



**ULTRASONIC**  
WASHING UNITS





# ULTRASONIC WASHING UNITS

## ULTRASONIC CLEANING

This method of cleaning uses high frequency sound to remove contaminants from a surface immersed in water: dirt, oil, grease, ink, paint, glue, detaching agents... Materials which can be cleaned by ultrasound include metal, glass, ceramic and many others. Ultrasonic cleaning is **powerful** enough to remove the most tenacious contaminants, but **delicate** enough not to damage the underlying surface; it penetrates into the smallest cracks and between closely joined parts.

## ULTRASONIC CAVITATION

This physical process employs alternating positive and negative pressure waves in a water solution to generate microscopic bubbles which grow until they reach resonating dimensions. Just before a cavitation bubble implodes, it accumulates an enormous amount of energy in its interior, where the temperature may be very high, at a pressure of as much as 500 atm (fig. 1). When the bubble implodes next to a hard surface it is transformed in a jet of around one tenth of the size of the bubble itself, travelling as fast as 400 km/h towards the surface. The combination of pressure, temperature and speed breaks the bond between the contaminant and the surface being cleaned. Due to the very small size of the jet and its relative high energy, ultrasonic cleaning can get into even the smallest cracks and effectively remove any dirt inside them.

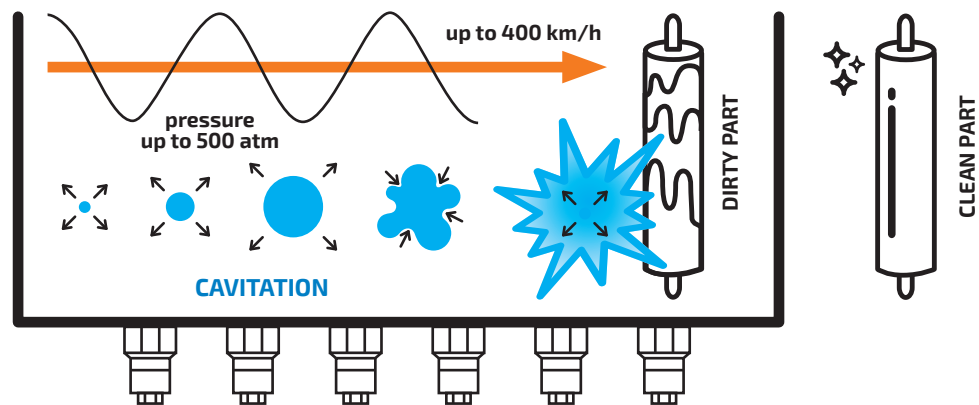
GENERATORS  
TiTAKO Digital Core®



40 HZ



FIG.1



TRANSDUCERS

## EQUIPMENT

The basic components of an ultrasonic cleaning system are the ultrasonic generator itself (1), a set of transducers (2) and a tank filled with a water solution (3).

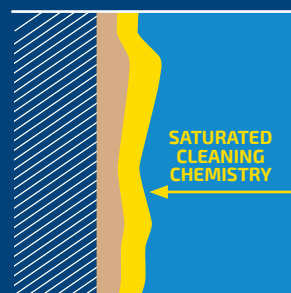
FIG.2



## DEEP, UNFAILING CLEANING

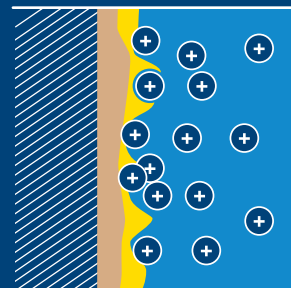
In most cases, cleaning a surface requires that the contaminant be dissolved, moved or both. The mechanical effect of ultrasonic energy both dissolves and moves the contaminating particles. To dissolve a contaminant, the detergent must come into contact with the surface being cleaned (fig. 2).

FIG.3



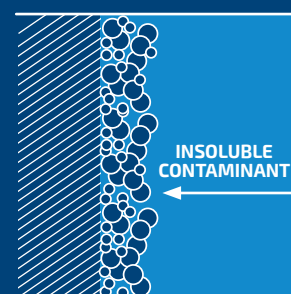
When the chemical detergent dissolves the contaminant, a saturated layer is created between the fresh detergent and the contaminant itself; this impedes the action of the detergent because the saturated chemical can no longer attack the contaminant (fig. 3).

