

PARTICLE SUCTION EXTRACTION



FOCUS ON
CLEANLINESS

C | PS

Function

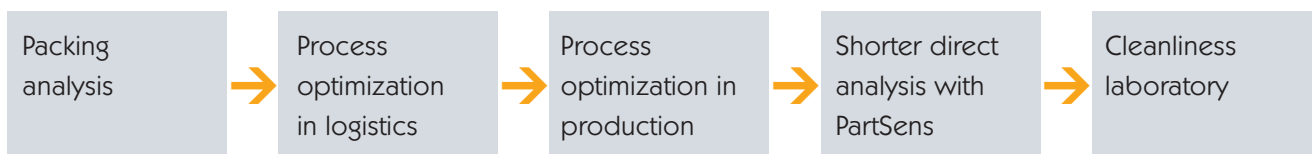
Particles are extracted by suctioning dry, adherent particles from component surfaces or from specific control areas. The particles are loosened from the surface using a suction nozzle, brush nozzle or surface nozzle before being aspirated and collected selectively or separated in sample holders such as a laboratory bottle, analysis filter or particle trap.

Wet extraction has been state-of-the-art technology in the technical cleanliness world for years. However, components which can become damaged after contact with liquid media due to soaking, dissolution, or similar can only be tested with wet extraction to a limited extent.

Air extraction with an air jet in a closed cabinet included in VDA 19.1/ISO 16232 a few years ago is now also reaching its limits as a consequence of the great change in the variety of components for electric vehicles. Large battery components can no longer be extracted in a closed cabinet. Established methods cannot be used to meet the requirement for test methods used directly in the process environment either.

CleanControlling has thus now developed its complementary suction extraction process. This method comprises a variant of the air extraction described in industrial standards. The test through to the photo-optical analysis complies with VDA 19.1/ISO 16232 and thus delivers reproducible results. Suction extraction truly impresses as it is mobile in its use and does not require closed test rooms.

Application areas



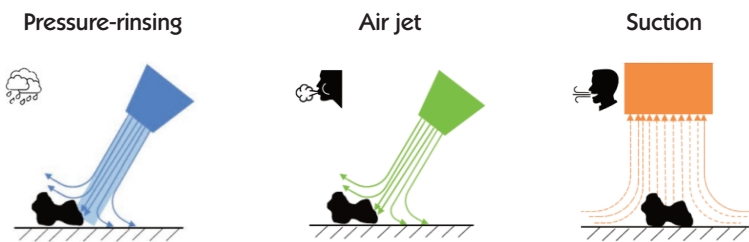
Advantages of suction extraction

- Non-destructive test (air/ESD protection) means the component can be reused after testing
- Particle monitoring can be used at any point on the production line
- Simple testing of extensive components thanks to the flexible test system
- Selective testing without masking sections possible
- Application-specific testing of components which must not be exposed to liquid media
- Reduced operational and logistics costs for component tests in the process environment and liquid extractive media no longer used.

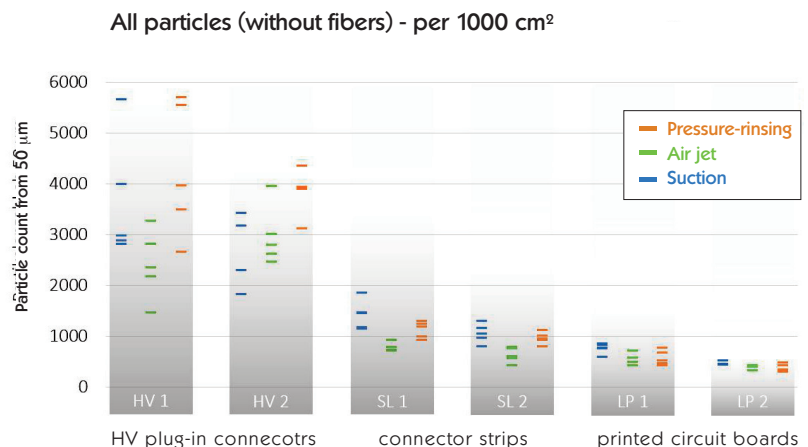
Indirect testing

An indirect test is used to identify particle contaminants mainly produced during the manufacturing process. These are extracted during the component's sampling stage before microscopic analysis consisting of measurement, counting and type identification of particles. A dry or liquid medium is used for this extraction process.

