Jet 34d Etching machine
Operating Instructions

Spray etching machine for laboratory use with integrated static rinse. Machine is suitable for double sided material.

Features:

- Maintenance free etching system with solid stream nozzles and magnetic pump
- High spray pressure; spray motor with 0,37 kW
- etching speed of 35 µm Cu within 60 seconds (warm and fresh Fe-III-CL).
- Line resolution better than 0.1 mm (100 µm)
- Inserting pcb over big opening lid with safety switch
- Maximum board size: 300 x 400 mm
- small pcbs can be clamped onto the board holder
- Easy and clean handling by flangeless lid and handle of board holder outside of etching chamber
- Easy processing of double sided boards by turning
- Big integrated static rinse compartment
- Digital control of temperature and etching time with count down, auto reset, beeper and safety function
- Strong 1000 W Quartz heater, controlled by thermostat
- overheat fuse
- Suitable for all common etchants (ferric chloride recommended)
- 3 cog valves for all tanks
- Suitable for spray developing

Technical Data

Dimensions:	ca. 60 x 70 x 110 cm	**Weight:**	ca. 35 kg
Working height:	ca. 90 cm	**Motor:**	0,37Kw
Electrical connection:	220 V~, 50Hz, ca. 1.5 kW	**Max. board dimensions:**	300 x 400mm
Fill Quantity:	ca. 16 l	**Heating:**	1000 Watt Quartz glow bare
Etching Speed:	ca. 35µm Cu /min (fresh and warm etching liquid)	**Rinse water outlet/drain etching chamber:**	Spout D20mm
		Rinse water inlet	3/4“ thread

Short instructions/Set Up

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. Mount the sieve into the spray chamber, if necessary.
7. For a first test of the machine fill the spray chamber up to the sieve with water. Also fill the rinse tank.
8. Connect the machine to the mains (we assume that your electric system is protected by RCD according to your local regulations).
9. Turn the main switch and the switch on the heater. In operation, the switch lights and the heating element changes to an orange-red color.
10. Set the plate holder into the etching chamber, close the lid, set the timer and make a test run.
11. Check operation of door safety switch by lifting the plate holder. The pump must turn off, when the lid is lifted for approx. 5mm.
12. Turn off the machine, let it cool down and then remove the water. Now fill in the etchant (the etching chamber takes approx. 16 litres, if you use ferric-chloride-granuelees, mix 9.5 kg of ferric-chloride and 11.5 l of water) or the developer (16 l water and 160 g neg developer). Please prepare all chemicals outside of machine!
13. 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.
14. Below the machine body, there are 3 cog valves for draining the etching chamber, rinse water drain and rinse water inlet. The Rinse compartment can be used either as a static rinse or in connection with a Bungard Ionex as closed loop rinse.

Safety Instructions

Please read the manual carefully and pay increased attention to the references on job safety and set-up. Deposit this instruction at a safe place. It contains information on maintenance or cleaning, which you will need later on as well.

Machine is suitable for aqueous-alkaline or sour etching of printed circuit boards or developing of positive or negative working, aqueous-alkaline processable photoresists or laminates (if necessary add antifoaming agents). All other applications are on your own risk, if not explicitly approved by us.

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 a 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 glow bar must be always sufficiently covered with etching agent! An uncovered glow bar may cause destruction of machine! The correct filling is on height of the sieve. If the spray tube turns without being “countercentered” in liquid, it may damage.

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 assembly

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 seizes the entire volume of the etching liquid.

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. (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 the 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.

Waste water

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. 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. 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 etching agent is sucked in when the snail pipe turns and sprays out of the perforated pipe by centrifugal force. Offsetted drillings in the tube lead to an oscillation effect. The cover of the machine is removable and possesses an opening for the plate holder. On the top right of the machine are the control elements. In this box are thermostat, heating and thermal protection. Under the machine is a drain cock for the etching chamber and a drain cock and an overflow cock for the rinse water tank. The rinse can be operated either as pure rinse or in combination with our water treatment plant **Ionex** as a circulation rinse.

