Language descriptor to ISO 639-1: en

ICS 03.120.10, 43.020

Descriptors: Cleanliness requirements, residual contamination, contamination, limit values, particles

Content

Earlier editions: 2010-06, 2014-06

	Name	Date	Signature
Created	G. Meier-Burkamp-VTA-arq M. Kämmerer-VPH-p1qg	2015-07-07 / 2015-10-12	sgd. Meier-Burkamp / Kämmerer
Checked	Dr. T. Huth-VTCR-are T.Weber-VTA-atdd	2015-08-18 / 2015-10-23	sgd. Huth / Weber
Approved	T. Knödler-VPH-p1qg	2015-10-28	sgd. Knödler

Original language: German

Changes:
Compared to VN 3221: (June 2014), the following alterations were made:
a) Chapter 14: Designation of "grey cast iron" was changed to "cast iron"
b) Chapter 14: Tables supplemented with limit values, weights of inspection lot added
c) Chapter 1: Scope was extended to entire Voith Turbo
d) Chapter 8.3: Indication of unit °K was replaced with °C
e) Chapter 12: Text of "or" was changed to "and/or"
f) Chapter 15: "or VQS" was added.
g) Chapter 15.2: Admissible particle size: round brackets were removed due to possible conflict with DIN 406, Chapter 3.2.8 Round brackets as indicator of auxiliary dimensions
h) German abbreviation "Stck" replaced with "St", no change in English and Portuguese version

1 Scope
This VN, as a whole, applies to components used for the production of drive components for Voith Turbo GmbH & Co. KG.

2 Area of application
This Standard applies to all components where reference is made to this Standard on the drawing or in the order. The cleanliness requirements apply to parts in finish-machined and ready-for-installation condition.
Purchased parts must meet the required values at the time of delivery.
Purchased parts that are delivered with anti-corrosive oil in accordance with the Ordering and Delivery Instructions must meet the requirements before application of the anti-corrosive oil.
Own manufacturing parts are cleaned in a suitable manner in the process flow and are allowed only a residual contamination in accordance with the following data in the end product.

3 Purpose
This Standard describes the requirements for technical cleanliness of components, such as unmachined parts, finished parts, single components, standard and catalog parts. What has been established in this Standard is intended to ensure that the components that are used at Voith and the cleanliness of which is important for their functional safety meet the requirements placed on them.

4 Normative references
ISO 16232 Part 1 - 10 Road vehicles - Cleanliness of components of fluid circuits -
VDA Band 19 Part 1 Inspection of Technical Cleanliness - Particulate Contamination of Functionally Relevant Automotive Components
VDA Band 19 Part 2 Technical cleanliness in assembly

- Unless stated otherwise, the most recent version of this standard shall apply.

5 Definitions and Abbreviations

Gravimetry	Maximum residual particle count/total mass of particle content of a component or component area to be tested
Particle	Body from a particle size of > 50 µm
M_B	Residual contamination quantity relating to the component [mg/Bauteil]
M_F	Residual contamination quantity relating to the surface of components [mg/1000 cm²]
X_M	Maximum size of a metallic particle [µm]
X_{nM}	Maximum size of a non-metallic particle [µm]
X_F	Maximum length of a fiber [µm]
Faser	Thin and flexible fabric relative to its length. Here, a fiber is characterized by a ratio of length to diameter of at least 10:1 and a non-metallic material.

6 Component cleanliness requirements / limit values
The component cleanliness requirements depend on the material and on the component weight. The indicated limits for the component cleanliness are a combination of the maximum allowable residual contamination quantity in [mg] (gravimetry) and the largest allowable metallic particle in its longest dimension in [µm] and the largest allowable non-metallic particle in its longest dimension in [µm].

7 General requirements on the technical cleanliness testing

Cleanliness testing according to VDA Volume 19 is used to measure and record, as completely and adequately as possible, particle contamination on relevant test component surfaces resulting from the manufacturing process and the environment. In addition to VDA Volume 19, the current version of ISO 16232 Parts 1 to 10 shall be observed.
An analysis of the amount of residual contamination (gravimetric analysis) and of the largest particle shall be made on finish-machined components released for dispatch. Cleanliness testing shall be performed on the entire surface of the component, unless specified otherwise (e.g. individual function-relevant areas, such as oil ducts, or the like). Make sure that all surfaces and hollow spaces are tested and no test liquid is left in the component.
During first sampling, cleanliness testing shall be performed. The scope of random sampling and the testing frequency for additional testing can be seen in the component-specific test plan and/or shall be coordinated with Voith.

