DL 500 Conveyorized Etching and Developing Machine

Translation of the original instructions

Content

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General

The DL 500 is a double sided conveyorised spray etching machine with integrated rinsing zone. This machine is easy to maintain and fits perfectly to a modern PCB laboratory. The maximum capacity within one hour is 10 m². Designed for being used for laboratory purposes, there are lots of different applications (e.g. spray developing of tenting or solder mask) and options available. Of course the machine can be modified according to your needs.

Features

- Working width 510 mm
- Stepless adjustable conveyor speed 0 - 1.5 m/min.
- Joint free belt drive
- PCB is firmly secured during etch process by upper and lower transport rollers
- Powerful etchant pump (200 l/min)
- Double sided etching with 4 x 14 flat jet nozzles. Due to special nozzle pattern, there are 6 rows of nozzles for each side !!
- Adjustable spray pressure. Upper and lower spray pressure can be regulated separately
- Thermostat with digital read out and self-safe overheat cut-off
- Integrated rinse zone. Optional fresh water rinse with solenoid valve or recycle water tank
- Drying by squeezing rollers with tissue
- Sturdy stand alone construction from PVC and Titanium
- Transparent top with security switch
- Line definition down to 35 µm lines and spaces on 18 µm copper
- 1000W quartz heater
- Maintenance free design, just normal cleaning/refill
- Easy dis-assembly and full access to all inner parts without special tools
- suitable for all regular etching agents. We recommend to use ferric-chloride. Please pay attention to the special features of each etchant (crystallization of per-sulfates and ammonium, exothermic reactions while etching). For alkaline etching, machine must be modified.

Variants:

- **Variant # 1 Spray Developing Machine**
- The DL 500 can be used as a spray developing machine for negative and positive etch resist or solder mask without modifications. Simply change the media!
- **Variant # 2 Spray Etching Machine**

  standard variant

- **Variant # 3 : Spray Stripping Machine**
- This machine is equipped with an additional filter basket at the front side of the machine to remove residues of tenting or solder mask from the stripping liquid.

Options:

Option # 1: Recycled Rinsing Tank

recycled rinsing tank with magnetic centrifugal pump instead of fresh water. Saves water costs. With a cock drain valve the used rinsing water can be used to compensate evaporation losses or to make up new etching liquid. Waste water free rinsing technique. The magnetic valve from the standard version is here obsolete. The tank fits underneath the machine body of DL 500. Format: 200x600x700 mm (BxHxT).

Option # 2: Conveyorised Rinsing Unit

a) conveyorised rinsing unit, stand alone version with adjustable conveyor speed, integrated magnetic valve for fresh water inlet (controlled by DL 500), squeeze drying roller. Transport width and height same as DL 500. Format: 450 x 940 x 620 mm (BxHxT)

b) as above but second stage cascade rinse (in combination with recycled rinse tank and magnetic centrifugal pump), 3 way cock valve to bypass rinsing water e.g. to water treatment unit IONEX. Format: 450 x 940 x 620 mm (BxHxT)

Option # 3: Inspection Table

Control zone in form of a roller table (not conveyorised). This roller table can be mounted between two DL 500 (e.g. Developer and Etcher), between DL 500 and rinsing unit or as a single exit table. Format ca. 620x530x50 mm (BxHxT)

Option # 4: Production Line

3 DL 500 and the rinsing unit can be connected to a small production line (Developing – Etching – Stripping - Cleaning) coupled together with inspection tables. Of course other variants are possible as well.

Option # 5 DL 500 Vario with separately adjustable spray pressure for bottom and top side.
For physical reasons the etching result on the bottom is better than on the top. For this reason, may be useful to adapt the spray pressure. Unlike many competitors, the board in the etch chamber is securely fixed by upper and lower transport rollers so that the spray pressure for the top can be completely turned off without the board stands by the lower spray pressure. This Version is standard since 2015!

Option # 6: Cooler

Some etching agents as well as other chemicals tend to exothermic reactions and need to be cooled during the treatment process. For this purpose we offer a special cooler for the DL 500. The Cooler consists of a recycling rinsing tank with cooling coils for the etching liquid. With a cock valve the etching agent is adjustable bypassed through the cooler.

Option #8: Filter unit

On request you can equip your DL 500 with one or two 10 " filter units to remove residues from the etching process. You can easily adjust the filter throughput via cock valve. On the picture you can see a filter unit together with an exit table.

Technical Data

Electrical connection:	220 V~, 50 Hz, ca. 1.5 kW
Dimensions	1200 x 670 x 1290 mm (LxWxH)
Max Board Size:	510 mm x endless
Min. Board Size:	100 x 160 mm
Fill Quantity:	ca. 55 l Etching Agent
Weight:	ca. 100 kg
Material:	PVC, PP, Titan
Conveyor speed:	Stepless adjustable 0 - 1.5 m/min
Pump:	Centrifugal pump delivery rate ca. 200 l/min, spray pressure stepless adjustable by valve
Heating:	1000W Quarz glow bar
Speed of Etching:	ca. 35µm in 90 s
Water connections:	Inlet: ¾ inch thread Outlet: Spout D30 (Closed Loop Rinsing Unit recommended)

Technical changes reserved.

EG-Declaration of Conformity

CE **EG-Konformitätserklärung/Declaration of Conformity**

Hersteller / Supplier:	Bungard Elektronik GmbH & Co. KG Rilkestraße 1 51570 Windeck Germany
Bevollmächtigte Person für die Zusammenstellung der technischen Unterlagen: Person in charge	Jürgen Bungard, Geschäftsführer /general director Rilkestraße 1 51570 Windeck Germany
Produkt:	Durchlaufätz- und -entwickleranlage DL500

Hiermit erklären wir, dass die oben beschriebenen Maschinen allen einschlägigen Bestimmungen der Maschinenrichtlinie 2006/42/EG entspricht.

