

# Titan 3500

## Rotation Wheel Etcher

### High Precision Etching Machine

Translation of the original instructions



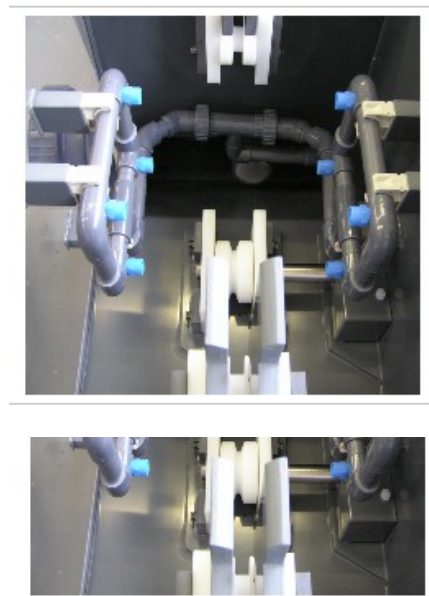
## Content

Leaflet.....	2	Operation.....	10
Technical Data.....	2	Maintenance/Cleaning.....	10
EG-Declaration of Conformity.....	3	Spare part list.....	12
Intended Use.....	4	Guarantee.....	13
Safety Instructions.....	4	Disclaimer of Warranty.....	13
Commissioning.....	6	Copyright.....	13
Setup.....	7		

### Leaflet

The Bungard Titan 3500 is a vertical etching machine for precision applications. In contrast to conventional etching or developing machines, the substrate is rotated on a rotation wheel during the etching process. This reliably avoids preferred directions and process strips and reduces and compensates for undercutting.

The substrate is clamped into the rotation wheel and the rotation wheel is hung into the machine from above. The special nozzles are designed on the inside so that the full spray cone hits the rotating substrate with a swirl. During the etching process, the rotation wheel is rotated continuously via a geared motor and transport rollers. The rotating tensioning wheel and the swirl of the spray cone of the precision full cone nozzles ensure a particularly precise etching result in cooperation with the even liquid flow of the etching medium.



### Technical Data

<b>LxWxH</b>	950 x 610 x 1230 mm <sup>3</sup>
<b>Working height</b>	1150 mm
<b>Weight</b>	90 kg
<b>Tank volume</b>	28 Liter
<b>Power supply</b>	230V,50Hz, 1,8 kW
<b>Materials</b>	PVC, Titan, PP, Viton
<b>Maxi. Board size</b>	350x350 mm
<b>Heater</b>	Titanium heater element 1250 W, thermostatically controlled RT – 45 °C, safety fuse
<b>Time Setting</b>	Digital-timer for time range 0-599 sec.
<b>Drain</b>	Front spout D20 mm approx. 300 mm height

Technical changes reserved

## EG-Declaration of Conformity



### 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:	Spray Etching or Developing Machine Titan 3500

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, 10.1.2020

\_\_\_\_\_  
Jürgen Bungard Geschäftsführer

## Intended Use

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

All other application need our written consent or happen on risk of the operator.

The Bungard GmbH & Co. KG accepts no liability for damages incurred in non-authorized use or application of the machine.

## 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 yellow-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.

### **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 heater must always be sufficiently covered with liquid! Uncovered heaters can cause damage of machine!

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 cover switch.

### **Exhaust**

An exhaust of air in the area above the machine body is recommended with regard to possible etching fumes. The need for extraction will depend on the liquid used.

