



More than cleaning



POWERJET ULTRA

**CLEANING THROUGH A KEYHOLE**

The Standard for High Purity Cleaning and more

ABOUT ...

LPW is a leading supplier of high quality systems and process engineering technologies to the industrial cleaning market. We sell our systems to the mechanical engineering, automotive, electronics, and aerospace sectors. Now with our High Purity Division, we are also a desirable partner in sectors with challenging cleaning specifications in Medical, Optical, and Semiconductor Industries. LPW provides standard as well as customized solutions, optimizing customers production processes.

We are especially focused on energy efficiency, uptime, and yield improvement on tool availability and quality terms.

We combine established cleaning and drying methods with new state of the art methods, and develop solutions to outperform customers process requirements. Therefore LPW is able to set the benchmark for the currently relevant undesired impurities (particulate, organic or biological). Our hermetically sealed process

chambers, which facilitates the exclusion of interfering environmental factors, are key for the above mentioned performance. Applying and combining physical factors, such as pressure, vacuum, spray technology, and flow dynamics are opening a multitude process of window, optimizing or increasing our total performance. Smart process engineering, in conjunction with the customers expertise, reflects the principal element of our continuous R&D work.



SURFACE ALLIANCE

LPW is part of the competence network Surface Alliance. Along with the german company Hemo GmbH and the foreign partners MecanoLav Ridel S.A.S. in France, NGCT Cleansys Pvt. Ltd. in India and Washtech S.A. in Mexico.

We complement each other by providing the entire solution for challenging cleaning jobs that

makes sure our customers are receiving the right solution to their cleaning requirements. Many years of experience as well as a reliable service and sales network are the foundation of our success. Particularly their targeted support and advice along the whole process chain is the main strengths of this cooperation, making it unique in this industry.



CONTENT

4	Description of the modular PowerJet
8	Modules and combinations
10	Cleaning and rinsing procedures
	Cleaning methods
12	PowerJet Cleaning method - Immersion-/Alternating Pressure Cleaning (IAPC)
13	Ultrasound cleaning method Multifrequency System (MFS)
14	Cyclic Nucleation process (CNp)
16	Drying procedures
18	Requirements on customers site
19	Special procedures of ultra-fine-cleaning

# GENERAL SYSTEM

## DESCRIPTION OF THE MODULAR POWERJET

The LPW PowerJet modular range is currently our strongest system to achieve high quality cleanliness requirements in all high tech sectors. By the end of the 90s, the automobile and general industries started investing in single chamber immersion systems as a benchmark for almost all applications in terms of final cleaning tasks. Meanwhile, these have been replaced by multi-chamber systems, considering that these have a much wider process engineering bandwidth. Especially for final cleaning of medical system devices or components up to the semiconductor industry, which is usually done in serial wet bench immersion systems. Now chamber systems clearly convince technically under consolidation of all relevant aspects. Therefore, the bottom line is that these machines are extraordinarily flexible and extremely powerful

systems, which are designed to meet residual cleanliness criteria, together with high availability and low operating costs.

Through its constructive design, these systems are ideal for integration in production processes. Also, integration as a „Quality Gate“ in between grey and clean room environment, our PowerJet modular system will satisfy the customers requirement. The unique characteristics of this modular design is its hermetically sealed treatment chamber(s), highest flexibility regarding throughput, and certainly the simplicity of upgrading the configuration. Conditioned by its design, this type of system allows the integration of all familiar cleaning methods and media preparation processes. With clearly higher filtration rates and minimized cross-

contamination compared to other familiar systems. We perform flexibility in relation to the materials used (e.g. stainless steel or plastic). LPW also offers suitable automation and control systems. The LPW range extends from simple loading automation to complex connections to multi-stage preliminary and follow-on processes; if required, even considering batch size 1 and load tracking aspects.



**PowerJet 960 T3 Twin ULTRA**  
(Semiconductor Industry)

## GENERAL SYSTEM

### DESCRIPTION OF THE MODULAR POWERJET

» Among all customer designs there are standard systems available:

- 530 (load size 530 x 320 x 200 mm)  
(load size 20,9" x 12,6" x 7,80")
- 670 (load size 670 x 480 x 300 mm)  
(load size 26,3" x 18,8" x 11,80")
- 960 (load size 1020 x 650 x 560 mm)  
(load size 40,1" x 25,6" x 22,0")
- As well as any special size.