8 Extraction procedure

Medium-pressure spray cleaning (preferably with 4 +/-0.2 bar, pressure ahead of nozzle) internal rinsing in an ultrasonic bath for tubular components and ultrasonic cleaning for small components (component weight < 0.3 kg) shall be used as extracion procedures.
To ensure comparability of analyses made by Voith and by the supplier, cleanliness testing shall be performed, using a uniform procedure. For each component a separate test specification must be prepared once, defining the extraction procedure and the influencing parameters A decay measurement shall be made once in order to validate the extraction procedure and the influencing parameters. The decay measurement shall be documented in the validation protocol. If changes are made to the testing equipment or to the component, Voith shall be informed and the decay measurement shall be repeated upon consultation, if required.

8.1 Medium-pressure spray cleaning

The component is cleaned by means of a spray gun at medium pressure (preferably at 4 + / 0.2 bar pressure ahead of the nozzle). The component-specific test specification for the extraction procedure is to be followed carefully, since the particle extraction strongly depends on the parameters influencing the spray cleaning process, such as test liquid characteristics, volume flow and spray pressure, geometry of nozzles and lances, distance and angle relative to the component, time per area and/or feed, repetitions per area and sequence during testing of component surfaces.

8.2 Internal rinsing in ultrasonic basin

The component is connected to a hose pump by means of hoses and is then placed in an ultrasonic bath. The test liquid is pumped through the hoses (defined volume flow) and the component is simultaneously exposed to ultrasound. After expiry of the rinsing time, the test liquid is drained from the hoses and the circuit, the entire circuit is rinsed, and the test liquid is filtered. The component-specific test specification for the extraction procedure must be followed.

8.3 Ultrasonic cleaning - Specification and cleaning parameters

The following data shall be observed for ultrasonic cleaning of a component.

- Specific power: approx. 20 W/l

  (specific power = total power [W] / filling volume [l])

  Testing of power:
  Ultrasonic power is a decisive parameter determining the extraction of contaminants. Over the period of operation, a power loss of the equipment may occur. At present, the power output can only be measured by using a hydrophone (subaqueous microphone).

- Frequency: 20 - 25 kHz

- Type of ultrasound: Designed to maintain a constant power
  Sound from the bottom for small components
  Sound from the bottom and from the sides for large components

- Ultrasonic medium: Addition of several drops of wetting agent (such as dishwasher detergent) for uniform propagation of sound waves

- Bath temperature: Approx. 60°C for aqueous medium
  No bath heating when a CH cleaning agent or petroleum ether is used!

- Degassing time: Approx. 30 minutes if water is used (removal of air inclusions that reduce the ultrasonic effect)

  Note: When using a CH cleaning agent or petroleum ether, do not degas, since the temperature will increase! In addition, when using a CH cleaning agent or petroleum ether, make sure to generally keep the temperature 10°K below the flash point of the cleaning agent.

- Materials: Too long or intense ultrasonic treatment of light metals, cast iron and coated surfaces may result in cavitation of the component. The particles detached from the component surface may wrongly be interpreted as residual contaminants.
- Sonification time: max. 3 min.
- Parts movement: Manual lifting movements (approx. 70 mm)
- Accessibility: For inner contours, the ultrasonic cleaning process is only suited to a limited extent because of the lack of effectiveness.

9 Test liquids

The task of test liquids is to extract as many contaminants as possible from components. The liquid to be used shall be compatible with the test component, with the equipment used and with the intended operational environment. In case of doubt, tested components are to be remachined or disposed of.

Water

The addition of tensides and/or neutral cleaning agents (approx. 0.1% concentration) to avoid corrosion is permissible. For the blank test, the addition of above additives shall be taken into account.

CH cleaning agent / Petroleum ether

CH cleaning agents and petroleum ether can be used as test liquids.
For comparable results, the type of cleaning agent shall be stated in the test specification.

