company/supply-chain/information-for-business-partners/).

## 7 Requalification (Layout Inspection and Functional Testing)

Unless otherwise specified, products supplied to Bosch must undergo a verifiable annual requalification check (in accordance with IATF 16949) in which all the dimensions, functional characteristics and material specified by Bosch must be checked for compliance.

A requalification system in accordance with all Bosch reference numbers / product families with annual planning (active reference numbers) must be available and agreed with Bosch. It must also contain provisions for requalification on the subcontractor side.

At least one reference number is to be selected for each product family. The selection can roll over from year-to-year. If it is not possible to form product families, the selection of the products to be requalified can be based on a risk analysis. In this case complaints and scrap quotas are to be taken into account.

The results of the requalification tests are to be archived and must be sent to Bosch upon request within one working day. A retention sample is to be archived for the last version of the requalified reference part number.

The requalification check/system must be included in the production control plans.

If deviations are identified during a requalification check, Bosch must be notified immediately (declaration by the supplier) and further measures are to be defined and agreed upon.

## 8 Delivery and Incoming Inspection (Goods Receipt)

Supplier shall supply the goods in suitable transportation containers in accordance with the relevant Bosch delivery and packaging specifications in order to avoid damage and reductions in quality (e.g. dirt, corrosion, chemical reactions).

Goods receipt inspection at Bosch shall be limited to externally visible transport damage and verification of compliance in terms of the volume and identity of the products ordered based on the delivery papers as a minimum. Any defects detected are communicated immediately to the supplier.

Defects not detected in incoming goods inspection shall be reported to supplier immediately as soon as they are found in accordance with the conditions of the regular business process. To this extent supplier shall waive objection to a delayed formal complaint.

Supplier shall organize its quality management system and quality assurance measures to include this reduced goods receipt check.

## 9 Scrap and Rework

The handling of scrap and rework of products must be clearly regulated. Rework must always be avoided and is only permitted if approved corresponding process descriptions are available.

Particular care is required in ensuring that a FMEA and a production control plan are in place for dismantling rejected products and re-introducing them to the production process, that the reworking time is limited and takes place on a standard system. Traceability must be assured. If the rework process is required on a permanent lasting basis, it is to be transferred to a standardized process.

Unplanned rework requires a special release from Bosch. Marking for deliveries of unplanned reworked parts has to be agreed with Bosch.

Scrap must be disposed of according to the standard; unauthorized further use of these products must be prevented (e.g. through destruction).

## 10 Quality Deviations and Complaints

Supplier shall analyze process disruptions and deviations in quality, determines the root causes, initiates corrective measures and documents this procedure. The analysis includes scrap parts, reworked parts (if allowed), set-up parts and any internal surplus.

### 10.1 Deviations from agreements

If it becomes apparent that Supplier cannot meet its supply obligations regarding, for example, quality features, schedules, delivery quantities, or packaging requirements, the supplier shall so inform Bosch promptly and always before delivering parts that may potentially be unusable. However, this information shall not release the Supplier from the need to adhere to its contractual obligations.

In some cases, a special release (concession) will be issued in relation to the reported deviation (see also 10.3).

### 10.2 Deviations from the agreed Delivery Condition

The Supplier shall immediately inform Bosch of all deviations detected after delivery. In the interests of a speedy resolution, the Supplier shall disclose all the necessary facts and figures. The notice shall be sent to the relevant Purchasing Quality Assurance Departments at the affected plants.

### 10.3 Interim Deviation Approval – Concession

If Supplier is unable to provide products according to specification, supplier must obtain a special release (concession) from Bosch before making a delivery. This requires a precise description of the variation and details of the volume or period affected.

Further procedure will be closely coordinated with Bosch. A delivery can only be made after approval by Bosch. The deliveries must be marked appropriately after agreement with Bosch.

### 10.4 Complaints, Problem Solving, 8D-Report

#### 10.4.1 Complaints

If Bosch reports defects to the Supplier, the Supplier shall immediately perform an error analysis. Bosch provides support within Bosch's range of capacities, if needed.

Supplier sorts claimed parts as an immediate containment action (D3). For the sorting activities, Supplier has to draw up and use inspection instructions, agreed by Bosch. Claimed products will be returned to the Supplier.

Marking for deliveries of sorted parts has to be agreed with Bosch.

