Supplier Quality Requirements
Business Sector – Mobility Solutions
Summary & Explanations

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0 Preface

Bosch expects quality from their suppliers for all aspects of cooperation. To support the implementation of a shared quality strategy in the 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 used in the Bosch automotive sector or in Bosch automotive products.

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**”.

Furthermore, information about cooperation between Bosch and its partners is available here:

- Information for business partners.

1 Requirements for Management Systems

1.1 Quality Management System

Following IATF 16949 requirements, suppliers’ manufacturing locations must:

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

Suppliers must provide Bosch copies of the relevant valid certificate on their own accord.

A convenient way to do this is to maintain certificates with the support of Supply On.

Further information is available here:

- Requirement for management system.

Suppliers of digital goods undertake to comply with the requirements of ASPICE, if applicable, and to prove this, e.g., by means of self-assessments. The proof for digital goods shall be provided to Bosch on request.

Furthermore, Supplier must ensure compliance with requirements specific to branches of industry and fields of material (e.g., AIAG, VDA, DIN) insofar as this corresponds to the state of the art and must be demonstrated in case of need.

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

Supplier must inform Bosch without undue delay of any delays in the issuance of a follow-up certificate and if one of its certificates is withdrawn.

1.2 Environmental Management System

Supplier must 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 must make sure that its sub-suppliers adhere to the same quality and environmental management system standards as described in chapters 1.1 and 1.2.

Supplier must ensure that its sub-suppliers fulfill all applicable state-of-the-art, industry specific and / or material field specific requirements (e.g., AIAG, VDA, DIN).

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

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

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's customers, 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, then Supplier must:

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

If non-conformities could have a high risk of quality to product deliveries, immediate actions can be requested.

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 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) at the Supplier's cost.

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 Supplier's potential to meet the requirements for the requested products and corresponding processes.

The analysis considers the experience and skills of 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 products).

The result gives a forecast 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].

2.2 VDA 6.3 Audit

The VDA 6.3 process audit is used to confirm the processes and process steps confirm 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].

A process audit can examine the following topics:

- P2: Project management
- P3: Planning of product and production process development
- P4: Implementation of product and production process development
- P5: Supplier management
- P6: Production process analysis
- P7: Customer 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 RB Remote Risk Assessment

In special cases, where an onsite Audit is not possible and VDA 6.3 rules can't be fulfilled, a RB Remote Risk Assessment can be conducted. The RB Remote Risk Assessment is based on VDA 6.3 Questionnaire with adapted evaluation logic (no risk, low risk, middle risk and high risk).

2.4 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.

2.5 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 must be fulfilled to reach a certain maturity level.

Further information and the assessment questionnaire is available in the Q-Basics App (available for IPads only) or on the Bosch purchasing homepage:

- Value Stream Q-Basics - General Information
- Q-Basics Overview
- Q-Basics description
- Q-Basics Booklet (download version)
- Q-Basics Assessment-Form

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 all technical documents. Technical documents are:

- parts lists (Bill of Material),
- specifications,
- drawings,
- CAD data,
- packaging specification,
- standards etc.

Supplier shall immediately inform Bosch of any deficiencies and risks identified during the review, as well as any improvement possibilities.

Based on the Supplier's feasibility analysis, Bosch expects the Supplier to provide a written confirmation of feasibility before final awarding of the contract, together with the filled "Component Supply Chain Chart" that shows the supply chain for all manufacturing steps / supplies. Bosch requests **entries** for **all ingredients** defined in the **specification** till mine. Bosch forms are available for download here:

- Feasibility Confirmation
- Component Supply Chain Chart.

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

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, 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 feasibility analysis, management of characteristics, reliability checks, risk analysis, FMEA, inspection planning etc. 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 and inspection planning (work instructions, inspection plans, resources, tools, machines, etc.), considering all characteristics.

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

The procedure includes:

- classification of those characteristics @ Bosch
- communication of those characteristics to the Supplier (via “Important Characteristics List”)
- requirements of Bosch for those characteristics regarding:
  - Management in the Supply Chain
  - Inspection planning in the Supply Chain
  - Measurement System Analysis
  - Process Capability Studies
  - Process Monitoring
  - Data Recording
  - Documentation, at least within Control Plan(s) and FMEA
  - Labeling in documents etc..

4.1.1 Classification of Characteristics

Bosch has defined a method to classify characteristics. The method aims to:

- analyze all defined product characteristics according to defined criteria
- assign a corresponding characteristic classification
- identify special characteristics
- define required inspection strategies to ensure efficient and effective control
- ensure suitable safeguards are defined for special characteristics
- improve product quality regarding safety, compliance with official or statutory regulations, and functional fulfillment.

Bosch has defined the following classification for characteristics:

CLASSIFICATION	EXPLANATION
CSC (CUSTOMER SPECIFIC SPECIAL CHARACTERISTIC):	• Special characteristics defined by Bosch's customer with safety relevance (S/C) • Special characteristics defined by Bosch's customer with legal relevance (G/C) • Special characteristics defined by Bosch's customer with functional relevance (F/C)
A	• confirmed special characteristics with safety relevance (S) • confirmed special characteristics with legal relevance (G) • confirmed special characteristics with functional relevance (F)
B	• potential special characteristics (B1) • "not functionally robust", but "manufacturing method robust" characteristics (B2) • "functionally robust", but "not manufacturing method robust" characteristics (B3) • process relevant characteristics, which are "functionally robust", and "manufacturing method robust" (B4) • process relevant characteristics, which are "not function relevant" (B5)
C	• characteristics, which are "functionally robust" and "manufacturing method robust" (C1) • characteristics, which are "not functionally relevant" and "not process relevant" (C2)

Table 1: Classification of Characteristics

4.1.2 Inspection Strategies

For the defined classification of characteristics, four groups of inspection strategies are defined.
The groups are:

I: Inspection strategies in the framework of the internal production process release
II: Inspection strategies within the scope of the product / process release (PPA/PPAP)
III: Inspection strategies in the running series production
III-1: Strategies for process monitoring and -control in the running series production
III-2: Strategies for sorting out failures
III-3: Strategies for production ramp up – Safe launch
IV: Periodic testing of series products (Product audit).

4.1.2.1 Overview Inspection Strategies

The following table shows an overview of the Inspection Strategies assigned to the four groups:

I - Inspection strategies in Framework of the internal production process release	II - Inspection strategies within the scope of the product / process release with Bosch (PPA/PPAP)	III -Inspection strategies in the running series production			IV - Periodic testing of series products (Product audit)
		III-1 Strategies for process monitoring and -control		III-2 Strategies for sorting out failures	
Initial Sampling/ Release measurement	(Initial-)Sampling (PPA/PPAP)	Poka Yoke	First-/Lastpart, Sampling inspection	100% Inspection	Quality Testing
Machine Capability Study c_{mk}	-	Process parameter monitoring	In-process control	Poka Yoke (Detection)	Reliability Testing
Short **T**erm Process Capability Study $c_{pk\text{-}ST}$	-	SPC	Regularly Cpk revalidation	-	Requalification / Layout Inspection & Functional Testing
Initial (Long Term) Process Capability c_{pk}/p_{pk}	-	-	-	-	-
Inspection of discrete characteristics with defined scope for the purpose of process release		-	-	-	-
		III-3 Strategies for production ramp up – Safe Launch			

Table 2: Overview of Inspection Strategies

4.1.2.2 Inspection Strategies Group I – Internal Production Process Release at Supplier

The inspection strategies of Group 1 are implemented before the start of series production (e.g., assembly line / station / variant / MAE) and used for releasing the production process for series production. Example inspection strategies are:

- Initial Sampling / Release Measurement
  - All specified characteristics are measured.
- Machine Capability Study (Cmk)
  - The capability of a production process to produce a characteristic according to specification is proven by means of a machine capability study (Cmk).
- Short-Term Process Capability Study (Cpk-ST)
  - The capability of a production process to produce a characteristic according to specification is proven by means of a short-term process capability study (Cpk-ST).

