

PARTICLE SUCTION EXTRACTION



FOCUS ON
CLEANLINESS

C | PS

Function

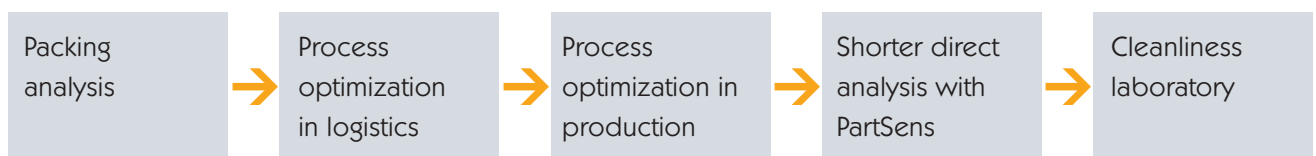
Particle extraction is performed by suctioning dry adhering particles from component surfaces or from specific control areas. For this purpose, the particles are loosened from the surface and suctioned off using a suction nozzle, brush nozzle, or surface nozzle. They are then collected in a targeted manner or deposited on sample carriers such as laboratory bottles, analysis filters, or particle traps.

In the world of technical cleanliness, wet extraction has been the state of the art for years. However, components that can be damaged by saturation, dissolution, etc. when in contact with liquid media can only be tested to a limited extent using wet extraction.

The previous method of "air extraction" by blowing off in a closed cabinet has also reached its limits due to the greatly changed range of components in connection with e-mobility. Large and unwieldy components, such as battery trays, can no longer be extracted in a closed cabinet. The demand for testing methods directly in the process environment cannot be met with established methods either.

CleanControlling therefore developed the suction extraction process some time ago. This was included in the new edition of VDA 19.1 from 2025 as (brush) suction extraction. This method is a variant of "dry extraction" and is comprehensively described in the new VDA 19.1 with regard to test parameters, test qualification, and light-optical analysis. Suction extraction is particularly characterized by its independence from closed test rooms and its mobile use.

Application areas



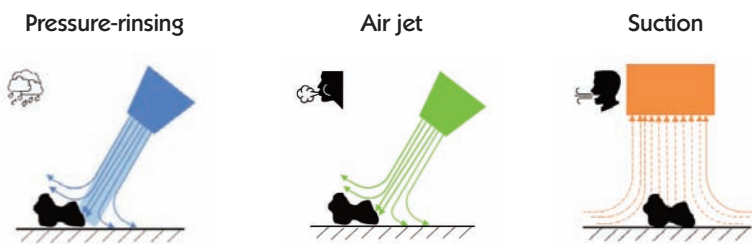
Advantages of suction extraction

- 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.

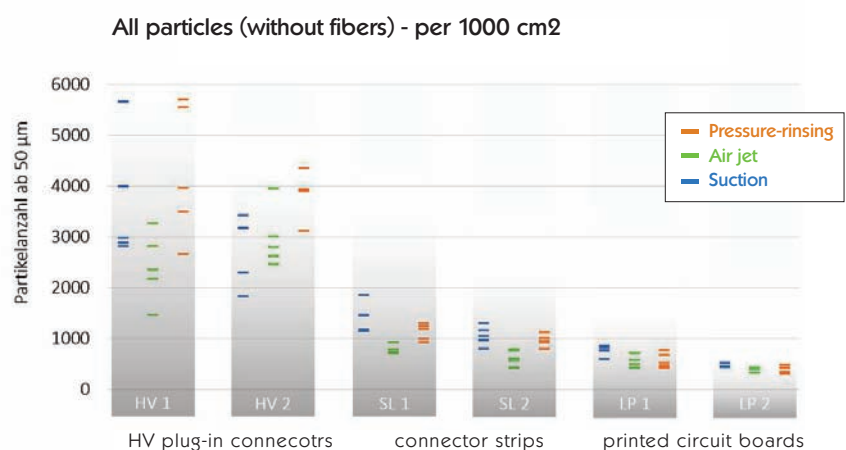
Indirect testing

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 Electroand 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.