10 Evaluation procedure

10.1 Gravimetric analysis - Amount of residual contamination in mg

To analyze residual contamination, suitable analysis filters of a defined pore size shall be used. The analysis filter is dried to a constant weight on a suited carrier, such as watch glass in Petri dish of glass as protective container, in a drying cabinet of 105°C. The analysis filter on the carrier in the closed protective container is put into a desiccator to cool down. For weighing the filters, an analytical precision balance with an accuracy d = 0.1 mg is required. In order to obtain a reliable weighing result, the analysis filter shall be weighed together with the carrier (such as watch glass). The filter tare weights shall clearly be assigned to the filters. The tare weights can be noted down on the protective containers. It is important that, after drying, both the carriers and the analysis filters are no longer touched with the hands, since this might distort the results; suitable tweezers may only be used for handling. Weighin shall be done in an air-conditioned room at constant temperature and air humidity (temperature 20 °C +/- 2 °C, relative humdity 65% +/- 5%).
After extraction, the contaminant-laded analysis filter is again dried to constant weight and then weighed. The difference between contaminant-laden analysis filter and tare weight is the amount of residual contamination in mg.
In the result thus obtained, the last decimal place is used for rounding. The result is stated in mg without post-decimal places. When the result is stated in mg/1000cm² for several components, it shall be converted. In this case, one digit after the decimal point is permissible. If a four-digit balance is used in a climatically uncontrolled room (fluctuations of air humidity and temperature), weighing results <1mg are not permitted due to the high influence of errors.

10.2 Determination of largest particle

The contaminant-laden analysis filter is observed under a microscope. The largest particle is measured by using a reticle or a relevant software (for video microscopes). The result is stated in µm. A post-decimal place is not indicated.

10.3 Surface-related particle size distribution

As with gravimetry, a surface reference is also possible with particle size distribution. Again, a reference surface of 1000 cm² is chosen. With this evaluation type, the conversion must be made for each particle size class. If conversion results in a number smaller than 1, 1 is generally entered. In addition, the result must always be rounded up, independent of the decimal place.

Calculation:

$$\text{Number of particles per size class and 1000cm2 surface} = \frac{\text{APG}*1000}{\text{A}}$$

APG = Particle size / size class
A = Surface of component [cm^2]
The size distribution indication shall preferably be related to the component. A surface-related indication only makes sense if it is used for comparing similar components of different sizes.

11 Documentation

The extraction process is to be documented during each cleanliness test on the basis of Annex A. The relevant forms in Annex B are to be used to show the test results. Additional parameters, results and measurements, such as the extraction procedure, influencing parameters and decay measurement are documented in the component-specific test specification.

12 Packaging requirements

To ensure that no additional contamination arises when the components are transported by the supplier and/or manufacture until they are installed, the components shall be adequately packed for delivery. The components are to be packed in foil and/or be stored in suitable closed containers. Further details are to be be taken from the component-specific packagaing data sheet and/or shall be defined.

13 What to do if the cleanliness requirements are exceeded

For in-house produced components, the manufacturing or cleaning lot shall not be released and shall be remachined and tested again if the permissible amounts of residual contamination and particle sizes are exceeded. For purchased components, the relevant components shall be remachined at Voith at the supplier's expense if there is a critical supply situation. However, return delivery to the supplier shall be preferred.
If the supplier realizes that he is not able to meet the demanded values, the components shall be remachined. In case of general problems regarding cleanliness as demanded, the supplier shall submit an application for special release. This application may be approved provided that the components are tested and remachined, if required, by Voith.
In the long run, however, the supplier shall be able to meet the demands by taking optimization measures.

14 Table with limit values

The following table is used to determine the limit values of residual contamination, depending on the component weight and the material. The residual contamination requirement is stated in the component drawing. The table does not apply to components where residual contamination limit values are defined in the component drawing (see Chapter 15.2) and/or where the entire component surface is tested.