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 in from above into the machine. The filling amounts to approx. 16 litres. The correct level is reached, when the sieve is just covered. Fill the rinse water tank of the jet up to a point, where a pcb on the plate holder is immersed completely.

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

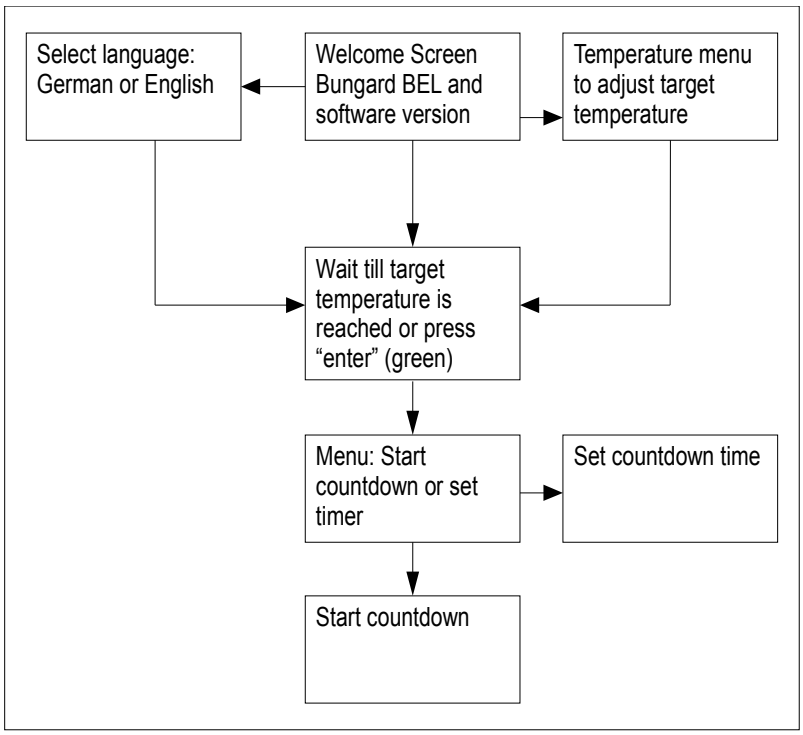
b) continuously adjustable temperature control from 30-45°C with a visual display of current temperature and the activity of the heating (displayed "H")

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

d) Door Switch monitoring with visual display and waiting call

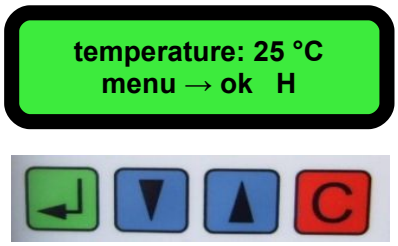
e) Select of language English or German (other languages are possible)

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).



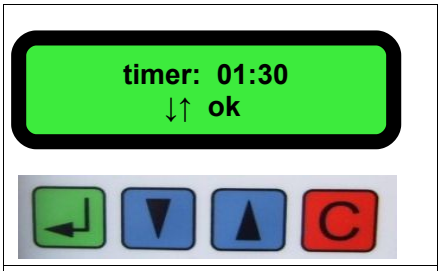
In the main menu the LCD shows:

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

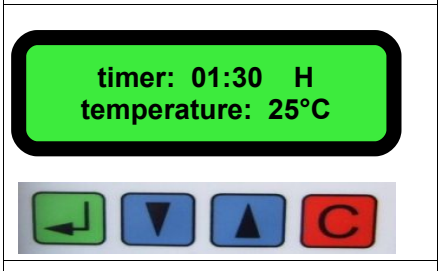
Pressing the Enter key the machine starts. Pressing the arrow key you can enter a new time value.

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.

