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01	500000009972	2018-03-06	D.CONZELMANN	2018-03-08	A.KUENSTLE	2018-03-08	U.KAMPHAUS
DOC-VER.	CHANGE NO.	EDITED		CHECKED		RELEASED	
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				REPLACEMENT FOR DOCUMENT NO -			

1 Scope and application

This Standard is valid for the ETO GROUP division.

This Specification shall be applied for determining the technical cleanliness of products, assemblies and components if drawings and order documents demand a certain cleanliness.

2 Purpose

This Standard serves quality assurance by definition and standardization of the test procedure for determining the technical cleanliness.

3 Change history

Issue	Change log
June 2010	First issue

4 Further applicable documents

- VDA 19: Inspection of technical cleanliness – particle contamination of functionally relevant automotive components.
- ISO 16232 1-10: Road vehicles – Cleanliness of components of fluid circuits – Part 1 to 10.

5 Test specifications

5.1 Quantity for testing

A test-relevant area of the total inspection lot of 500 cm² to 1000 cm² has to be used for the testing process.

Example: Test-relevant surface of the component: 80 cm²
1000 cm² / 80 cm² = 12.5
The inspection lot per cleanliness test is 13 components

5.2 Test methods

5.2.1 Extraction

Extraction method: Low-pressure rinsing
Spraying pressure: 2 ± 0.5 bar before the nozzle
Nozzle shape: Round
Nozzle diameter: 1.8 to 2 mm
Test medium: Safety cold cleaner, A3 hazard category

Optional parameter adjustment alternatively to the rinsing pressure:

Volume flow: 1.6 to 2 l/min

5.2.2 Filtration

Filter diameter: 47 mm
Filter material: Nylon, polyamide, nitrocellulose
Mesh size: 5 µm
Filtration method: Negative-pressure filtration

5.2.3 Gravimetry

Evaluation criterion: Residual particle mass in mg / 1000 cm²

5.2.4 Microscopy

Particle evaluation: Automatic particle recognition

Evaluation system: Jomesa measuring systems or equivalent

Evaluation criteria: Particle number

Particle size distribution greater 25 µm to VDA 19

Maximum particle length

Particle classification: Metallic / non-metallic by means of polarization / gloss properties
Fibers and lint

5.3 Blank test

The blank reading analysis should be performed and documented as described in VDA 19. A blank test must be performed prior to every testing, analyzed and documented in the test log.

5.4 Decay curve measurement

The decay curve measurement should be performed and documented as described in VDA 19.

5.5 General test specifications

5.5.1 External laboratories

Externally commissioned laboratories must be accredited in the methods applied for fulfilling the requirements of the TS 16949 according to ISO 17025.

5.5.2 Packaging / transportation to the laboratory

Packaging close-to-production should be preferred when transporting samples so as to include the cross contamination into the test result.

5.5.3 Filter archiving

The original filter membranes shall be archived in appropriate diapositive glass frames and attached to the written test log.

6 Particle definitions

6.1 Metallic and non-metallic particles

Particle definition for metallic and non-metallic particles

Detection method: Particle polarization or gloss properties

Gloss share: greater 5 % of particle surface

Criterion: Maximum length to VDA 19

6.2 Fibers and lint

Two software filters need to be used for demarcating fibers and lint from metallic and non-metallic particles. These are the length to width ratio (LWR) as well as the compactness criterion (C). The length to width ratio serves to demarcate long, thin fibers. The compactness criterion serves to separate spiral fibers (Fig. 2) and fiber balls.

Non-lustrous fibers and lint particles definition

In order to prevent long, thin swarf from being rated as fibers or lint, the gloss properties of fibers and lint also needs to be allowed for and the lustrous particles have to be attributed to the metallic particles.

Length to width ratio

The length to width ratio (LWR) is defined as quotient of the maximum length and the maximum width acc. to Fig. 1. An LWR of 10 means a classification as fiber or lint respectively.

Example 1:

Maximum length = 1000 µm, maximum width = 25 µm
LWR = 40 => Fiber / lint (if lustrous => metallic particle)

Example 2:

Maximum length = 200 µm, maximum width = 25 µm
LWR = 8 => (metallic or non-metallic) particle

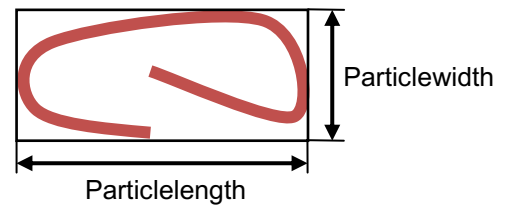
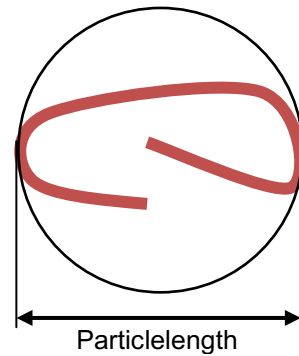


Figure 1: Definition of maximum particle length and width

Compactness criterion:

The compactness criterion (C) is defined as quotient of the area covered by the particle (red in Fig. 2) and the projected area of the particle. The projected area is the product of particle length and particle width. In this context, the particle length is to be understood as the diameter of the smallest circle which the particle can be completely included into. The particle width then results as the expansion of the projection surface perpendicular to the particle length. A compactness of no more than 0.3 or 30 % ($C \leq 30\%$) means a rating as fiber or lint.