» Cylindric tanks

» Integration of all known cleaning methods possible (e.g. spray/flood cleaning, ultrasound, cyclic nucleation, QD etc.)

» Integration of all known drying methods possible (e.g. hot air, vacuum, CNp drying, IR drying, steam drying, etc.)

» Integration of all known media preparation methods possible (e.g. full flow/bypass filtration)

» Fine and ultra-fine-cleaning:

- Metal, plastic, glass or ceramic components
- Bulky goods or positioned individual components
- Fully or partially automated
- Cleaning for residual contamination or surface tension
- Safe process removal of chips and machining residues after mechanical processing
- Use of all known mechanical washing and wet chemical flood and spray methods
- Cleaning to sector-specific cleanliness criteria

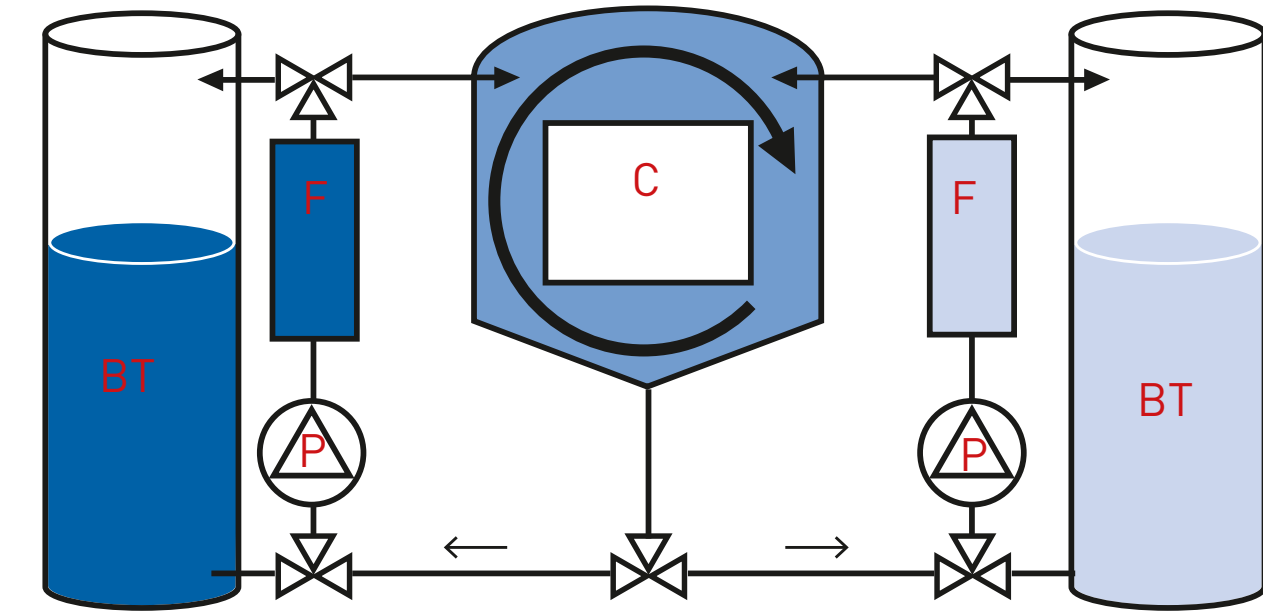
530

670

960

// THE STANDARD FOR HIGH PURITY CLEANING AND MORE!

#### //Basic Configuration



F filtration  
P pumps  
BT buffer tanks (cleaning, rinsing)  
C chamber (single, twin, triple)

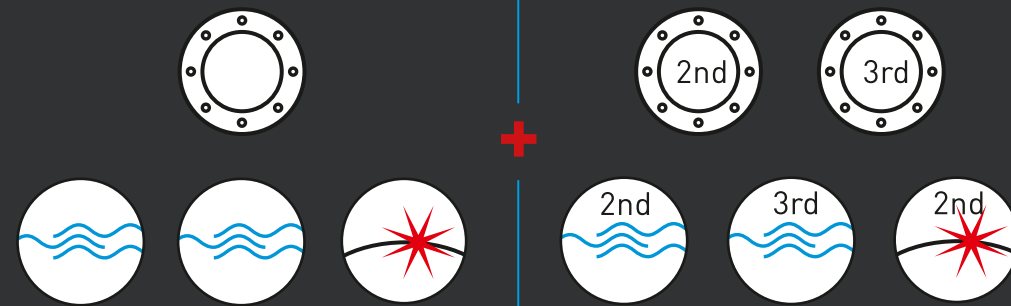


## MODULES AND COMBINATIONS

The PowerJet system is available in different configurations and sizes. Depending on the customers specification, the modules can be combined acc. the cleanliness requirements and the requested capacity.

