



# LITERATURE REVIEW ON DEGREE OF CLEANLINESS OF A COMPONENT

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**Abstract:** This Literature research paper focuses on the Degree of cleanliness of a component which is the topic. The term includes component cleanliness analysis, cleaning methods, example of cleanliness cabinets, cleanliness testing, experimental, the results moreover includes a Component Cleanliness according to VDA Volume 19.1, Cleanliness: A vital component of Camshaft's manufacturing process, services for component cleanliness, automotive parts cleanliness. They all underline the degree of cleanliness of a component.

**Index Terms - Degree of Cleaning, Metals, manufacturing, Solvent Cleaning**

## I Introduction

The topic is entitled Literature Review on Degree of cleanliness of a component. The term includes an abstract, an introduction, 7 chapters, conclusion and references. The first chapter includes introductory notions about cleaning processes and components and fluids cleanliness classification/parts cleaning.

The most important idea in this chapter is that IFTS is a European Reference Center for particle pollution measurement and control. The second chapter contains the Palm readiness Cabinets (PCC) models which are three examples: Pall Cleanliness Cabinets Extra Small (PCCXS), Pall Cleanliness Cabinets Small (PCCS), and Pall Cleanliness Cabinets Medium (PCCM) along with the tasks.

The third chapter contains cleanliness testing where according to ISO16232/VDA 19 inspection standards, particulate technology may provide the necessary equipment or analytical services to determine the technical cleanliness of the components, the component cleanliness where explains with what the laboratory should be equipped, the services for component cleanliness which are plenty.

The fourth chapter incorporates the component cleanliness according to VDA Volume 19.1 explaining that the automotive parts requires special knowledge and laboratory equipment. This chapter contains also the subchapters testing, liquid extraction, air extraction, analysis. The subchapter testing has the offers of the independent reference laboratory, the subchapter liquid extraction includes the variety of methods and equipment, the subchapter air extraction underlines that this process will be possible in the future in the context of the VDA Volume 19.1., the last subchapter of the chapter fourth includes analysis characteristics of the analytical technology.

The fifth chapter presents the chapter Component cleanliness that requires effort throughout manufacturing process, which underline the idea that even the smallest film particles or residues at the level of microns can have a negative impact on subsequent processes. The fifth chapter contains the subchapter component Cleanliness (1):

A vital component of Camshaft's manufacturing process, with the subchapters Cleaning is an integral part of the process, Customer Cleanliness Criteria, Cleaning throughout Production, Cleaning Methods. The subchapter cleaning methods includes Method of cleaning and Measurement and Testing. The subchapter component Cleanliness: A vital component of Camcraft's manufacturing process strengthens the idea that at Camcraft is keeping the manufactured parts clean and free of dust, debris or other contaminants. The sixth chapter includes Automotive Parts Cleanliness with the subchapters An Alternative to Traditional Method Challenges, Analytical Solutions for Automotive Applications, Automated Instrument Setup and Calibration, Compliant with ISO 16232 and VDA 19, Particle Identification, Rugged Design Fits All Environments, Clench Platforms.

## 1. Introductory Notions About Cleaning Processes

Cleaning processes include solvent cleaning, cleaning with hot alkaline cleaning agents, electrochemical cleaning, and acid attack. The most common industrial cleaning test is the waterproof test, in which the surface must be rinsed and placed vertically.

In recent years, cleaning of components has become very important. As part of the iso16232-1 and vda19 standardization activities, technical cleanliness has been quantified. Currently, in the automotive industry, the specifications are provided for all the relevant components in the drawings for this purpose (2). The cleanliness of the components has certain quality characteristics and must be checked systematically.

Cleaning components are not considered in the production process or in the cleaning system. Everything starts at the beginning of the design process. In the design process, the basic characteristics of the component are defined by the following restrictions: 1. sensitivity of components to dust. 2. barrier-free cleaning. 3. Deburring quantity. 4. easy to contaminate during assembler. 5. The amount of work and the cost of the cleaning process.