Multiple applications according to VDA 19.1

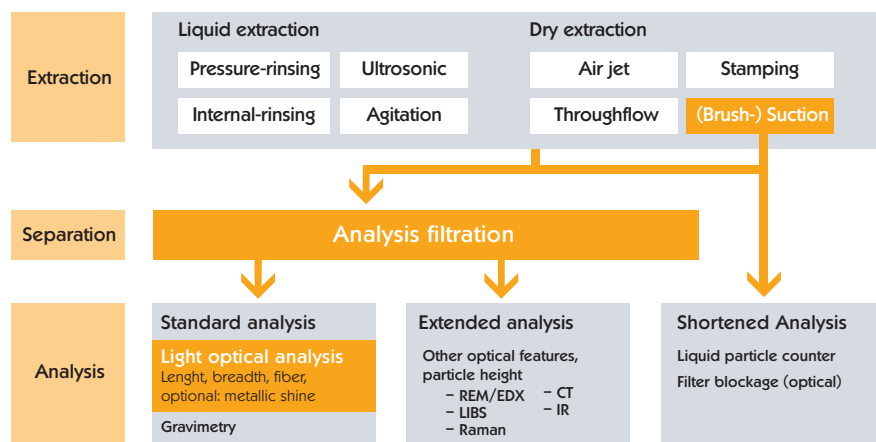
The new VDA 19.1 describes the start parameters relevant for testing. These parameters are used to determine the final test parameters by means of a qualification test (decay measurement). In addition to the inlet area of the nozzle (2.0 cm^2), the suction volume flow ($\geq 20 \text{ m}^3/\text{h}$) and the suction distance (max. 8 mm), the suction time per component surface is defined. It can either be calculated using a formula or taken from the table or diagram in chapter 6.5.3 of VDA 19.1.

Several methods of particle separation are available for suction extraction using the CIPS suction extraction system. This allows the system to cover a wide range of different applications.

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



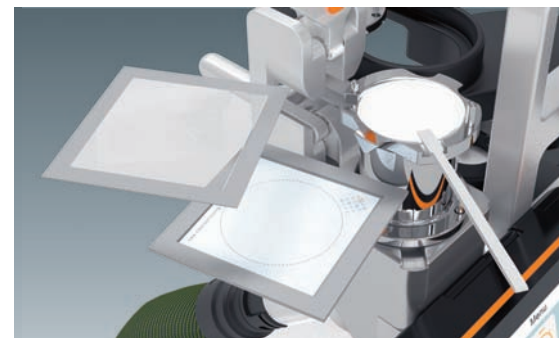
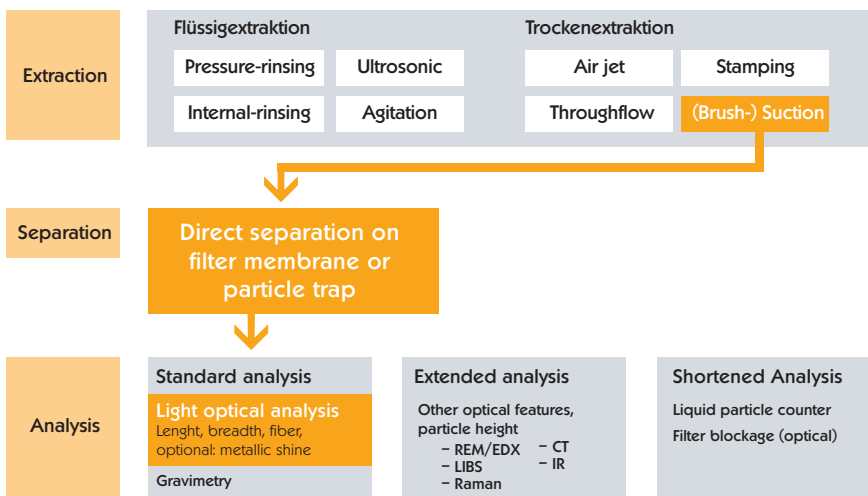
Video
Particle separation
on filter membrane



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|PS³ flex

The new C|PS³ flex compact system is characterized by its flexible, modular, and compact design. The individual system modules can be combined as desired or used separately. This facilitates transport and access to confined areas, for example during particle extraction in process environments or in production facilities for particle monitoring. The new ergonomic clamping concept for the cyclone and filter unit, including a new nozzle hose lock, significantly simplifies operation and delivers fast and reliable results.

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 C|PS³ flex system consists of an extraction module, a suction unit, and a practical accessory module containing all the accessories required for extraction, analysis, and cleaning in separate drawers.

Extraction module

The extraction module contains the core element of the particle suction extraction system with cyclone, filter, and flotation unit. The new volume flow measuring device, which has an integrated digital display, enables monitoring of the volume flow in accordance with VDA 19.1.

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. This can be ordered optionally.

Ergonomics

Other special features include the suction extraction system integrated into the work surface with ergonomic quick-release fasteners for the filter clamping point, suction and connecting hoses, holders for nozzles and suction hose, and extended functionality for particle separation.

Accessories for extraction, analysis and cleaning

The extensive range of extraction accessories, analysis accessories, and cleaning equipment are stored in separate drawers with custom-fit compartments in the accessory module. The accessories also include all suction nozzles and brushes recommended in accordance with the new VDA 19.1 standard.

The system is cleaned easily and effectively before each test using the digitally controlled wet cleaning accessories included as standard.





The complete system C|PS³ apex 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

Thanks to its digital control system, the system is particularly suitable for recurring tests, such as in-line testing during series production in the process environment or in the laboratory. The digital control system guides the user intuitively through the decay measurements for determining the test parameters and through the actual test process with voice prompts and screen displays. Multiple component-specific test parameters can be stored. Monitoring of the test parameters also includes fully integrated monitoring of the volume flow 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.

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Equipment features

C|PS³_{flex} C|PS³_{apex}

Extraktionssystem

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	
Direct filtration on analysis filter	X	X
Flushing unit / cascade filtration unit	X	X
Automated wet cleaning	X	X
Ergonomic quick release for filter unit and hose holders	X	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	–	X
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

Suction nozzle set recommended according to VDA 19.1 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
Particle trap adapter for particle separation on CleanControlling particle traps for microscopic evaluation	X	X
Clever-Stamp adapter for quick evaluation with Clever-Stamp and PartikelLens app from PartikelART	optional	optional
PartSens adapter for evaluation with PartSens 4.0 from PMT	optional	optional
Particle trap adapter for particle separation on Jomesa particle traps for microscopic evaluation	optional	optional

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

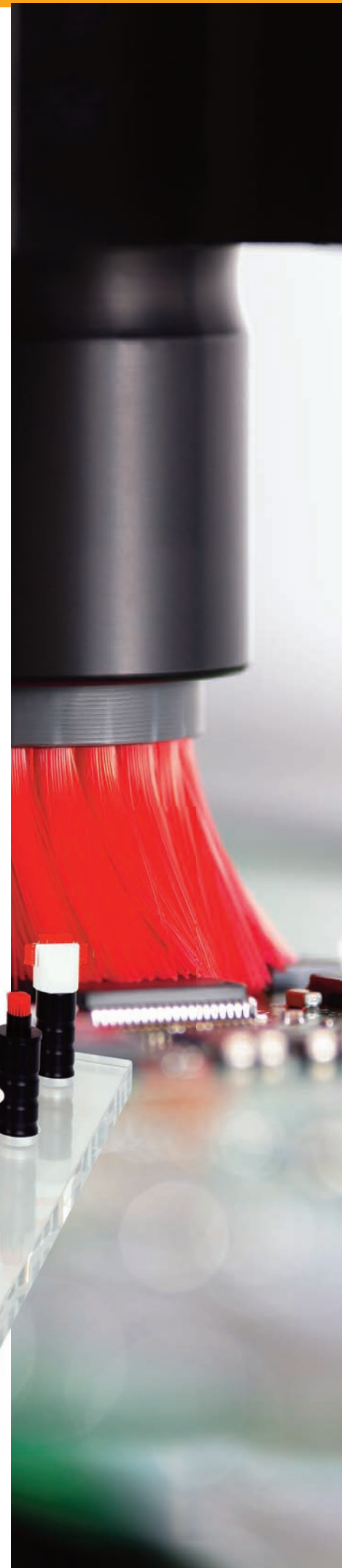
Suction nozzles – universal or component-specific

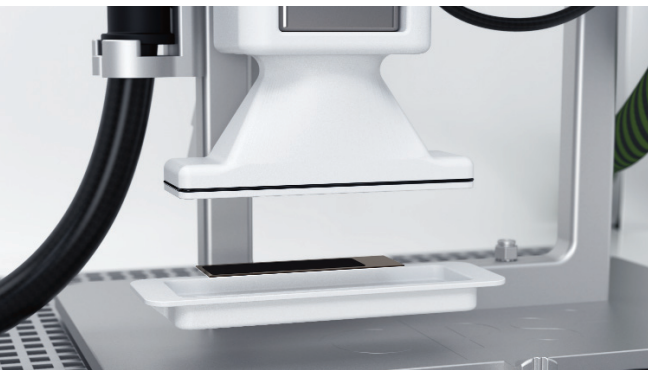
In addition to the three standard nozzles included in the scope of delivery for the C|PS³ flex and C|PS³ apex, ESD-capable and component-specific nozzles and brushes can also be developed and manufactured to requirements. The ESD-compliant use of materials ensures optimum derivation and thus prevents 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.





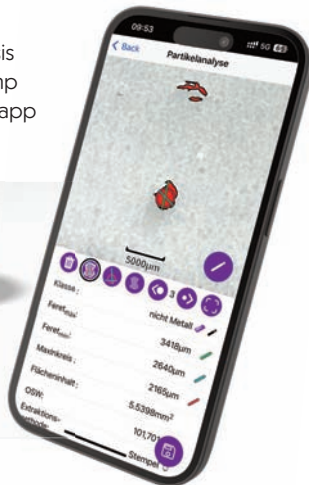
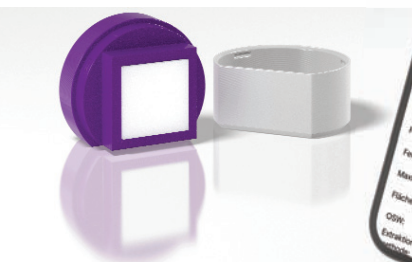
Video
Reduced
direct analysis

Reduced direct analysis using surface measurement system

In combination with the PartSens 4.0 surface measurement system from PMT Partikel Messtechnik GmbH, a shortened direct analysis is possible. The test is ideally carried out in a laminar flow environment to keep the blank value as low as possible. This is made possible by the mobile design of the extraction system. The special analysis pads for direct analysis with the PartSens 4.0 are attached to the cyclone unit using the specific, optionally available adapter. The extracted particles are deposited on the adhesive analysis pad. Subsequently, a 5-fold series measurement is performed with the PartSens measuring head of the PartSens 4.0. The five series measurements are summarized and output as a total result. The measurement result is very close to the light microscopic analysis according to VDA 19.1.



Video
Fast direct analysis
with Clever-Stamp
and PartikelLens app



Fast direct analysis with Clever-Stamp and PartikelLens app

For quick and regular tests, such as those useful for monitoring in the process environment, direct analysis with the PartikelLens app from PartikelART is ideal. For this purpose, the Clever-Stamp is attached to the special, optionally available adapter as a particle trap. After suction extraction, the Clever-Stamp can be quickly and cost-effectively evaluated digitally using the PartikelLens app.

Robot-guided suction extraction

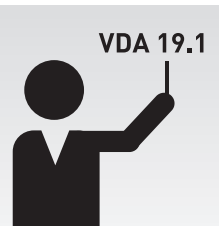


Video
Robot-guided
suction extraction

Cleanliness testing of large components, such as battery systems, places new demands on particle extraction. This is often necessary during the production process. Robot-guided suction extraction enables automated and reproducible sampling, either across the entire surface or at different control points.

For such applications, CleanControlling uses a robot-based solution developed in-house for components measuring up to 4,600 x 2,600 mm. Thanks to the seven degrees of freedom of the robot system, particles can also be extracted automatically from three-dimensional areas, including recesses, holes, or undercuts.

The robot's movement sequence for extraction is programmed by simple, manual teaching and stored as a component-specific extraction 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.

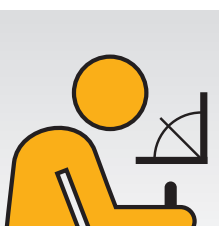
The maintenance contract - how you benefit

- 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.

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