Even customized systems can be developed.

## //Tanks and chambers



## / Basic configuration

- 1 working chamber
- 1 cleaning tank
- 1 rinsing tank
- 1 final rinsing

**/ Additional options\***

- 2nd/3rd working chamber
- 2nd cleaning tank
- 2nd/3rd rinsing tank
- 2nd final rinsing

### // Available cleaning processes



## Spray-cleaning



## Ultrasonic systems



## PowerJet cleaning method



Cyclic Nucleation  
process (CNp)



### Quick dump system (QD)

### // Available drying processes



Hot air-drying



## Vacuum-drying



## IR-drying system



CNp-drying

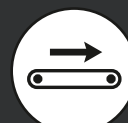
**/Additional options**  
(samples)



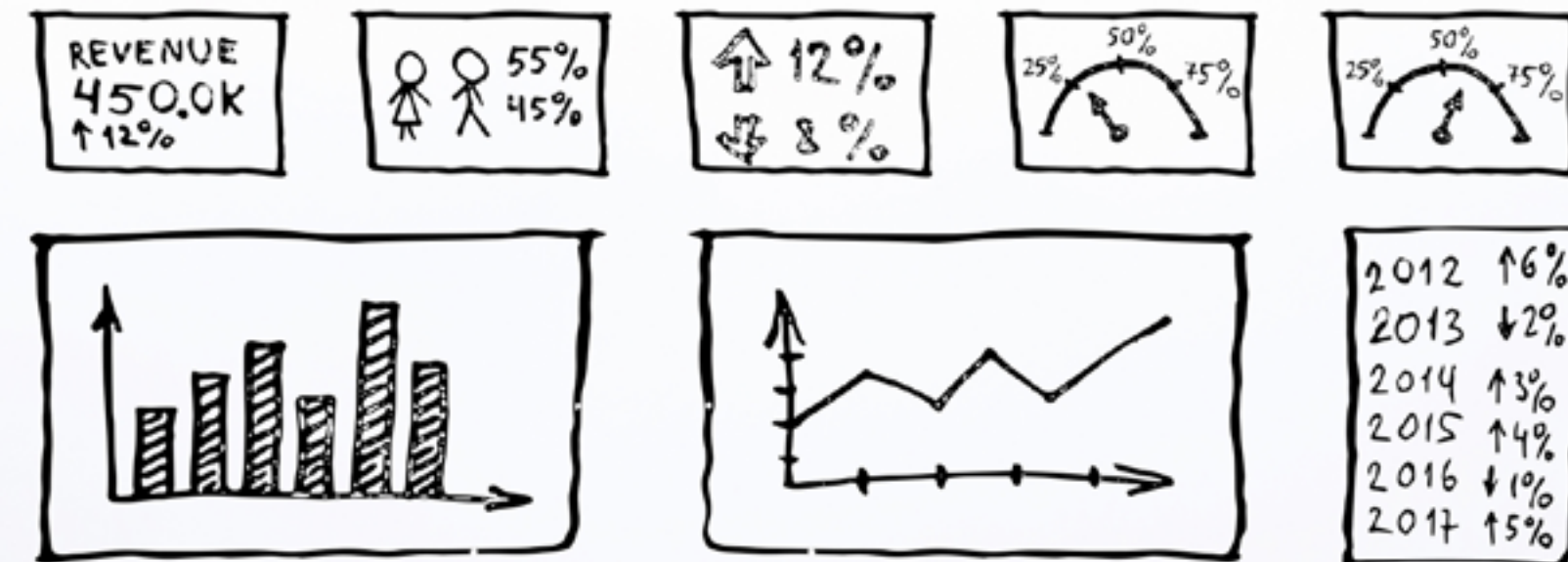
## Filtration



Di-water/ultra pure water system



## Automation



# GENERAL SYSTEM

## CLEANING AND RINSING PROCEDURES

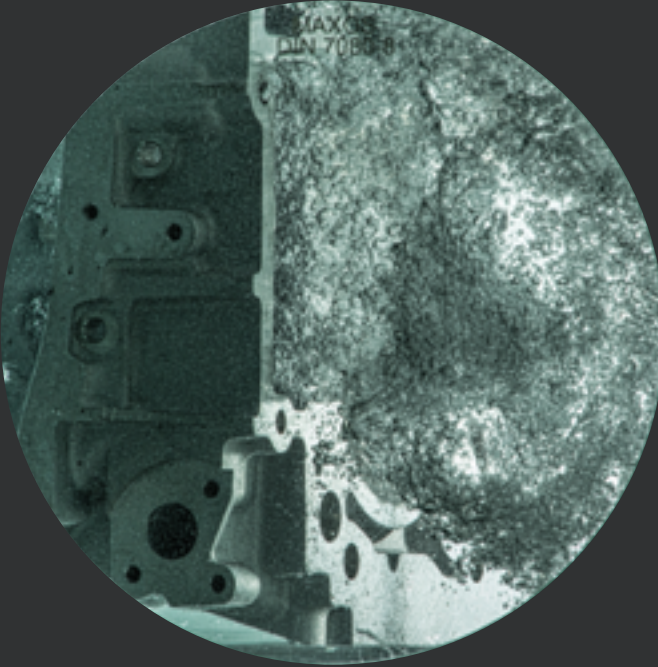
The cleaning process is divided into several sub-processes. In precision cleaning, it may also be required that the quality of the parts is known with respect to their input contamination.

