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| <b>COMPANY STANDARD</b>                                       | <b>February 2014</b> |
| <b>Cleanness of engine components<br/>and component parts</b> | <b>952 344 00</b>    |

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(Modification have been marked YELLOW resp. marked by a vertical bar)

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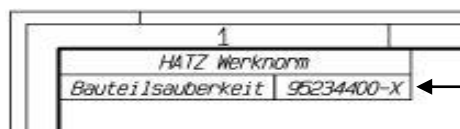
## 1. FIELD OF APPLICATION / PURPOSE

This company standard is exclusively applicable for engine components/**component parts** and must be made accessible for authorised suppliers or suppliers which are designated for authorisation only.

This standard is used as definition for permitted residual dirt volume on engine components as well as identification of residual dirt concerning particle volume and particle size resp. particle weight.

The purpose of residual dirt limitation on engine components is to avoid malfunction, to reduce failure probability of parts in order to increase the durability of the complete engine.

### 1.1 DRAWING MARK



Cleanness acc.95234400 class „X“ = required condition as delivered


## 2. GENERAL

The part is subdivided in degrees of purity depending on its character resp. usage. The purity of part is rated according the maximum volume of adhesive dirt particles or the weight of the dirt particles. Which assessment factor is used depends on the respective part group.

The examination regarding residual dirt is carried out on the prefinished part. Parts which have to be tested will be removed from the original packing and washed according this company standard. The particles which removed by washing are filtered from the liquid and analysed afterwards.


Note: The described procedure in point 4. – 4.2 is a HATZ internal mode to designate residual dirt and can be used as a guideline, but is not binding for suppliers. Similar processes may be carried out which guarantee the requirements defined in the residual dirt matrix.

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### 3. INSPECTION LOT

In order to define the gravimetric- residual dirt an average is used of at least 5 parts if no other agreements have been made.

 Test quantity may be changed in exceptional cases after consultation **resp. according customer specification.**

Particles in its size/length (engineering morphology) count as real size and may be subject to an average calculation.

### 4. DESIGNATION PROGRESS


#### 4.1 TAKING/WASHING of parts

The cleanness analysis should be carried out straight after taking. A dust-proof transport has to be guaranteed. The testing parts have to be handled with a suitable means of transport.


Preferably the washing (extraction process = spraying/spray angle 30 - 40°; test pressure 2bar) is carried out with G60 special industry degreaser resp. with an appropriate cleaner, suitable to remove particles which adhere with a slight oil film from the surface. The adequate quantity of cleanser has to be identified via creating a fading curve acc. VDA-band 19. It is allowed to summarize similar parts in one group.

#### 4.1.1 DECAY CURVE VALUES

|                          |                 |
|--------------------------|-----------------|
| Fuel pressure pipe       | 3.000 ml        |
| Crankcase 1B20           | 6.000 ml        |
| Crankshaft 1D60          | 6.000 ml        |
| Crankshaft 4H50          | 20.000 ml       |
| Oil cooler 4H50          | 3.600 ml        |
| Cylinder head 1D81       | 6.000 ml        |
| Connecting rod truck/car | 4.800 ml        |
| <b>Rinsing quantity</b>  | <b>3.000 ml</b> |

 The values from chart 1 are valid for the test cabinet type: **Hydac CTU-1230-M-Z-R/-S10**

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#### 4.1.2 FINISHING TREATMENT OF CLEANED COMPONENTS

Due to the use of cold cleaner, the parts are degreased after the cleaning process. Parts may corrode within a short time. Conservation measures have to be carried out, depending on production surroundings, humidity, etc.

#### 4.1.3 DEMAGNETISATION

Magnetism is the effect when magnetisable particles with higher forces adhere to the test object. Ferromagnetic test objects should be tested for residual magnetism before sampling and demagnetised if necessary.

The value for uncritical residual magnetism on medium-contacted components for diesel injection systems:

- magnetic field strength:  $H \leq 0,4 \text{ kA/m}$

#### 4.1.4 RINSING

Acc. the definition in VDA-band 19 the test parts, e.g. fuel filter, have to be rinsed in the direction of the future fuel flux.

The extraction of parts has to be done with the defined rinsing quantity in the test cabinet. The complete surface of the part must be covered during the test. Rinsing of both connecting rods (1), rinsing of front side (2), rinsing of outer face of the conrod – turn conrod while rinsing. Afterwards rinse the test cabinet with the defined quantity of jetting liquid.