Die oben genannte Maschine erfüllt die Anforderungen der nachfolgend genannten Richtlinien und Normen:

We hereby declare that the machines described above complies with all relevant provisions of the Machinery Directive 2006/42/EC.

The above machine meets the requirements of the following guidelines and standards:

- **Maschinenrichtlinie 2006/42/EG / Machinery Directive 2006/42/EC**
- **EMV-Richtlinie 2014/30/EG / EMC Directive 2014/10830EC**
- **Niederspannungsrichtlinie 2014/35/EG / Low Voltage Directive 2014/35/EC**

- **DIN EN 60204-1** Sicherheit von Maschinen - Elektrische Ausrüstung von Maschinen - Teil 1: Allgemeine Anforderungen / Safety of machinery - Electrical equipment of machines - Part 1: General requirements

- **DIN EN ISO 14121-1** Sicherheit von Maschinen - Risikobeurteilung - Teil 1: Leitsätze / Safety of machinery - Risk assessment - Part 1: Principles
- **DIN EN ISO 12100-1** Sicherheit von Maschinen - Allgemeine Gestaltungsleitsätze, Risikobeurteilung und Risikominderung / Safety of machinery - Basic concepts, risk assessment and risk reduction
- **DIN EN 55014-1 2012-05** Elektromagnetische Verträglichkeit, Anforderungen an Haushaltsgeräte, Elektrowerkzeuge und ähnliche Elektrogeräte, Teil 1: Störaussendung / Electromagnetic compatibility Requirements for household appliances, electric tools and similar electrical appliances Part 1: Emission
- **DIN EN 55014-2-2009-06** Elektromagnetische Verträglichkeit - Anforderungen an Haushaltgeräte, Elektrowerkzeuge und ähnliche Geräte - Teil 2: Störfestigkeit - / Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 2: Immunity
- **Niederspannungsrichtlinie / Low Voltage Directive 2014/35/EG**
- **Maschinenrichtlinie / Machinery Directive 2006/42/EG/37/EG**

Windeck, 10.1.2021

Jürgen Bungard Geschäftsführer

Intended Use of Machine

Aqueous-alkaline or acid etching of printed circuit boards or plates.

Developing of positive or negative-working, aqueous-alkaline processable photoresists or laminates (add defoamers if needed).

Alkaline resist stripping (additional filtration unit required).

All other applications require our written consent, or are performed completely on the operator's own risk.

Safety instructions

General

Please read the following instructions carefully and pay particular attention to information on operating safety and set up.

Keep these instructions at a safe place. It contains information which also refer for later maintenance and cleaning.

The machines are intended for chemical-physical treatment of printed circuit boards.

The machines are not designed to be embedded or interconnected with other machines or systems. They may only be used in specially equipped rooms and be operated only by qualified staff. Children and pets are to be kept away!

Transport

Only use suitable lifting and transport equipment such as forklifts or pallet lifts. Secure the machine against sliding / tilting.

Place of installation

The machine must be standing level and around the machine there has to be sufficient space for operation and maintenance work (approx 1m on all sides). To prevent the penetration of chemicals into the ground, set up the machine either in a room with solid, waterproof and chemical resistant floor (no tiles nor concrete!) or in a chemical resistant waterproof collection tray which can take the whole filling volume (safety tray available as an option).

Electricity

The machine is made from certified parts according to standard practice for electrical safety. This does not relieve the user of his duty of care when handling electrically powered devices.

The I/O-labelled red main switch disconnects the machine from the power supply. We presuppose that the safety fuses of the circuit and the residual current circuit are provided by the building's power supply.

After completion of the work, the main switch should always be turned off.

Before all maintenance work on the machine (filling, emptying, cleaning, etc.) turn off machine and pull the plug.

The chemicals used in the machines often have a high electrical conductivity. Any contact of the liquid with live parts therefore constitutes a serious threat to electrical safety. In such a case, the machine must be immediately disconnected from the mains and the defect must be eliminated immediately and professionally. This applies correspondingly with leaked or spilled etchant.

Water connection

After work or prolonged interruption close the cock valve of the building water supply to prevent water damage from a possible leak in the hose.

Personal protection equipment

When handling corrosive chemicals make sure to wear protective clothing, gloves and face protection. Observe the safety instructions of the manufacturer or the supplier.

Temperature

Switch on machine only when tanks are filled! The quartz glow bar must be always sufficiently covered with etching agent! **Uncovered glow bar may cause destruction of machine!** Fill the etching chamber up to 1 cm under the cover of the medium container.

The electronic thermostat is protected against breakage and short circuit of the cable to the thermal sensor. This does not relieve the operator from the obligation, to monitor the temperature of the liquid. Exothermic chemical reactions may under certain circumstances, which we cannot influence, cause overheating of the etchant. The maximum operating temperature of the machine is 45 °C.

If the etchant is prepared by dissolving salts or mixing liquids, do that in any event outside of the machine! Observe the safety instructions of the chemical supplier.

If you want to use liquids which may react exothermic, take additional measures to prevent overheating. If, despite all precautions, overheating of the etchant occurs, the heater must be switched off first. The pump however must remain switched on, so that the etchant is cooled by the circulation.

Before draining the tanks, let the heater cool down for approx. 10 min, so the heaters will not get damaged.

Working safety

The machine has a lid safety switch which stops the pump circuit when opening the cover. Please check the function regularly of the position switch.

There is a ball valve at the bypass of the tubing leading upward. Opening this ball valve while the etching pump is on will lead to exit of etchant. This is an unavoidable danger in case of any improper or unattended operations at the back of the machine. The you may encounter by the closing the ball valve, pull off the handle and store the handle separately.

Exhaust air

We recommend to install an exhaust above the machine for eventual etching steams. This recommendation is however purely precautionary. Leakage of aggressive steams could not be proven in two independent investigations (water vapour escapes, the salts of the etching agent remain in the solution).

The machine possesses at the back of the rinsing compartment a pipe socket, which can be connected to the exhaust air system of the building. The ventilating outlet is consciously not arranged at the etching zone, in order to prevent that except steams also liquid etching agent can arrive into the exhaust air system.