The result is different and only a great effort can perform the necessary cleaning of the components. Awareness of the cleaning process and of the factors affecting cleanliness has changed greatly. The consequences of cleaning are different and considerable effort must be made to clean the components if necessary. Awareness of the cleaning process and the factors affecting cleanliness has changed greatly. Cleaning is no longer seen as an essential evil, but is now seen as a value-added process that affects.

### 1.1. Components and fluids cleanliness classification/parts cleaning

IPTS is a European Reference Center for particle pollution measurement and control. The Institute has the tools and knowledge to develop and verify the most effective rinsing methods for all types of parts in the automotive, medical, electronic, aerospace, micro-hydraulic and mechanical industries (3).

As an independent laboratory, IPTS may: research and check the best extraction for each component, - test and prove cleanliness of all types of components -apply to cleaning the batch of parts to be manufactured-diagnose the cleaning industry complex parts in the environment, mounting system.

IPTS offers clear and professional services to its customers:- to study the susceptibility of components (pumps, solenoid valves.), to particulate contamination;- customized pollution control training in industrial workshops and laboratory measurements;- secret audit tasks, consultancy and specialization to improve the cleaning of the production of industrial workshops.

IPTS is involved in the formulation of cleaning specifications and international standards (extraction methods, cleaning specifications) for main contractors.

## 2. The palm Cleanliness Cabinets

Measure component rinsing industry codes for manufactured parts and components in accordance to ISO 18413, ISO 16232 and VDA 19 standards (4).

The Palm readiness Cabinets (PCC) models:

- ❖ automated and repeatable process to control part cleanliness
- ❖ up to 50% improvement of performance-incomplete value is reached quickly and samples can be tested in a shorter time
- ❖ reduced human error
- ❖ reduced post processing - note quality speed is very fast



### 3. Cleanliness Test



As suppliers, manufacturers and end-users seek better reliability and longer warranty periods, it is becoming increasingly important to remove pollution from components used in automotive, aerospace, hydraulic and production systems (2).



According to ISO16232/VDA 19 inspection standards, Particulate Technology may provide the necessary equipment or analytical services to determine the technical cleanliness of the components.

#### 3.1 Component Cleanliness Analysis

The component cleanout services primarily use pressure washing/washing methods to remove contamination from pipes, injectors, pumps, valves, radiators, engine blocks, cylinder heads, crankshaft and manifolds. The washing liquid was extracted through a membrane filter and analyzed with a Leica microscope to count the particles and weighed to obtain the weight in mg.

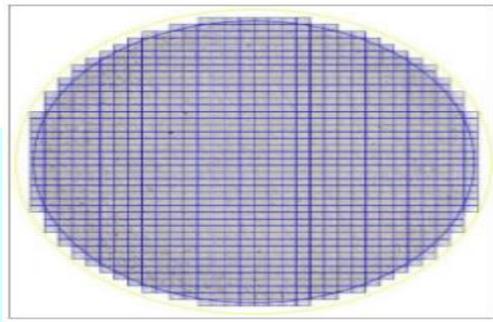


The laboratory shall be equipped with a solvent washing cabinet, water-washable, high-precision balances and two high-precision automatic microscope. All cleaning equipment is placed in our separate cleaning area to ensure that pollution is minimized. Depending on the applicable test standards, microscopic analysis may identify the number of particles of different size categories, including the longest particles and fibers. Save the result and send it to the customer as a report according to the following template.

ISO 16232	
Class	Particle count
5 µm - 15 µm (B)	47475
15 µm - 25 µm (C)	16083
25 µm - 50 µm (D)	11049
50 µm - 100 µm (E)	4000
100 µm - 150 µm (F)	628
150 µm - 200 µm (G)	120
200 µm - 400 µm (H)	31
400 µm - 600 µm (I)	2
600 µm - 1000 µm (J)	0
>= 1000 µm (K)	0
<b>Total</b>	<b>79388</b>
<b>CCC : A(B16/C15/D14/E12/F10/G7/H5/I1/J0)</b>	



The microscope system can divide particles into reflective particles and non-reflective particles to indicate the ratio of metallic particles to non-metallic particles. In order to analyze contaminants in depth, the particles can be analyzed using the XRF microscopy – which can accurately identify the particle type and its correlation with the possible source (1).