#### 4.1.5 FILTRATION

The cleaning liquid incl. dirt is filtered via a try-type filter (max. pore size 10 µm).


The particles are separated from the test liquid by using a vacuum function. The analysis liquid has to pass the defined filter (pore size 10µ nylon filter) and has to be extracted by a vacuum pump.

#### 4.1.6 FILTER DRYING

Is there no specification the filters have to be dried in the dryer at 85°C for a min. of 1 hour and kept in the dryer during the whole test.

After 1 hour of drying cool down the filter at room temperature for 1 minute and identify the filter weight afterwards.

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#### 4.1.7 CLEANNESS OF RINSING AREA AND TEST LIQUID

The limit values for contamination (blank value) of the system are allowed acc. VDA-band 19 (i.e. 10 % of the max. contamination of the part which has to be cleaned must not be exceed).

#### 4.2 ANALYSIS

The particles which are in the dry-type filter are subdivided in size ranges and counted via an appropriate microscope. A magnification of at least 100:1 gets necessary for analysing particles  $\geq 10$ . For particle sizes of 25  $\mu\text{m}$  a magnification of at least 50:1 has to be used.

The **weight** is determined with a special accuracy weighing machine (resolution: 0,0001g)  
The following is applicable for the identification of contamination:

$$\Delta m = m_2 - m_1 - m_b$$

$\Delta m$  = residual dirt

$m_2$  = filter weight after cleaning and drying

$m_1$  = filter weight after before cleaning


$m_b$  = blank value

**The target value of cleanness for component parts are evaluated according customer specification(s).**

#### 4.3 TYPE OF PARTICLES

Fibres and particles with a transparent appearance may be examined explicit in individual cases and rated depending on the use of the part.

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#### 4.4 OUTLIER REGULATION:

For parts showing residual dirt particles which exceed the given dimensions the following rule will be applied:

In case the limit, e.g. max. 200 µm, is exceeded 3 particles of the **next** and 2 particles of the **next but one** size range may be available in the analyse picture.

Example: Requirement max. 3 mg <200 µm → 3 particles max. 400 µm  
→ 2 particles max. 600 µm

**An exceedance of the following size range is not permitted!!!!**

|                  |
|------------------|
| size<br>range µm |
| 200              |
| 400              |
| 600              |
| 1000             |
| 2000             |
| 3000             |



Differing on this see footnote 3) in residual dirt matrix.


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## 5. RESIDUAL DIRT MATRIX

| Cleanness class | Mounting groups - example   | Part in total                                       |                 |               | Mechanical injection system |                 |               | Common-Rail-System |                 |               | Oil conveying areas |                     |               | Pressure oil conveying areas/part(s) |                 |               | water containing areas |                 |               | Intake air / gas containing areas/parts |                 |               |
|-----------------|---|---|-----------------|---------------|-----------------------------|-----------------|---------------|--------------------|-----------------|---------------|---------------------|---------------------|---------------|--------------------------------------|-----------------|---------------|------------------------|-----------------|---------------|---|-----------------|---------------|
|                 |   | Gravimetry (mg)                                     | Morphology (µm) | Particle type | Gravimetry (mg)             | Morphology (µm) | Particle type | Gravimetry (mg)    | Morphology (µm) | Particle type | Gravimetry (mg)     | Morphology (µm)     | Particle type | Gravimetry (mg)                      | Morphology (µm) | Particle type | Gravimetry (mg)        | Morphology (µm) | Particle type | Gravimetry (mg)                         | Morphology (µm) | Particle type |
| X               | According agreement:<br>-for new, external part (bought-in-part):residual dirt analysis must be verified in the "Initial Sample Inspection Report", this is reported in the SAP-QM (reported "ZE").<br>-for new, internal part (in-house production): is defined in the working plan (see working instruction).<br>-for existing parts (components): <b>no change</b> for existing series performance |   |                 |               |                             |                 |               |                    |                 |               |                     |                     |               |                                      |                 |               |                        |                 |               |   |                 |               |
| 0               | Parts with general cleanness demands, e. g. engine bracket...   | 10  | <3000           | a*2)          |                             |                 |               |                    |                 |               |                     |                     |               |                                      |                 |               |                        |                 |               |   |                 |               |
| 1               | Mounting parts / -groups (ready to mount)   |   |                 |               |                             |                 |               |                    |                 |               |                     |                     |               |                                      |                 |               |                        |                 |               |   |                 |               |
| 2               | Fuel conveying parts after main filter (clean side) e.g. injection nozzle...  | 1   | <200            | a*2)3)        |                             |                 |               |                    |                 |               |                     |                     |               |                                      |                 |               |                        |                 |               |   |                 |               |
| 3               | Fuel conveying parts between main and pre-filter, e.g. pressure pipes...  | 3   | <200            | a*2)          |                             |                 |               |                    |                 |               |                     |                     |               |                                      |                 |               |                        |                 |               |   |                 |               |
| 4               | Fuel conveying parts <b>before pre-filter</b> , e.g. tank...<br>Usage for single-filter-system: <b>before main filter</b> , e.g. pipes...   | 5   | <600            | a*2)          |                             |                 |               |                    |                 |               |                     |                     |               |                                      |                 |               |                        |                 |               |   |                 |               |
| 5               | e.g. elastomeric sealing: O-rings, oil seals.....   | 3   | <600            | a*2)          |                             |                 |               |                    |                 |               |                     |                     |               |                                      |                 |               |                        |                 |               |   |                 |               |
| 6               | e.g. air filter, charge-air pressure pipe/hoses,  | 10  | <2000           | a*2)          |                             |                 |               |                    |                 |               |                     |                     |               |                                      |                 |               |                        |                 |               | 3                                       | <600            | a*1)2         |
| 7               | e.g. camshaft, crankshaft, conrods  | 10  | <1000*          | a*2)          |                             |                 |               |                    |                 |               |                     |                     | 3             | <600                                 | a*2)            |               |                        |                 |               |   |                 |               |
| 8               | e.g. water pumps, coolant pipe, water channels  | 5   | <1000           | a*2)          |                             |                 |               |                    |                 |               |                     |                     |               |                                      |                 |               |                        |                 |               |   |                 |               |
| 9               | e.g. exhaust turbo charger, inlet manifold, OXI-Kat, AGR-route, exhaust manifold  | 10  | <2000           | a*2)          |                             |                 |               |                    |                 |               |                     |                     | 3             | <600                                 | a*2)            |               |                        |                 |               | 3                                       | <600            | a*2)          |
| 10              | e.g. crankcase, cylinder head, oil pump, oil pressure pipe, oil cooler, oil sump, timing cover 1Bxx;  | 10  | <2000           | a*2)          | 1                           | <400            | a*            | 1                  | <200            | a*            | 5                   | <1000 <sup>1)</sup> | a*2)          | 3                                    | <600            | a*2)          | 5                      | <1000           | a*2)          | 3                                       | <600            | a*2)          |
| 11              | e.g. standard parts: bushing, screws and nuts, shim, cap....., inlet & outlet valve, cylinder head gasket   | 5   | <600            | a*2)          |                             |                 |               |                    |                 |               |                     |                     |               |                                      |                 |               |                        |                 |               |   |                 |               |
| 12              | e.g. piston, piston rings....   | 5   | <600            | a*2)          |                             |                 |               |                    |                 |               |                     |                     |               |                                      |                 |               |                        |                 |               |   |                 |               |
| 13              | raw parts / parts without special cleanliness   | Optically parts have to be free from chips and dirt |                 |               |                             |                 |               |                    |                 |               |                     |                     |               |                                      |                 |               |                        |                 |               |   |                 |               |

a\* = all particles;    1) = deviating specification of morphology (µm) acc. drawing;    2) = deviating specification of particle type acc. Drawing

3) = Exception-regulation **must not** be applied here

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## 6. TEST REPORT / DOKUMENTATION

The test report shall contain the recommendation for documentation of VDA-volume 19.

The results have to be recorded in a data base.

Archiving:

- Either the particle analysis of evaluated filters or their high-definition pictures have to be recorded.
- In case of exceeded standards the filters have to be archived (e.g. slide frame)
- All pictures and archived filters have to be stored for 1 year.
- The test report has to contain pictures or the typification (e.g. swarfs, plastic, fiber, moulding sand, etc.) of at least the three biggest particles.

## 7. APPLICABLE RESP. COMPARABLE STANDARDS OR SIMILAR

VDA-Band 19      Test for technical cleanliness, particle contamination of performance relevant automotive parts

The company standard 95234400 has more priority than VDA-volume 19 "test of technical cleanness"-recommendation, which completes the CS 95234400 in individual points.

## 8. TERMS AND DEFINITIONS

Gravimetry (gravimetric)      quantity of residual particles / total volume of particles for a part or part area which has to be tested

Morphology (morphologic)      geometric dimension (longest dimension) of particle

Definitions according to VDA-volume 19.

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