FIG.4



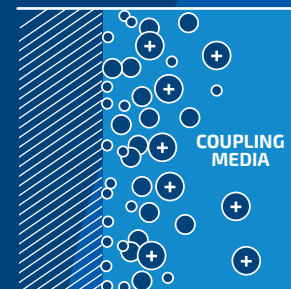
Ultrasonic cavitation and implosion effectively move the saturated layer to enable the fresh detergent to act on the contaminant yet to be removed (fig. 4).

FIG.5



However, some contaminants are composed of insoluble particles, which are held onto to the surface by ionic cohesive forces. Such particles must be displaced sufficiently to break the ionic bonds (fig. 5).

FIG.6



Ultrasonic cavitation and implosion remove non-adhering contaminant from the surface, such as dust. For this to be effective, the coupling fluid must be able to wet the particles being removed (fig. 6). Figure 6 shows how ultrasonic energy improves the cleaning action compared to its alternatives, including high pressure jets, brushing and blasting with sodium bicarbonate or sand.

Another characteristic of ultrasound is that it penetrates restricted spaces and cleans the interiors of complex parts.

## HOW ULTRASOUND IS GENERATED

To produce the positive and negative pressure waves in the water, a mechanical vibrating device is required. The ultrasound is produced by a diaphragm applied to high frequency transducers. An electronic generator makes the transducers vibrate at their resonant frequency, thus inducing an amplified vibration of the diaphragm which generates the pressure waves. The mechanism is very similar to that of a loud speaker, except that the frequencies involved are much higher.

When the pressure waves are transmitted through the water, they generate the cavitation process described above. The resonant frequency of the transducers determines the size and amount of the resonance bubbles: the higher the frequency, the smaller the cavitation bubbles; in contrast, lower frequencies generate larger bubbles.

A large bubble has more energy than a smaller one; this is the energy that is discharged against the surface when the bubble implodes. High frequencies generate many more bubbles per unit time, and thus distribute the cavitation better over the surface. For instance, in a 40 kHz system, the distance between the nodes and rings of the acoustic wave is double that generated by a 20 kHz system. It follows that, per unit time and area, 40 kHz systems generate many more bubbles, especially smaller ones, which can therefore reach into even the smallest cracks or restricted spaces.

## ULTRASONIC GENERATORS



IST uses ultrasonic generators manufactured by an Italian company, Unitech, one of the leaders in the manufacture of this type of equipment, which can also run 3D simulations to describe the propagation of the waves through the fluid. Our machines use the **TiTAKO Digital CORE®** model. These innovative, advanced generators were developed to control and maximise the effect of TiTAKO wave transducers and multi-frequency transducers; their high quality, reliability and precision satisfy the most challenging requirements for any application. The highly evolved control system uses the S.I.A. (Smart Impedance Analyzer) algorithm, which analyses the impedance in real time, thus ensuring the best working conditions even as the physical conditions of the system vary. TiTAKO Digital Core® features a unique, attractive and high functional design; the highly user-friendly interface uses a 4.3" TFT colour display and illuminated keypad, and allows the user to program and control all the generator's operating parameters with ease.

All the system's functions can be customised:

- Automatic Power-Timer-Signal Mode cycles
- Degas Mode
- Pulse cycle STEP MODE
- Sweep Mode
- Modbus Ethernet communications
- Datalogger
- Programmable working frequency
- Energy saving mode

One of the TiTAKO® system's main advantages is its extreme flexibility.

In the multiple plug and play versions, the powerful multitasking control system can control different frequencies even at the same time, thus equipping the system with an innovative multi-frequency functionality.

## THE TRANSDUCERS

Another key component is the transducer, which transforms the power of the generator into high frequency mechanical energy. The transducers are generally positioned, depending on the application, on the sides or bottom of the washing unit. This is a low cost solution, but it compromises the durability and efficiency of the system; they may be welded directly into the tank (fig. 7) or housed in waterproof casings (fig. 8) which are immersed into the water solution. IST has taken the latter approach, which assures simpler maintenance, no downtime for transducer replacement and high performance. Two types of ultrasonic transducers are used in industrial applications: piezoelectric and magnetostrictive.