### 3.2 Services for component cleanliness:

Independent manufacturer consulting

- 23 years experience in this field
- Development and planning of cleaning and deburring concepts
- planning and acquisition of investments
- High-pressure water jets (3000 bar) for deburring, surface activation and abrasion
- Optimizing the cleaning processes (process and filtration)
- Acceptance, commissioning, testing and monitoring start of production
- Residual contamination analysis according to VDA 19-1, ISO 16232
- Optimization of component design (cleaning, deburring, assembly)
- Optimized assembly process with cleaning (VDA 19-2)
- Mechanical deburring process (vibration type) finishing, sanding brushes, deburring, etc.)

### 4. THE CLEANLINESS OF THE COMPONENTS ACCORDING TO VOLUME VDA 19.1

Cleaning of automotive parts is a quality technical feature that must be controlled and recorded. The so-called residual dirt test must provide reliable data on the quality of products and processes in order to make reasonable investment decisions and related quality measures. Analysis of residual dirt in functionally connected automotive parts requires special knowledge and laboratory equipment.

#### 4.1 Testing

The independent reference laboratory offers:

- Standardized cleanliness analyses of parts and assemblies in accordance with the established standards
  - VDA Volume 19.1
  - DIN EN ISO 16232
  - as well as customer/ company standards
    - Qualified testing specifications
    - Analyses of sediment traps and particulate stamps from the environmental monitoring or for the localization of particle sources

## 4.2 Liquid extraction

Due to functional areas of parts and components (mainly inside or inaccessible), affected particles must be removed from the affected area using a liquid. The variety of methods and equipment are:

- Process extraction equipment:
- Spray
- Wash
- Agitation
- Ultrasound
- Variable Ultrasonic Equipment
- Extraction systems for components up to 1m
- Very clean suction system to clean components
- If necessary, extract to a clean environment

## 4.3 Air extraction

For many components, such as electronic devices, air extraction can lead to destructive testing. The damage is particularly severe for expensive components. In addition, some components tested during the manufacturing process or end-use will never come into contact with the liquid, so it is doubtful whether the liquid test can produce significant results. In research into the testing of composite optics, precision engineering and electronic systems, packaging materials and automotive headlights, the removal of private pollutants is now done through clean air pressure. The evidence shows that its applicability is impressive, the new so-called air extraction. This process will be possible in the future in the context of the VDA Volume 19.1 (5).

## 5. Analysis

Because its own technical laboratory has a wide range of analytical capabilities, it can not only determine the quantitative determination of the addition of particles, but also determine the composition of the three-dimensional elements and the size information.

- Characteristics of the analytical technology:
- Five-digit analytical scales
- Scanner for particle analysis
- Light optical microscopes for automated particles analysis from 5 microns
- Fluorescence microscope
- Electronic microscope with automatic particle analysis scan inorganic/metal
- Organic material analysis (Such as plastic particles) by:
- Analysis of organic material, for example plastic particles by:
- RAMAN spectroscopy
- FTIR (Fourier transformations infrared spectrometer)
- Micro-CT for 3D particle analysis
- Correlative analysis between light microscopy and SEM-EDX systems<sup>1</sup>

## 6. Component cleanliness requires effort throughout manufacturing process

Of course, for many processed components, the specification of purity of particles and film residues is very important. In addition to part cleaning procedures, manufacturers must consider the whole process chain when trying to achieve and maintain the required leanliness effectively. Even the smallest film particles or residues at the level of microns can have a negative impact on subsequent processes, on the quality of the parts and on the functionality of the final product.