14.1 Components of aluminium

Old desig.	Cleanliness class	Weight of inspection lot [kg]	0-0,5 [1]	0.5-1	1-2	2-4	4-8	8-16	16-32	32-64	64-128	128-256
Coarse	VSK0 [2]	Allowable residual contamination [mg]	Components must be free from contaminations such as chips, dust, sand, casting residues, oil and cooling lubricants.									
		Largest metallic particle [µm]										
		Largest non-metallic particle [µm]										
		Longest fiber [µm]										
Nor-mal	VSK1	Allowable residual contamination [mg]	4.2	6	8.5	12	17	24	34	48	68	96
		Largest metallic particle [µm]	No particle >2000 Max. 1 particle >1000									
		Largest non-metallic particle [µm]	-	-	-	-	-	-	-	-	-	-
		Longest fiber [µm]	-	-	-	-	-	-	-	-	-	-
Critical	VSK2	Allowable residual contamination [mg]	4.2	6	8.5	12	17	24	34	48	68	96
		Largest metallic particle [µm]	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
		Largest non-metallic particle [µm]	-	-	-	-	-	-	-	-	-	-
		Longest fiber [µm]	-	-	-	-	-	-	-	-	-	-
---	VSK3	Allowable residual contamination [mg]	2.1	3	4.2	6	8.5	12	17	24	34	48
		Largest metallic particle [µm]	<600	<600	<600	<600	<600	<600	<600	<600	<600	<600
		Largest non-metallic particle [µm]	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
		Longest fiber [µm]	-	-	-	-	-	-	-	-	-	-
---	VSK4	Allowable residual contamination [mg]	1.1	1.5	2.1	3	4.2	6	8.5	12	17	24
		Largest metallic particle [µm]	<400	<400	<400	<400	<400	<400	<400	<400	<400	<400
		Largest non-metallic particle [µm]	<600	<600	<600	<600	<600	<600	<600	<600	<600	<600
		Longest fiber [µm]	-	-	-	-	-	-	-	-	-	-
---	VSK5	Allowable residual contamination [mg]	1.1	1.5	2.1	3	4.2	6	8.5	12	17	24
		Largest metallic particle [µm]	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250
		Largest non-metallic particle [µm]	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250
		Longest fiber [µm]	-	-	-	-	-	-	-	-	-	-

[1] The inspection lot must be selected so that the indicating weight is approximately reached.
2) For the residual contamination requirement "VSK0", no documentation obligation is necessary, only visual tests are required.

14.2 Components of cast iron (GJL, GJS)

Old desig.	Cleanliness class	Weight of inspection lot [kg]	0-0,5 [1]	0.5-1	1-2	2-4	4-8	8-16	16-32	32-64	64-128	128-256
Coarse	**VSK0** [2]	Allowable residual contamination [mg] Largest metallic particle [µm] Largest non-metallic particle [µm] Longest fiber [µm]	Components must be free from contaminations such as chips, dust, sand, casting residues, oil and cooling lubricants.									
Normal	**VSK1**	Allowable residual contamination [mg]	-	6	8.5	12	17	24	34	48	68	96
		Largest metallic particle [µm]	-	No particle >2000 Max. 1 particle >1000								
		Largest non-metallic particle [µm]	-	-	-	-	-	-	-	-	-	-
		Longest fiber [µm]	-	-	-	-	-	-	-	-	-	-
Critical	**VSK2**	Allowable residual contamination [mg]	-	6	8.5	12	17	24	34	48	68	96
		Largest metallic particle [µm]	-	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
		Largest non-metallic particle [µm]	-	-	-	-	-	-	-	-	-	-
		Longest fiber [µm]	-	-	-	-	-	-	-	-	-	-
---	**VSK3**	Allowable residual contamination [mg]	-	3	4.2	6	8.5	12	17	24	34	48
		Largest metallic particle [µm]	-	<600	<600	<600	<600	<600	<600	<600	<600	<600
		Largest non-metallic particle [µm]	-	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
		Longest fiber [µm]	-	-	-	-	-	-	-	-	-	-
---	**VSK4**	Allowable residual contamination [mg]	-	1.5	2.1	3	4.2	6	8.5	12	17	24
		Largest metallic particle [µm]	-	<400	<400	<400	<400	<400	<400	<400	<400	<400
		Largest non-metallic particle [µm]	-	<600	<600	<600	<600	<600	<600	<600	<600	<600
		Longest fiber [µm]	-	-	-	-	-	-	-	-	-	-
---	**VSK5**	Allowable residual contamination [mg]	-	1.5	2.1	3	4.2	6	8.5	12	17	24
		Largest metallic particle [µm]	-	<250	<250	<250	<250	<250	<250	<250	<250	<250
		Largest non-metallic particle [µm]	-	<250	<250	<250	<250	<250	<250	<250	<250	<250
		Longest fiber [µm]	-	-	-	-	-	-	-	-	-	-

[1] The inspection lot must be selected so that the indicating weight is approximately reached.