The main extraction processes include:



A working group of the German Electro and Digital Industry Association (ZVEI e.V.) carried out a comprehensive study to investigate the effectiveness of these three extraction processes in 2021 based on a large-scale series of tests with different electric and electronic assembly groups. A number of components were taken from HV plug-in connectors, connector strips and printed circuit boards from the same production batches and then tested and analyzed using these three extraction processes. The study focused on the total number of particles in several individual analyses and the breadth of their dispersion among them.



The analysis showed that all three methods studied reliably extracted the largest metallic particles. The results also reveal that, although components from the same batch have a wide dispersion, this dispersion shows an adequately normal distribution so that mean values and standard deviations can be derived from it.

The statistical analysis shows that the different methods can be combined with one another. As a general rule, there is

- a correlation of 88–96% between air jet and pressure-rinsing with a mean rel. deviation of -24%
- a correlation of 97–99% between suction and air jet with a mean rel. deviation of +34%
- a correlation of 96–98% between suction and pressure-rinsing with a mean rel. deviation of -1%.

Conclusion of the study

All extraction processes are suitable for determining and comparing the surface cleanliness of electronic components. Firstly, this is thanks to the reliable extraction of the largest particles and, secondly, due to the good correlation between the processes.

PARTICLE SEPARATION METHODS

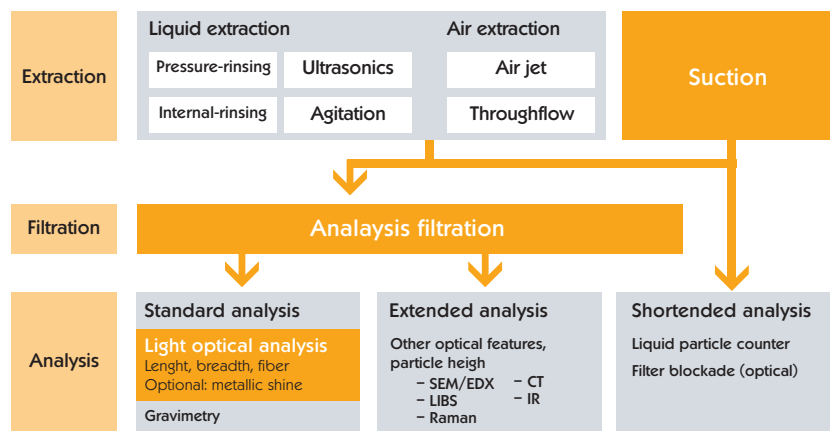
Flexible application

The CIPS suction extraction system offers several particle separation methods for suction extraction. This allows the system to cover a wide variety of different use cases.

Particle separation in laboratory bottles

The aspirated particles are collected in a clean laboratory bottle via the cyclone unit. For the subsequent analysis, the particles collected in the laboratory bottle are transferred to analysis filters using liquid analysis filtration and then analyzed using light-optical and gravimetric measurement.

This method is especially suitable for large component surfaces with higher particle loads. It impresses thanks to dry, non-destructive testing of large components, including with delimited control areas.



Video
Particle separation in
laboratory bottle



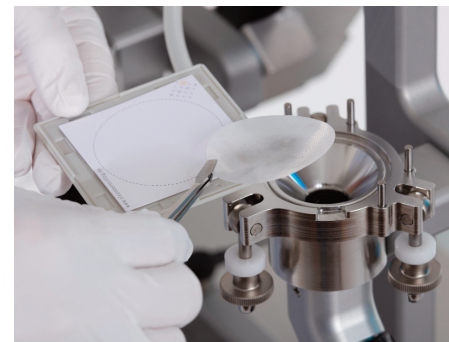
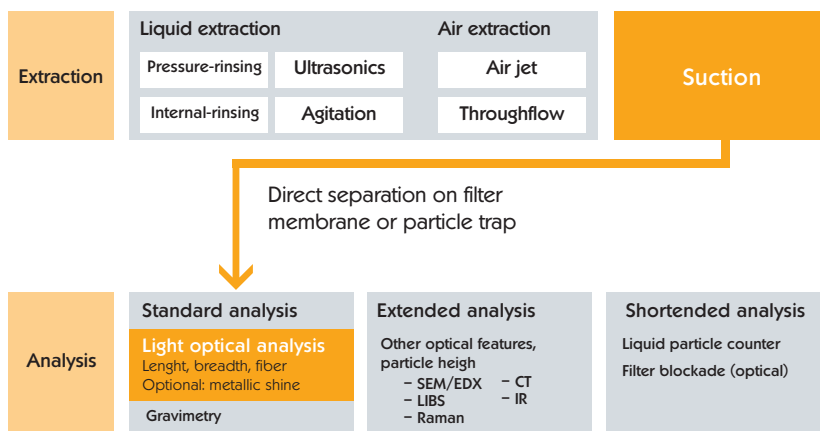
Video
Particle separation
on filter membrane