#### 10.4.2 Problem Solving / 8D-Report

Complaints must always be processed according to the 8D method. The following rules in relation to processing times shall apply unless otherwise agreed with Bosch (e.g. shortened processing times for customer complaints, safety-related deliveries or new deliveries):

- No later than 2 calendar days after the information / parts arrive, an initial response must be made to Bosch, outlining the immediate measures.
- No later than 14 calendar days after the complaint has been made by Bosch an interim report on the cause of the error must be provided.
- No later than 60 days after the complaint is made by Bosch the definition of measures must be complete and planned dates for the introduction of the final measures and measures to avoid repeated error must be defined if they have not yet been introduced and the date for the conclusion of the complaint must be defined.

### 10.4.3 Root Cause Analysis

The Supplier must provide evidence of the root cause analysis using the 5-Why and Ishikawa method and, on request, must also perform a process analysis or process audit. 14 Q Basics assignment is expected.

During root cause analysis, both the technical causes (Technical Root Cause) and the management causes (Managerial Root Cause) for the occurrence and failure to detect the deviation are to be determined.

The Supplier will process all 8D reports using the SupplyOn supplier portal, <https://www.bosch.com/company/supply-chain/information-for-business-partners/>.

As part of the lessons learned, the Supplier shall apply the information gained to other works / products / processes (where appropriate).

### 10.4.4 Complaints at Sub-Suppliers

Complaints shall immediately be made by Supplier directly to the sub-supplier. In response to inquiries, Supplier shall notify Bosch of the current status of complaint processing, which must comply with the specifications of Bosch (see above).

Supplier is also responsible for the quality of the purchased products when using supply sources specified by Bosch or negotiated by Bosch in a transaction.

## 10.5 Controlled Shipping Level (CSL)

If defects repeatedly occur and if the measures taken are not effective, Bosch may demand additional 100% tests in order to improve the quality situation. Corresponding agreements shall be reached between Bosch and the supplier in accordance with events. Both the test criteria and the criteria for lifting the additional test are defined individually.

100% tests can be carried out either by the Supplier or a service provider commissioned to do so.

### 10.5.1 Controlled Shipping Level 1 (CSL 1)

Controlled Shipping Level 1 (CSL 1) means:

- Supplier has to install additional tests to the normal scope of control
- The scope of the additional tests has to be agreed upon with Bosch, including the part numbers and the characteristics
- The tests have to be done for and prior to every delivery.
- Full documentation of the tests and their results has to be available
- Marking for these deliveries has to be agreed upon with Bosch

### 10.5.2 Controlled Shipping Level 2 (CSL 2)

Controlled Shipping Level 2 (CSL 2) means:

- Supplier has to install an additional 100% check on top of the normal scope of control carried out by an external provider accepted by Bosch,
- part numbers and characteristics have to be agreed upon with Bosch,
- tests have to be done for and prior to every delivery,
- Full documentation of the tests / results has to be available,
- Marking for these deliveries has to be agreed upon with Bosch,
- Stock on both sides, Supplier and Bosch, has to be inspected as well as goods currently in transit,
- For the sorting activities, Supplier has to draw up instructions for the service provider, agreed by Bosch,
- Supplier is responsible for the orderly implementation of sorting tasks, the documentation of the results and the quality of the products supplied.

## 11 Change Management - Information and Documentation

### 11.1 Supplier information about changes – Supplier Initiated Change Request

Prior to

- modifications of the product or packaging,
- change of sub-suppliers throughout the supply chain,
- change of production methods, production equipment, processes with influence on form, fit, function, performance and reliability (including at sub-suppliers in the supply chain),
- relocating or setting up production and development sites (only for development facilities responsible for BOSCH projects during development period)

the Supplier obtains the written approval of Bosch and provides the agreed quality documentation in this regard.

Prior to

- changes of production methods, production equipment, processes without influence on form, fit, function, performance and reliability (including at sub-suppliers in the supply chain),
- changes of test methods and test equipment,
- relocating or setting up of production equipment at the same site,
- suspension of development and/or maintenance of digital goods (legacy support),

the Supplier notifies Bosch well in advance, so that Bosch can check whether the planned changes could have a negative effect.

The Supplier Initiated Change Request (“SICR”) form and further information about change management are available here: <https://www.bosch.com/company/supply-chain/information-for-business-partners/>.

The SICR must be used in order to provide notice of any planned changes.

Examples of notifiable changes are given as well in VDA Volume 2 (current version).

### 11.2 Electronic components

ZVEI “Guideline for Customer Notifications of Product and /or Process Changes (PCN) of Electronic Components specified for Automotive Applications” (revision 3, January 2015 or newer) applies to change management for electronic components in automotive applications.

### 11.3 Labeling of Deliveries after Changes

The first deliveries after the start of a series and after the aforementioned change measures must be marked according to Bosch specifications (Specifications in accordance with the logistics manual below or separate agreements).

In addition, the papers accompanying the first three deliveries after a change must be marked as follows:

- 1., 2., 3. Delivery after change [number of the change, revision level].

### 11.4 Documentation of a Change

All changes to the product and process chain and any validation measures will be documented by the Supplier and made available to Bosch upon request.

## 12 Digital Goods

### 12.1 Scope

New business cases associated with Connected, Autonomous, Shared and Electrified mobility solutions are drivers for particular emphasis on handling of digital goods in supplier quality management at Bosch.

Under digital goods we consider the following classes:

- Software (incl. embedded-SW)
- Data (e.g. Map-Data)
- IT-Services.

For each of those classes corresponding quality models apply:

- Software → Automotive SPICE®
- Data → CMMI DMM<sup>SM</sup>
- IT-Services → ISO 20000

Depending on the specific project needs, additional quality requirements for

- Functional Safety (e.g. ISO 26262)
- Cybersecurity (e.g. ISO 21434)

are applicable.

### 12.2 Preventive Quality

In the project specific Request for Quotation Supplier will receive a Quality-Book which is based on the quality model named above and contains additional Bosch specific requirements. The Software, Data and IT-Service Q-Book respectively contains non-functional, process related quality requirements. The corresponding Q-Book is a part of project specific contracting and is a precondition for sourcing.

Before sourcing, additionally to the agreement on a corresponding Q-Book, Supplier will be evaluated on his process capability on SW development, Data Management or IT-Service Management. Results of those capability evaluation (e.g. ASPICE Assessment) will be used in risk evaluation and considered in the sourcing decision.

After sourcing the fulfillment of in the corresponding Q-Book agreed quality requirements will be evaluated and the evaluation results will be considered in the PPA/PPAP release or corresponding Quality Gate.

### 12.3 Complaint Management

A complaint for digital goods is a severe (customer, safety or security related) deviation or a frequently occurring deviation from Bosch requirements.

Complaints for digital goods must always be processed according to the 8D method. The rules in relation to processing times as defined in the “Agreement on Quality and Corporate Social Responsibility” shall apply unless otherwise agreed with Bosch (e.g. shortened processing times for customer complaints, safety- or security-related deliveries).

Bug-Fixing will be managed on project level.



## 13 Sub-Supplier Management

The requirements of this guideline also applies if the Supplier purchases parts or services from sub-suppliers. Supplier establishes appropriate sub-supplier management in order to ensure quality.

Production process and product approval (PPA/PPAP) must be implemented.

The manufacturing and delivery chain must be presented to Bosch on request. The CSCC (Component Supply Chain Chart) form is provided by Bosch, <https://www.bosch.com/company/supply-chain/information-for-business-partners/>.

Supplier shall be held responsible for a failure on the part of its sub-supplier to the same extent as if it were itself directly responsible for the failure. This principle shall apply equally to sub-suppliers specified by Bosch.

In the event of deviations from the agreed quality, Supplier develops its sub-suppliers using agreed targets and development programs.

## 14 Cooperation for Quality Improvement

### 14.1 Quality Targets

Just as Bosch is committed to a zero defect target in the interests of its customers, the Supplier has a similar commitment to Bosch and communicates this both internally and to its subcontractors.

If zero-defect delivery cannot be guaranteed, Bosch may agree interim targets with the Supplier (e.g. upper limits for error rates within specific time frames). The Supplier shall introduce measures for continuous improvements and for achieving the zero defect target.

### 14.2 Upper Limits

Adherence to agreed upper limits shall not relieve the Supplier from its obligation to process all complains or from its liability for all defective deliveries. If the agreed upper limits are exceeded, the Supplier will introduce effective improvement measures at short notice at its own expense and will keep Bosch informed of progress on an on-going basis.

### 14.3 Liability / escalation

The liability of the Supplier for all defective deliveries shall remain unaffected by the agreed upper limits. Quality talks focusing on topics such a preventive quality assurance, the assessment of replaced quality data, error meetings, discussions relating to current topics, etc. will take place at the request of a contract partner. In the event of escalation, the Supplier should attend discussions at management level+.