At the beginning, the wet-chemical cleaning process needs to dissolve the contaminants away from the complete surface, even inside complex three-dimensional geometries and capillary structures. Strong media streams transport the dissolved impurities to the filtration systems. In addition to the chemistry use, the appropriate mechanical processes in relation to component geometry and packing density, is elementary. If this process is not clearly defined and completed, there is a high risk of cross-contamination in the subsequent processes. Even material removal can be performed here (e.g. etching processes).

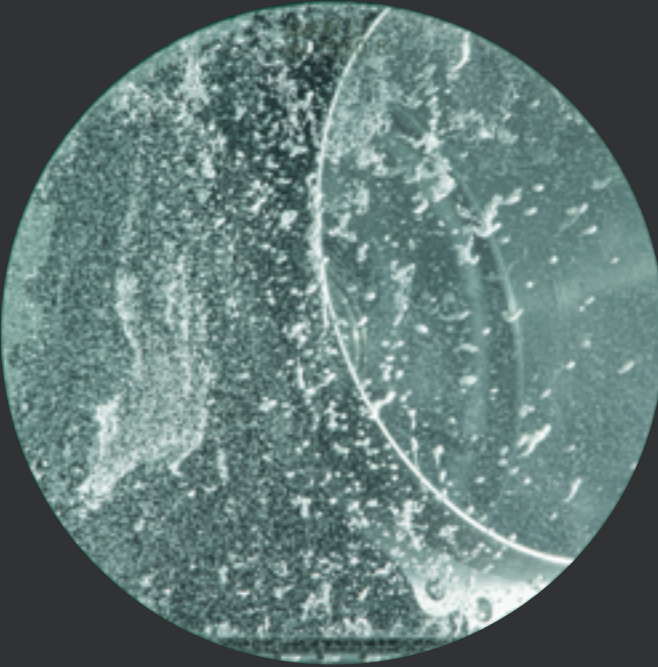
- LPW's ultimate combination of mechanical force to the parts include:**
- » Spray Cleaning up to 77°C/170°F
  - » Immersion-/Alternating Pressure Cleaning up to 77°C/170°F (IAPC)
  - » Ultrasound Cleaning method Multifrequency System up to 77°C/170°F (MFS)
  - » Cyclic Nucleation process up to 77°C/170°F (CNp)
  - » Quick dump method (QD)

Spray Cleaning is used as a pre- or intermediate cleaning process. Immersion-/Alternating Pressure Cleaning serves additional support for cleaning and chip removal. This is especially the case with parts densely packed, loose and/or with complicated geometries.