For example, cutting tools are often covered with hard materials such as grounded carbon to improve their performance and life. The storage of these coatings requires a high degree of surface cleanliness and the residual particles or the traces forming the film will degrade.

### 6.1. Cleanliness: A vital component of Camcraft's manufacturing process

Crushed stones or foreign objects in the fuel system can plug fuel injectors and cause efficiency losses, resulting in low power and fuel mileage. Debris can also cause fuel system malfunctions, which can result in engine damage and malfunctions. Hydraulic systems can also be damaged by debris, which can cause excessive wear to moving parts and reduce performance. At Camcraft, therefore, we pay special attention to keeping the manufactured parts clean and free of dust, debris or other contaminants (5).

### 6.2 Cleaning is an integral part of the process



Part cleaning begins at the Advanced Plan quality product (APQP) stage, when our engineers and customers have outlined the steps needed to effectively demonstrate the specified final dimensions. The sequence and selection of the cleaning steps are an integral part of the overall process engineering, as are the selection of looks, drawings and processing methods. At this time, the customer defines the cleaning specifications for certain parts.

For automotive brake components, the strictest cleaning tolerance ever required is 300  $\mu\text{m}$  (300 microns) and the interior is maintained at 300  $\mu\text{m}$ . The average tolerance specified by the customer is 600 to 1200 microns, but we can consistently provide 400  $\mu\text{m}$  (400 microns) results. Typically, we will solve cleaning problems that meet our customers' specifications, with a very low incidence (almost never) (zero in the last five years) (3).

### 6.3 Customer Cleanliness Criteria

Cleaning products are divided into three categories. Camcraft has the ability to test all three of these categories simultaneously.

- Weight/mass – Mass of contamination on the part
- Particle Size – No particle allowed larger than a defined size
- Particle Count – A maximum number of particles allowed in various size ranges

All three of these testing methods utilize the millipore test method. The automatic analysis algorithm used on the Millbury filter can distinguish these three. Camcraft maintains an internal database of part specific customer cleanliness requirements and the testing equipment generates an automated report with a clear PASS/FAIL result for each test.

### 6.4 Clean in the production process

Camcraft maintains an internal database containing customer-specific parts cleaning requirements, and the test team generates automatic reports with clear pass/fail results for each test. We clean the parts almost after each operation, step by step through the cleaning steps to meet the final customer's specifications and to ensure that the chips or debris do not affect the entire manufacturing process.

Once the parties leave the production line, they are subject to final cleaning to ensure that they meet the customer's delivery requirements. For these purposes, our factory contains over a dozen dedicated cleaning and washing systems distributed throughout the plant.

## 7. Cleaning Methods

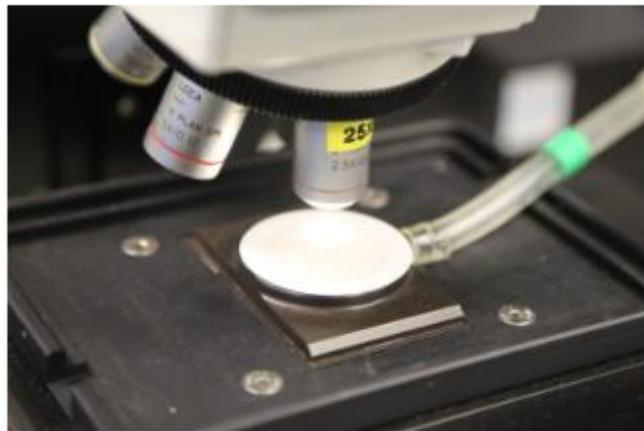
The primary final cleaning method is immersion with rotation, ultrasound and a cleaning solvent used to remove contaminants from the surface of an object. If a customer's product demands cleaning equipment that we don't currently employ, Camcraft will make the investment to get the equipment and process in-house. This willingness to invest in new systems, along with the number of dedicated cleaning machines we have on site, gives us a distinct advantage over our competition (4).