### *Piezoelectric transducers*

These employ the piezoelectric effect, in which certain materials change size when an electric charge is applied to them; they thus convert an alternating current directly into mechanical energy. The ultrasonic electric charge is supplied to the transducers by an ultrasonic generator and applied to the piezoelectric elements they contain.

The vibrations generated by the piezoelectric elements are amplified by the transducer's resonating masses and directed into the fluid via a radiating plate. The transducers used by IST incorporate ceramic piezoelectric elements which are resistant, efficient and very stable, developed in the Forties by the United States Navy for advanced sonar transponders.

The piezoelectric transducers are composed of several components.

The ceramic crystal (usually lead zirconate) is inserted between two tin strips which, when charged, create a displacement in the crystal - the piezoelectric effect. When these transducers are mounted to a diaphragm (fig. 9), the displacement in the crystal moves the diaphragm, which thus transmits a pressure wave through the water solution in the tank.

### *Magnetostrictive transducers*

For a given voltage variation, piezoelectric transducers generate a greater displacement than magnetostrictive transducers, which are thus less efficient. Zero space magnetostrictive transducers are composed of laminations of nickel closely bound to an electric winding located above them. As the current flows through the winding it generates a magnetic field, analogous to the deformation of the piezoelectric crystal when charged.

When an alternating electric current flows through the winding, the stack of nickel laminations vibrates at the current's frequency.

FIG.7



FIG.8

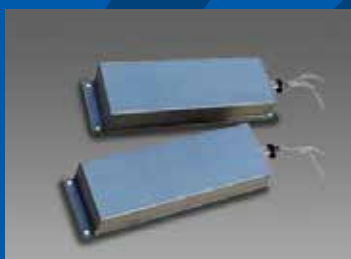


FIG.9



## THE DESIGN SYSTEM

The design of any cleaning system must account for at least the following factors:

- the type of contaminant
- the level of cleaning desired
- the geometry of the parts being cleaned and the material of which they are made
- the amount of surface being cleaned

Once the overall cleaning process has been chosen, the size of the system will depend on the geometry of the parts, the system's productivity, and the necessary cleaning time: heavy industrial applications require heavy duty industrial ultrasonic equipment. Other factors which must be taken into consideration include the cleaning solution and its temperature, rinsing (with or without ultrasound), drying, automation and loading requirements.

FEM (Finite Element Method) simulation enables us to see how the ultrasonic waves will propagate for a given type of bath and shape and size of part.

## THE WASHING UNIT

Not all ultrasonic tanks are equal. The principal difference between ultrasonic cleaning systems is the application for which they are to be used. If the application consists in occasionally cleaning low cost, non-critical parts, the best solution is a low cost ultrasonic cleaning system. If, on the other hand, the application involves production-critical systems, or cleaning must be done several times a day, every day, one must choose a reliable partner using high quality materials.

For instance, plastic fabricators must keep their injection moulds perfectly clean at all times to ensure high quality results; they therefore need a system which will always work perfectly, day after day. The same applies to a hospital, where the health of the patients depends on medical equipment being perfectly clean; or for a manufacturer of commercial jets, who must be sure he is installing properly cleaned electrical and mechanical components to avoid risking the lives of the passengers and crew.

IST systems have been proven to excel in such industrial applications because our cleaning tanks are fabricated to handle the challenges of an industrial workplace.

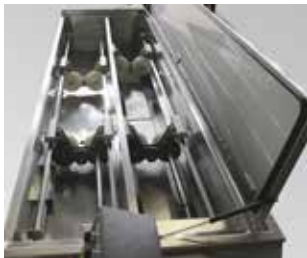
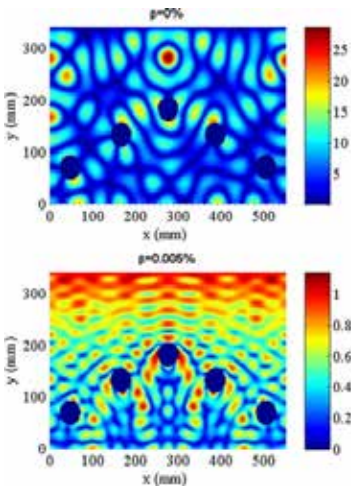
## CAVITATIONAL EROSION

This is the erosion of the steel surface of an ultrasonic washing unit.