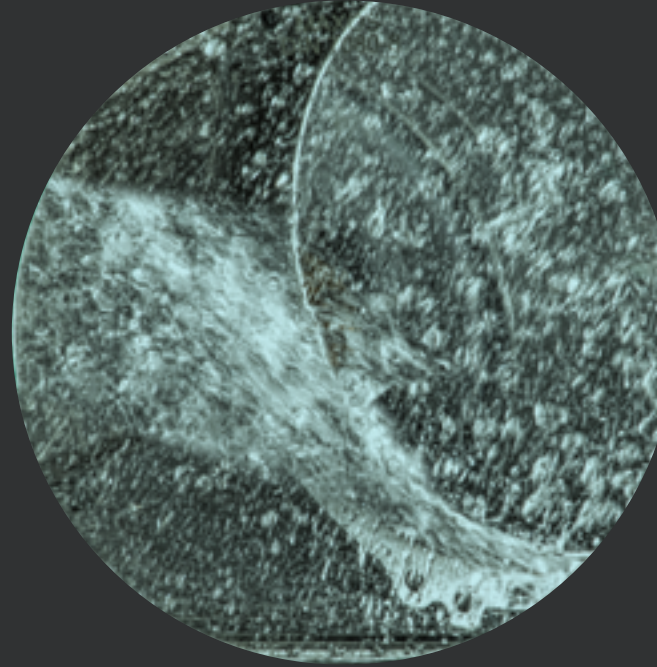
The ultrasonic unit is intended to support cleaning and chip removal, especially for parts contaminated by grinding or polishing residue and other pigment dirt. For the support of ultrasonic cleaning, the filling of



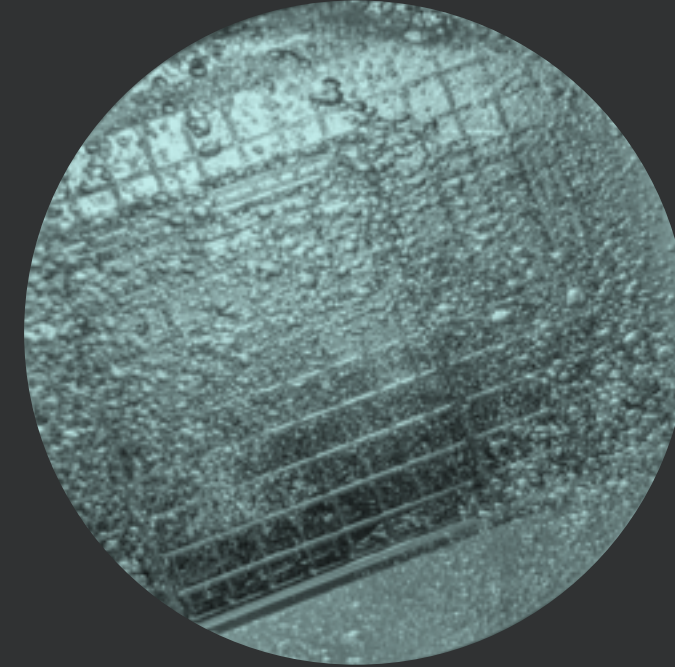
// Immersion/Alternating Pressure Cleaning



// Ultrasound Cleaning method



// Spray Cleaning



// Cyclic Nucleation process

the working chambers can also be carried out at or by means of negative pressure (option). This accelerates the outgassing of the medium and shortens the cycle time of the selected process. For ultra-fine-cleaning, LPW provides a US-patented process called Cyclic Nucleation process (CNp). With this specific process, the PowerJet system is able to support the cleaning and the rinsing processes, even in complex geometries. In addition, the system has an above-average

filtration rate during recirculation and spraying. This ensures that the dissolved contamination disappears from the area of the part to be cleaned immediately. The capability of implementing a Quick Dump (QD) step further guarantees avoiding any cross-contamination.

The following multifunctional rinsing processes have the task of removing the already dissolved organic and inorganic residues from the surface and from the surrounding of the part.