Direct filtration

The particles are extracted directly via the filter unit and separated from the air stream using the special analysis filter ($>5\mu\text{m}$). The analysis filter can be evaluated based on its light-optical properties immediately after suction extraction. If required, the flushing unit can be used to prepare the filter residue for light-optical analysis. The flushing unit also allows a filter cascade to be used in the case of greater particle volumes.

This method is suitable for testing smaller surfaces with a lower particle load, e.g. on workpiece carriers in process environments or for testing printed circuit boards. The filter residue can be prepared for analysis with a liquid medium and then aspirated for drying. This method impresses thanks to the analysis filter being quickly available for the subsequent light-optical analysis.



Particle separation on the particle trap

The suction flow in the cyclone unit separates the particles and deposits them on a particle trap mounted in the particle trap holder provided for this purpose. The particle trap can then undergo light-optical analysis with no further pretreatment required.

This method is suitable for components with smaller particle loads, i.e. components that tend to be smaller and "clean". It impresses due to the possibility of immediate light-optical analysis and results which are quickly available.



C|PS²

The time-tested compact C|PS² system inspires with its flexible, modular, compact design. The individual system modules can be combined or used separately as desired. This makes them easier transport or take into confined spaces, e.g. for particle extractions in process environments or particle monitoring on production lines.

Lightweight, compact system for mobile use

The individual modules can be easily stowed away in a car boot and are thus also suitable for flexible use at other production sites.

The compact system C|PS² comprises the extraction module, the suction unit and the practical accessory module with complete accessories for extraction, analysis and cleaning in separate drawers.

Extraction module

The extraction module contains the particle suction extraction system's core element of with a cyclone, filter and flushing unit, and connection and suction hoses.

Suction unit

The suction unit is set and calibrated in the factory for the volume flow specified for operation and is designed for wet cleaning of the system.

Accessories for extraction, analysis and cleaning

The accessories module contains extensive accessories for extraction, analysis and cleaning in separate drawers with precisely fitted dividers.





The complete system C|PS³apex is the result of consistent further evolution based on all user experiences with the C|PS² particle suction extraction system over the years.

The ergonomic complete system with digital controls for reliable user guidance

In addition to a full ergonomic redesign of the entire structure, the system provides user-friendly navigation with voice prompts throughout the freely programmable test sequence to assist in providing reproducible cleanliness tests. For this purpose, the suction extraction system features a modern digital control system for storing analysis parameters and for visual guidance with on-screen display of the test sequences.

Digital controls

With its digital controls, the system is particularly suitable for recurrent tests, such as inline tests during series production in the process environment or also tests in the laboratory. Several component-specific test parameters can be stored, which then guide the user through the test process with accompanying voice prompts and on-screen display. Test parameter monitoring also incorporates fully integrated volume flow monitoring during suction extraction.

Ergonomic design

Special features also include the suction extraction system integrated into the work surface with its ergonomic quick clamp devices for the filter clamping point, suction and connection hoses and holders for nozzles and the suction hose. It also comes with an extended range of functions for particle separation.

ESD protection

As you would expect, the system features an ESD-compliant design, thus allowing its use in ESD areas or for testing ESD-sensitive components. This is particularly important in production environments for electrical vehicle components. In conjunction with the control system, this ESD conformity is an important basis for automated robot inline testing applications.

Accessories for extraction, analysis and cleaning

The comprehensive extraction accessories, the analysis accessories and the cleaning equipment are housed in separate drawers with precisely fitted dividers.



Equipment features

C|PS² C|PS³_{apex}

Extraction system

Particle separation in a laboratory bottle	X	X
Particle separation on particle trap	X	X
Adaption for reduced direct analysis in conjunction with surface measurement system (not in scope of delivery)	X	X
Direct filtration on analysis filter	X	X
Flushing unit /cascade filtration unit	X	X
Adaption for efficient wet cleaning of the system	X	-
Automated wet cleaning with adapter	-	X
Ergonomic quick release for filter unit and hose holders	-	X

Controls and monitoring

Differential pressure measurement to monitor volume flow	X	X
Digital controls to program and store the test process	-	X
Integrated voice prompt for reliable user guidance	-	X
Screen panel with swiveling bracket to position the screen where it is visible	-	X
Integrated volume flow monitoring with direct flow rate measurement	-	X

Structural features

Modular design, demountable, compact and portable	X	-
Fully integrated complete system, mobile thanks to swivel castors with brakes	-	X
Complete ESD protection	-	X

Accessories

Universal suction nozzle set with round nozzle, flat nozzle and brush nozzle with round brush in ESD-compliant design	X	X
Flexible accessory module with separate drawers, equipped with extensive extraction accessories, analysis accessories and cleaning equipment; precisely fitted dividers keep everything tidy	X	-
Integrated ESD-protected accessory drawers, equipped with extensive extraction accessories, analysis accessories and cleaning equipment; precisely fitted dividers keep everything tidy	-	X

Suction system

Bluetooth remote control on suction hose	X	X
Mobile suction unit with volume flow set in the factory	X	-
Integrated suction unit controlled by digital controls and with monitored volume flow	-	X

Suction nozzles – universal or component-specific

In addition to the three standard nozzles included in the scope of delivery for the C|PS² and C|PS³ apex, ESD-capable and component-specific nozzles and brushes can also be developed and manufactured to requirements. The ESD-compliant use of materials ensures optimum derivation and thus prevents electrostatic discharges on the component during suction extraction. The nozzles are either made of ESD-capable material or are given a special ESD coating.



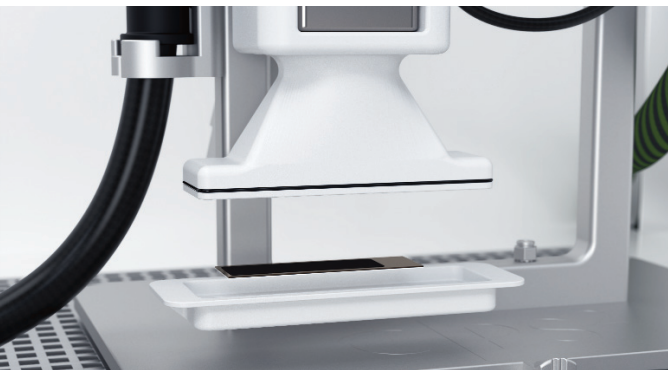
Customized nozzle variants

Nozzle geometries can be customized to meet specific component requirements on request.





Video



Reduced direct analysis using surface measurement system

A reduced direct analysis can be performed in combination with a surface measurement system PartSens 4.0 by PMT Partikel Messtechnik GmbH. The special analysis pads for direct analysis with the PartSens 4.0 are attached to the cyclone unit using the special analysis pad holder. Optimal testing of highly sensitive components is performed within a laminar flow environment, made possible by the extraction system's mobile design. Suction extraction in the laminar flow environment extracts particle contaminants from the component with the lowest possible blank value. The extracted particles are deposited onto the adhesive analysis pad.



The analysis pad is then inserted into the PartSens measuring head of the PartSens 4.0. The series measurement process commences and is performed five times. The results of the five series measurements are combined and displayed as an overall result. The measurement result is very close to the light microscopic analysis according to VDA 19.1. In addition to the measurement of the particle length as $Feret_{max}$, the PartSens+ 4.0 offers the option of distinguishing between particle sizes and particle numbers of metallic and non-metallic particles as well as fibers.

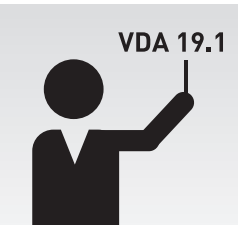


Robot-guided suction extraction

Cleanliness tests on components that impose new requirements for particle extraction can be performed over the entire surface or part of it using the advantages of suction extraction in conjunction with a robot-based extraction system. These tests are especially beneficial in the field of electric vehicles, where they are conducted on items such as battery systems.