Most of our competitors install the transducers directly onto the outer surface of the wall of the ultrasonic tank, which is too thin to resist the effects of cavitation erosion.

To make up for the resulting lack of power delivery, transducers mounted in this way are installed on a thin radiating diaphragm which flexes to transmit the vibration to the body of the washing unit. This vibration works the steel to the point of eroding it, creating microscopic cavities on its inside face. During the wash, the detergent penetrates into the cavities, thus increasing the erosion of the tank. A failure due to cavitation erosion of the tank thus becomes a very expensive failure of the entire system.

To prevent cavitation erosion and ensure a long life for the cleaning system, IST transducers are encased in waterproof 3 mm gauge AISI 316 L stainless steel housings (double the gauge of a standard tank, usually made of AISI 304 stainless steel).



## THE WASHING SOLUTION



The choice of an ultrasonic washing solution is as important as that of the machine's equipment and design. Chemical suppliers are developing products to satisfy the requirements of cleaning while also being compatible with occupational health and safety and environment requirements.

Whenever possible, it is best to use a **water based detergent**: this is an excellent, non-toxic, non-flammable and eco-friendly solvent. However, disposing of the wastewater may be difficult and costly. Furthermore, the high surface tension in solutions without detergents makes it complicated to clean hard to access areas. To reduce the surface tension and ensure the wetting required to break the bond between the contaminant and the surface, one can add detergents, in an amount appropriate to the level of contamination. A further advantage of water solutions is that they provide a higher cavitation energy than organic solvent baths.

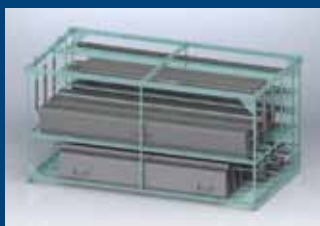
The **temperature** of the water solution has a profound effect on the effectiveness of ultrasonic cleaning: higher temperatures yield more intense cavitation and better cleaning.

Another important parameter is the vapour tension of the detergent solution, which does not depend on the amount of fluid but only on its temperature. Heating a fluid increases its **vapour tension**. Every fluid has its own vapour tension and boiling point. It is important to understand the concept of vapour tension, since it plays a key role in the cavitation process. The energy required to form a cavitation bubble is proportional to both the fluid's vapour tension and its surface tension. Cavitation is difficult when the fluid has a low vapour tension (when the water is cold); when it is high, on the other hand, the cavitation bubbles implode with more energy, although more power is required to achieve the cavitation threshold.

One should also not forget the role played by the **viscosity of the fluid**: a high viscosity impedes cavitation, whereas a low viscosity facilitates diffusion of the ultrasonic waves and the formation of bubbles.

Solvent based inks, water based inks and UV inks all have very different chemical compositions, as do oils and paints: it is therefore not possible to recommend a single wash solution. To identify the best cleaning system for your needs, you must review every aspect of the application with your technicians.

## PART HANDLING



The geometry of the parts being cleaned must be carefully analysed to determine how to position them in the tank.

Analysis of the parts and of the company's in-house logistics are essential to offering a safe and reliable solution for part handling throughout all processes.

IST offers a variety of customisable part trolleys which facilitate the work of collecting, loading and unloading the parts.



Installation area  
**NON HAZARDOUS**

Typical application  
**Blades / Inkwells /  
Flexo and roto machine  
parts / Ink recirculation  
tanks / Cans and  
buckets / Carter /  
Various equipment**



1400 ÷ 3200 x  
800 x 800 mm



Easy to use



Low maintenance



Water resistant  
transducers



Eco cleaners

# VU

## NEXT LEVEL CLEANING

**Deep cleaning for more complicated geometries** and high power delivery to **large volumes** (up to 2 m<sup>3</sup>) are the strengths of this series, with its ability to deep clean large amount of parts of any type. They feature **2 to 5 high performance generators** which operate synchronously to maximise efficiency; the control units are independent, for more personalised control.