- The quality of the process depends on three key factors:**
- » Water purification systems adapted to the cleanliness specification
  - » High quality of cleanliness of the flushing medium in conjunction with a large flush volume and a continuous flow
  - » Hermetically closed treatment chambers to avoid external influences

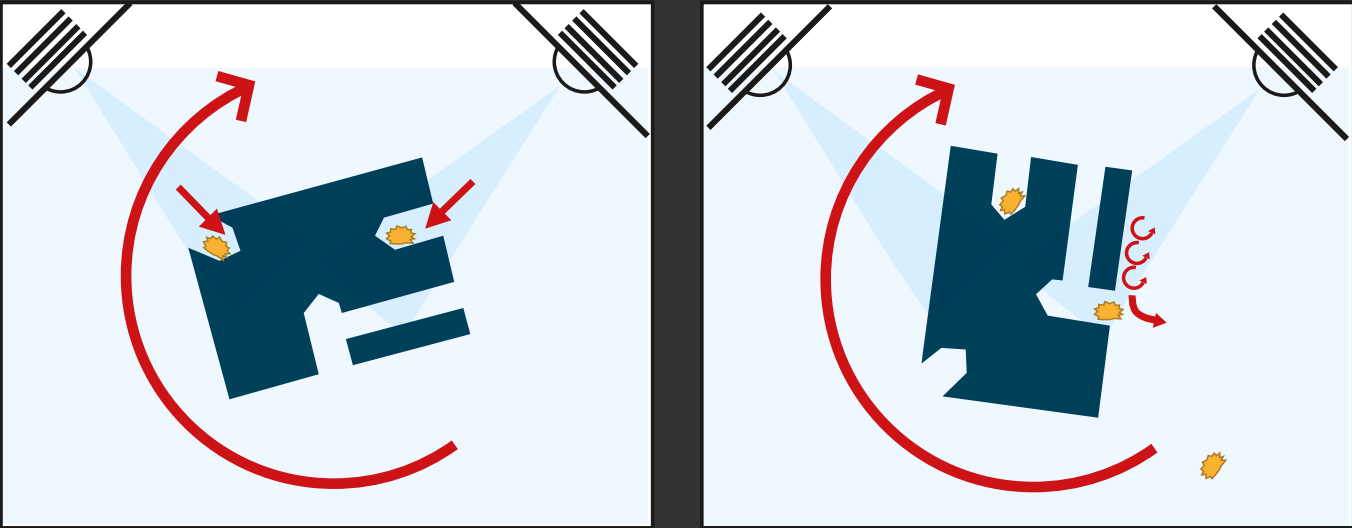


CLEANING METHODS

IMMERSION-/ALTERNATING PRESSURE CLEANING (IAPC)

Turbulences cause localized pressure and under-pressure effects in combination with a high filtration rate. Pressure flood washing serves for additional support for cleaning and chip removal. This is especially the case with densely packed loose material and/or with parts with a complicated geometry.

PowerJet Cleaning method: Immersion-/ Alternating Pressure Cleaning (IAPC)