2) For the residual contamination requirement "VSK0", no documentation obligation is necessary, only visual tests are required.

14.3 Components of steel

Old desig.	Cleanliness class	Weight of inspection lot [kg]	0-0,5 [1]	0.5-1	1-2	2-4	4-8	8-16	16-32	32-64	64-128	128-256
Coarse	VSK0 [2]	Allowable residual contamination [mg]	Components must be free from contaminations such as chips, dust, sand, casting residues, oil and cooling lubricants.									
		Largest metallic particle [µm]										
		Largest non-metallic particle [µm]										
		Longest fiber [µm]										
Normal	VSK1	Allowable residual contamination [mg]	3	4.2	6	8.5	12	17	24	34	48	68
		Largest metallic particle [µm]	No particle >2000 Max. 1 particle >1000									
		Largest non-metallic particle [µm]	-	-	-	-	-	-	-	-	-	-
		Longest fiber [µm]	-	-	-	-	-	-	-	-	-	-
Critical	VSK2	Allowable residual contamination [mg]	3	4.2	6	8.5	12	17	24	34	34	34
		Largest metallic particle [µm]	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
		Largest non-metallic particle [µm]	-	-	-	-	-	-	-	-	-	-
		Longest fiber [µm]	-	-	-	-	-	-	-	-	-	-
---	VSK3	Allowable residual contamination [mg]	1.5	2.1	3	4.2	6	8.5	12	17	17	17
		Largest metallic particle [µm]	<600	<600	<600	<600	<600	<600	<600	<600	<600	<600
		Largest non-metallic particle [µm]	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
		Longest fiber [µm]	-	-	-	-	-	-				
---	VSK4	Allowable residual contamination [mg]	0.8	1.1	1.5	2.1	3	4.2	6	8.5	8.5	8.5
		Largest metallic particle [µm]	<400	<400	<400	<400	<400	<400	<400	<400	<400	<400
		Largest non-metallic particle [µm]	<600	<600	<600	<600	<600	<600	<600	<600	<600	<600
		Longest fiber [µm]	-	-	-	-	-	-	-	-	-	-
---	VSK5	Allowable residual contamination [mg]	0.8	1.1	1.5	2.1	3	4.2	6	8.5	8.5	8.5
		Largest metallic particle [µm]	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250
		Largest non-metallic particle [µm]	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250
		Longest fiber [µm]	-	-	-	-	-	-	-	-	-	-

1) The inspection lot must be selected so that the indicating weight is approximately reached.

2) For the residual contamination requirement "VSK0", no documentation obligation is necessary, only visual tests are required.