### 7.1 Method of cleaning

The most important final cleaning methods are rotary immersion, ultrasound and cleaning solvents used to remove contaminants from the surface of the object. If a customer's product requires cleaning equipment that it does not currently rent, Camcraft will invest in the equipment and processes to be carried out indoors.

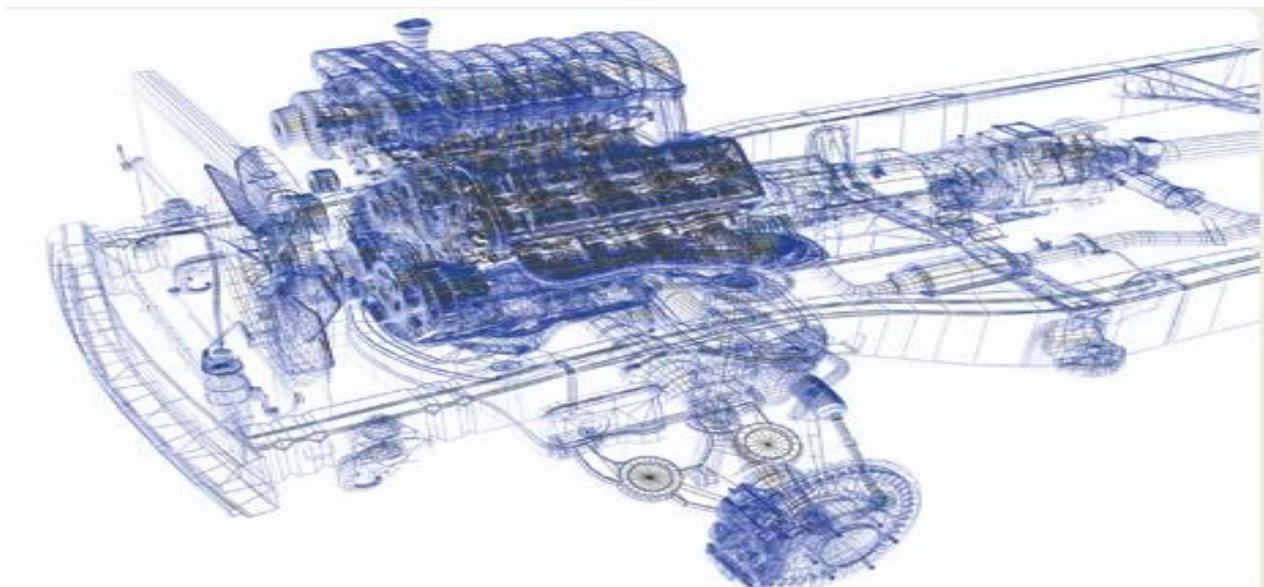
### 7.2. Measurement and Testing

To test the weight of the contaminants, the Millipore process was used, which cleans free particles adhering to the parts, filters, weighs and analyzes the liquid to determine the cumulative weight. For further testing, a calibrated water mirror is used to determine the different particles sizes in the sample to ensure that the acceptable limit set by the customer is not exceeded. Both systems generate detailed reports that can share with customers. Intensive cleaning of Camcraft can also save the end user time, money and future problems.



## 8. Automotive Parts Cleanliness

Thermo Scientific Explorer 4 with CleanCHK software can monitor the cleanliness of car parts on the production floor. CleanCHK software is the first fully automatic particulate pollution monitor specially designed for automotive applications. Monitors the cleanliness of car parts by providing particle data on the production floor in minutes. Technological advances in the automotive industry have led to stricter cleaning standards for automotive fluid systems (such as brakes, hoses, nozzles and pumps). Monitoring the cleaning of parts for rapid contamination source determination is a major concern for quality conscious manufacturers who want to reduce field failure rates and warranty costs (3).