Environmental protection

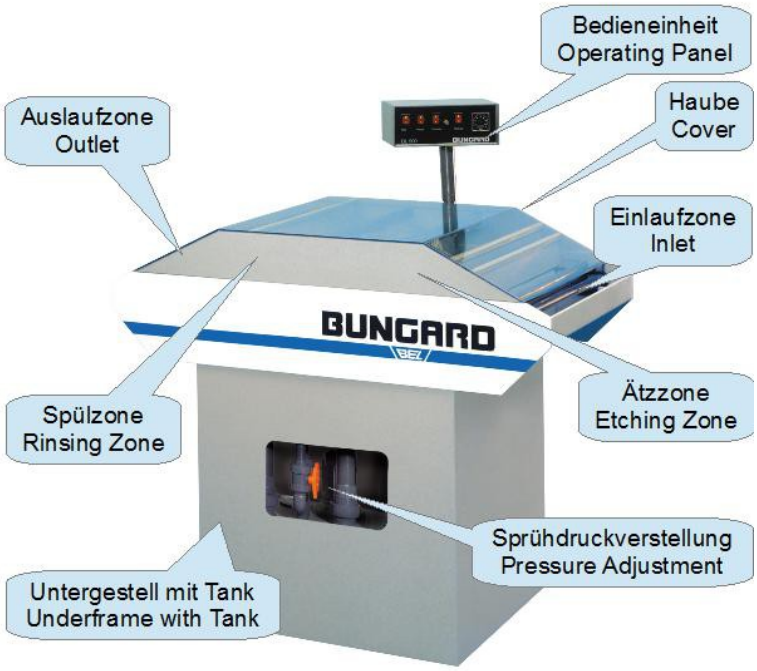
Dispose used etchant according to your local regulations. Pay heed to the material safety data sheet (MSDS) of your chemicals.

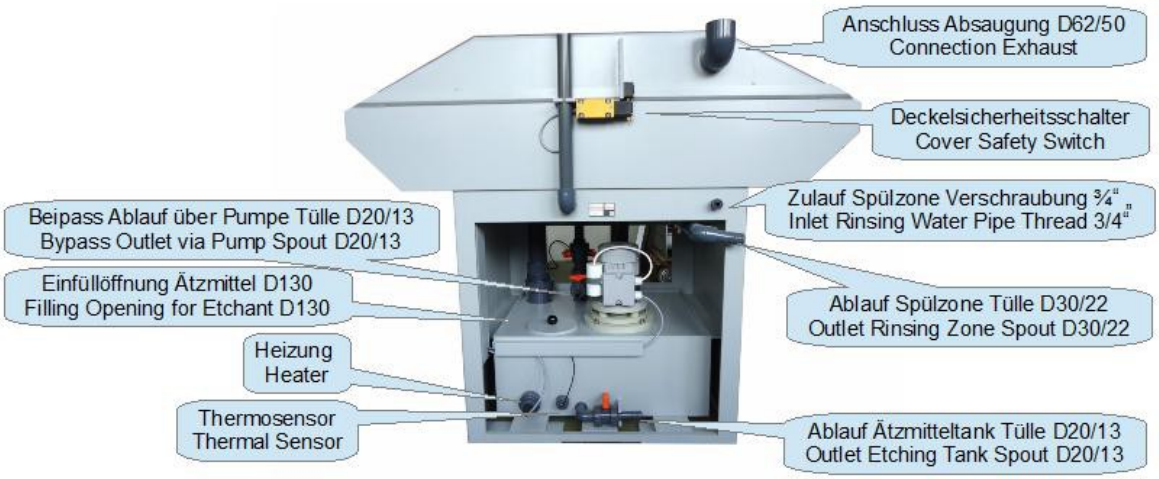
Rinsing water

The legislation generally prohibits to exceed certain maximum concentrations and quantities of copper (and other heavy metals) in the waste water (usually 0.5 mg copper / liter of water). After etching the boards should not be rinsed under running water and do not dispose used rinsing water into the sewer! Operate the rinsing water only either in a closed loop rinse or treat the rinse water with a ion

exchanger. If you do not have an in-house water treatment for the rinse water, we recommend our waste water treatment plant IONEX or AquaPur for this task.
We recommend to use the water in the closed loop rinsing zone(s) as long as possible.
Collect used rinsing water and reuse for set up new etchant. Dispose the surplus together with the used etchant. Neutralization of the rinsing water or even the etchant can and should be left to a specialist!

Composition





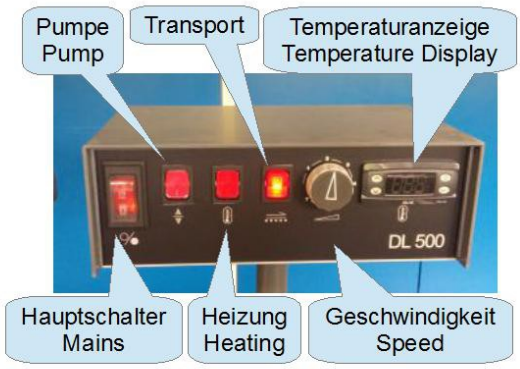
The machine body is made from PVC. It is divided into infeed-, etching-, rinsing- and outfeed-zone. The removable media tank is located in the pedestal of the machine.

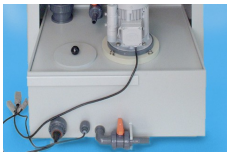
The cover is made from grey and transparent PVC. It carries housings to fix the removable partition walls.

The media tank is easy to access and can be entirely removed from the machine. The top cover of the tank carries the pump. This is a submersion centrifugal pump which propels with highpressure the etching medium to the 4 manifolds, each of them equipped with 14 flat spray nozzles. The liquid returns to the tank via 2 PVC drain pipes of big diameter. The tank carries a 1000 W heater element and the temperature sensor.