14.4 Components of ceramics, polymer materials, non-ferrous metal

Old desig.	Cleanliness class	Weight of inspection lot [kg]	Components of ceramics		Components of synthentic material/rubber		Components of non-ferrous metal (Cu, CuZn, CuSn)	
			0-0,5 [1]	0.5-1 [1]	0-0,5 [1]	0.5-1 [1]	0-0,5 [1]	0.5-1 [1]
Coarse	VSK0 [2]	Allowable residual contamination [mg] Largest metallic particle [µm] Largest non-metallic particle [µm] Longest fiber [µm]	Components must be free from contaminations such as chips, dust, sand, casting residues, oil and cooling lubricants.					
Normal	VSK1	Allowable residual contamination [mg]	2.5	5	2.5	5	2.5	5
		Largest metallic particle [µm]	No particle >2000 Max. 1 particle >1000					
		Largest non-metallic particle [µm]	-	-	-	-	-	-
		Longest fiber [µm]	-	-	-	-	-	-
Critical	VSK2	Allowable residual contamination [mg]	2.5	5	2.5	5	2.5	5
		Largest metallic particle [µm]	<1000	<1000	<1000	<1000	<1000	<1000
		Largest non-metallic particle [µm]	-	-	-	-	-	-
		Longest fiber [µm]	-	-	-	-	-	-
---	VSK3	Allowable residual contamination [mg]	1.2	2.4	1.2	2.4	1.2	2.4
		Largest metallic particle [µm]	<600	<600	<600	<600	<600	<600
		Largest non-metallic particle [µm]	<600	<600	<1000	<600	<1000	<600
		Longest fiber [µm]	-	-	-	-	-	-
---	VSK4	Allowable residual contamination [mg]	0.7	1.4	0.7	1.4	0.7	1.4
		Largest metallic particle [µm]	<400	<400	<400	<400	<400	<400
		Largest non-metallic particle [µm]	<400	<400	<600	<400	<600	<400
		Longest fiber [µm]	-	-	-	-	-	-
---	VSK5	Allowable residual contamination [mg]	0.7	1.4	0.7	1.4	0.7	1.4
		Largest metallic particle [µm]	<250	<250	<250	<250	<250	<250
		Largest non-metallic particle [µm]	<250	<250	<250	<250	<250	<250
		Longest fiber [µm]	-	-	-	-	-	-

[1] The inspection lot must be selected so that the indicating weight is approximately reached.

2) For the residual contamination requirement "VSK0", no documentation obligation is necessary, only visual tests are required.

15 Drawing entries

In the drawing or OICS or VQS, the admissible contamination must be stated by indicating the VSK (Voith Cleanliness Class) acc. to Chapter 14. With deviating requirements, the admissible contamination must be defined by indicating the admissible residual contamination mass, the admissible particle sizes, the particle material and other particle properties.

15.1 Indication according to table

Cleanliness requirement VSK1 acc. to VN3221

15.2 Indication freely defined

Cleanliness requirement VSK1 acc. to VN3221
Allowable residual contamination $MB_{adm.}$ [mg] max. 10
Admiss. metallic particle $XM_{adm.}$ [µm] 0x >1000
1x ~~(~~600 < X_M < 1000~~)~~
5x ~~(~~400 < X_M < 600~~)~~
40x ~~(~~200 < X_M < 400~~)~~
Admiss non-metallic particle X_{nMadm} [µm] <1000
Longest admiss. fiber X_{Fadm} [µm] <1000

or

Cleanliness requirement VSK1 acc. to VN 3221:
Component surface 1615 cm²
Limit values relating to component surface of 1000 cm² [1)]
Allowable resiudal contamination M_{Fadm} [mg/1000cm²] max. 5
Admiss. metallic particle XMadm. [µm] 0x >1000
3x 400 < X_M < 600
50x 200 < X_M < 400
Admiss. non-metallic particle X_{nMadm} [µm] <600
Longest fiber X_{Fadm} [µm] <1000

[1)] With surface-related limit values, the particle size distribution must also be related to the reference surface. See Section 10.3.

Annexes
Documentation of extraction procedure

General data		
Test specification no.	Date:	Number of pages:
Component manufacturer: Place:	Tester:	

Component data			
Component designation: Drawing number: Material:	Component weight: Component surface: Cleanliness requirements:		
	Limit values	$M_{B_{adm}}$ = mg $M_{F_{adm}}$ = mg	XM adm. = µm XNM adm. = µm XF adm. = µm

Preparation of component for cleanliness testing				
☐ None	☐ Isolation of areas	☐ Disassembly	☐ Demagnetization	☐ Local pre-cleaning
☐ Other:				
Ambient condition of the preparation:	☐ Not defined	☐ Air-conditioned	☐ Cleanroom class (ISO 14644-1) :	

Test liquid		
☐ Acqueous cleaning agent, ____%	☐ Solvent	☐ Other:
Trade name:	Manufacturer:	
Notes:		

Test filter		
☐ Single test filter	☐ Several identical test filters: pcs.	☐Filter cascade: Filter porosity: µm

Filter material:	Filter diameter: mm	Nominal pore size: µm
Manufacturer:	Designation:	

B Documentation of filtration and spray cleaning

Filtration	
☐ Vacuum filtration: bar	☐ Overpressure filtration: bar
☐ Post-rinsing fluid used: Designation: Manufacturer: Amount: ml	Notes: (Filter loading, irregularities, cracks etc.)