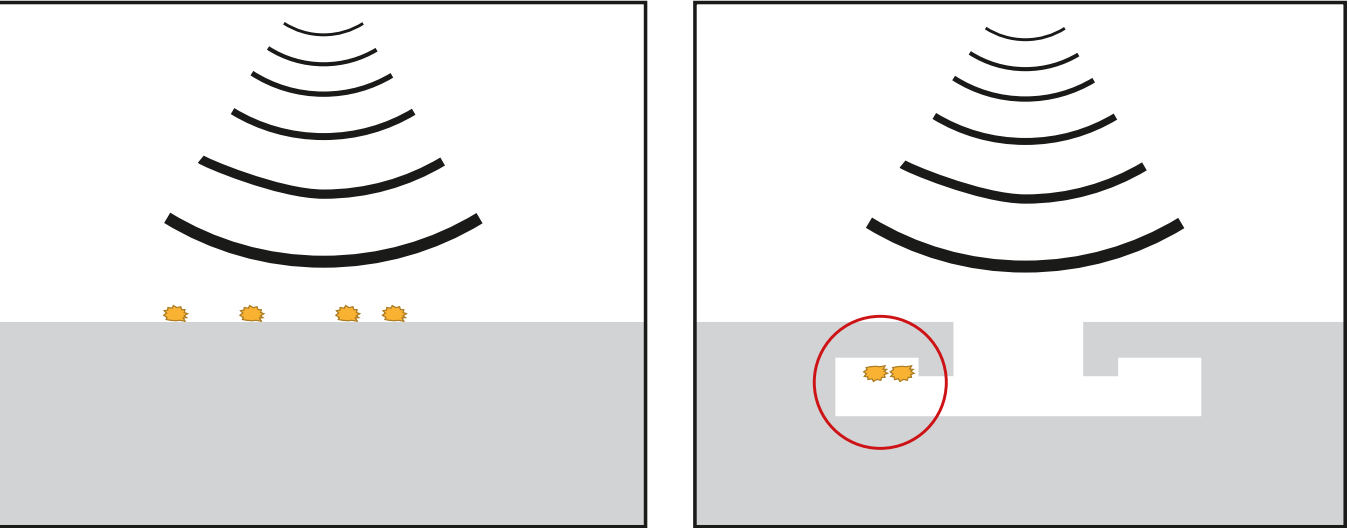


CLEANING METHODS

ULTRASOUND CLEANING METHOD MULTIFREQUENCY SYSTEM (MFS)

Ultrasound cleaning is a proven and powerful cleaning method. Depending on the individual cleanliness requirement, we can equip our systems with a variety of different ultrasound solutions. Single or multi-frequency systems between 25 and 1000 kHz and a power up to 20 watts per liter.

Ultrasound Cleaning method Multifrequency System (MFS)



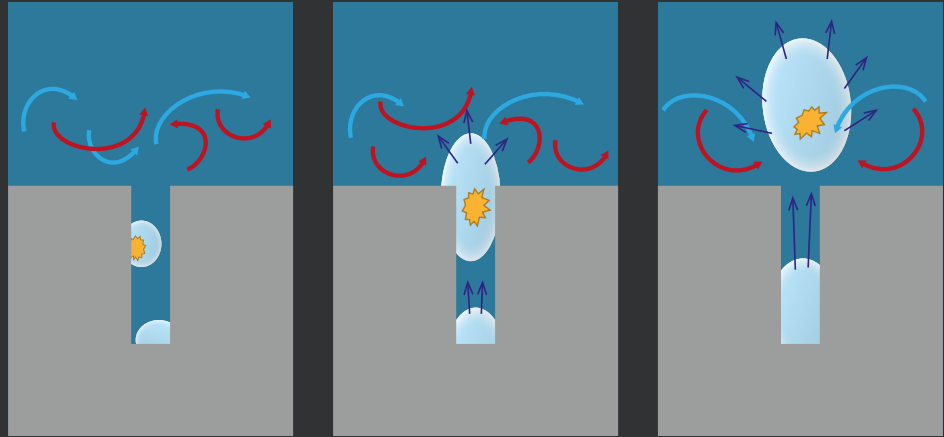
Ultrasonic effects on the dirt and the surface.

Ultrasonic do not reach entirely inner structure.



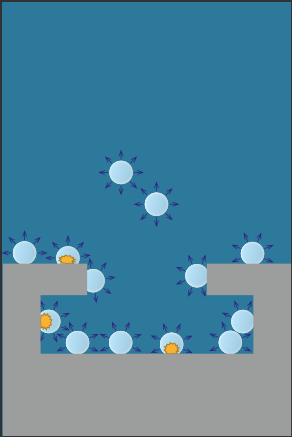
# CLEANING METHODS

## CYCLIC NUCLEATION PROCESS (CNP)

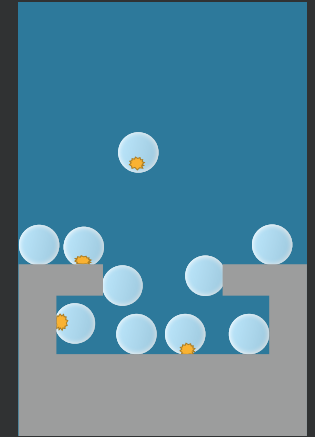


The asymmetric change of volume creates a pumping effect ensuring the exchange of media in capillaries and blind holes helping to remove impurities.

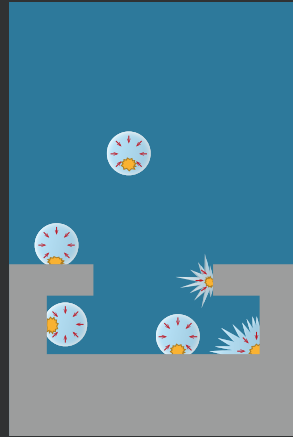
Due to the isostatic distribution of pressure change in the cleaning fluid, Cyclic Nucleation (CNp) is highly effective in cleaning difficult geometries like undercuts and narrow chanel.



