Introduction

The Splash is a laboratory spray etching machine with integrated rinse. The machine is suitable for single and double-sided copper-clad base material. This equipment is designed with a special focus on ergonomic, clean and low carryover etching and rinsing.

Areas of application:

- acid or aqueous-alkaline etching of circuit boards.
- Developing of positive or negative-working photoresists or laminates (aqueous-alkaline processable - add anti foam if necessary).
- Alkaline resist stripping.

In the Splash Center all wet process steps of photo positive pcb production can be processed in a single machine, without having to carry the dripping board to the next machine. In the spray chamber the pcb is etched, tank 1 and 2 include a cascade rinsing, tank 3 is used for alkaline developing and in tank 4 the etched circuit board can be tinned.

Features:

- maintenance-free spray etching system with special jet nozzles
- Etch rate of approximately 70 s in 35 micron Cu in fresh, warm FeCL3
- large window to the etching chamber made of transparent PVC
- maximum board size 210 x 300 mm (Splash XL 300 x 400mm)
- Resolution down to 0.1 mm
- suitable for all common acid etchants
- Opening door for etching zone with safety switch
- removable, etching shadow free titanium plate holders, can be locked in drip off position
- easy access to the interior, no tools needed, therefore easy to clean
- heated by quartz heater 1000 W
- thermostatically controlled etchant temperature
- Etching time is set by digital timer 1 s - 99 min., with count-down, end alarm and auto-reset function
- Overtemperature protection, response temperature 72 ° C
- Stand alone unit with integrated static rinse and drip off frame
- Splash Center with static rinse and a combined static and spray rinse activated by foot switch
- All tanks can be easily emptied by ball valves

Splash Center:

- A spray etching or spray developing chamber and 4 more treatment tanks
- Cascade rinsing with a static and a combined static / spray rinse; foot switch activated
- Tank 4 with magnetic coupled pump for revolving e.g. stripper
- integrated squeeze-off-dryer
- Collecting tray included in delivery

Technical Data

Splash			**Splash Center**	
LxWxH	60x66x120cm XL: 80x77x120cm		**LxWxH**	100x67x121 cm XL: 116x77x120 cm
Weight	35 kg / XL: 40kg		**Weight**	46 kg / XL: 56 kg
Tank capacity	25 l / XL: 40l		**Tank capacity**	25 l / XL: 40l
Power Supply	230V 50 Hz 1500W		**Power Supply**	230V 50 Hz 1500W
Materials	PVC, Titan, PP, Viton		**Materials**	PVC, Titan, PP, Viton
Maxi. Board size	210 x 300 mm / XL: 300 x 400 mm		**Maxi. Board size**	210 x 300 mm / XL: 300 x 400 mm
Heater	1000W Quarz heater		**Heater**	1000W Quarz heater

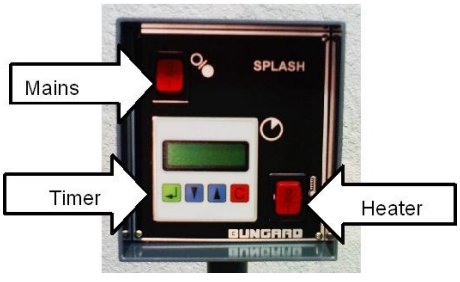
Tanks

			Splash Center		**Splash Center XL**
Nr.	**Name**	**Cont.**	**Mixture**	**Cont.**	**Mixture**
1	Spray Chamber	24l	13,5 kg FE3; 17 l water (or if used for developing: 24 l water and 240 g neg. developer)	36l	20,5 kg FE3; 25,5 l water (or if used for developing: 35 l water and 350 g neg. developer)
2	Static Rinse	8 l	water (possible 250g RX3)	16 l	water (possible 250g RX3)
3	Combined static/spray rinse	12 l	water	24 l	water
4	Strip tank	8 l	8 l water and 400 g NaOH	16 l	15,5 l water and 750 g NaOH
5	Reserve tank	8 l	e.g. f. chem. tinning	16 l	e.g. f. chem. tinning