- A short-term capability study provides an early indicator for the process capability.
- It is unlikely that all influencing factors on the process behavior are evident.
- A short-term process capability study offers a tradeoff between the speed of a machine capability and the accuracy of a long-term process capability.

- Initial (Long-Term) Process Capability Study (Cpk / Ppk)
  - The capability of a production process to produce a characteristic according to specification is proven by means of long-term process capability study (Cpk / Ppk).
  - The initial long-term process capability study is performed after the start of series production and should be continued as part of the series inspection strategy.
- Inspection of Discrete Characteristics with Defined Scope for the Purpose of Process Release
  - If a production process produces discrete product characteristics that do not permit proof of capability in terms of machine capabilities, an inspection of discrete characteristics with a defined scope for the purpose of process release is applied.
  - The target condition must be described based on discrete characteristics. The scope of release and acceptance criteria must then be defined.

4.1.2.3 Inspection Strategies Group II – Inspection strategies within the scope of the product / process release with Bosch (PPA/PPAP)

- see chapter: 4.9 Production Process and Part Release - Procedure / Sampling

4.1.2.4 Inspection Strategies Group III – Inspection strategies in the running series production

4.1.2.4.1 Inspection Strategies Group III-1 – Strategies for Process Monitoring and Control

The inspection strategies for process monitoring and control in the running series are applied as soon as series production starts.
Example inspection strategies are:

- In process control
  - Monitoring process parameters serves to safeguard product characteristics indirectly.
- Process Parameter Monitoring (100%)
  - Monitoring process parameters serves to safeguard product characteristics indirectly.
- Poka Yoke
  - a method for avoiding/detecting unintentional misconduct or deviations.
- Statistical Process Control (SPC) incl. Regular Process Capability Revalidation
  - SPC is a method for controlling a manufacturing process based on statistical methods. Random samples are taken from the process according to process-specific sampling rules. Their characteristic values are measured and entered in quality control charts. Statistical parameters calculated from the characteristic values are used to assess the current process status. If necessary, the process is corrected by suitable measures.
- Acceptance Chart

        - An acceptance control chart ensures tolerance compliance with an acceptable uncertainty.
    - Random samples are taken, and their values entered into the chart.
        - Acceptance control charts are used if an understood and systematic process behavior exists (e. g. trend due to tool wear).
    - First-/Last Part Inspection, Sampling Inspection
        - This inspection strategy is applied to safeguard against systematic cause-and-effect relationships.
        - This inspection strategy is suitable for both discrete and continuous characteristics.
        - The following cases should be considered (individually or in combination):
            - Production restart after a technical (e. g. setup) or organizational (e. g., break) interruption with the aim of releasing production again
            - Lot release to confirm parts produced since the last inspection
            - Random inspection at defined intervals to confirm the quality situation (e. g. time-based /quantity-based)
    - Process Specific Nonstandard Strategies
        - Alternative process-specific inspection strategies are described (inspection instruction) and agreed between Bosch and Supplier.

4.1.2.4.2 Inspection Strategies Group III-2 – Strategies for sorting out failures

These strategies attempt to reliably detect and sort out parts which do not meet the specifications. Example inspection strategies are:

- 100% Inspection
    - The strategy “100% Inspection” involves the testing of a product characteristic on every produced part to confirm the specification is met. Non-conforming parts must be securely segregated.
- Poka Yoke
    - a method for avoiding/detecting unintentional misconduct or deviations.
    - This strategy is adequate if all nonconforming parts are reliably rejected.

4.1.2.4.3 Inspection Strategies Group III-3 – Strategies for Production Ramp Up – Safe Launch

- See chapter: 4.8 Ramp-up validation (Launch Management)

4.1.2.5 Inspection Strategies Group IV – Periodic testing of series products (Product audit)

- E.g., Quality Testing as defined in the specification,
- E.g., Reliability Testing as defined in the specification
- Requalification
    - See chapters:
        - 4.9 Production Process and Part Release - Procedure / Sampling
        - 7 Requalification (Layout Inspection and Functional Testing)

4.1.2.6 Inspection Strategies assigned to the specific classification

For the defined classification of characteristics, specific inspection strategies are predefined.

CLASSIFICATION	EXPLANATION	MIN. REQUIREMENT
CSC (CUSTOMER SPECIFIC SPECIAL CHARACTERISTIC):	• Special characteristics defined by Bosch's customer with legal relevance (G/C) • Special characteristics defined by Bosch's customer with safety relevance (S/C) • Special characteristics defined by Bosch's customer with functional relevance (F/C)	• Assurances required by Bosch's customer must be implemented regardless of any Bosch internally defined classification => see classification
A	• confirmed special characteristics with legal relevance (G) • confirmed special characteristics with safety relevance (S) • confirmed special characteristics with functional relevance (F)	• Group I • Group II • Group III-2 • Group IV
B	• potential special characteristics (B1) • "not functionally robust", but "manufacturing method robust" characteristics (B2) • "functionally robust", but "not manufacturing method robust" characteristics (B3) • process relevant characteristics, which are "functionally robust", and "manufacturing method robust" (B4) • process relevant characteristics, which are "not function relevant" (B5)	• Group I • Group II • Group III-1 • Group III-2 • Group IV • Remark: ▪ For potential special characteristics with F-relevance (B1), the defined process quality must be monitored by means of continuously proven process capability.
C	• characteristics, which are "functionally robust" and "manufacturing method robust" (C1) • characteristics, which are "not functionally relevant" and "not process relevant" (C2)	• Group I • Group II • Group IV

Table 3: Inspection Strategies assigned to the specific classification

4.1.2.7 Predefined inspection strategies for all characteristics

Characteristics of **all classes**

- must be evaluated in the internal production process release **= group I** and
- are part of the measurement of all characteristics during initial sampling (PPA/PPAP) **= group II** and
- are included in the respective layout inspection and functional testing (requalification) **= group IV**.

Additionally, Supplier must describe and use appropriate error-proofing methods (e.g., dummy test, stability chart, working standard, master part testing). The method must include the testing of error-proofing devices for failure or simulated failure. Test frequencies must be included in the control plan.

Assurances required by Bosch's customer must be implemented regardless of any Bosch internally defined classification.

4.1.2.8 Predefined inspection strategies for characteristics with classification A

Characteristics with **classification A** are confirmed special characteristics, and require in addition to the rules for all characteristics (see chapter 4.1.2.7), a safe sorting out of faulty parts with an inspection strategy of group III-2.

These are either

- confirmed special characteristics with legal relevance (G)
- confirmed special characteristics with safety relevance (S)
- confirmed special characteristics with functional relevance (F)

or a combination thereof.

For class A characteristics, no defective parts are allowed.

For characteristics of Class A, in addition to the rules for all characteristics, an inspection strategy for sorting out failures (group III-2) applies:

- Strategies for sorting out failures (group III-2):
  - 100% Inspection
  - Poka Yoke (detection)

It must be technically or organizationally ensured that the NOK parts are reliably removed from production. The method is to be described.

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

Assurances required by Bosch's customer must be implemented regardless of any Bosch internally defined classification.

4.1.2.9 Predefined inspection strategies for Characteristics with Classification B

Classification B applies to

- potential special characteristics (B1)
- “not functionally robust”, but “manufacturing method robust” characteristics (B2)
- “functionally robust”, but “not manufacturing method robust” characteristics (B3)
- process relevant characteristics, which are “functionally robust”, and “manufacturing method
- robust” (B4)
- process relevant characteristics, which are “not function relevant” (B5)

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

Therefore, for classification B characteristics, in addition to the rules for all characteristics (see chapter 4.1.2.7), at least one of the following predefined inspection strategies for process monitoring and -control in the running series production (group III-1) applies:

- Strategies for process monitoring and -control in the running series production
  - In-process control
  - Process parameter monitoring (100 %)
  - Poka Yoke
  - Statistical Process Control (SPC) incl. regularly process capability revalidation
  - Acceptance chart
  - First / last part, sampling inspection
  - Process specific nonstandard strategies

For potential special characteristics with F-relevance (B1), the defined process quality must be monitored by means of continuously proven process capability.

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.

Process capability requirements are defined in chapter 4.2.3.

Standard requirements for process capabilities are listed in Table 11.

Assurances required by Bosch’s customer must be implemented regardless of any Bosch internally defined classification.

4.1.2.10 Predefined inspection strategies for Characteristics with Classification C

Class C applies to

- characteristics, which are “functionally robust” and “manufacturing method robust” (C1)
- characteristics, which are “not functionally relevant” and “not process relevant” (C2).

For class C characteristics, the predefined inspection strategies for all characteristics apply:

- must be evaluated in the internal production process release (strategies of group I),
- are part of the measurement of all characteristics during initial sampling (PPA/PPAP, group II),
- are included in the respective layout inspection and functional testing (requalification, group IV).

Class C characteristics are not listed on the ICL unless they are defined by Bosch's customer as a special characteristic. In this case, assurances required by Bosch's customer must be implemented regardless of any Bosch internally defined classification.

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 different forms for the communication of the important characteristics:

- Bosch uses the form "ICL" which contains the characteristics and their classification. The related rules apply. Results for MSA, capabilities etc. will be requested during initial sampling (PPA/PPAP). Evidence of compliance forms part of the initial sampling documentation.
- Another form used is the "ZZ-ICL-result". If requested, Supplier needs to record results in the form and submit the filled form as documentation of evidence during initial sampling (PPA/PPAP). Further evidence is part of the initial sampling documentation.
- Bosch has another form "ICL" 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). Further evidence is part of the initial sampling documentation.

4.1.3.2 Communication & Implementation: Suppliers to Sub-Tier Suppliers

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

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

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

4.1.4 Terms / Abbreviations / Remarks:

Functional robustness:

- A characteristic is designed to be “functionally robust” if it does not immediately lead to failure after the tolerance has been exceeded. A characteristic is also functionally robust if it is a subordinate contributor to a failure (design, expert decision).
- 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).

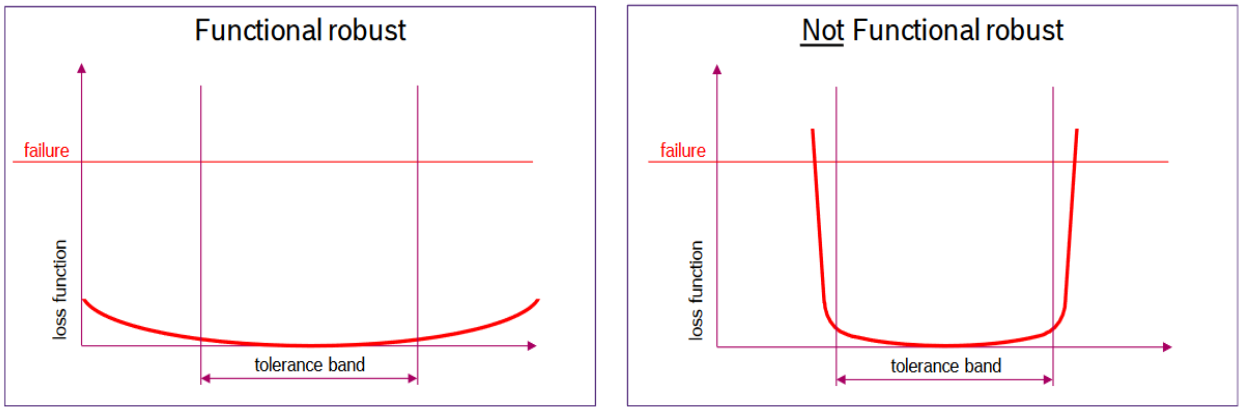


Figure 1: Functional robust / not functional robust

Manufacturing method robustness:

- A characteristic is designed to be “manufacturing method robust” if the tolerance of the characteristic can be ensured with the selected manufacturing method at current state of the art and normal care (including usual outliers).
- Product characteristics are “not manufacturing method robust” if there exists high likelihood of exceeding the tolerance for the chosen manufacturing method. That means the product characteristic is failure sensitive for the chosen manufacturing method.

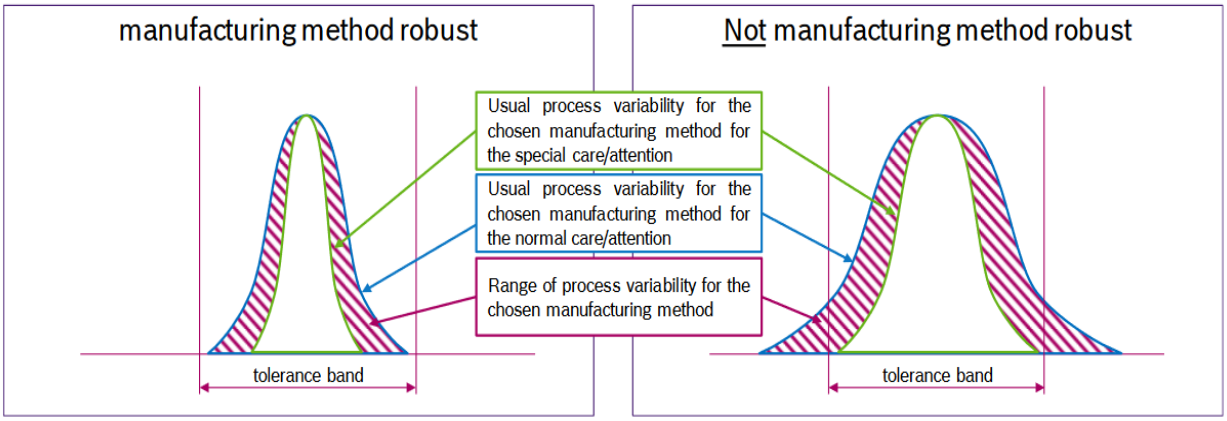


Figure 2: Manufacturing method robust / not manufacturing method robust

Potential special characteristics

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 is not reached the characteristic becomes a confirmed special characteristic (class A). Otherwise, it remains as class B (B1).

Confirmed special characteristics:

Confirmed special characteristics are functional relevant characteristics that are not “functionally robust” and “not manufacturing robust” and cannot be manufactured with the required process quality. At Bosch, the term special characteristics is used synonymously for this.

Special Characteristics:

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 must be measurable or testable, and must be considered during inspection planning as inspection characteristics; they must be secured, controlled and monitored in the relevant manufacturing processes and must be documented in the control plan, in risk analysis and in work instructions.

- The extension `/C` and/or the abbreviation “CSC” identifies a special characteristic specified by a customer from Bosch.

Process relevance:

Product characteristics can be defined as process relevant if they

- are essential for the execution, control, regulation of a subsequent process (e.g., in multilevel processing steps, for fixing / alignment in component assemblies) or
- serve as quality indicators of the manufacturing process (e.g., for tool wear, process behavior, systematic error possibilities).

4.2 Capabilities - general information

Capability studies are carried out to determine the behavior of measurement processes, machines and production processes and to describe them statistically. On this basis, a prediction of the future behavior is derived.
For a new or modified production process (incl. assembly) a process capability study must be carried out to verify the (preliminary) process capability / process performance and to obtain additional inputs for the process control.

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 No. 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 No. 7 Statistical Process Control.

Statistical software for the collection and monitoring of data, preferably QS-Stat (RB 2018 calculation strategy) shall be used.

Additionally, eISIR (web application) offers the opportunity to calculate C_{mk} values using QS-Stat (RB 2018 calculation strategy).

If these methods cannot be applied neither unchanged nor modified, it is permissible to check and apply methods from the technical literature for their applicability or suitable modifiability.

If it is not possible to verify a product characteristic 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. If there are no alternative options for capability verification, the measurement uncertainty must be determined. In such cases, a control chart with a moving calculated statistical value (e. g. mean value) can be used for process control. This is described in

- Booklet No. 7 Statistical Process Control.

In exceptional cases, own procedures may be developed. The intended procedure must be documented and agreed upon between Bosch and Supplier.

4.2.1 Actions in Case of Non-Capable Processes

For each not capable manufacturing process, either through a check (e. g. 100% inspection) by means of a capable measuring process or other suitable measures (e. g. function check in down-stream process steps, risk analysis, decision / approval management) ensure that only parts are delivered in accordance with the specifications.

4.2.2 Measurement process capability (Measurement System Analysis)

The verification of capability must 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.

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:

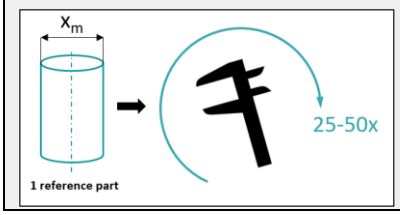
PROCEDURE	EXPLANATION	CAPABILITY CRITERION
Procedure 1 (type-1 study) Systematic measurement error and repeatability 	Verification of the capability of a measurement process in terms of location and variation of measured values within the tolerance field of this characteristic (as a test process for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

Table 4: MSA Procedure 1

Remarks:

- Procedure 1 must 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).
- For chemicals / bulk material: If no certified reference material (CRM) is available, carry out MSA procedure 1 using an own validated homogeneous & stable standard. The nominal value of the standard should be in the middle of the tolerance range.

Procedure 2:

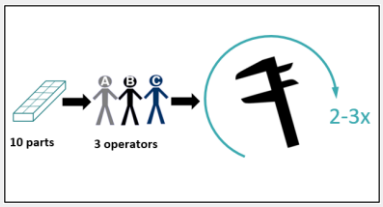
PROCEDURE	EXPLANATION	CAPABILITY CRITERION
Procedure 2 (type-2 study) Repeatability and reproducibility (gage R&R) with operator influence  	Verification of the capability of a measurement process (as a test process for a particular characteristic) in terms of its variation behavior using measurements 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 ≤ 10%: measurement process is capable 2. 10% ≤ %GRR ≤ 30%: measurement process is conditionally capable 3. %GRR ≥ 30%: measurement process is not capable

Table 5: 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.
- For chemicals / bulk material: If only less then 10 different batches of the product are available, this can be compensated either by using more than one sample per batch (if number of batches ≥ 5) or another product which is comparable in the characteristic to be measured (same material class, nominal value in the same range) can be used to perform the MSA procedure 2 study.
- For chemicals / bulk materials: Destructive measurements can be regarded as non-destructive measurements in case batch homogeneity is proven (multiple samples from a batch can be taken).

Procedure 3:

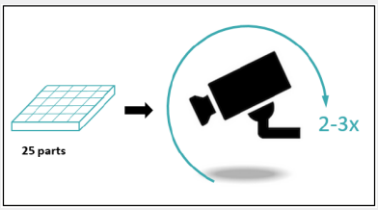
PROCEDURE	EXPLANATION	CAPABILITY CRITERION
Procedure 3 (type-3 study) Repeatability and reproducibility (gage R&R) without operator influence  	Verification of the capability of a measurement process (as a test process for a particular characteristic) in terms of its variation behavior using measurements 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: 1. %GRR ≤ 10%: measurement process is capable 2. 10% ≤ %GRR ≤ 30%: measurement process is conditionally capable 3. %GRR ≥ 30%: measurement process is not capable

Table 6: 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:

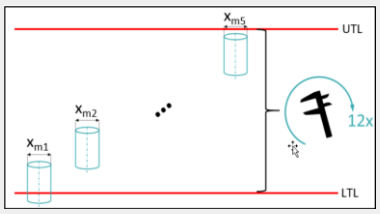
PROCEDURE	EXPLANATION	CAPABILITY CRITERION
Procedure 4 Linearity  	Verification of a sufficiently linear relation between the values of a physical quantity to be measured and the corresponding measured values determined by the measuring system. This procedure determines whether the systematic measurement 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: 1. ≤ 5%T = capable 2. ≤10%T = conditionally capable

Table 7: 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:

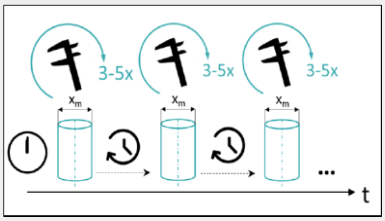
PROCEDURE	EXPLANATION	CAPABILITY CRITERION
Procedure 5 Stability  	Validation of consistently correct measurement results by monitoring the long-term behavior of a measurement process and corresponding evaluation of the stability of the measuring system (similar to an $\bar{x}$s-SPC control chart whereas a measurement process is not controllable in terms of a SPC process). 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 $\bar{x}$s-chart	The stability of a measurement process is evaluated by means of the stability- ($\bar{x}$s-) chart. All values (usually the mean values) are within the control limits and vary unsystematically (randomly). There are no indications of instability.

Table 8: 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;
  - Bosch 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 must 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:

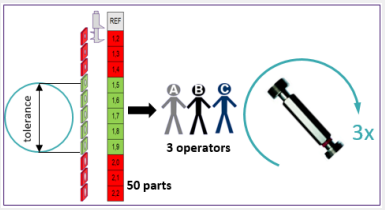
PROCEDURE	EXPLANATION	CAPABILITY CRITERION
Procedure 6 Test decisions for discretized continuous characteristics  	Verification of the capability of a test process regarding unambiguous test decisions when testing discretized characteristics. 3 operators in 3 runs inspecting 50 parts (randomized) and 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.	The following limits apply: 1. %GRR ≤ 10%: measurement process is capable 2. 10% ≤ %GRR ≤ 30%: measurement process is conditionally capable 3. %GRR ≥ 30%: measurement process is not capable (corresponding to procedures 2 and 3)

Table 9: 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 must 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:

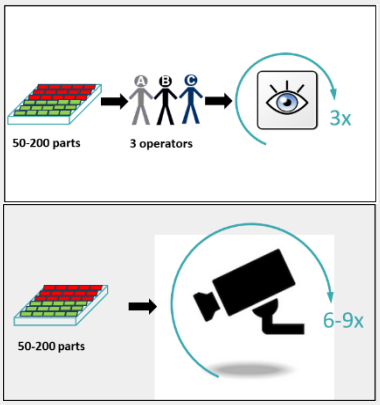
PROCEDURE	EXPLANATION	CAPABILITY CRITERION
Procedure 7 Test decisions for discrete and discretized continuous characteristics 	Verification of the capability of a test process regarding unambiguous test decisions when testing discrete or discretized continuous characteristics. Minimum 3 operators in 3 runs inspecting a randomized reference lot (inspection automat 6-9 runs, all cameras included). Documentation of ok / nok-results	The capability is classified by means of the parameter κ "kappa"): 1. κ ≥ 0.9 test process is capable 2. 0.9 > κ ≥ 0.7 test process is conditionally capable 3. κ < 0.7 test process is not capable The minimum of all determined κ – values is relevant for the final classification of the test process.

Table 10: 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 must 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 always ensured.

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 disassembly, 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 must be repeated and the capability must be verified again.

4.2.2.4 Actions in case of Non-Capable Measuring Process

In the case of conditionally capable and definitively non-capable measurement processes the tolerance range of the inspection characteristic must 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 must be arranged with Bosch.

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	Cm ≥ 1,67 Cmk ≥ 1,67	sample size n ≥ 50 (n ≥ 100 recommended) (sequential parts)
Preliminary process capability (= short term = ST) Stabile process	Cp-ST ≥ 1.67 Cpk-ST ≥1.67	Sample size n ≥ 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)	Pp-ST ≥ 1.67 Ppk-ST ≥ 1.67	Sample size n ≥ 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	Cp ≥ 1,33 Cpk ≥ 1,33	Long term study, stable process
Process performance index	Pp ≥ 1,33 Ppk ≥ 1,33	Long term study, instable process

Table 11: 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 12: 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 must 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 Actions in case of non-capable Manufacturing Process

If a manufacturing process is not capable, it must be ensured that all parts delivered to Bosch are in accordance with the specifications.

This can be achieved either

- by an inspection (e.g., 100%-inspection) using a capable measurement process or
- other suitable measures (e.g., functional testing during successive process steps).

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 must be developed for each production location and all products supplied.

The production control plan provides evidence that

- the information from the FMEAs was considered 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 must 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 must 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 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 must 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
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. 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.	The process FMEA analyzes the design of processes in terms of quality from the receipt of goods to the delivery to the customer. The process FMEA (PFMEA) analyzes the potential failures of manufacturing, assembly and logistical processes to produce products which conform to design intent. 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. Process-related failures are different than the failures analyzed in the design-FMEA. 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.

Table 13: 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 AIA[G] 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) must 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:

- Bosch Booklet 14 - Failure Mode and Effects Analysis FMEA.

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 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:

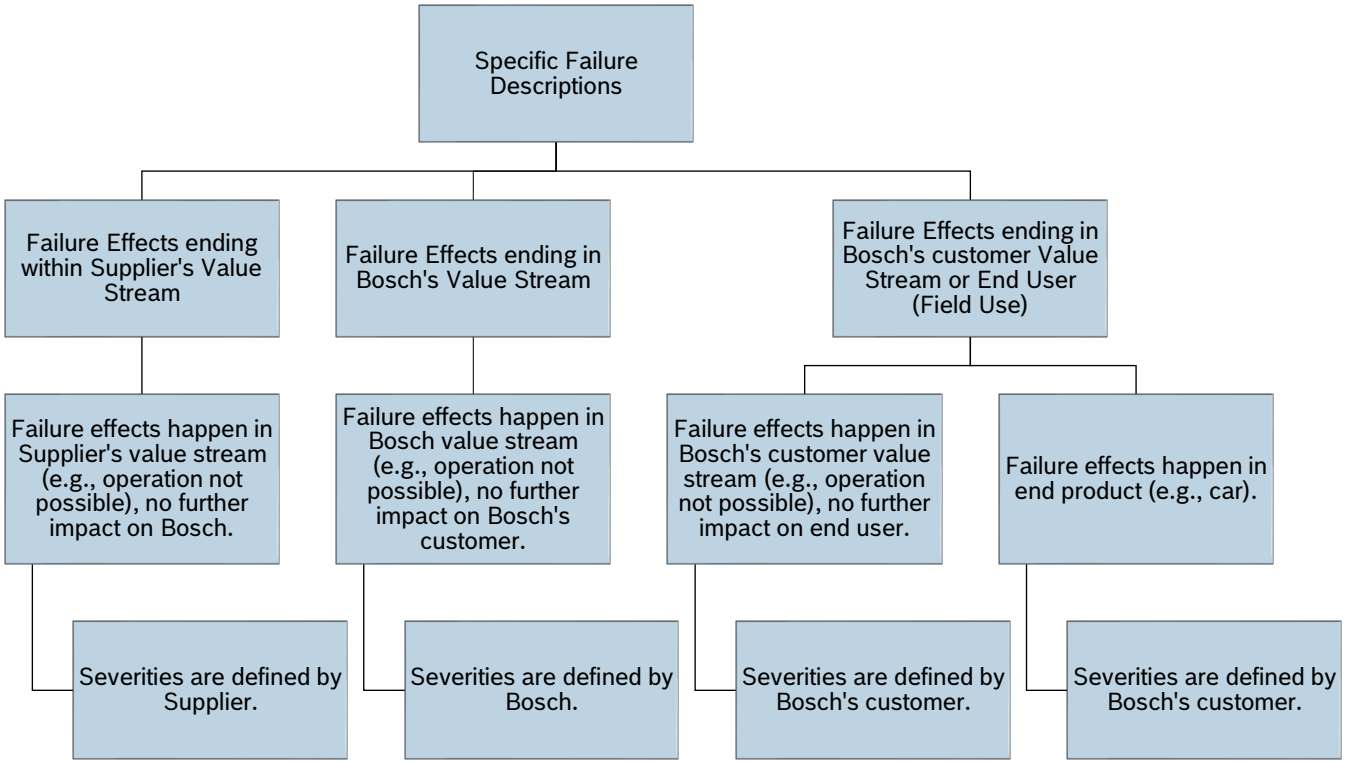


Figure 3: Evaluation of Severities

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

- must 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 and test specification specify the required component properties and the heat treatment processes.

Basic requirement in the context of process approval is extended testing on parts taken from specified furnace positions. Testing of the parts 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, available for download here:

- Bosch-Norm N67W 02 - Release of heat treatment processes.

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 Suppliers site.

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 (4th 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 eISIR.

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:

No.	Deliverables	Explanation
0.1	**"Cover sheet for PPA report" and "PPA evaluation"** (VDA Volume 2, current version, Appendix 4) **If requested:** **Part Submission Warrant (PSW)** (AIAG 4th edition, PPAP) **see under "others", 5.9.1**	❖ Based on the current production and documentation status, the "Cover sheet for PPA report" and "PPA evaluation" must be completed in full (reference number, designation revision level, tool no., number of nests, production machine/line, etc.) and must be signed by Supplier (here: 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 for PPA report" and "PPA evaluation", AIAG cover sheet (Part Submission Warrant): => either in the field provided or in a remarks field).
0.2	**Self-assessment for product, process, and, if applicable, software**	❖ With the self-assessment 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 (acc. to VDA Volume 2, current version, Appendix 3).
1	**Deliverables of the product development**	
1.1	Technical Specifications	❖ Supplier must confirm by reference on the cover sheet that it has all the technical specifications (including for the components) at it's disposal (note: in principle the bill of material (BOM) is the leading document). The technical specifications include e.g., drawings, CAD data, short-circuit resistance requirements, voltage protection, functional safety. ❖ 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.
1.2	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 (as well additional documents for design changes not covered by 1.1.).

No.	Deliverables	Explanation
1.3	Design, engineering approvals (in case of development responsibility)	❖ If Supplier is responsible for design as per agreement, Supplier must provide proof of the relevant releases according to requirements.
1.4	Material Data via IMDS	❖ Suppliers must fulfill N2580 – for further details see Prohibition and Declaration of Substances - General Information Bosch-Norm N2580.pdf MDS Guideline Declaration Sheet ❖ Supplier must enter the part-specific data in the "International Material Data System" (IMDS Supplier Code for Robert Bosch GmbH: #202). ❖ The reference number must be specified without blanks or separators (e.g.: 1234567890). ❖ The respective IMDS-ID-No. must be entered on the cover sheet. ❖ Additionally, a copy of the MDB-report with status “accepted” for the 10-digit serial part-no. must be provided.
1.5	**Design FMEA**	❖ The organization responsible for product development carries out the Design-FMEA. If Supplier has responsibility for product 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 D-FMEA documents. ❖ The cover sheet must contain details of the designation, reference number (including the edition) and the change history of the documents.

No.	Deliverables	Explanation
2	**Deliverables of the production process development**	
2.1	**Process flowchart**	❖ Supplier shall submit a process flow chart (production process and inspection 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.
2.2	**Process FMEA**	❖ Supplier carries out the Process-FMEA. At a minimum, a copy of the cover sheet for the completed process P-FMEA must be submitted as part of the sampling documentation. The cover sheet must contain a reference number, including the document status and the designation. Bosch has a right to inspect the P-FMEA documents.
2.3	**Control Plan**	❖ Supplier prepares a control plan that describes the control of processes for production and for inspection of a product. The findings from the P-FMEAs are considered when preparing the CP. For details of the content see chapter 4.3. ❖ Bosch has a right to inspect the CP. Supplier shall submit a copy of the control plan. For details of the content see chapter 4.3. At a minimum, a copy of the cover sheet of the CP must be provided to Bosch as part of the sampling documentation.

No.	Deliverables	Explanation
3	**Deliverables of the validation of the product** Exclusively for the requirements from the technical specifications agreed upon with Bosch.	
3.1	**Geometry** Remark: Detailed requests are possible.	❖ For providing proof of the product characteristics, **all requirements** contained in drawings and specifications must be tested and documented. ❖ All characteristics must 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, at least 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) must be clearly marked.
3.2	**Material** Remark: Detailed requests are possible.	❖ In addition to the results of the material check, Supplier must 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). ❖ Certificate of conformity must be checked, approved, and acknowledged by Supplier (with regard to Bosch material order specification / norm).
3.3	**Function**	❖ -
3.4	**Haptic**	❖ -
3.5	**Acoustic**	❖ -
3.6	**Odour**	❖ -

No.	Deliverables	Explanation
3.7	**Appearance**	❖ Decorative surfaces (e.g., graining – see also VDA Volume “6 "Decorative surfaces of accessories and functional parts in the exterior and interior areas of automobiles")
3.8	**Surface**	❖ Technical surfaces: For surface-coated components, complete systems composed of a substrate (if required) and surface coating are approved according to Bosch requirements (e.g., assurance of adhesion, resistance, roughness, free of grease, etc. according to the drawing)
3.9	**Technical cleanliness**	❖ Generally: The cleanliness analysis is to be carried out and documented in accordance with VDA19 or ISO 16232. ❖ Special requirements, for example defined by a limit value definition (“Prüfwerteblatt”) and a definition of the method of the particle extraction and analysis (“Prüfmethodenblatt”) must be considered.
3.10	**Reliability**	❖ Reliability indicators, e.g., service life, overload etc. see VDA volume 3 Part 2 “Reliability Assurance of Car Manufacturers and Suppliers”
3.11	**Resistance to electrostatic discharge (ESD)**	❖ -
3.12	**Electrical safety / high-voltage safety**	❖ -
3.13	**Electromagnetic compatibility (EMC)**	❖ -

No.	Deliverables	Explanation
4	**Deliverables of the validation of the production process**	
4.1	**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”), incl. results for respective measurement equipment analysis studies. ❖ Requirements for capability indices are listed in chapter 4.2. ❖ 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.
4.2	**Laboratory qualification**	❖ Acc. to IATF16949 requirements for test laboratories. ❖ Results from internal laboratories for PPA procedures in the supply chain continue to be used for subsequent PPA procedures. ❖ External, commercial or independent test laboratories must be accredited according to either ISO/IEC 17025 or a comparable national standard.
4.3	**Samples incl. labeling (e.g., identification of series, production lot etc. that allow conclusions to be made about the documentation accompanying production)**	❖ 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.
4.4	**Master sample**	❖ Supplier must retain a master sample for the same period as for the documentation of the PPA procedure. The master sample must be marked as such.

No.	Deliverables	Explanation
4.5	**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.
4.6	**Tools**	❖ Supplier must specify how many tools (molds, forming dies) devices etc. are used to manufacture the respective product or how many cavities a multi-cavity mold (e.g., injection molding) contains. The reference between the tools and the production line must be represented.

No.	Deliverables	Explanation
5	**General deliverables**	
5.1	**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.")
5.2	**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 and attached to the PPA/PPAP documentation, Component Supply Chain Chart. ❖ Releases for all materials and (sub) components (including customer / Bosch directed buy) used in the supplied product must be attached to the sampling documents.
5.3	**Test equipment list for product and production process**	❖ Supplier creates a product-specific list of the measuring devices used for the initial sampling and for the serial production, allocated to the measured characteristics.
5.4	**Measurement equipment analysis studies product and production process**	❖ Supplier must have evidence for the capability: ❖ Product: Capabilities of the test equipment for the characteristics ❖ Production process: Calibration certificate or adequate capability studies in cases in which test equipment capability verification cannot be provided. ❖ Requirements for measuring system capabilities are described in chapter 4.2. ff. ❖ In cases where test equipment capability verification cannot be provided, calibration certificate or adequate capability studies may be sufficient.
5.5	**Part history**	❖ Supplier documents all changes to the product and production process in the part history (acc. Appendix 6, VDA Volume 2).
5.6	**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.

No.	Deliverables	Explanation
5.7	**Documentation of agreements regarding the about diagnosis and analysis process** **Complaint handling (e.g., 8D)** **Field failure Analysis**	❖ see VDA Volume “8D - Problem Solving in 8 Disciplines” / VDA Volume “Field Failure Analysis” ❖ see chapter 11
5.8	**Documentation about agreements about Requalification (Layout inspection and functional testing)**	❖ see chapter 4.3 “Control Plan” and chapter 7 “Requalification Check (Layout Inspection and Functional Testing)
5.9	**Others**	
5.9.1	**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 must be added to the documentation. ❖ 2. Heat treatment query: ❖ Filled heat treatment query must 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, cgk). Remark: See also ICL requirements ❖ 4. Heat treatment 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 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) must be added to the documentation. ❖ Overall rating green or yellow, provided that all release relevant measures (see coversheet) have been completed in OPL.

No.	Deliverables	Explanation
5.9.1	**continued:** **Documentation for heat-treated parts**	❖ 6. Results of defined checks (e.g., surface hardness, core hardness, CHD, microstructure, ...) ❖ Inspection certificates must be added to the documentation. ❖ Inspection amount according N67W0.2 Bosch Norm N67W0.2 - Release of heat treatment process and after consultation with Bosch heat treatment expert.
5.9.2	**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).

No.	Deliverables	Explanation
6	**Deliverables for software**	
6.1	**SW-release**	❖ SW release (e.g., Appendix 5 “Cover sheet PPA software”)
6.2	**Definition of scope of the SW product**	❖ e.g., Share of in-house development of organization ❖ Integrated software without in-house development (re-use, directed part SW, 3rd-party SW, FOSS) ❖ Use of legacy software, re-use of software that does not fully meet Bosch customer quality requirements. ❖ Additional points in which the fulfilment of Bosch quality requirements for this software scope cannot be verified or only to a limited extent. ❖ Share of in-house development of organization• Integrated software without in-house development (reuse, directed part SW, 3rd-party SW, FOSS) ❖ Use of legacy software, reuse of software that does not fully meet customer quality. ❖ Additional points in which the fulfillment of Bosch quality requirements for this software scope cannot be verified or only to a limited extent. 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.).
6.3	**Reference to contractually stipulated quality requirements**	❖ 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.).
6.4	**Documentation of technical SW specifications (functional and non-functional)**	❖ The technical SW specification contains the agreed scope of contract volume incl. agreed changes. ❖ The degree of detail of the documentation must aligned between Supplier and Bosch. ❖ Evidence can also be provided in the form of a reference to the agreed software specification, approved Bosch document, or similar documentation.

No.	Deliverables	Explanation
6.5	**Implementation of the requirements from 6.3 and 6.4, especially the Special Characteristics**	❖ The type of evidence must be aligned between Supplier and Bosch. ❖ In addition to the general requirements, this may include: ❖ Traceability of Functional Safety requirements (ISO 26262) up to testing ❖ Evidence of the fulfillment of the agreed requirements concerning security ❖ Evidence of the fulfillment of the legal and official requirements in the agreed area of application ❖ Failure analysis concept for SW components
6.6	**Documentation of FOSS (free and open-source soft-ware)**	❖ Documentation of the FOSS modules used incl. the license terms and Bosch approvals
6.7	**List of known errors**	❖ -
6.8	**Documentation of testing 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.
6.9	**Documentation of development 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.
6.10	**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.
6.11	**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 Bosch 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.

Table 14: (Initial) sampling deliverables

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 must 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 must 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

- Logistics Supplier Manual .

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 must 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 Bosch.

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** must 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.

Further details are defined in Bosch supplier logistics manual,

- Logistics Supplier Manual .

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 requirements 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 considered.

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 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 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 must 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, determine the root causes, initiate corrective measures and document this procedure.

10.1 Deviations

If it becomes apparent that Supplier cannot meet its supply obligations regarding quality, Supplier shall inform Bosch promptly and always **before** delivering parts that may potentially be unusable. However, this information shall not release Supplier from the need to adhere to its contractual obligations.

Supplier shall immediately inform Bosch of all deviations detected **after** delivery. In the interests of a speedy resolution, 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.

In some cases, a special release (concession) will be issued in relation to the reported deviation (see also 10.2).

10.2 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.

11 Complaints, Problem Solving, 8D-Report

11.1 Complaints

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

Supplier must sort claimed parts as an immediate containment action (D3) or agrees to sorting by a third party. For the sorting activities, Supplier draws up and use inspection instructions, agreed by Bosch. Claimed products will be returned to Supplier or are scrapped at Bosch after Supplier's agreement.

Marking for deliveries of sorted parts must be agreed with Bosch.

11.2 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 Bosch 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.

11.3 Root Cause Analysis

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.

Supplier will process all 8D reports using the SupplyOn supplier portal,

- Supply On Info-Portal.

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

11.4 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.

11.5 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 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 Supplier or a service provider commissioned to do so.

11.5.1 Controlled Shipping Level 1 (CSL 1)

Controlled Shipping Level 1 (CSL 1) means:

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

11.5.2 Controlled Shipping Level 2 (CSL 2)

Controlled Shipping Level 2 (CSL 2) means:

- Supplier must 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 must be agreed upon with Bosch,
- tests must be done for and prior to every delivery,
- Full documentation of the tests / results must be available,
- Marking for these deliveries must be agreed upon with Bosch,
- Stock on both sides, Supplier and Bosch, must be inspected as well as goods currently in transit,
- For the sorting activities, Supplier must 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.

12 Change Management - Information and Documentation

12.1 Supplier information about changes – Supplier Initiated Change Request

Supplier must notify Bosch without undue delay of changes by Supplier listed in the VDA Volume 2 "Trigger Matrix" (Annex 8 of VDA Volume 2) which are in connection with products delivered to Bosch.

The Supplier Initiated Change Request (“SICR”) form and further information about change management are available here:

- New Process for Supplier Initiated Change Request (SICR) - Overview
- Supplier Manual for SICR Process
- Direct Link SICR Application

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

The scope of proof required for this shall be agreed by Supplier with the Bosch quality department responsible.

12.2 Electronic components

The "Guideline for Customer Notifications of Product and/or Process Changes (PCN) of Electronic Components specified for Automotive Applications" (Revision 4.0, December 2019 or more recent) drawn up by the German Central Association of the Electrical Engineering and Electronics Industry (ZVEI) applies to the change management for electronic components in automotive applications.

12.3 Labeling of Deliveries after Changes

The first deliveries after the start of a series and after changes subject to compulsory notification must be marked in accordance with Bosch requirements/specifications (e.g., in accordance with the logistics manual 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].

12.4 Documentation of a Change

All changes to the product and in the process chain and any safeguarding measures shall be documented by Supplier and submitted to Bosch on request.

13 Digital Goods

13.1 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^{SM}
- 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.

13.2 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.

13.3 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 complaints, safety- or security-related deliveries).

Bug-Fixing will be managed on project level.

14 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:

- Component Supply Chain Chart.

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.

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

The aforementioned rules apply equally to sub-suppliers specified by Bosch.

15 Cooperation for Quality Improvement

15.1 Quality Targets

Just as Bosch is committed to a zero defect target in the interests of its customers, 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 Supplier (e.g., upper limits for error rates within specific time frames). Supplier shall introduce measures for continuous improvements and for achieving the zero defect target.

15.2 Upper Limits

Adherence to agreed upper limits shall not relieve Supplier from its obligation to process all complains or from its liability for all defective deliveries. If the agreed upper limits are exceeded, 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.