The conveyor system is made from 13 pairs of PVC covered rollers and of one infeed and outfeed roller at each end of the machine. The squeegee rollers are covered with a sponge cloth each. Using an endless belt, the rollers are directly coupled to a gear motor.

The water access to the rinsing compartment is controlled by both a magnetic and a manual operated valve. The magnetic valve opens only when the etching pump is operating. A circuit rinse or a downstream rinsing water treatment are as an option available.





The control unit is mounted on top of the machine. To permit easy access from each side of the machine, it can be turned into almost any position. The front panel carries illuminated switches for the main supply, pump, conveyor and heating circuits as well as a potentiometer for conveyor speed adjustment and the digital-reed-out thermostat.

Setup

Take over from the transport agent

After receiving and unpacking, check the machine for possible transport damages. In case of transport damage, please inform your insurance, the transport company and the manufacturer / supplier.

Transport to the place of installation

Only use suitable lifting and transport equipment such as forklifts or pallet lifts. Secure the machine against sliding / tilting.

The machine is fixed to the transport container or to the palette by plastic tapes. Remove all packing material and tapes from the cover, the control unit and the medium tank.

To avoid damage, do not move the machine on the ground. With the help of at least one other person, carry it to the desired location. The best possibility to handle the machine is to hold it at the left and right side walls on each end.

Place of installation

The location must fit the labour protection requirements for etching machines, i. e. ventilation, sealed floor etc. It must further offer power and water installation close-by.

The place must be straight and even. It must carry the entire bottom of the machine (no palettes!). With respect to an easy feeding and a good access also to the back side of the machine, there should be a free area of about 2m x 2m.

Connections

Connect the overflow of freshwater rinse (PVC Spout D30/22) with your rinse water treatment. Make a connection to the fresh water inlet (Thread 3/4”). If you use a closed-loop rinsing tank, connect this tank as well. If there: Connect the exhaust tube (D62/50) to your room ventilation.

Control

Before connecting the machine to the power supply, please check:

The conveyor belt must run parallel to the side walls of the machine. All upper rollers must lay close on the lower ones.

If the cover has been taken off the machine, the intermediate walls and the cover must be remounted. Take care to mount the cover in a way that it sits well all on the machine body and that the security switch is closed.

Check if all fittings are well attached and if all appropriate valves are closed. If necessary, tighten the fittings manually.

With respect to the built-in stoppers, move the control unit to the desired position.

Electrical connection

Switch off all the switches on the front panel. Turn the adjustment knobs of the conveyor belt and the thermostat to zero position. Connect the power plug to a splash water-protected wall socket. The machine's power consumption (with the heater running) is about 1.9 kW on 220 V, 50 Hz. We assume that an appropriate fuse has been installed to the in-house power circuit.

Now turn on the main switch. It will be lit.

First Filling

As a check for tightness and function you should operate the machine first only with water. After successful test run the water is replaced by etching agents. If the medium container was demounted for transport, put it back into its position, bolt the connections of the two gutter-pipes and the tubing and connect the plug contacts for thermostat, heating staff and engine (plug are permutation implemented). You can give the water through the opening in the cover (filling height is approx. 1 cm under cover of the medium container).

Test Run

Referring to the description in chapter Operating, check the function of **conveyor heater pump rinse.**

Pay special attention to the following topics:

Conveyor

The belt and the rollers must move in a steady and uniform way. At position 1 on the scale, the conveyor must just transport a board through the machine.

Pump

When running the pump, have a close look on the fittings and the cover. No leaking should be obvious.

There are two ball valves in the mounting tubes fed by the pump. These valves can be used to reduce spray pressure, if necessary. A very low pressure also permits to see if all nozzles are operating and spray in the right direction. See chapter **Cleaning and Maintenance** for details on how to adjust the manifolds.

Heater

In the first test run, it is not necessary to wait for the water to heat up completely. The thermostat is adjusted during the final inspection at the factory. It is therefore sufficient to check the control behavior at any temperature setting by adjusting the set value just above or below the displayed actual value and control if the LED turns on (machine is heating) or turns off (heater is switched off). You can change the set temperature by pressing SET tow times at the thermostat display and then adjust Set-temperature with the arrow buttons. Press again SET -. the display shows the word "set" and will return after a few seconds to the actual temperature).

If you open the cover of the hand hole of the medium container the Quartz heater visible. In the heating phase, the switch will light up at the control panel and the heating element takes a orange-red color.

Rinse compartment

Check if there is sufficient, but not too much water. Pressure is good if the lower jets almost reach the cover. See if the descent to the drain is sufficient. If not, the water floods the rinsing compartment and exits into the etching zone. Adjustment of the water inlet is described in chapter **Cleaning and Maintenance**.

Discharging

Empty now the machine completely and pull the power supply plug. In order to replace the filled in water by etching agents, empty the medium container:

Fasten a short piece of hose to the ball valve of the medium container, the other end of the hose should end in a plastic bucket. Open the ball valve and let the air escape from the hose. Hold the filled hose then into the bucket. With this `principle of the communicating tubes you can empty the medium container so far, that you can move the container from its position without spilling and then empty it completely. Do not forget to loosen the fittings and the electrical connections before moving.

There is a ball valve at the bypass of the tubing leading upward. Opening this ball valve while the etching pump is on will lead to exit of etchant. This is an unavoidable danger in case of any improper or unattended operations at the back of the machine. The you may encounter by the closing the ball valve, pull off the handle and store the handle separately.

Alternatively: emptying the machine via the etching pump: The ascending tubes in which the etchant is transported under pressure to the nozzle manifolds, has a bypass with a ball valve. At the spout of this ball valve you can put on a piece of hose. The other end of the hose must end in an appropriate bucket. Turn on the pump and carefully open the ball valve of the bypass. The water will be drained into the bucket. This way you can empty the medium container down to 1/3 of the content. The remaining ater you can drain via the ball valve at the bottom of the container.

The ball valve has a screw connection to the ascending tubes. Before starting the pump check this screw connection on tightness and retighten if necessary by hand.

Fill with etching agent

The machine can be filled alternatively through the hand hole of the medium container or after removing the hood, from above via the etching zone (in that case do not forget to firmly close the tube fittings). Make sure before filling that the drain cock of the medium container is closed. This is the case, if the handle stands perpendicularly to the sleeve. The correct filling level is about 1 cm under the cover of the medium container with the pump switched off. A too small amount of filling can lead to damages and must be avoided. After some operation refilling of etching agent can be necessary by the hand hole in the cover of the medium container. After you filled in the finished and cooled down etching agent and the possibly dismounted parts are reassembled the machine is ready for use.

Trouble

If there were problems coming up during this first test, which are not described in this manual, please contact us immediately.

Operating

Control Panel

All electric functions of the DL 500 are controlled from the front panel of this unit (compare **Composition**). From the left to the right, there are: The switches for the main supply, for the pump motor, the heater and the conveyor. Next is the button for speed control of the conveyor. All to the right, there is the thermostat unit.

The main switch turns off all other switches and circuits. This permits an instant stop

Etching circuit

The second switch from the left being turned on and the cover being closed, the etching pump will start. It propels the liquid to the nozzle-equipped manifolds. The flow capacity and the pressure can be set manually by a valve located in the liquid mounting pipe. The liquid returns to the tank via two fitting connected PVC pipes.

The tank capacity is about 55 litres. The correct filling level is about 1 cm below the tank cover plate. A too little filling level will cause the pump to suck air, which can be heard as a specific sound.

If the filling level should be lower than the pump inlet level, the heater element could run free. This would most certainly lead to a damage to the machine. It is though necessary to control the level periodically. To fill up, switch the pump off and add water or etching medium until the liquid level is 1 cm below the tank cover.

Conveyor

The boards to be etched are inserted into the machine at it's right end, seen from the front. Boards are put onto the first roller and carefully moved forward until they are attached by the next roller pair. It may be necessary to support very long boards manually until they have completely entered the machine.

If you did not install a trap table at the machine's left end, you must take off the etched boards from the machine manually. Otherwise they might fall down and get damaged. We offer inlet and outlet tables as an option.

Speed can be varied using the button right to the conveyor switch. At a reading of 1 on the button scale, the conveyor will run at it's minimum speed. Actual speed setting depends on temperature, saturation and type of the etching medium as well as on copper thickness and spray pressure. For fresh warm ferric chloride at about 45°C, a speed setting of about 3 will do.

It might be a good idea to keep a once found setting for 35µm also if boards with 70µm copper are etched: Just have the board pass the machine twice.

The speed adjustment is at it's optimum if there are only very few rests of copper remaining on the board at the moment that it reaches the last roller pair in the etching compartment. A board which was incompletely etched may be processed again at a high speed setting. A too little speed will cause severe undercut.

Heater

Important: The heater circuit may only be activated with the tank filled!

The control switch being lit, the heater circuit is enabled. The switch relates to the thermostat located on the right. The thermostat first makes a self test and after some seconds the present temperature of the etching liquid is shown.

The temperature of the thermostat is preset to 45°C. You should only changes this value, if your etching liquid **compellingly** requires another temperature. You can change the value by pressing 2 times the **SET**-key. With the arrow-keys you can move up or down to the desired temperature. Press **SET** again. On the display appears the word “Set” and above the display the orange “OUT”-LED goes on. After some seconds the present temperature of the liquid is shown again.

Cooler

The temperature setting depends on the type of etching medium to be used. For ferric chloride we suggest to set temperature to 45 °and for sodium persulfate to 40°C. For copper chloride or sulfate based media, 30°C are recommended. Ask your chemistry dealer for details.

Although the thermostat range is up to 60°C, a temperature setting of more than 50°C is not permitted. Please note that certain etching media produce heat when used. In this case, the temperature setting must be reduced in advance. Do not feed the machine with boards until it has cooled down. We supply a cooling tank as an option.

Closed-Loop rinsing Unit

Rinse

The rinse compartment can either be used with fresh water or, with an optional tank and pump, as a closed loop rinse.

If you use the DL500 with fresh water rinse, you need to connect the machine with a pressure resistant hose to the wall-mounted valve. In addition, the flow capacity can be manually set by a valve located below the rinsing compartment. Set the ball valve approx. to ¾ open and then open the cock valve so much, that the spray of the lower manifold just reaches the height of the upper manifold.

Attention: A too high flow rate might cause the water to mount in the compartment instead of passing into the drain!

When the etching pump has stopped, the magnetic valve also interrupts the rinse. When you have finished work, hclose the wall-mounted valve to prevent excessive stress to the hose.

If the optional closed-loop rinse system is installed, the valve below the rinse compartment should always be fully opened. See amendment for the closed loop rinse and remarks in chapter **Waste Water**.

Ball Valve for the rinsing zone

Cleaning and Maintenance

The machine requires almost no maintenance. The main service labour is the periodical exchange of the etching medium and a thorough cleaning of the machine. When doing such service, you may easily check the conveyor system for wear or use.

Detailed information as for changing the **tooth belt**, the adjustment of the nozzle and the **diassembly of the pump**, refer to the corresponding **disassembly instructions**. This is available from us on request.

Cleaning

Except for the transparent cover, all PVC parts of the machine can be cleaned using liquid abrasive products known from the household. If ferric chloride was used with the machine, we recommend to use our special stain remover RX3. A thorough rinsing of the appropriate parts is necessary after each cleaning process.

To clean the tank, remove it from the pedestal, as described above. To have better access, you may remove the heater element by unscrewing it's fitting. If you use flowing water, be careful not to moisten electric parts. Remember your anti-pollution responsibility! The nozzles can be removed from the manifolds for cleaning. Just rinse them and blow them out with compressed air. The sponge cloths on the squeegee rollers must be treated carefully. Just wash them without rubbing them. You can wring them by rolling them on a piece of carton. Damaged sponge cloths should be replaced by new ones. You may have such spare cloths together with a special adhesive from us. The sifter of the suction zone of the motor can be mechanically cleaned when mounted.

Cleaning of the machine in use of FeCl3:

Equipment:

Apron, eye protector, (Latex) gloves, 2 plastic scrapers, 2 plastic sponges, 2 buckets, paper cleaning cloths, plastic foil, container from plastic for used etching agent

Chemicals:

Hydrochloric acid HCl technically, concentration approx. 15%, quantity approx.: DL500 55l, stain remover RX3

Proceed:

Cut the plastic foil in the double size of the utility space of the machine. Put on protective clothing. Discharge etching agents from the machine into suitable container. Take up existing sludges with scraper mechanically and give it to the etching agent. Lift the machine and set it on the foil. If you do not have an exhaust move the machine to proper ventilated room or outside.

Fill the machine with 15% HCl. Close the cover. Run the machine with heating switched on for several hours. Repeat if necessary the cleaning run the next day.

To Clean from the outside give warm water into a bucket. Add stain remover on a wet sponge and use it like abrasive powder Let the paste act on the surface, if necessary moisten again with sponge. Repeat this procedure, until the marks are faded. Particularly persistent deposits carefully dab with HCl. To clear rinse thoroughly wipe of machine with a not dripping sponge and clean this sponge in a second bucket.

Discharge HCl from the machine and store to re-use it again. Close drain valve. If the machine is not filled again, wipe off the inside of the machine beginning from the top and working your way down. Clean sponge in second buck. Do not touch the uncleaned parts of the machines, wear long sleeved gloves if necessary. Give the contents of the second bucket to the used up etching agent. Alternatively clean the inside by making a test run with water.

Return the machine to its location. Examine whether the glow bare is intact (do not switch on, only visual check.) If necessary remove the electric case and pull back the rubber seal of the glow bare to check for any penetrated liquid. In this case you have to exchange the glow bare. Fill the machine with water for a test run and after that replace the water with fresh FeCl3.

The hydrochloric acid can be used later, in order to dissolve Sludge sediments in etching agent. Give HCl in portions of approx. 0.5l to the dirtily brown etching agent and let the machine run briefly. Do this so long, until the solution is to a large extent clear again. But: NEVER give Hydrochloric acid to fresh iron-III-chloride ! Dispose possible surplus of HCl with used etching agent.

This guidance represents only the fundamental procedure in standard situations. Mistake and change reserved. Handling the chemicals takes at one`s own risk. Regard safety regulations!

Against FeCl3 marks on clothes, smooth and porous surfaces we supply a highly effective stain remover on organic basis.

Drain the dirty rinse water from floor drain of the rinsing zone. The waste laws demand economical handling of rinse water. We advise to collect the water from the first rinse a) To compensate evaporation losses and b) for new FeCl3 solution! After discharging the water sediment remains in the basins. Take up mechanically and give these it to the used up etching agent. Dispose surplus rinse water together with the used up etching agent.

Motor protection:

we recommend to regularly inspect the the radial sealing shaft of the PVC-flange or to change this shaft every second year. On request we supply a detailed instruction on how to change this ring.

Chemical drag out

It is in the nature of the application, that a small amount of etchant from the etching zone is deported to the rinsing zone via tooth belt and pcb.

By arranging the walls in a special way and fit the outlet rollers with absorbent cloths the chemical drag out is reduced to a low level.

The following points affect the chemical drag out significantly:

Machine in balance: if the machine is not standing level, the liquid will flow over the plate towards the lower part of the machine.

Board size: large bords drag out more solution than small boards, because the fluid can not drain quickly to the sides.

Holes: undrilled boards drag out more than drilled ones, where etchant can drain through the holes or slots.

Curved boards: if you run curved boards through the machine with the curve showing down, the board will a kind of channel for etchant or rinsing water. If a curve can not be avoided, put the buckle up. If necessary, we can supply heavier upper squeeze of rollers with double cloth, to soak as much etchant from the board as possible.

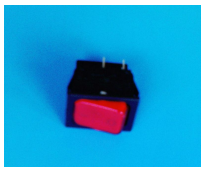
Disposal:

The disposal of the etching medium must be negotiated with the chemical supplier.

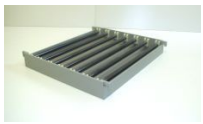
The etching machine itself was predominantly made from recyclable materials and is to be supplied at the end of use to a proper and environmentally sound disposal.

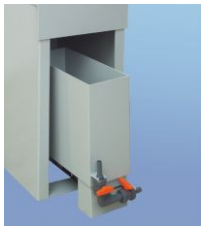
Spare part list

699300	Kugelhahn DN15 f. Ätzmaschine	cog valve DN15 f. etching machines	
699301	Kugelhahn DN25 f. Ätzmaschine	cog valve DN25 f. etching machines	
699303	Heizung komplett f. Ätzmaschine	Complete heater for etching machine	

699304	Schalter beleuchtet f. Ätzmaschine	Switch illuminated	
699305	Quarzrohr f. Heizung Ätzmaschine	quartz tube for heater element	
699306	Heizelement 1000W f. Ätzmaschine	Heater element 1000W f. etching machine	
690303	Satz Vliestücher f. DL 500	set of drying cloth f. DL 500	
690304	Satz Flachstrahldüsen f. DL 500 (56St)	Set (56 pc) flat spray nozzles f. DL 500	
690305	Düsenstock unbestückt f. DL 500	Manifold without nozzles f. DL 500	
690306	Lagerrollen für Wellen DL 500	Bearing rolls for DL 500	
690308	Niederhalter f. Riemen DL 500	Downholder with roller f. belt DL 500	
6000	Niederhalter f. Riemen ohne Röllchen DL 500	Downholder **without** roller f. belt DL 500	
690309	Führungsrolle f. Riemen DL 500	DL500 guidance roll for tooth belt	
690310	Zahnriemen 900H037 f. DL 500	DL 500 belt type 900H037	