Example 1:

Particle surface = 10.000 µm²
Particle length= 2000 µm, particle width = 50 µm
C = 0.1 => Fiber / lint

Example 2:

Particle surface = 50.000 µm²
Particle length= 2000 µm, particle width = 50 µm
C = 0.5 => Particle

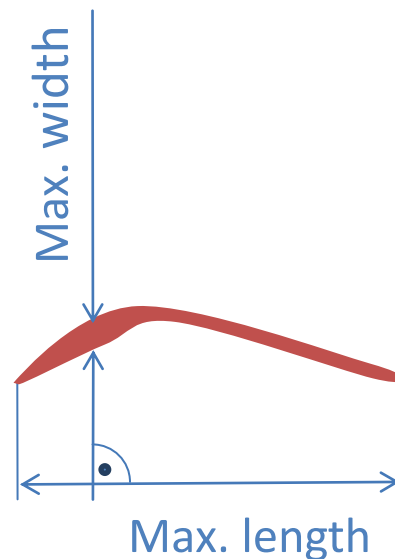


Figure 2: On the definition of the compactness criterion

7 Drawing content

Reference to ETO company standard

Example: Component cleanliness to ETN005

Test-relevant surface of the component in cm²

If only parts of the surface are relevant for the technical cleanliness, these surfaces must be marked on the drawing.

For example, comment "Inner surfaces only" or surfaces with double dotted line.

Example: Component surface: 50 cm²

CCC code

Included particles: Metallic and non-metallic particles without fibers and lint

Example: CCC = A(F8/G7/H5/I4)

Instead of the CCC code the maximum particle size in µm

Included particles: Metallic and non-metallic particles without fibers and lint

Example: Maximum particle length: 600 µm

Maximum particle mass (normalized to the component surface) in mg/1000 cm²

Included particles: All particles on the filter membrane

Example: Maximum particle mass: 10 mg / 1000 cm²

Examples of possible drawing entries

Example 1:

Component cleanliness to ETN005

Component surface: 50 cm²

CCC = A(F8/G7/H5/I4)

Example 2:

Component cleanliness to ETN005

Component surface: 50 cm²

Maximum particle length: 600 µm

Maximum particle mass: 10 mg / 1000 cm²

8 Guide values for technical cleanliness of systems (informative)

The guide values for technical cleanliness of systems are used for orientation on determination of component cleanliness in drawings and specifications. This informative listing does not replace the component-specific specification in the drawing. When no specification for component technical cleanliness is defined in the drawing, the component is off the scope of this company standard.

Fluid systems in the vehicle and their component technical cleanliness

Designation	Largest particle	Component cleanliness code (CCC)
Fuel system	200 µm	CCC=A(D15/E10/F5/G2)
Brake fluid system	250 µm	CCC=A(E10/F6/G3)
Steering/suspension hydraulics	400 µm	CCC=A(F9/G7/H6)
Transmission fluid system	400 µm	CCC=A(F8/G6/H4)
Coolant system	600 µm	CCC=A(F9/G8/H7/I5)
Working hydraulics	600 µm	CCC=A(F8/G7/H5/I4)
Engine oil system	600 µm	CCC=A(F9/G7/H6/I4)
Air-conditioning system	600 µm	

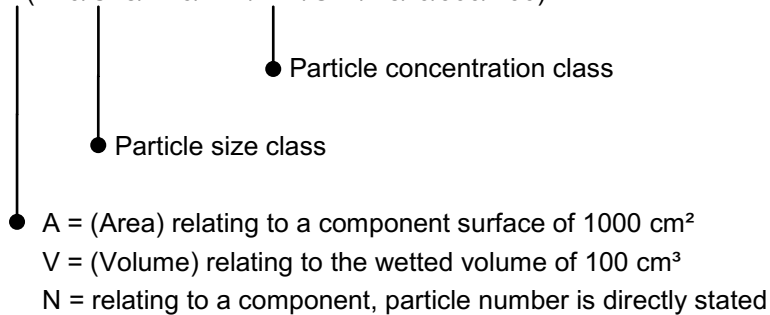
Values from practice, as of: 01/2007; source: company: HYDAC

9 CCC code explanation

CCC code = Component Cleanliness Code

Structure

Example: CCC= A(B20/C18/D16/E12/F12/G12/H8/I0/J00/K00)



Size classes

Size Class (Größenklasse)	Größe x [µm]
B	5 ≤ x < 15
C	15 ≤ x < 25
D	25 ≤ x < 50
E	50 ≤ x < 100
F	100 ≤ x < 150
G	150 ≤ x < 200
H	200 ≤ x < 400
I	400 ≤ x < 600
J	600 ≤ x < 1000
K	1000 ≤ x

Figure 1: Table of size classes

(source: VDA 19)

Concentration classes

Contamination Level (Konzentrationsklasse)	Anzahl der Partikel (pro 1000 cm ² oder pro 100 cm ³)	
	Mehr als	bis einschließlich
00	-	0
0	0	1
1	1	2
2	2	4
3	4	8
4	8	16
5	16	32
6	32	64
7	64	130
8	130	250
9	250	500
10	500	1 x 10 ³
11	1 x 10 ³	2 x 10 ³
12	2 x 10 ³	4 x 10 ³
13	4 x 10 ³	8 x 10 ³
14	8 x 10 ³	16 x 10 ³
15	16 x 10 ³	32 x 10 ³
16	32 x 10 ³	64 x 10 ³
17	64 x 10 ³	130 x 10 ³
18	130 x 10 ³	250 x 10 ³
19	250 x 10 ³	500 x 10 ³
20	500 x 10 ³	1 x 10 ⁶
21	1 x 10 ⁶	2 x 10 ⁶
22	2 x 10 ⁶	4 x 10 ⁶
23	4 x 10 ⁶	8 x 10 ⁶
24	8 x 10 ⁶	16 x 10 ⁶

Figure 2: Table of concentration classes (source: VDA 19)

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