The robot-based solution developed specifically for this task provides automated and, consequently, reproducible sampling on components measuring up to 4,600 x 2,600 mm. The robot system's seven degrees of freedom also allows particles to be extracted automatically from three-dimensional areas, such as recesses, holes or undercuts.

No special knowledge is required to program the robot; the extraction motion sequence is simply created by a one-time manual teach-in session and can be saved as a component-specific program.



Initial operation, instruction and training

Performing extractions for particle contamination sampling is essentially a manual process with assistance from user-friendly extraction systems. Extraction cannot be carried out by merely pressing a button on the extraction system. The requirements for cleanliness-compliant handling specified in VDA 19.1 not only presuppose knowledge of how to operate the system, but also thorough basic knowledge of technical cleanliness.

CleanControlling offers a special training program for users on their premises or online to provide this knowledge. In addition to initial operation, the training also includes technical cleanliness basics. Operation and use of the system is demonstrated using practical examples, on the users' own components where applicable. The time required for training depends on the users' preexisting knowledge.



Inspection and maintenance

Reliable cleanliness tests generally require clean extraction systems which do not exceed the permissible blank value, even with good cleanability. Regular system cleaning and inspection are thus essential for reproducible cleanliness tests alongside proper installation, initial operation and user qualification. Signs of wear may appear over the system's operating life despite system components being designed to be as clean as possible. Regular cleaning may no longer reliably eliminate these signs of wear after a long period of operation. As a result, regular renewal of the system components relevant to cleanliness is a crucial preventive measure for ensuring reliable test results.

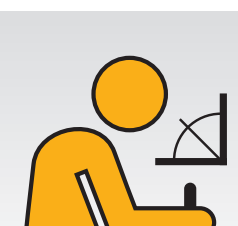
Annual maintenance

Annual maintenance and inspection is recommended for the aforementioned reasons to ensure operational and process reliability. Wear parts relevant to correct functioning and cleanliness, such as hoses, plugs and suction nozzles, are replaced as part of this annual maintenance. What's more, not only is a function test performed during the maintenance visit; the system is thoroughly cleaned too.



The maintenance contract - how you benefit

- We take care of everything – from basic cleaning to calibration
- No need to keep an eye on the due date for maintenance – we will also take care of that for you
- Maintenance is performed on your premises – at a reasonable price thanks to our route planning
- Our qualified technician can answer your questions about the application directly
- You keep up to date and can benefit from further technical developments
- No long-term contract commitment – duration of one year, cancellation three months before contract expires



Project support

When you are creating test specifications for complex components, it helps to draw on our cleanliness specialists' wealth of experience. With our project support, we offer you assistance with test planning and development of special suction nozzles, performance of qualification tests and preparation of test specifications.



Testing laboratory for technical cleanliness,
medical technology and environmental analysis

www.cleancontrolling.com

What CleanControlling is all about

CleanControlling is synonymous with comprehensive services in the field of technical, medical and environmental cleanliness for surfaces, materials and media. In addition to cleanliness testing and documentation, it offers consultation, training and a specialist product range for the definition, achievement and maintenance of technical cleanliness. It also focuses on preserving human health in connection with product cleanliness and on ensuring there are no pollutants in water, soil and waste.

Through our customer-oriented services, we embrace our commitment to supporting and assisting our customers as a helpful, expert, transparent partner. A trust-based, cooperative approach to the way we treat employees and a fair working partnership with suppliers and service providers forms the key basis for all of this. Acting in compliance with laws and regulations reflects our core values with regard to these relationships.

CleanControlling GmbH

Headquarters

Gehrenstr. 11a
78576 Emmingen-Liptingen
Germany

Phone +49 74 65 / 92 96 78-0
Fax +49 74 65 / 92 96 78-10
info@cleancontrolling.com

Dresden branch

Lockwitzgrund 100
01257 Dresden
Germany

North America branch

CleanControlling Inc.
North America Sales Office
1029 S. Belvedere Ave.
Gastonia, NC 28054 US

CleanControlling Medical GmbH & Co. KG

Headquarters

Gehrenstr. 11a
78576 Emmingen-Liptingen
Germany

Phone +49 74 65 / 92 96 78-0
Fax +49 74 65 / 92 96 78-10
info@cleancontrolling.com

Niederlassung Leipferdingen

Kellhofstr. 6
78187 Leipferdingen
Germany