## 9. The challenges of replacing traditional methods

Gravimetric analysis can calculate the total amount of pollutants, but does not produce data on individual particles. Therefore, these components may have passed the weight test, but still cannot function due to the loss of small, undetected particles (such as alumina). The Explorer 4 Analyzer with CleanCHK software offers:

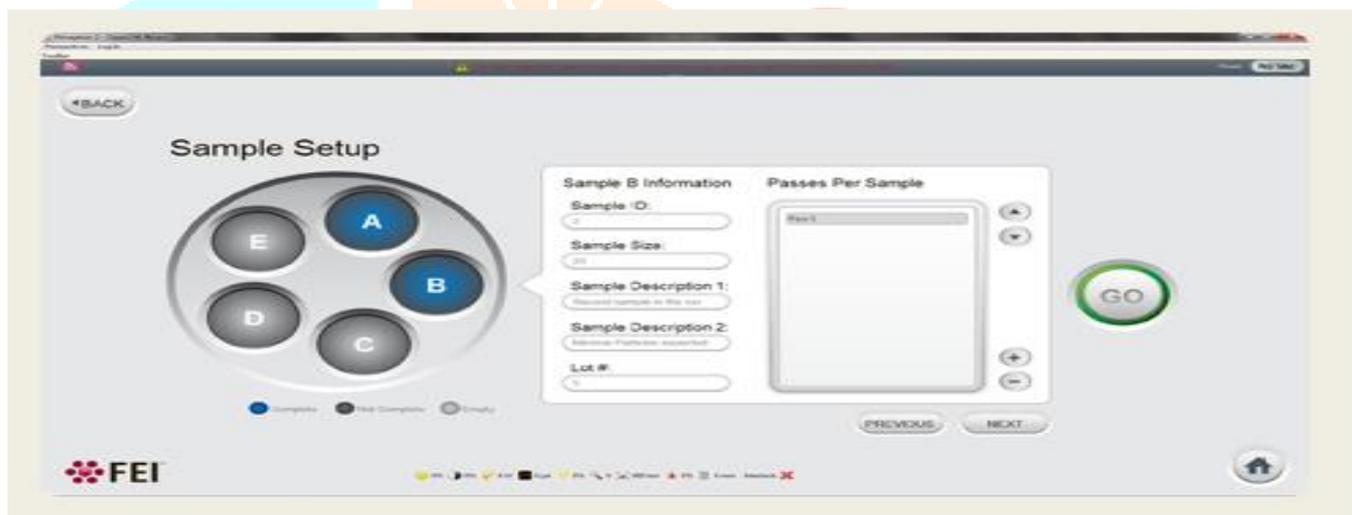
- particle size
- particle shape
- chemical composition
- particle number

### 9.1. Analytical Solutions for Automotive Applications

From leather interiors to alternative energy propulsion groups, each in-car component is designed to increase profitability, performance and popularity. The analysis tools reveal the chemical and composition details needed to maximize every automotive material.