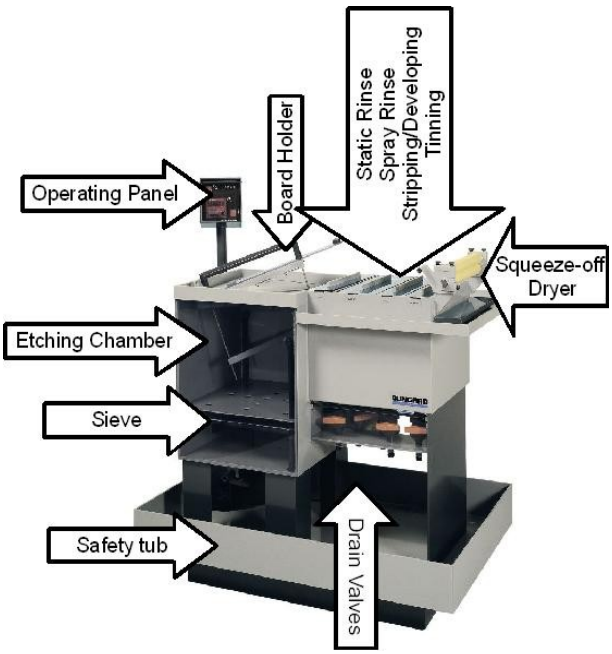
Splash /Splash XL only Spray Chamber + Static Rinse

Short instructions

1. Upon reception examine the machine for any apparent damage, and if so inform your shipping agent and us immediately.
2. Please read the manual carefully and follow the safety instructions.
3. Transport the machine to its place by lifting it up at two legs on each side.
4. The floor must be level. Underlay the legs if necessary.
5. Make sure the drain valves are closed.
6. Splash Center: Connect the combined spray/static rinse inlet to your water supply and the drain to the sewer system. The inlet has a ¾ inch screw and the outlet a 20 mm drain spout. Choose the appropriate hoses and clamps. Please understand that we cannot supply these hoses due to different connection standards worldwide.
7. Mount the sieve into the spray chamber, if necessary.



8. For a first test of the machine fill the spray chamber up to the sieve with water. Fill the rinse and treatment tank, each with about 10 liters of water.
9. Connect the machine to the mains (we assume that your electric system is protected by RCD according to your local regulations).
10. Turn the main switch and the switch for the heater. In operation, the switch lights and the heating element changes to an orange-red color.
11. Set the plate holder vertical, select etching time on the timer to approx. 10 seconds and remove the air from the pump. Turn the pump on for about 10 seconds and turn off again. Repeat this process if necessary at intervals of 30 seconds, two or three times. The pump must not run dry for long periods.
12. Check operation of door safety switch by lifting the plate holder. The pump must turn off, when the lid is lifted for approx. 5mm.



13. Turn off the machine, let it cool down and then remove the water. Now fill in the etchant (13.5 kg ferric chloride and 17 l of water give 24l caustics) or the developer (24 l water and 240 g neg developer). Please prepare all chemicals outside of machine!
14. We generally recommend the use of ferric chloride as etchant. The etching of 35µm copper takes about 1 minute (etch rate of 0.5 micron/s) with fresh and warm ferric chloride. The etching times are prolonged with increasing copper saturation. At an etching time > 4 minutes, we recommend to change the etchant.

Safety Instructions

Read all safety and operating instructions thoroughly before using the unit for the first time. Keep this manual at a safe place in case you need to refer to it again in the future.

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

The machines are not intended to be integrated or connected with other machines or plants. They may be operated only in appropriate areas and run only by qualified technical personnel. Children and domestic animals are to be kept away!

Electrical connection

The machine is manufactured using certified parts according to the usual guidelines for electrical security. This does not release the user however of his duty to exercise diligence while handling electrically operated devices.

Before all maintenance work on the machine (filling, emptying, cleaning etc.) switch off the machine and pull power supply plugs.