Once the basket is loaded, the operator simply starts the cycle and the machine automatically immerses the basket in the bath. Once the cover is sealed, fixed to the lift, the ultrasonic generators are started and the cavitation wash cycle starts. An optional accessory moves the basket up and down during the wash, to better detach the contaminant from the parts. When the wash time has expired, the basket is made available for unloading onto the trolley and machine is ready for a new wash cycle. Thanks to the numerous personalisable wash cycles, there is always an optimal cycle available to ensure perfect results every time.

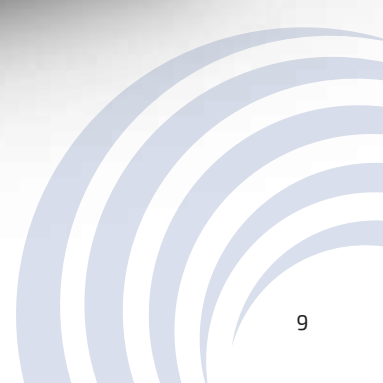
Our laboratories will run the tests required to identify the **right detergent and dilution**, as well as to quantify the running costs of the technology.

Model	L (mm)	W (mm)	H (mm)
VU 140 S	1400	800	800
VU 180 S	1800	800	800
VU 260 S	2600	800	800
VU 320 S	3200	800	800

### THE BENEFITS OF THE VU SERIES

- high capacity: up to 2 m<sup>3</sup> of available volume
- from 2 to 5 high performance generators with independent control units
- personalisable wash cycles
- intelligent wash fluid management with integrated filter
- ergonomic part loading trolley for easy part collection and loading





# LRC - LRC4

## THE DIFFERENCE BETWEEN WASHING AND CLEANING

Installation area  
**NON HAZARDOUS**

Typical application  
**Rotogravure cylinders /  
Anilox sleeves /  
Anilox rollers /  
Engraved sleeves**



Specific detergents



1500 / 3900 mm



Touch Screen  
e PLC



Short cycles



Micro cleaning

To formulate the correct tone of ink, one must know the actual condition of the anilox rolls throughout their service life; cleaning them properly is critical to efficient ink transfer, coverage, density and conformity of the colour, and the resulting print quality in general. LRC series machines regenerate **the anilox rolls**, restoring colour to your prints and reducing your ink consumption.

Various sizes (up to 3,900 mm available clearance) and the capacity to **wash 1 or 4 rollers at a time** make this series one of the most highly appreciated by professional printers. The ink deposited during printing is removed from the millions of cells easily and safely thanks to the combined action of ultrasonic cavitation and the wash detergent. The high frequency of the treatment generates **microscopic bubbles**, which penetrate easily into even the deepest cavities without damaging their walls.

These machines are **designed to facilitate everyday professional printshop operations** and can be equipped with numerous tools such as hermetic anilox sleeve closures, or a rinse gun and drying gun.

The work area is divided into two independent parts: one dedicated to ultrasonic washing with the chemical bath, and the other for rinsing or preparing the rolls before and after the wash. The operator need only place the roll on the rotary mounts in the wash area, close the cover and start the cycle.

The machine then starts the roll rotating and initiates ultrasonic cavitation.

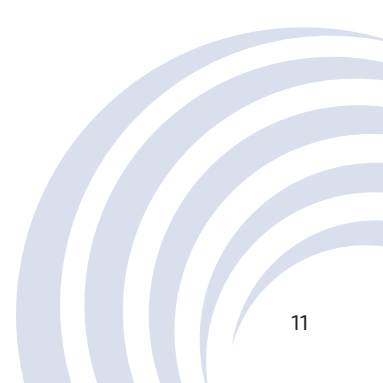
The machine can also be adapted for cleaning **laser engraved elastomer sleeves**, or specialised for cleaning **the shoulders of rotogravure rolls**, where ink builds up more easily.

Model	L (mm)	Ø (mm)
LRC 20 / LRC 20 PLUS*	1900 - 1500	210 - (320*)
LRC 25 / LRC 20 PLUS*	2400 - 1800	210 - (320*)
LRC 30 / LRC 20 PLUS*	2900 - 2200	210 - (320*)
LRC 35 / LRC 20 PLUS*	3400 - 2700	210 - (320*)
LRC 40 / LRC 20 PLUS*	3900 - 3200	210 - (320*)
LRC 20-4	4 X 1900	210

## THE BENEFITS OF THE LRC SERIES

- high capacity: up to 3,900 mm available clearance
- cleans from 2 to 6 rolls at a time, depending on size
- work area is divided into two independent parts
- can be adapted for cleaning laser engraved elastomer sleeves
- can be adapted for cleaning the shoulders of rotogravure rolls





# LA NW - LP

## ULTRASONIC CLEANING FOR ALL

Installation area  
**NON HAZARDOUS**

Typical application  
**Blades / Inkwells /  
Rotogravure cylinders /  
Anilox sleeves /  
Anilox rollers/  
Engraved sleeves /  
Various equipment**



Eco cleaners



900 ÷ 2000 x  
800 x 800 mm



Easy to use



Low maintenance



Water resistant  
transducers

This product range is designed to satisfy the growing demand for **high technology equipment at an affordable price**. The LA NW series is dedicated to washing anilox rolls for label printing, while the LP series is designed for **part washing**.

They are modular units which, with their enormous versatility and wide range of accessories, can be configured for innumerable industrial applications.

The LA NW machines can clean **from 2 to 6 rolls at a time**, depending on size. A pneumatic lift (optional for the LP series) makes placing the parts into the machine and lowering them into the bath effortless. If particularly aggressive fluids are used, a vapour extraction system can be installed around the perimeter of the machine.

All models have a handy service tank with accessories for pre-washing and rinsing the parts. The work cycle is controlled by a user-friendly interface with timer and thermostat which includes operator safety equipment and diagnostics for the installed equipment.

Model	L (mm)	P (mm)	H (mm)
LP 10 / LP 10 PLUS*	900 / 900*	280/380*	250/380*
LP 15 / LP 15 PLUS*	1400 / 1400*	280/380*	250/380*
LP 20 / LP 20 PLUS*	1900 / 1900*	280/380*	250/380*
LP 15 S PLUS / *	1600 / 1600*	300/300*	350/550*
LP 20 S PLUS / *	2100 / 2100*	300/300*	350/550*

### THE BENEFITS OF THE LA NW – LP SERIES

- versatility: modular construction and a wide range of accessories for innumerable applications
- cleans from 2 to 6 rolls at a time, depending on size
- pneumatic lift (optional for the LP series)
- vapour extraction system around the perimeter of the machine (optional)
- user-friendly control interface
- handy adjacent service tank







## CERTIFICATIONS SAFETY FIRST

Safety is a critical factor in the choice of a distillation solution. IST has a long, well established experience in flammable liquid treatment. Combining the benefits of the Made in Italy brand with the use of cutting technologies, our products conform to all EU legal requirements and those of many other countries.

Since 1997 our processes have been controlled by a certified Quality System, currently pursuant to UNI EN ISO 9001:2015.



### DISCLAIMER

This publication is a general guide: the photographs, illustrations and technical data may refer to models still being designed and may therefore differ from products already in production. IST reserves the right to modify its product specifications and information at any time without advance notification; it is the responsibility of the reader of this document to obtain the correct information at any given time.

Technical data, especially relating to productivity, refer to generic applications.

Actual productivity data may vary in practice, either positively or negatively.

The distillation rate depends on the type and composition of the solvent, the type and amount of contaminant, the heating temperature, vacuum pressure, coolant temperature and pressure and the machine's operating conditions.

## AFTER-SALES SERVICE

### **ASSISTANCE IN THE FIELD AND REMOTE ASSISTANCE**

The service life of equipment is a decisive factor in the production efficiency of any plant. Defects and malfunctions must be identified and corrected as promptly as possible. You need not always wait for one of our technicians to arrive at your premises; in many cases, you can contact our technical assistance team by phone or email, at no charge and for an immediate response.

### **Preventive maintenance**

IST after-sales service offers preventive maintenance contracts which include the inspections required to keep your equipment in good working order.



**General information  
and spare parts**

[info@ist.it](mailto:info@ist.it)



**After-sales service and  
technical assistance**

[service@ist.it](mailto:service@ist.it)

IMPORTANT! Take special care when distilling the nitrocellulose contained in printing solvents and inks.

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