### 14.4 Development Programs

Supplier development programs are intended to improve cooperation in quality questions between Bosch and the Supplier and continuously improve the performance of the supply chain. Fundamental cooperation takes the form of so-called Standard Quality Cooperation (SQC) where standard day to day business is handled.

In the event of quality and process problems with the Supplier and when the Supplier's overall situation is assessed by Bosch, it may be possible to include the Supplier in a supplier development program:

- In order to improve maturity of a specific quality topic, the Supplier can be included in EQC (Extended Quality Cooperation) which is a strategic supplier development and support program.
- If upcoming incidents make it necessary to escalate the quality problems (for the criteria see below), the Supplier may be included in SQIP (Supplier Quality Improvement Program).

#### 14.4.1 EQC (Extended Quality Cooperation)

As part of Extended Quality Cooperation, Bosch's Q activities with the Supplier will be intensified supporting Supplier strategically to achieve better maturity in Q-Topics.

- Extended and preventive Q activities
- Regular reviews with the involvement of: quality engineers, senior managers (Supplier & Bosch)

#### 14.4.2 SQIP (Supplier Quality Improvement Program)

Important part of the escalation management is the inclusion of management representatives from both sides (Supplier and Bosch) into the quality improvement process. Aim of the escalation status is to improve quality performance (e.g. reduce number of quality incidents) and to achieve an acceptable level of quality. Open and unlimited cooperation is accepted. A quality agreement between supplier and Bosch defines criteria to achieve to be able to exit the escalation stage.

The Quality performance and escalation stage also are used for of supplier evaluation.

For further details see <https://www.bosch.com/company/supply-chain/information-for-business-partners/>.

## 15 Other Requirements

In addition to the existing contractual agreements, Bosch also requires compliance with the requirements listed below.

### 15.1 14 Quality Basics for the Value Stream

14 Q Basics are the fundamental quality enablers to avoid errors in the value stream. Bosch expects adherence to the 14 Quality Basics.

For further information see <https://www.bosch.com/company/supply-chain/information-for-business-partners/>.
















	<b>1 Stop Sign</b>  Customer complaints are communicated within the production site and, if possible, displayed directly at the station in question. Using problem-solving techniques, they are processed in a fast and systematic manner. The supply chain is promptly informed.	<b>2 Andon Cord</b>  In the event of deviations in quality or if control limits are exceeded in the value stream (source, make, deliver), the employee needs to stop the process or escalate.	<b>3 Instructions</b>  Safety, health, production, and inspection instructions are complied with. 5S standards are put in place and observed.	<b>4 Process Instructions</b>  The target values/tolerances for all stated process parameters are observed.
<b>5 Measuring/Test equipment</b>  Measuring and test equipment is defined, and monitoring intervals are observed.	<b>6 Check the Checker</b>  The "check the checker" principle is applied, and the "checker's" suitability is ensured.	<b>7 Total Productive Maintenance</b>  A maintenance standard is installed and observed at every station.	<b>8 Tools</b>  Each tool has a defined service life; the current status must be recognizable. A quality evaluation must be carried out during installation, removal or disassembly.	<b>9 Restart</b>  Restart after disruptions is clearly regulated for all machinery and equipment.
<b>10 Labeling</b>  Products and containers are labeled according to the set standard.	<b>11 Rework/ Scrap</b>  The handling of rejected parts and those to be reworked is clearly regulated.	<b>12 Dropped Parts</b>  Any products that fall on the floor, into the machine or cannot be classified must be scrapped.	<b>13 Correct Products</b>  Only the correct product may be provided for removal and assembly.	<b>14 Remaining Items</b>  The handling of remaining items/quantities is clearly regulated.

Figure 6: 14 Value Stream Q-Basics

## 15.2 Special Process Assessments (AIAG CQIs)

Some special and critical production processes need high attention. For such processes self assessment of the suppliers according to the AIAG CQI rules shall be carried out in the whole supply chain. Confirmation from supplier to work accordingly will be requested yearly by Bosch. Upon request copies of the performed special process assessment cover sheet need to be provided within one day.

CQI Assessments and instructions are available via [www.aiag.org](http://www.aiag.org).

Listed special production processes in CQIs:

ISSUE	CONTENT (LISTED PROCESSES)		
<b>CQI-9 Heat Treatment</b>	1. Carburizing 2. carbon correction 3. neutral hardening 4. tempering 5. precipitation hardening	6. aging 7. nitriding (Gas) 8. Ferritic birtrocarburising (Gas/Salt) 9. Aluminium heat treatment 10. Induction heattreatment	11. Annealing 12. Normalizing 13. Stress relieving 14. low pressure carburizing 15. Sinter hardening 16. Ion nitriding
<b>CQI-11 Plating</b>	1. Zinc&Zinc Alloy plating 2. Mechanical plating 3. Surface conditioning of Metals for decorative Plating 4. Surface conditioning of plastics for decorative Plating	5. Decorative plating for metal/plastics 6. Electropolishing 7. hard chrome plating 8. electroless Nickel 9. Hydrogen embrittlement relief bake process	10. process control and testing equipment  Hint: typical platings for contacts as gold, silver or tin are not listed!
<b>CQI-12 Coating</b>	1. Pretreatment (Aqueous) 2. Pretreatment (mechanical) 3. conversion coatings 4. Powder 5. Spray	6. electrocoat 7. Dip/Spin 8. Autodeposition 9. Cure	10. Anodizing and hard coat anodizing 11. Equipment 12. Part Inspection and Testing
<b>CQI-15 Welding</b>	1. Gas Metal Arc Welding 2. Laser Welding 3. Drawn Arc Welding 4. Resistance Welding 5. Friction Welding (without friction stir welding)	6. Induction/High Frequency Magnetically Impelled Arc Butt Welding 7. Friction Welding (without friction stir welding)	8. Induction/High Frequency Magnetically Impelled Arc Butt Welding 9. Tube Welding 10. Fastener Projection Welding
<b>CQI-17 Soldering</b>	1. Paste printing 2. Inspection 3. Surface Mount device placing 4. Reflow 5. Glue dispensing 6. Flux application for wave soldering	7. Pre heating 8. Wave 9. Fountain 10. Dip 11. Selective 12. automated iron 13. manual iron	14. laser and soft beam 15. induction 16. conformal coat and test 17. PCB separation 18. ICT – In-Circuit-Test 19. Rework
<b>CQI-23 Molding</b>	1. Injection Molding 2. Blow Molding 3. Vacuum Forming	4. Compression Molding 5. Transfer Molding (Thermoset materials)	6. Extrusion 7. Equipment 8. Part inspection and testing
<b>CQI-27 casting</b>	1. Sand Casting (Iron/Steel) 2. Centrifugal Castings 3. Centrifugal Liners 4. Investment Castings (Iron/Steel)	5. Aluminum SPM Cylinder Heads 6. Aluminum Sand Castings 7. Aluminum Metal Mold	8. Aluminum High Pressure Die Cast 9. Magnesium High Pressure Die Cast 10. Zinc High Pressure Die Cast

Table 13: CQI

### 15.3 Product Safety & Conformity Representative

A Product Safety & Conformity Representative (PSCR) must be available at all production sites that produce for Bosch. Product safety officers must be familiar with product manufacturing, methods for risk assessment and the relevant rules for product safety and reliability.

PSCR are members of the supplier management team or report directly to this team or to senior quality management.

### 15.4 Retention (Archiving)

Supplier shall define the general handling of information and documentation. This includes retention (archiving).

The retention must ensure that documents are safe from manipulation, access by third parties. Their contents must remain available over the entire retention period.

Storage locations should ensure adequate protection against possible risks such as fire and/or water (storm damage, floods, firefighting water) and should prevent unauthorized access and changes to the documentation with appropriate protective measures.

Notes on procedure can be found in VDA Volume 1 current version.

## 16 Sources

Sources for the present document, including quotes passages and content:

- VDA Volume 1 "Documented Information and Retention"
- VDA Volume 2 "Securing the Quality of Supplies"
- AIAG "Production Part Approval Process, 4th Edition"
- VDA Volume 4 "FMEA"
- VDA Volume 4 "Cost-effective Tolerance Process"
- VDA Volume 6.3 "Process Audit"
- VDA Volume "Process Description for Special Features (BM)"
- Automotive SPICE®
- CMMI DMMS<sup>CM</sup>
- ISO 20000
- ISO 26262
- ISO 21434

Sources and notes on further reading are also available within the chapters.



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