Pay increased attention to electrical defects because of the conductivity of etching solution containing metal salts. In this case pull the plug of the machine and replug only after professional repair. This is also valid for spilled etching agent. As protection against unintentional contact with chemicals, the machines are equipped with a cover protection (door contact switch). This switch is connected to the timer and stops the pump. Note: For job safety examine occasionally the correct functioning of the cover protection. Doing so wear protective clothing and eye protection.

The machine may be switched on only with filled etching agent chamber. The quartz heater must be always sufficiently covered with etching agent! Uncovered glow bar may cause destruction of machine! The correct filling is on height of the sieve.

Never run machine without the sieve over heater, thermostat and and thermal fuse.

Chemicals

If the etching agent is prepared by release from salts or mixing liquids, this must always take place ***outside*** *of the machine! Pay attention to the safety references of the chemical manufacturer as well.*

Personal protection equipment

While handling etching agents, thus in particular when filling and emptying the machine, wear usual protection equipment, like apron, gloves and eye protection.

Place of operation

Requirement according to WHG and/or supervision of trade: In order to prevent the penetration of etching agent into the ground, the machine must be installed a) in a sufficiently large area with chemical-firm, waterproof ground lining (no tiles, no concrete!) or b) in a chemical resistance, waterproof collecting tray (we offer this as option), which takes up the entire volume of the etching liquid.

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. (It escapes water vapour, the salts of the etching agent remains in the solution). An exhaust connected firmly to the machine is not possible - risk of damage by negative pressure.

Environmental protection

Used up etching agent is special refuse. It must be handed over to certified disposal enterprises under indication of the waste key number. Pay attention to the refuse laws and regulations of your country. We are not authorized to redemption.

Prior to operating the machine, be informed on all applying environmental protection legislation of your country. Used etching liquid contains copper and must be treated as special waste. In most countries, this applies also for the rinse water. We recommend that you collect dirty rinse water and use it to set up fresh etching liquid or to compensate evaporations losses. In accordance to anti pollution laws, the final cleaning of the boards normally requires a cascade rinsing unit, or further wet process steps, like chem. tinning or resist stripping. Any attempt to neutralize the etchant or the rinse water is NOT recommendable to other than approved chemists.

If you do not have an appropriate water purification for the rinse water in your facility, we recommend our waste water processing facility **Ionex** for this task.

Body

The machine body consists of light-grey PVC and transparent PVC at the front. The interior of the machine is divided into the spray zone and the medium container. They are divided by a removable and punched sieve.

The two full jet nozzles are arranged diagonally in the spray zone. Their spraying angle and their arrangement ensure that the foremost and back of the entire effective area are shade-free covered.

The cover of the machine is removable and carries the diagonally arranged pcb holder. On the upper left the tiltable control console is attached. On the back of the machine is a maintenance-free, magnet coupled centrifugal pump.


view inside the spray chamber

Splash:

At the right side of the machine is the rinsing zone.

Splash-Center:

Beside the spray chamber there are 4 vertical treatment basins with each having approx. 10 l (16l XL) content. The first tank from left is the first (static) rinsing zone. Then follows the combined static/spray rinse with two horizontally attached nozzle tubes, which are activated by single magnetic valve and foot switch. This rinse has a floor drain and an adjustable overflow.

The third basin serves for developing positive coated plates or for stripping negative laminate. The liquid herein is rolled over by a small centrifugal pump when the machine is switched on. Note! This pump may not run dry! Therefore this bath must be always filled at least with water. In this basin is a lifting device which enables to take out pcbs out of the tank without having contact to the caustic solution. A sifter prevents parts from getting into the pump.

The drain valves for the etching agent and the rinse water are well accessible below the respective containers.

In the rinsing zones are short pipes in the floor drains. These are to hold back possible slugde sediments when emptying. If you want to completely empty the tanks, just pull up the pipes with a plier.

Splash-Center: The machine is supplied with a safety catch pan. This tub is so dimensioned that it can take up the entire liquid in the accident.

Adding the Etching Liquid

The machine can be operated with all usual etching agents. We recommend to use as etching agents ferric-III-chloride (FeCl3). Using ferric-III-chloride you will obtain a substantially higher etching achievement and precision than e.g. with sodium persulfate. It can be also used much longer than most other etching liquids and so meets the requirement to reduce special refuse. You can purchase ferric-III-chloride from us.