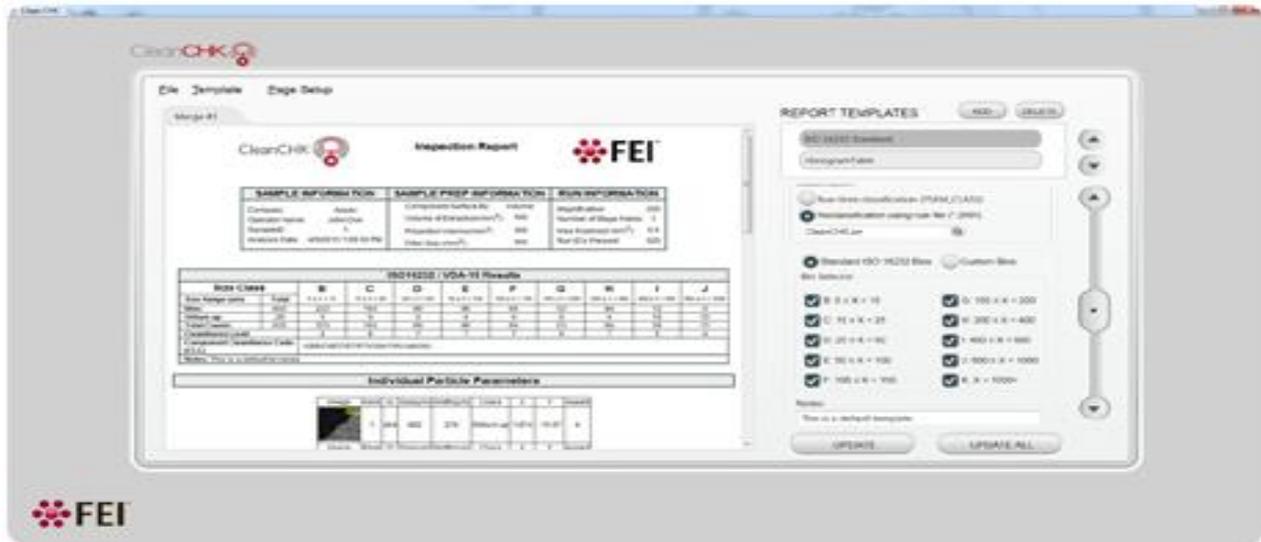
### 9.2. Automated Instrument Setup and Calibration

Implementing the Explorer 4 with CleanCHK software in your automotive manufacturing process means that no longer is it a requirement for specialized personnel to monitor and use the instrument. CleanCHK software allows an administrator to set up the calibration and test sequences and store this information on the internet so that any operator can simply load the sample and click 'Start'. Once activated, the tool will be lifted and the user can simply remove the soil and return after test is complete. This feature prevents users from performing setup and calibration of the instrument manually, but releases them when analyzing samples to resume normal tasks.



### 9.3 Compatible with ISO 16232 and VDA 19

The CleanCHK Software Reporting Module is designed to allow users to meet industry standards, such as ISO 16232 and VDA19, or to combine their own standards. It will automatically classify each sample according to the standard and clean part code and can generate reports using only larger particles or displaying trend data using histograms.