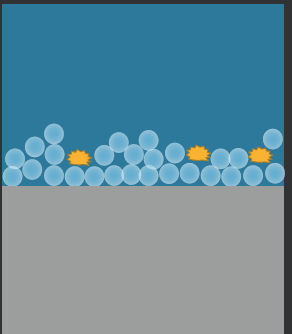
Gas bubbles form on the reactive surface.



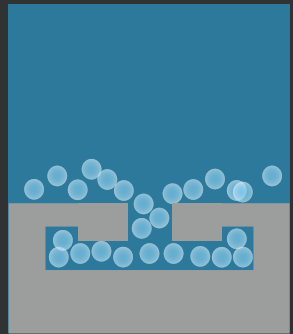
The gas bubbles expand.



The bubbles implode and generate cavitation.



Effects between dirt and reactive surface.



Easily reaches shaded areas.

// THE STANDARD FOR HIGH PURITY CLEANING AND MORE!



Cyclic Nucleation in progress



GENERAL SYSTEM  
DRYING PROCEDURES

In ultra-fine-cleaning, the drying process is of particular importance. Since this is the last step of the entire process and therefore it is the key to meet the highest quality cleanliness requirements.

**The PowerJet system fulfills this task in a unique way:**

- » The hermetically sealed treatment chambers allow defined rinsing and drying process.
- » The system design always ensures that there is no concentration of unwanted contaminations in the chamber throughout the combined rinsing and drying process.
- » The supply of CDA or N2 usually takes place via on-site connections and is also filtered according to the purity requirement.
- » The specific orientation of the blower prevents the air from being additionally contaminated with impurities up to defined specifications (HEPA 13 and more).

These measures guarantee optimized process quality defined by the respective cleanliness criteria.

**LPW offers different types of drying methods:**

- » Blow drying using filtrated ambient or hot air
- » Vacuum-drying
- » Infrared-drying systems
- » CNp-drying
- » Steam-assisted drying method

All drying methods can be employed as an alternative, additionally, or even in combination.

In the drying process, the following types of movement are possible: stationary, rotation, or sweep mode. The sweeping angle can be set individually. Treatment times are adjustable as well.

Blow drying can also be individually parameterized from room temperature up to 320°F/160°C and even combined additionally with vacuum drying.

50–160°C  
130–320°F



## REQUIREMENTS ON CUSTOMERS SITE

Characteristically, ultra-fine-cleaning has requirements that either have a high risk of cross contamination with upstream/downstream processes, handling, or environmental influences. In addition, it is necessary to absolutely avoid contamination by mechanical components. This means focusing on the mechanical and procedural design as well as of the quality of the supplied media (liquid carrier media, used chemistry and process gases). In addition, it is necessary to avoid contamination by mechanical components (particulate and filmic

contamination entry through valves, rotary movements, dead spaces etc.). Supplementary to the cleaning and rinsing, especially the drying processes with their thermodynamic loading on subcomponents (e.g. air heaters and filter components) as well as strong pressure changes (for example pressure equalization with vacuum) have to be taken into consideration in the design of the ultra-fine-cleaning process. Otherwise they can be a clearly noticeable particle sources.



## SPECIAL PROCEDURES OF ULTRA-FINE-CLEANING

Special ultra-fine-cleaning procedures are primarily focused on the removal of sub-micron particles or organic residues; particularly structure size contaminants with undesirable influence on surface properties like roughness, wetting, chemical, electrical or optical quality. These are typically physical or physical chemical processes.

For the required target size, only the distinction according to the type of unwanted contaminations is not enough.

Preparation of the specific environment to reach high-purity-specifications requires care and the same effort as the creation of a cleaning system itself.

// THE STANDARD FOR HIGH PURITY CLEANING AND MORE!



### 1st place CLEAN 2018!

With the Fraunhofer Cleanliness Technology Award »CLEAN!« Fraunhofer IPA annually honors groundbreaking developments, new applications and technologies regarding cleanliness technology.





More than cleaning

**LPW Reinigungssysteme GmbH**

Industriestraße 19  
D-72585 Riederich

Phone: +49 (0)71 23-38 04-0

Fax: +49 (0)71 23 - 38 04-19

[info@lpw-cleaning.com](mailto:info@lpw-cleaning.com)

[www.lpw-cleaning.com](http://www.lpw-cleaning.com)