Be cautious with all regeneration-needing etching agents. They can overheat by chemical reaction. Prepare fresh etching agent outside of the machine. Fill in only completely dissolved etching agent! If incompletely dissolved etching agent comes into the pump, it can block and damage the pump.

The etching agent is filled from above into the machine. In order to remove the cover, first carefully raise the surrounding rim on all sides evenly and remove it. The cover including the pcb holder can now be lifted.

The filling amounts to approx. 24 l (36 l XL), the correct level is reached when the sieve is covered.

After the first filling, the pump must be aired out. Run it for approximately 10 seconds. Repeat this procedure if necessary after 30 seconds two or three times. The pump may not dry run for longer time.

Fill the static rinse of the Splash so far with water that a plate, which is immersed with the plate holder, dives in completely.

Fill the two rinsing chambers of the Splash-Center with water until the upper board holder bar of the board holder is covered with water

The tank next to the two rinsing tanks has a centrifugal pump and can be used for developer (photopositive process) or stripper (negative process). The tank on the right you may use for tinning. If you do not want to use a developer nor tin, please fill the tanks in any case with water. The pump in the developer basin may not dry run, empty tanks can deform.

Etchants

Ferric-III-chloride is very easy to handle, has very good etching quality and broad band of application. That is why it is the most popular etching agent for laboratory uses. Ferric-III-chloride has a high etching speed and ensures perpendicular copper walls after etching. We strongly recommend to use ferric-III-chloride with our machines.

Mix 800 g Granulate per litre water. This will be 1.4 l of ready solution. Ferric-III-chloride etches warm and cold. The optimum temperature is approx. 45°C.

With our etching machine JET 34 a fresh solution of ferric-III-chloride etches 35 µm Cu in approx. 70 seconds. With increasing saturation etching time goes up to 3 Min for 35 µm Cu. Under-etching increases only slightly.

Ferric-III-chloride can take up to 50 g Cu per Litre. In reality you will not reach that limit, because etching time will take too long. Recognize the saturated solution from its milky look.

Experienced users add small portions of 15% Hydrochloride acid (HCl) to the used solution to prevent copper mud and Ferric stain in the machine. We will supply further information on request.

The used etching agent has to be disposed according to your national legislation.

We do **not** recommend to neutralize the used etchant, because you have to precisely analyse the copper concentration after neutralisation. In Germany copper concentration in waste water has to be less than 0.5 mg Cu/l.

Your Disposal administration will advice you on how to dispose the used etchant. Additional information you will find in the material safety data sheet (MSDS).

By the way: the brown spots on clothing and items caused by Ferric-III Chloride are easily removed by our stain remover RX3.

Other Etchants:

Etchants	Pros	Cons
Ferric-III-Chloride	Cheap, high copper capacity (50g/l) good etching rate (0,5µm/s), stable, good sharpness, low underetching, not considered as a dangerous good, stains easily removable with RX3	sludge formation Regeneration only difficult
ammonium persulfate	„clean“, good etching rate (8-30µm/min) and copper capacity (30-40 g/l)	Forms complex salts (including double salts of copper sulphate and ammonium sulphate), disposal 10 times as expensive as Fe3Cl, corrosive fumes, Crystalline deposits at temperatures below 30 ° C, which are sharp as glass and can damage pumps and cut moveable machine parts,
Sodium persulfate	no sludge, suitable for metal, copper can be deposited electrolytically	Low etch rate (0.1-0.2 micron/s), does not etch in cold state, decomposes when heated (especially in the vicinity of the heating rod), catalyst (mercury) is toxic.
copper chloride	Regenerable, good capacity (100g / l) and etching rate (30µm/min)	Bath control is very complicated, fumes are toxic/aggressive
ammonia	suitable for metal resist, good copper capacity (up to 200g / l)	bath control difficult, exothermic reactions, toxic fumes, complex salts, crystallization risk

Operation

The control panel is protected by an upward tiltable, transparent cover against contamination. The grasp to open the cover serves at the same time as actuator for the start-stop tracer of the timer.

Control panel with new timer

Main Switch

The button on the upper left of the control panel switches the electric circuit for the pump and the heating.

Heating

The switch down right on the control panel controls the heating. A thermostat regulates the temperature on 2 degrees exactly. As additional security against overheating the machine is equipped with a not resetable temperature protection in the heater circuit.

Timer features:

a) Adjustable timer up to max. 99 minutes 59 seconds

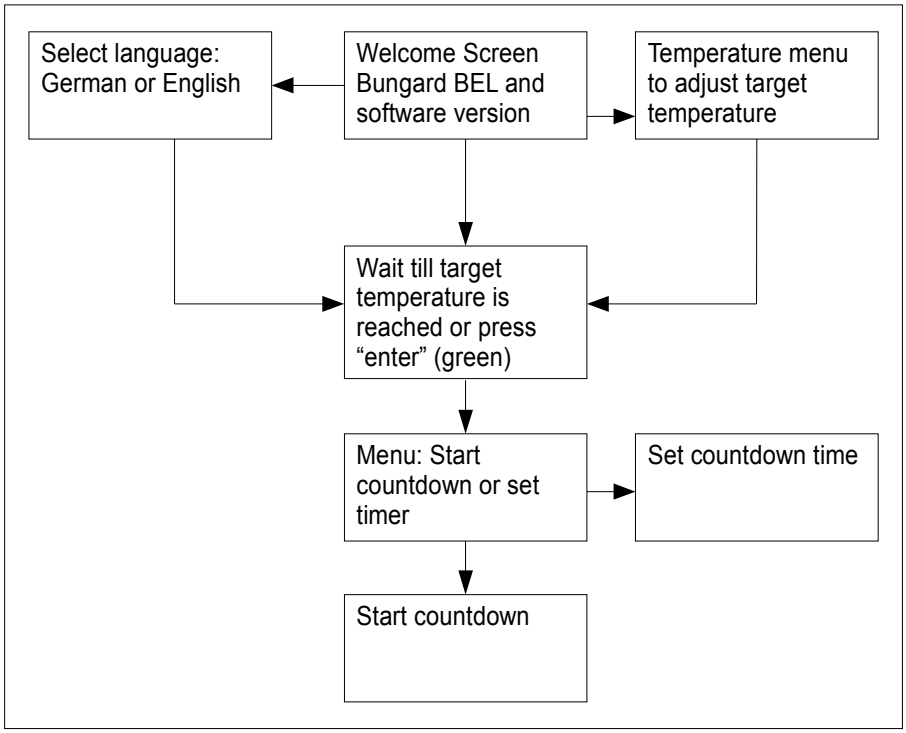
b) continuously adjustable temperature control from 30-45°C with a visual display of current temperature and the activity of the heating (displayed "H")

c) audible and visual alarms for over temperature (T > = 55°C)

d) Door Switch monitoring with visual display and waiting call

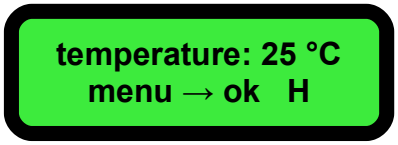
e) Select of language English or German (other languages are possible)

f) automatically stores the last set parameters: language, set temperature, time.



After switching on the mains
the welcome screen "Bungard BEL" appears on the LCD and the software version

Then the temperature control starts, and on the LCD appears the "current" temperature as well as a H for heating (if the machine has not yet reached the target temperature) and menu "ok". When the set temperature is reached, the timer automatically switches to the main menu. If the user does not want to wait for reaching the target temperature, he gets directly to the main menu by pressing the Enter key (green).



In the main menu the LCD shows:

Time: xx: xx (adjusted value) start = ok; Timer = arrow.

Pressing the Enter key the machine starts. Pressing the arrow key you can enter a new time value.

If you want to change the time, then press the arrow key. The display shows Time: 00:00 arrow up/down ok. The cursor jumps to the first 00:00. Now use the arrow keys to adjust the desired value.

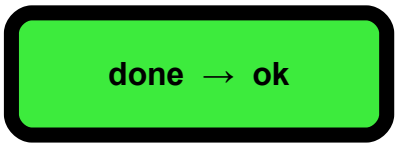
Pressing the Enter key you confirm the value and the cursor moves to the next digit (10:00). Now enter the remaining digits in the same way. Pressing "enter" you confirm the setting and you jump back to the main menu.

If you press Enter in the main menu, the timer starts and the pump switches on. On the LCD the remaining time, the current temperature and the activity of the heating (H) are shown.

If you open the lid, the timer and the pump stop. The display shows „stop → cap open.

If you close the lid again, the job continuous.

When the job is finished, you will hear a beep and on the LCD appears "done → ok". Pressing the Enter key, you return to the main menu.



When the temperature of the etchant reaches 55°C (eg by exothermic reaction), an audible alarm sounds and the display shows the message "Attention temperature too high".

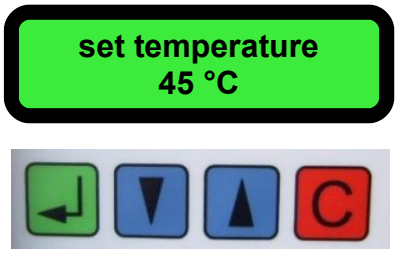
If the temperature is getting too high during the etching process, the pump will continue to support the cooling.

Now, the operator must take measures to lower the temperature.

As long as the temperature is > 55°C, the alarm remains, and only by turning off mains the machine can be stopped.

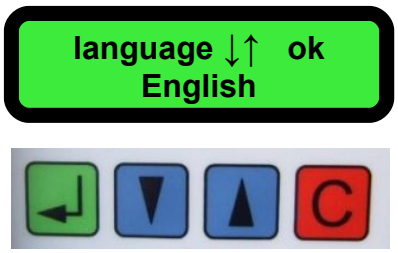
If the temperature falls below the threshold temperature, the alarm can be cancelled by pressing the Enter key. In stand-by mode (machine is turned on, but no etching process is taking place) the temperature is still monitored and an audible and visual alarm is displayed when reaching the threshold temperature of 55°C. The pump will start if lid is closed and will stop when lid is opened. If the temperature falls below the threshold temperature and the alarm is cancelled the pump turns off again.

Setting the target temperature: To set the target temperature, press both arrow keys, during the welcome screen, until the temperature menu appears. Then set the desired temperature with the arrow keys and press Enter.



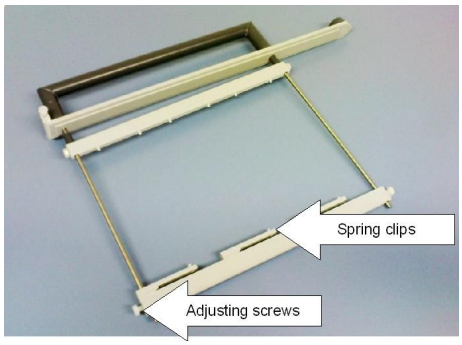
Setting the language is similar. Press both "C" and the "Enter" key during the welcome screen until the language menu opens. Then use the arrow keys to select the desired language and confirm with Enter.

Additional protection function: if temperature sensor is not connected or the wire is interrupted, then an audible alarm can be heard and a message: **Warning: temperature is too high** is displayed on the screen.



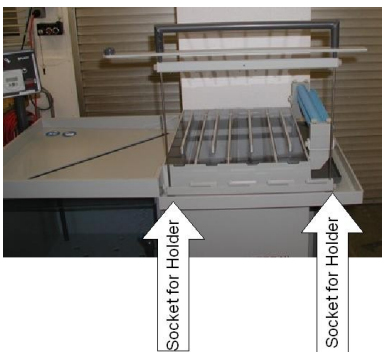
Feeding the etching chamber

The machine can take at a time either 1 board of 210 x 300 mm or e.g. 3 boards of 100 x 160 mm. The left side of the board holder is fixed to the machine's cover. This pivot allows to either put the board holder in it's horizontal operation position or to put it vertically for feeding/discharging boards. We have chosen this principle to allow that the liquid can easily drop off from the boards (saving rinse water) and that the dropped of liquid immediately returns into the machine.



The board holder has two bars mounted on titanium pins. They can be adjusted in height and thus allow adaptation to different board sizes.

One of the bars carries three clamps. These allow to mount the boards to the holder without necessity to slide the entire bars for and back. To feed a board, proceed as follows: Keep the board with your right hand, insert it into the clamp(s), keep it there with your left hand and make it snap into the right bar's PVC teeth. To dismount, proceed in reverse order.



On the surrounding frame the Splash-Center has two small pieces of dark grey PVC in front of the tanks. These provide a stand for the board holder, so you have both hands free for placing the PCBs in the holder.

Rinsing - Splash

After retracting the boards from the holder, immerse them into the rinsing tank and move them slightly for and back. On the upper right of the rinsing tank, there is a slotted bar. Put the rinsed boards there to allow them to drip off. We recommend that you wear thin latex gloves when handling the boards. There is space to put the gloves on the frontal or the right side of the rinsing tank's surrounding.

Rinsing - Splash-Center

The machine provides multiple rinse technique. The first tank is a static rinse that accepts most of the metal salts sitting on the board after etching. The next tank is a combined static and spray rinse. Here you immerse the board into the rinse water, then you press the foot switch and while pulling the PCB upwards, the spray rinse gives it a final cleaning. What you get is a triple rinse in two tanks. This allows to reach the minimum requirements for environmentally safe rinse techniques: Each rinse step dilutes the remaining copper concentration by a factor of 10, so the water going through the overflow is purified by a factor of 1000.

Maintenance/Cleaning

Changing of the etching agent

The etching agent is discharged over a ball valve, which is under the machine body. As described above, you have access to the etching chamber when you remove the cover. This makes it easy to remove any sediments manually. If you use ferric-III-chloride and consider the following proposal, you can change the etching agent without large cleaning expenditure: With increasing saturation ferric-III-chloride tends to deposit surplus cuprous salts as mud. The solution changes its colour from a initially transparent to a milky green-brown. At this time usually the etching time doubles in comparison to the beginning. If you change the etching agent at this time, then the mud formation can be stopped and mud already set off will be brought back into solution.

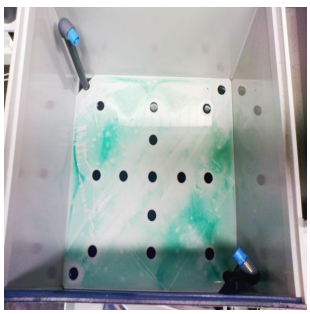
Dismantling

For cleaning and repair works, it may be necessary to dismantle the inner parts of the spray chamber. To do this, follow these steps:

1. Remove the lid frame

2. Remove the board holder from its hinge

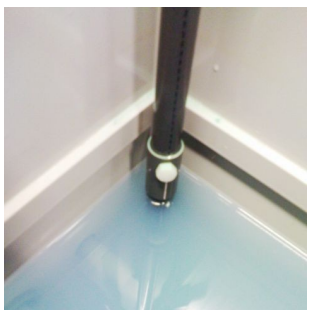
3. Lift the lid of the spray chamber



4. Dismount the sieve

5. Discharge the etching or developing liquid

6. Now you have access to e.g. the etching nozzles adjustment



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.: 24 l, 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%iger 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 rinses 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 machine from the inside by 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 and perform for a test run and then exchange 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 ferric 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 of the etching liquid 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.

Guarantee

All machines are submitted before distribution to examination on tightness, 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

All parts subjected to wear and the heater element are excluded from this warranty. Any direct or indirect damage resulting from over-heat or chemical reaction shall void all warranty claims. This also applies to defects to the machine caused by non-observance of this manual or of parts of it.

We cannot accept subsequent claims from damage or destruction of workpieces 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.

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