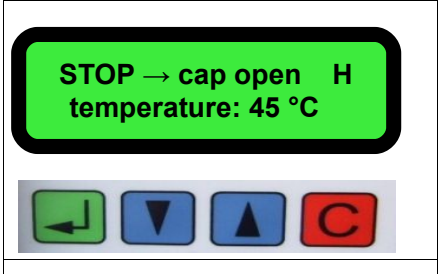


If you press Enter in the main menu, the timer starts and the pump switches on. On the LCD the remaining time, the current temperature and the activity of the heating (H) are shown.

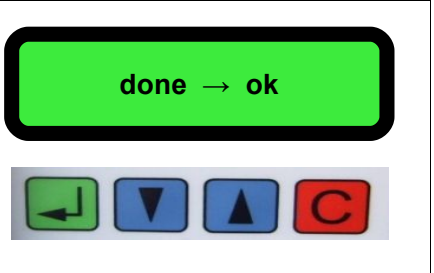


If you open the lid, the timer and the pump stop. The display shows „stop → cap open.

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".

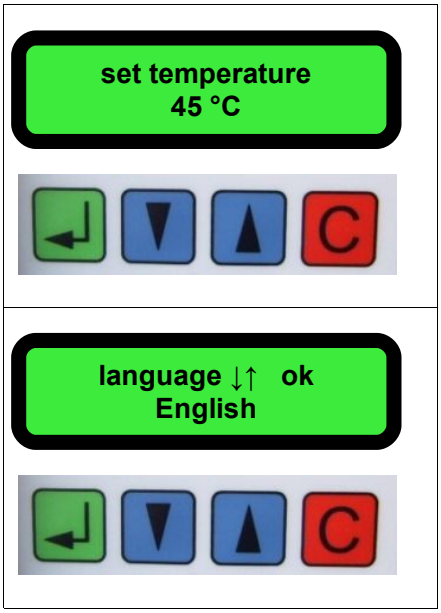
If the temperature is getting too high during the etching process, the pump will continue to support the cooling.

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.

7.5 Board carrier

The boards are fixed on a carrier that has one fixed and one movable horizontal bar. To adjust the setting of the movable bar, just loosen the plastic screws and shift it into the desired direction.

Slide the carrier with the board(s) vertically into the etching compartment. Lift the lid towards yourself and drop it into a horizontal position.

The board carrier handle sticks out of the etching compartment. To remove the carrier, just pull the handle upwards. The lid will open and slide back so you can remove the carrier.

Keep the carrier in a slightly slanted position to allow excessive liquid to drop off. Finally, rinse the boards with the holder in the rinse compartment. Now you can remove the boards.

7.6 Rinse compartment

The water inlet and outlet connections are mounted to the rear of the machine and can be easily accessed through a wide opening in the machine socket.

You may at choice use a flow or stationary rinse. This will depend on the pollution regulations and your in house waste water treatment facilities. If you decide to have a stationary rinse please close the two valves at the rinse – in and outlet. For a flow rinse, open the outlet valve entirely and adjust the flow rate with the inlet valve. The water inlet is equipped with a standard 3/4" threading like household appliances.

If you use ferric chloride you may recycle the dirty rinse water a) to substitute evaporation losses in the etching compartment and b) for making up fresh etchant.

Maintenance

8.1 Changing of the etching agent

The etching agent is discharged over a ball valve, which is under the machine body (between the two valves for the rinse). 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.

8.2 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.: Jet: 18 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 rinse thoroughly wipe of machine with a non-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. Give the contents of the second bucket to the used up etching agent. Alternatively you can rinse 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 to make a test-run and then replace the water with fresh FeCl3 according to the description above.

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 called **RX3** 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 to the used up etching agent. Dispose surplus rinse water together with the used up etching agent.

Motor:

we recommend to check the shaft sealing ring in the PVC flange regularly or to exchange this shaft regularly every two years. On request we send an instruction on how to change this shaft ring.

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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