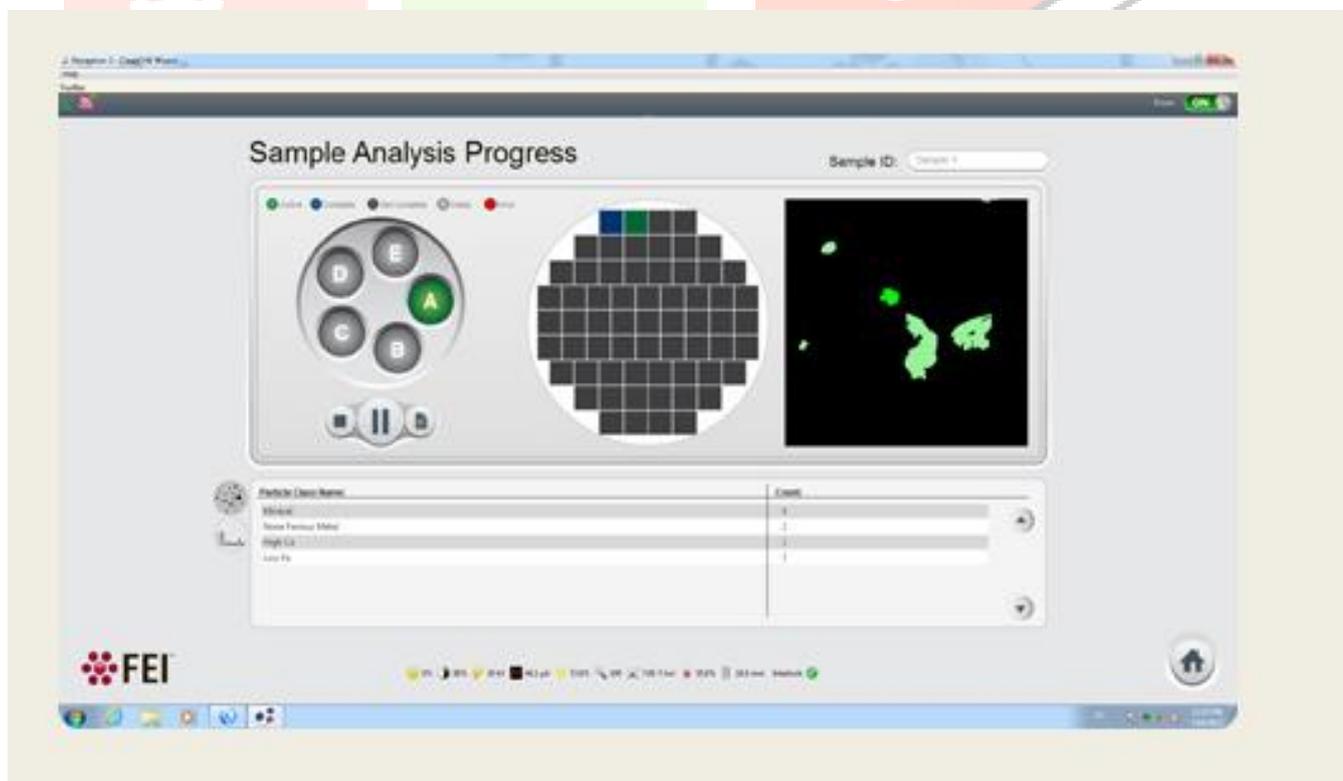


### 9.4. Particulate Recognition

CleanCHK software allows you to quickly search a large sample area and locate problem particles without considering “empty” space or benign substances in the sample.

### 9.5 Rugged Design that Fits All Environments

The Explorer 4 Analyzer with CleanCHK software is strong enough to be used directly in the production shop. The analyzer has a small footprint and can be installed near the production line for immediate monitoring. Engineers and quality control managers can immediately discover the source of potential pollution and quickly resolve the problem, which ultimately reduce the error rate, recall rate and cost (7).



## 9.6 CleanCHK Platforms

CleanCHK software is available on the Explorer 4 Analyzer is the only automatic lab SEM integrated into an industrial software package that can be installed almost anywhere (6).

*This truly integrated and easy-to-access tool offers:*

- Automatic sample set-up and analysis
- Automatic instrument calibration
- Flexible ratio mode for any purity standard
- Accurate particle size, shape and chemical composition can be achieved in minutes
- Robust design, can be installed and used in a production environment 2

## 10. CONCLUSION

In addition to our topic Literature Review on Degree of cleanliness of a component, the term paper concludes by explaining in details what cleaning methods are used, the component cleanliness analysis, what type of cleanliness cabinets exist, the results, which services exist for component cleanliness etc.

In the first chapter, Introductory notions about cleaning processes, presents that the result is different and only a great effort can perform the necessary cleaning of the components. Awareness of the cleaning process and of the factors affecting cleanliness has changed greatly. The consequences of cleaning are different and considerable effort must be made to clean the components if necessary. Awareness of the cleaning process and the factors affecting cleanliness has changed greatly. Cleaning is no longer seen as an essential evil, but is now seen as a value-added process that affects.

In conclusion, one of the results of this work show that the adsorption of organic matter in the atmosphere has a significant impact on the surface chemistry of the cleaning components. This also applies to articles kept under vacuum. This makes it particularly important that the properties of these adsorbents are known to assess their potential impact on the future functionality of the future functionality of the product in the intended use environment.

The adsorbed material may be particularly harmful to the adhesion of the substrate coating or the electrical properties of the multi-layer semiconductor component. If it penetrates the body, it may expose you to a certain toxicity. The application of surface analysis techniques (such as those mentioned in this Article) may be particularly useful in identifying these adsorbed species. In addition, this work sets ultimate standard for cleaning that is intended to remove contaminants from the surface.<sup>3</sup>

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