Documentation of spray cleaning				
Test specification no.		Validation report no.		
Test environment:	☐ Not defined	☐ Air-conditioned	☐ Cleanroom class (ISO 14644-1) :	
Pressure level	☐ Manually with laboratory spray bottle	☐ Low pressure (< 1 bar): bar	☐ Medium pressure (1-10 bar): bar	☐ High pressure (>10 bar): bar
Measuring point of spray pressure	☐ At pressure generator	☐ Ahead of the nozzle	☐ Other:	
Nozzle geometry:	☐ Round steel	☐ Flat steel	☐ Cone	☐ Other:
Brief description of nozzle (if any):				

Nozzle diameter (equivalent):		mm
Spray pressure ahead of nozzle:		bar
Spray distance:		mm
Volume flow:		ml/min
Time per test area:		s
Amount of spray liquid		ml
Amount of spray liquid per test area:		ml/mm²
Amount of post-rinsing liquid (10% of amount of spray liquid)		ml
Description of post-rinsing procedure (with reference to test specification, if any):		

C Documentation of the ultrasonic cleaning

Filtration	
☐ Vacuum filtration: bar	☐ Overpressure filtration: bar
☐ Post-rinsing fluid used: Designation: Manufacturer: Amount: ml	Notes: (Filter loading, irregularities etc.)

Documentation of the ultrasonic cleaning			
Test specification no.		Validation report no.	
Test environment:	☐ Not defined	☐ Air-conditioned	☐ Cleanroom class (ISO 14644-1) :
Ultrasound:	☐ Ultrasonic bath	☐ Sonotrode	☐ Other:
	Frequency: kHZ	Power: W	Sonication time: s
Container for the component/ Testing fluid:	☐ Ultrasonic bath	☐ Beaker, or the like	☐ Other: with specification
Volumes:	Total volume exposed to ultrasound: ml Analyzed volume: ml		
Sketch of the test sequence attached: ☐ Yes ☐ No		Movement of component: ☐ Yes ☐ No	Lift: mm Frequency: Hz
Notes: For example, rotation of component during testing, reorientation of component in bath, internal/external testing, etc.			

D Documentation of results of gravimetric analysis

Required data			
Test environment:	☐ Not defined	☐ Air-conditioned	☐ Cleanroom class (ISO 14644-1) :
Number of test components: pc.			
Analyzed volume:	V_a = ml	Post-rinsing volume:	V_n = ml
Drying of filter	☐ Desiccator	☐ Room air drying	☐ Other
Analysis environment:	☐ Not defined	☐ Air-conditioned	☐ Cleanroom class (ISO 14644-1) :
Laboratory balance accuracy:	☐ +/- 0.1 mg	☐ +/- 0.01 mg	☐ Other:
Blind value before testing: G_V = mg; L_V = µm			
Filter membrane weight:	Tare weight: mg	After filtration: mg	Difference: mg
Blind value after testing: G_N = mg; L_N = µm			

Amount of residual contamination:	M_B = mg/component	M_F = mg/1000cm²	
Longest particle:	X_M = µm	X_{NM} = µm	X_F = µm

Comments:

E Documentation of results of particle analysis

Method of analysis			
☐ Microscope	☐ Stereo microscope		☐ With image processing
☐ Gravimetric analysis	☐ EDX		☐ SEM
Test environment:	☐ Not defined	☐ Air-conditioned	☐ Cleanroom class (ISO 14644-1) :

Microscopy data	
Type and manufacturer: Analysis process: ☐ Manual ☐ Automated ☐ Laboratory microscope ☐ Stereo microscope ☐ SEM ☐ Other (with description)	Magnification: times Acceleration voltage (only SEM): kV Date of last calibration:

EDX data	
Type and manufacturer (deviating from SEM manufacturer): Analysis process: ☐ Manual ☐ Automated	EDX detector resolution: meV Working distance: mm Date of last calibration: