Test Specification
Technical cleanliness - external (parts or components)

Prüfvorschrift
Technische Sauberkeit - extern (Teile oder Komponenten)

BOSCH

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1 General Information

1.1 Scope of application

This test specification defines the permissible cleanliness limits of parts or components from suppliers assembled to an active part (rotor, stator), an electric motor, an eDrive module (eDM = eAxle without gearbox) or an electrified drive axle (eAxle). Adherence to the limit values is obligatory. The selection and application of suitable extraction and analysis methods is also regulated. Organic impurities (e.g. oils, greases) and residues of cleaning media are not the subject of this test procedure.

1.2 Referenced documents

VDA 19 Part 1 – 2015-03: Inspection of Technical Cleanliness

VDA 19 Part 2 – 2010-10: Technical cleanliness in assembly

The terms and definitions used in this test specification (e.g. definition of a fiber) are given in the referenced documents.

2 Cleanliness requirement respectively permissible particle limit values

The cleanliness requirement is subdivided into a standard cleanliness requirement (cf. chapter 2.1) and in a user-defined respectively component-specific cleanliness requirement (cf. chapter 0). Unless stated otherwise in the technical drawing, the limits of the standard cleanliness requirement apply. However, the user-defined cleanliness requirement is used to enforce deviations from the standard cleanliness requirement. In contrast to the standard cleanliness requirement, user-defined limit values must be indicated directly on the technical drawing.

The permissible particle number n_Z is determined by Robert Bosch GmbH and refers to a component surface area of 1000 cm^2. The permissible number of particles must be specified for defined particle size classes. The component or particle-specific permissible particle number n_B is to be determined as follows, based on the actual component surface area A_B:

Component-specific permissible number of particles:	$n_B = \frac{n_Z \cdot A_B}{1000\ cm^2}$
Example: n_Z = 6 for particle sizes in the range of 500 – 1000 µm A_B = 2453 cm²	$n_B = \frac{6 \cdot 2453\ cm^2}{1000\ cm^2} = 14{,}72$

The result may not be rounded due to an inadmissible tolerance expansion.
It should also be noted that dirt accumulations with particles of any kind and size are not allowed, even if the specified limits are observed.

2.1 Standard cleanliness requirement

The standard cleanliness requirement applies only for parts or components from suppliers. The standard cleanliness requirement makes a distinction between hard particles and soft particles.

Hard particles:

- Metallic shiny particles (e.g. iron, steel, aluminum alloys)
- Crystalline morphology (e.g. sand, abrasives, oxides)

Soft particles:

- Organic and non-organic (synthetic) particles (e.g. elastomers)
- Coatings and paint residues

When applying the standard cleanliness requirement, the following text must be indicated on the technical drawing:

CLEANLINESS REQUIREMENT ACC. TO POS. 994.7

Component surface: (e.g.) 2453 cm²

The permissible particle sizes and quantities per 1000 cm² of component surface defined in the standard cleanliness requirement must **not** be exceeded.

The following values are valid as standard cleanliness requirement:

Standard cleanliness requirement part	
Reference value: 1000 cm² of component surface	
Particle type (resp. restriction): hard particles *1	
Particle size	**Number of particles allowed**
0 - 100 µm	No requirement
100 - 200 µm	500
200 - 600 µm	250
600 - 1000 µm	6
Maximum permissible particle size: 1000 µm	
Fiber length *2	**Permissible number of fibers** *2
0 - 1000 µm	No requirement
1000 - 2500 µm	10
Maximum permissible fiber length: 2500 µm	
Escalation model: C	

*1 For soft particles a max. particle size of 1000 µm also applies, but without limiting the number of particles.
*2 Applies to sealing surfaces

2.2 User defined cleanliness requirement

The user-defined cleanliness requirement is used to define particle size distributions that differ from the standard cleanliness requirement. Particle type, size and number are to be specified individually. The limit value is defined for the particle size distribution by assigning a maximum number of particles to size classes.

When using the user-defined cleanliness requirement, the following text must be indicated on the technical drawing in accordance with the following table version (Note: content is only an example):

Cleanliness requirement	
Reference value: 1000 cm² of component surface	
Particle type (resp. restriction): e.g. only metallic particles	
Component area [cm²]: z.B. 2453	
Particle size	**Number of particles allowed**
(e.g.) 0 - 100 µm	(e.g.) no requirement
(e.g.) 100 - 200 µm	(e.g.) 500
(e.g.) 200 - 600 µm	(e.g.) 200
(e.g.) 600 - 1000 µm	(e.g.) 6
Maximum permissible particle size: (e.g.) 1000 µm	
Fiber length	**Permissible number of fibers**
(e.g.) 1000 µm – (e.g.) 2500 µm	(e.g.) 10
Escalation model: (e.g.) C	

3 Selection of appropriate extraction / analysis methods

3.1 Declining test and blank value

Test parameters are defined via declining tests according to VDA 19. The correct declining behavior has to be shown for all 6 extractions conducted in a row. A blank value test, which falls below the maximal limit required by VDA 19, is absolutely necessary immediately before the complete declining test. The tolerances have to be within the VDA 19-described tolerances. Rinsing is not allowed during each single extraction.

If the declining test shows no successful decrease, the extraction parameters have to be optimized and consequently the declining procedure has to be repeated again.

A successful declining behavior has to be confirmed by 3 double inspections from different manufacturing charges. The frequency of the 3 inspections and the evidence of the effectiveness have to be capable and have to be determined regularly, at least 1x per year. Results as well as test parameters will be submitted to Robert Bosch GmbH after a successful initial qualification. Further modifications have to be reported to Robert Bosch GmbH, including test parameters. Approval of serial test procedure by Robert Bosch GmbH.

Blank value is generated under complete identical test conditions but without test pieces. It characterizes the influence of environmental conditions, e.g. particle contamination of test bench as well as of surrounding area on the result of the cleanliness analysis.

The number of test pieces per cleanliness analysis has to be chosen that the result of the analysis differs significantly to the blank value according to VDA 19. The blank value must be determined before each serial cleanliness analysis.

3.2 Extraction method

The cleanliness value of a component depends on the extraction method. In addition to the limit values, therefore, the test cleaning procedure must be specified in accordance with VDA 19 Part 1. The selection of the test cleaning method to be used depends on the component category, the component function and the material. Unless defined in the drawing, the selection and application of a suitable extraction method according to VDA 19 Part

1, shall be agreed with Robert Bosch GmbH. Necessary parameters and extraction sequences must be documented using a corresponding process description.

3.3 Analysis method

The cleanliness value of a component depends on the analysis method. Unless defined in the drawing, the selection and execution of a suitable analysis method takes place according to VDA 19 part 1 and has to be agreed with Robert Bosch GmbH. Necessary parameters and analysis sequences must be documented using a corresponding process description.

For the analysis of small parts (i.e. with surface areas < 1000 cm²), the sample size should be se-lected in such a way that a minimum area of 1000 cm² per sample is reached; provided that the filter coverage does not become so high that evaluation of the filter is made more difficult.

Example: control slide with the surface of 33 cm²; 1000 cm² / 33 cm² = 33.3 → 34 components per analysis.

4 Frequency of analysis

The analysis frequency must be selected in such a way that the agreed cleanliness of the com-ponents can be ensured and changes in the process chain which can affect the cleanliness of the components (e.g. tool changes, changing of the bath interval, etc.) are monitored (monitoring).

5 Special instructions

Permanent magnetized components or assemblies (e.g. rotor) must not be subjected to demag-netization.

6 Test samples

6.1 Extraction point

After the last process step at the supplier (before packaging). If no test is possible or useful after the last process step, the modification must first be coordinated with Robert Bosch

GmbH and secondly it must be shown that there is no risk of critical recontamination after the location of the test.

6.2 Characteristics of test samples

For the cleanliness test, the respective components must be taken directly after the last production step of the assembly line and kept in suitable, clean containers until the cleanliness analysis has been carried out. It should be noted that dirty containers or careless handling of the parts can mean an unacceptable recontamination.

6.3 Reuse of test samples

The "reuse of test samples" is to be understood as the handling of test specimens (e.g. reintroduction of an analyzed test item into the production process, scrapping of the parts, etc.) to the analysis process. The possibility and the type of reuse of test items must always be agreed with Robert Bosch GmbH.

7 Documentation of test results

A test report, including the results of the examination and test specification in accordance with VDA 19, shall be prepared and archived for each analysis carried out. In addition, the protocol must include the supplier's definition of batch delimitation and differentiation. The archival period is analogous to the corresponding technical drawing and must be agreed with Robert Bosch GmbH. The results shall be submitted to Robert Bosch GmbH upon request.

8 Escalation model

The escalation model indicates the measures to be taken when limits are exceeded.
Cleanliness analyzes has to be proceeded according to the following scheme, taking into account the following supplementary hint on the B-sample (1. Post-measurement):
In case of a B-sample, one single cleanliness analysis has to be carried out. Depending on the result of this analysis, two cases have to be distinguished:

- Result of the cleanliness analysis is OK: no measures required.
- Result of the cleanliness analysis is not OK: Generation of the mean value from three further cleanliness analyzes.

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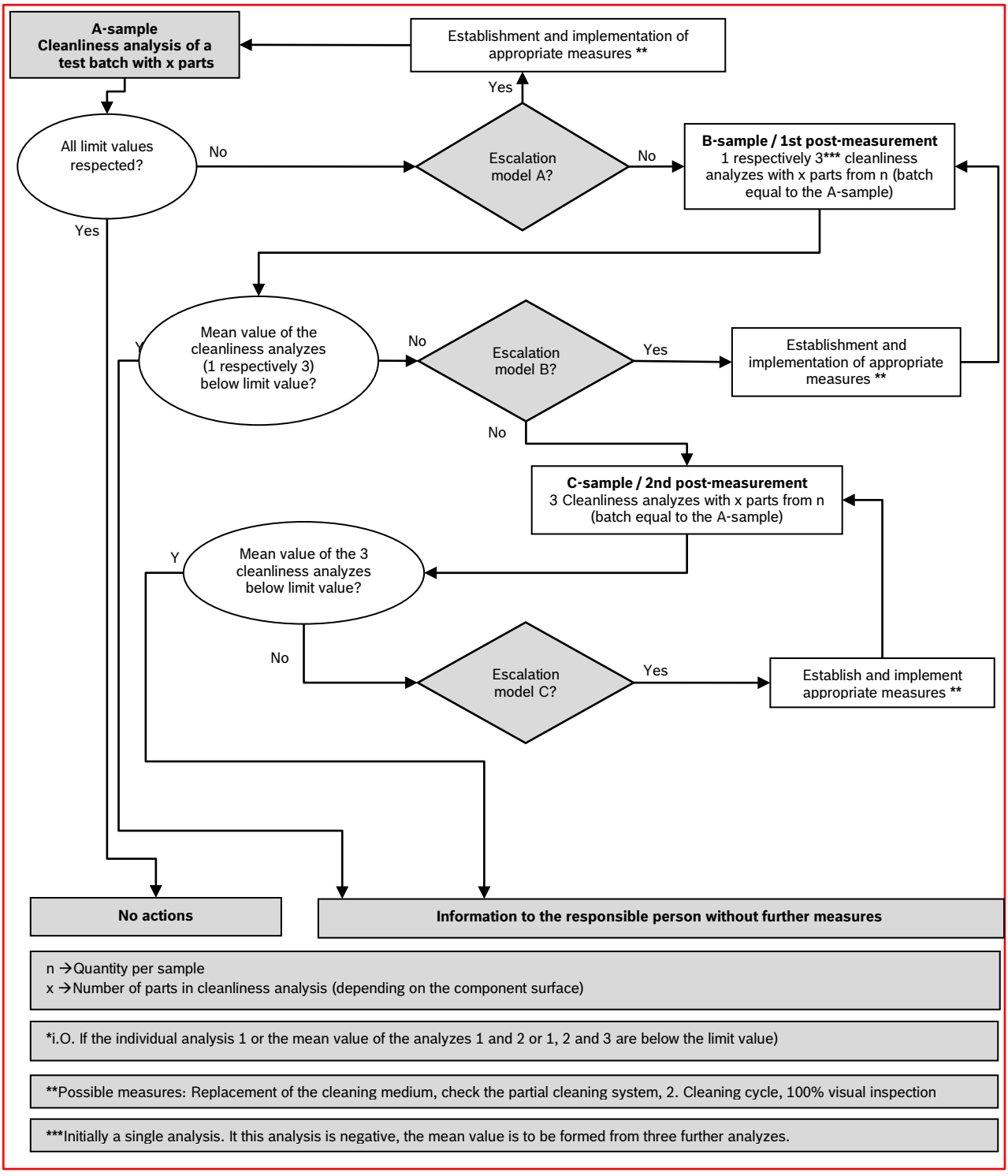

n →Quantity per sample
x →Number of parts in cleanliness analysis (depending on the component surface)

*i.O. If the individual analysis 1 or the mean value of the analyzes 1 and 2 or 1, 2 and 3 are below the limit value)

**Possible measures: Replacement of the cleaning medium, check the partial cleaning system, 2. Cleaning cycle, 100% visual inspection

***Initially a single analysis. It this analysis is negative, the mean value is to be formed from three further analyzes.

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