15.3 Liability / escalation

The liability of 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, Supplier should attend discussions at management level+.

15.4 Development Programs

Supplier development programs are intended to improve cooperation in quality questions between Bosch and 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 Supplier and when Supplier's overall situation is assessed by Bosch, it may be possible to include Supplier in a supplier development program:

- In order to improve maturity of a specific quality topic, 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), Supplier may be included in SQIP (Supplier Quality Improvement Program).

15.4.1 EQC (Extended Quality Cooperation)

As part of Extended Quality Cooperation, Bosch's Q activities with 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)

15.4.2 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 supplier evaluation.

For further details see

- SQIP Flyer

16 Other Requirements

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

16.1 14 Quality Basics for the Value Stream

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

For further information see

- General information
- Q-Basics overview
- Q-Basics description
- Q-Basics Booklet (download version)
- Q-Basics Assessment-Form.

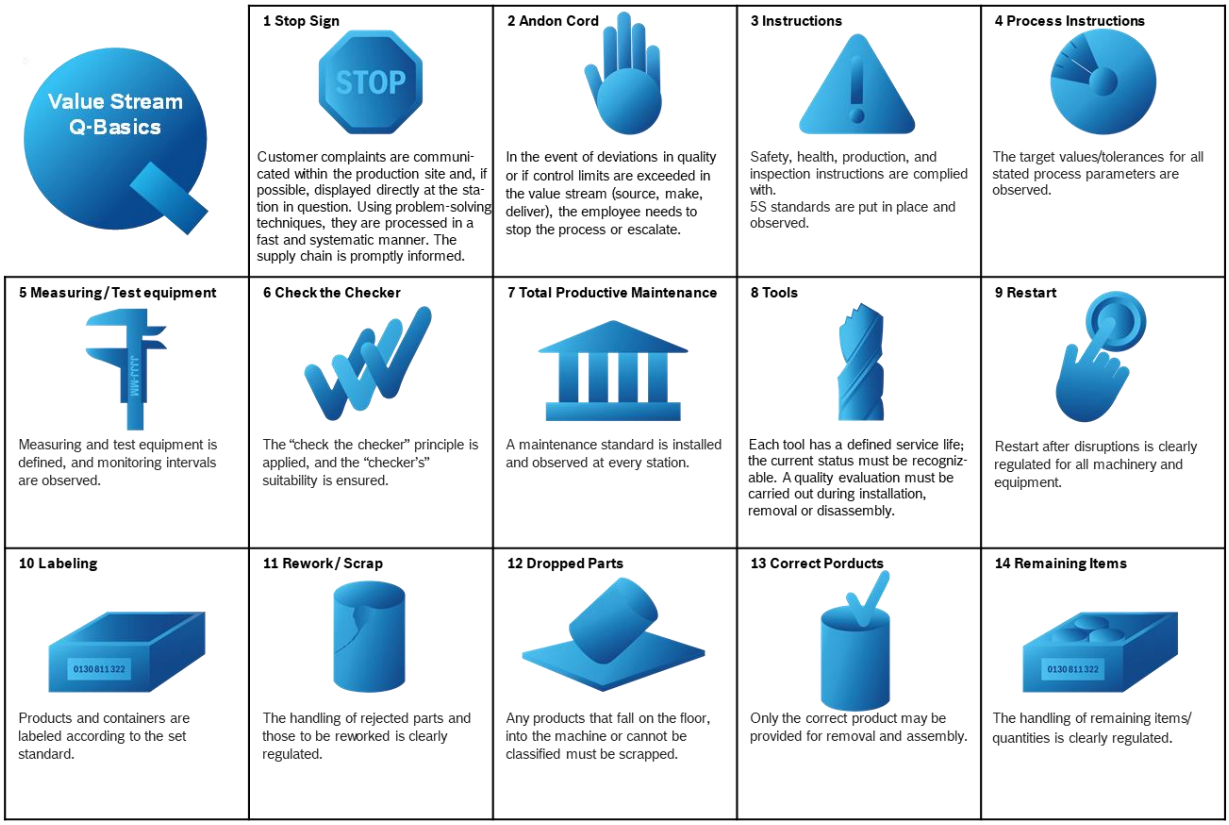


Figure 4: 14 Value Stream Q-Basics

16.2 Special Process Assessments (AIAG CQIs)

Some special and critical production processes need high attention. For such processes self-assessments 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.

Listed special production processes in CQIs:

ISSUE	CONTENT (LISTED PROCESSES)		
CQI-9 Heat Treatment	Carburizing carbon correction neutral hardening tempering precipitation hardening	aging nitriding (Gas) Ferritic birtrocarburising (Gas/Salt) Aluminium heat treatment Induction heat treatment	Annealing Normalizing Stress relieving low pressure carburizing Sinter hardening Ion nitriding
CQI-11 Plating	Zinc&Zinc Alloy plating Mechanical plating Surface conditioning of Metals for decorative Plating Surface conditioning of plastics for decorative Plating	Decorative plating for metal/plastics Electropolishing hard chrome plating electroless Nickel Hydrogen embrittlement relief bake process	process control and testing equipment Hint: typical platings for contacts as gold, silver or tin are not listed!
CQI-12 Coating	Pretreatment (Aqueous) Pretreatment (mechanical) conversion coatings Powder Spray	electrocoat Dip/Spin Autodeposition Cure	Anodizing and hard coat anodizing Equipment Part Inspection and Testing
CQI-15 Welding	Gas Metal Arc Welding Laser Welding Drawn Arc Welding Resistance Welding	Friction Welding (without friction stir welding) Induction/High Frequency Tube Welding	Fastener Projection Welding Induction/High Frequency Magnetically Impelled Arc Butt Welding
CQI-17 Soldering	Paste printing Inspection Surface Mount device placing Reflow Glue dispensing Flux application for wave soldering	Pre heating Wave Fountain Dip Selective automated iron manual iron	laser and soft beam induction conformal coat and test PCB separation ICT – In-Circuit-Test Rework
CQI-23 Molding	Injection Molding Blow Molding Vacuum Forming	Compression Molding Transfer Molding (Thermoset materials)	Extrusion Equipment Part inspection and testing
CQI-27 Casting	Sand Casting (Iron/Steel) Centrifugal Castings Centrifugal Liners Investment Castings (Iron/Steel)	Aluminum SPM Cylinder Heads Aluminum Sand Castings Aluminum Metal Mold	Aluminum High Pressure Die Cast Magnesium High Pressure Die Cast Zinc High Pressure Die Cast
CQI-29 Brazing	CAB Furnace Vacuum Furnace	Flame	Induction
CQI-30 Rubber	Compression molding	Transfer molding	Injection molding

Table 15: CQI

16.3 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 Suppliers management team or report directly to this team or to senior quality management.

16.4 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.

Supplier must store all the documents, records and master samples relevant to the contract and the product and also the source codes, if applicable, pursuant to VDA Volume 1, however for at least 15 years from the date of the last delivery to Bosch. Digital archiving is possible, provided that this does not contravene statutory provisions.

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

17 Sources

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

- IATF 16949
- 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
- VDA Volume 6.3 "Process Audit"
- VDA Volume "Process Description for Special Features (BM)"
- Automotive SPICE®
- CMMI DMMS^{CM}
- ISO 20000
- ISO 26262
- ISO 21434

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

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