690340	Zahnriemen 900H037 Kevlar/PU	belt for DL 500, type 900H037 Kevlar/PU	
690311	Getriebemotor (Transp.) f. DL 500 . ink. PVC Ritzel bis 2016: 12V bitte Seriennummer der Maschine angeben	gear motor (Transp.) f. DL 500 . incl. PVC teeth wheel for belt drive till 2016: 12 V. Please supply serial number of machine	
690311	Getriebemotor (Transp.) f. DL 500 . ink. PVC Ritzel ab 2016: 24 V bitte Seriennummer der Maschine angeben	gear motor (Transp.) f. DL 500 . incl. PVC teeth wheel for belt drive from 2016: 24 V. Please supply serial number of machine	
690312	Thermostat f. DL 500	Thermostat f. DL 500	
690313	Ätzmittelpumpe f. DL 500 ohne Motor bitte Seriennummer der Maschine angeben	pump body for DL 500 without motor Please supply serial number of machine	
690314	Spülwasserpumpe f. DL 500	Rinse water pump f. DL 500	
690315	Magnetventil f. DL 500	Solenoid valve f. DL 500	
690316	Personenschutzschalter f. DL 500	Cover protection switch Moeller AT4	
690317	Frontplatte FÜR DL 500	Front Panel FÜR DL 500	

690318	Welle und Impeller für Ätzmittelpumpe f. DL 500 bitte Seriennummer der Maschine angeben	shaft and impeller for DL 500 etchant pump Please supply serial number of machine	
690319	DL500 PVC Transportwelle 6 Zähne	DL500 PVC Transport roller 6 dents	
690301	DL500 PVC Transportwelle 5 Zähne	DL500 PVC transport roller 5 dents	
690302	Abquetsch-Welle f. DL 500 (5Z, unten)	Squeeze roller f. DL 500 (5 dent, lower)	
690320	Abquetsch-Welle f. DL 500 (oben)	Squeeze roller f. DL 500 (upper)	
690321	Transport-Welle f. DL 500 (oben)	Transport roller f. DL 500 (upper)	
690322	Spülwassertank mit Pumpe für DL 500	recycled rinsing tank w. pump for DL 500	
690323	Kühltank mit Pumpe für DL 500 S. Kühlt die	cooling tank (w. pump) for DL 500S machines.	
690325	DL Kontrolltisch als Puffer zwischen zwei	DL control table, inline buffer between two	

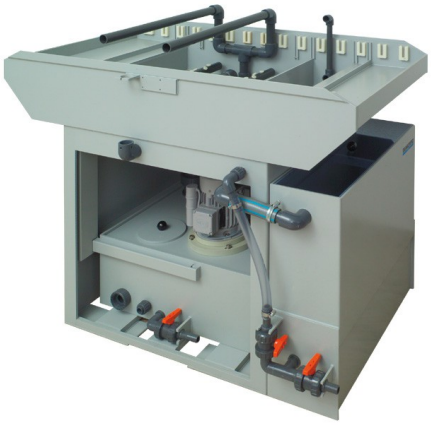
690330	Durchlauf-Spülmodul	Conveyorised rinsing unit, stand alone, as shown in	
690350	Spülwassertank mit Pumpe	recycled rinsing tank w. pump	
690613	Motor f. DL 500 bitte Seriennummer der Maschine angeben	Motor f. DL 500 Please supply serial number of machine	
6000	Regelnetzteil für DL500 230VAC/12VDC/22VA (bis 2015) bitte Seriennummer der Maschine angeben	Rectifier Pcb for DL500 230VAC/12VDC/22VA (until 2015) Please supply serial number of machine	
690326	Motorsteuerung 2016 PWM bitte Seriennummer der Maschine angeben	Motor control 2016 PWM Please supply serial number of machine	
6000	Motorwelle PVC	PVC motor gear wheel	
6000	Hauptschalter mit Relais	Main Switch for DL500	

Amendment 1 Closed-Loop Rinsing Unit

This description supplements the operating instructions for the conveyorized etching machine DL 500 to the aspects of installing and operating the closed-loop rinsing module. This text cannot replace professional literature and safety discussions on the issue of waste water treatment, though.

Setup
The module is designed for installation behind the DL500 and under the delivery table of the etching machine DL 500. You can also place the rinsing tank at any other place near the machine, as long as both

Installation



Tubes and connectors that are necessary to connect tank with the rinsing section of the DL500 are part of delivery. Water inlet into the machine is a 3/4” thread connection. At the tank there is a vertical 20mm spout.

The water flows back from the machine via a 30mm inner diameter tube.

The remaining valve at the tank serves to drain the water from the tank with the help of the pump.

The cover of the rinse module canbe remove to allow control of water quality or to add chemicals such as flocculants or similar.

Connect the power cable of the tank to the plug underneath the DL500

The tank can take up 30l. There is a small nozzle at the drain of the tank sticking a little up. This is done by purpose to provide room for sedimentation underneath the drain of the tank. The pump is not suitable for dry run. Make sure that this nozzle is always covered with water !

The pump switches on, when the etching pump of the DL500 starts running. The amount of rinsing water can be adjusted by the ball valve underneath the DL500. Normally leave the valve completely open when using a rinsing tank.

Amendment 2 Stripper

This description supplements the operating instructions for DL 500 for the special version DL500-S Stripper.

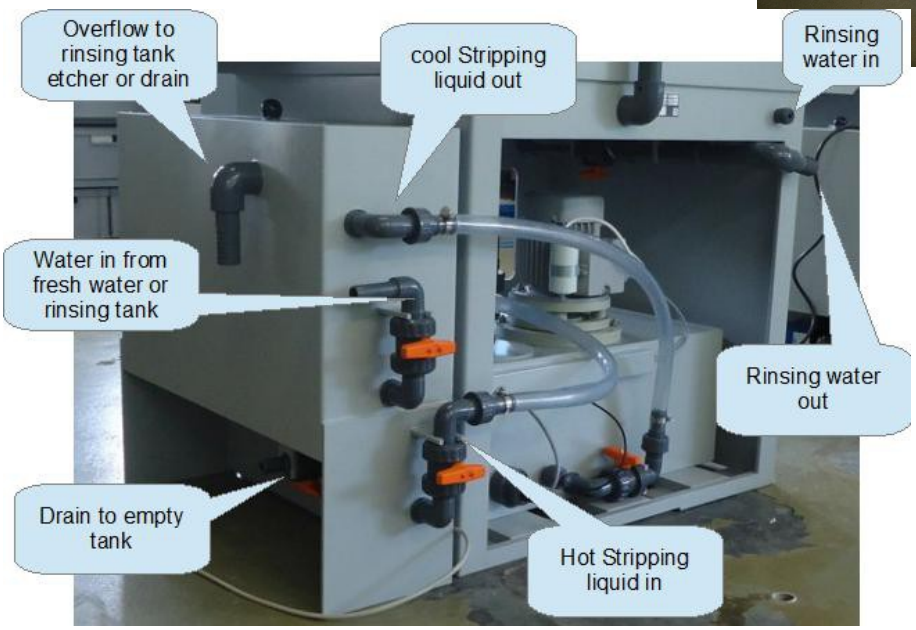
Divergent of the standard DL500 the stripper version comes with an additional lateral filter basket to filter out possibly residues from the stripping process. The machine also has a bright, alkali-resistant tooth belt. The stripper version is filled instead of the etchant with special stripping liquid. The approach for negative tenting resist is about 50g stripping chemical on one liter of water.

Please pay heed to the following points:

Check regularly the sieve in the side tank of the machine, so that the stripping agent does not overflow.

Using for example sodium hydroxide, foam may arise. Please add a suitable anti-foaming agent to the stripping liquid.

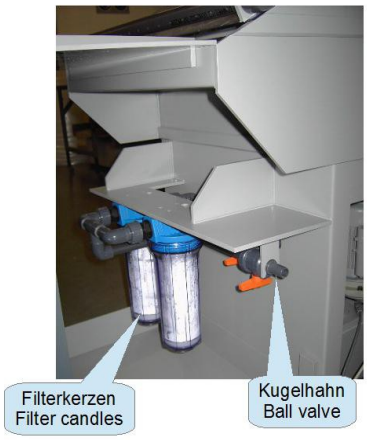
To protect against exothermic reactions, please see an appropriate cooling for the stripping agent, e.g. the Bungard Cooler, who cools the stripping agent with the rinse water. This Cooler can be connected in different ways to the DL500. One option is to connect cooler and the fresh water inlet for a rinsing unit module (as you can see in the picture below.

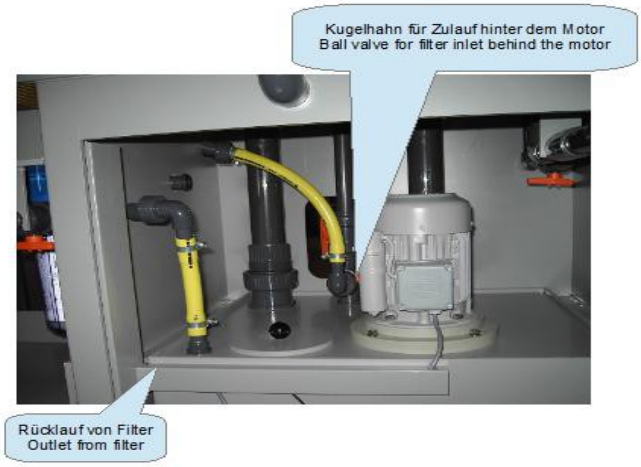


Amendment 3 filtration unit

The DL 500 can be equipped with an extra filter unit. You can filter the etching liquid by opening the ball valve pointing horizontal off the vertical pressure tubes

Filters have to be exchanged when the flow rate is noticable reduced.





Guarantee

All machines are submitted before distribution to examination on function and continuous operation firmness. On the machine we grant a work warranty of 12 months to our customers starting from purchase date on accuracy in material and processing. We warrant at our choice by exchange of incorrect parts or by repair of the machine in our house. Old parts change into our possession.

Disclaimer of Warranty

Bungard GmbH & Co. KG reserves the right to change or enhance its machines or machine specifications according to its judgement, if necessary. Bungard cannot be held responsible to implement aforesaid changes into machines sold already.

Bungard products and services are liable to the current prices and conditions, which are subject to change.

The instructions and definitions in this document are also subject to change and mark no assurance on the part of Bungard.

This manual contains informations of the Bungard DL500 and is the translated English version.

Please regard the “Sales terms and delivery conditions”. These are available after fulfilment of the contract. We don't furnish a guarantee or warranty in cause of damages at material or hurts of people because of

Incorrect use of the machine

Wrong setup, installing and operating of the machine or incapable service

Use of the machine with defective safety equipment

Non-observance of the service manual in regard to transport, stocking, setup, installation and service of the machine

Unlicensed modifications at the machine

Incorrect or incomplete repairs

Destructive force effect at the machine in cause of foreign objects or external use of force

Use of non-original spare parts

normal wear parts.

We cannot accept subsequent claims from damage or destruction of work pieces worked on in the machine, because we have no knowledge or control over the operating conditions at your site. This is valid in a general manner also for requirements from damage to articles, buildings and persons as well as the environment.

We do not warrant that the function of the machine will meet the customer's requirements or that the operation of the machine will to this regard be error free.

In no event will we be liable to the customer for any incidental, consequential, or indirect damages of any kind, including loss of profit and prosecution for environmental pollution, even if we could have been aware of the possibility of such damages.

All information was arranged with great care. We reserve ourselves however mistake and technical changes without previous announcement.

Running the machine in corroding, humid, dusty, extremely hot or explosive atmosphere happens at the operator's own risk and responsibility.

We explicitly exclude any warranty for damages resulting from running the machine in in corroding, humid, dusty, extremely hot or explosive atmosphere.

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