### **Environmental protection**

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

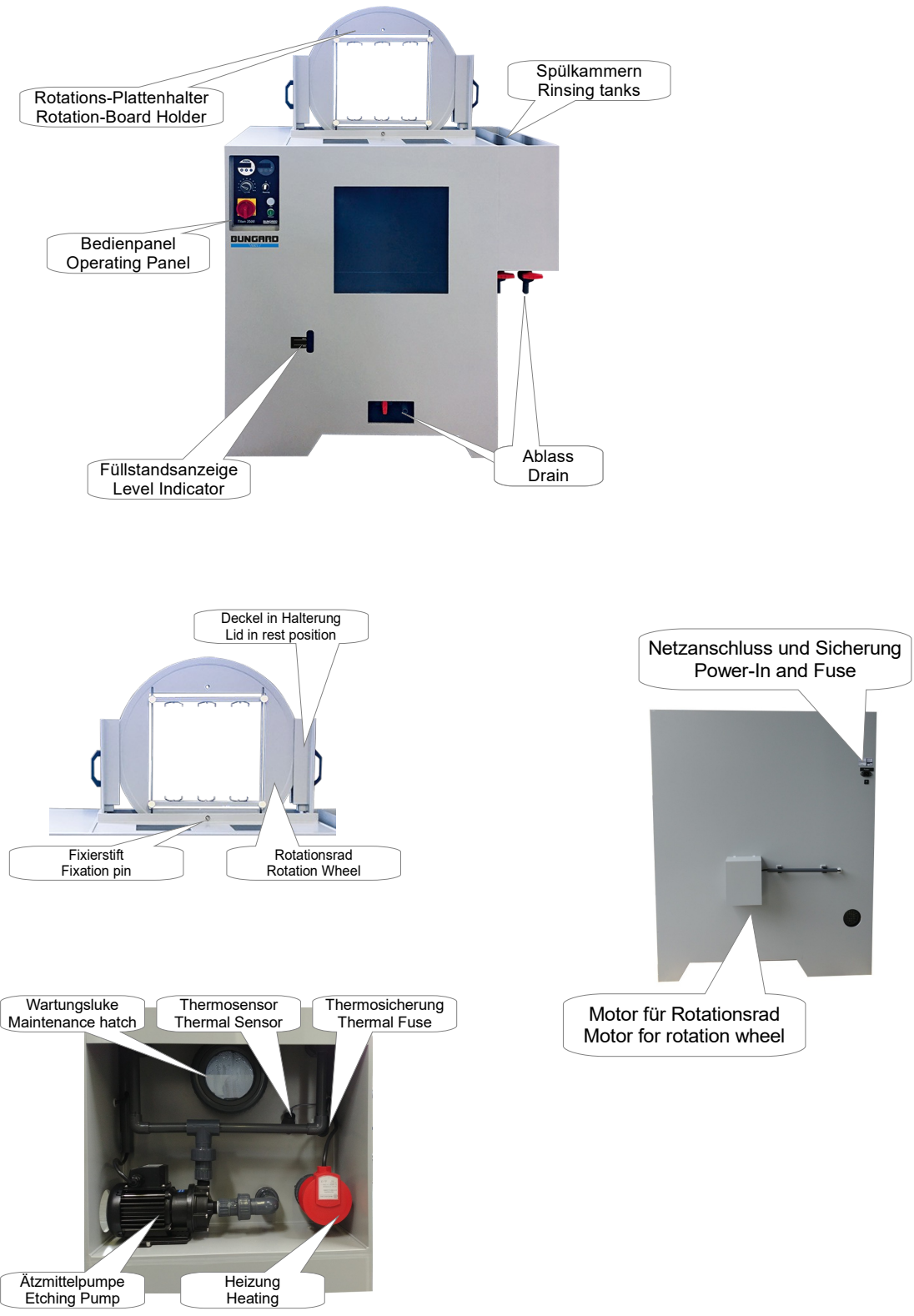
### **Rinsing water**

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 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!

**Commissioning**



## Setup

### Taking 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.

Open the lid and take out the Rotation Wheel. Carefully clean the inside of the machine from transport residues with a vacuum cleaner and a rag.

### 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.

### 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, water-proof and chemical resistant floor (no tiles or concrete!) or in a chemical resistant waterproof collection tray which can take the whole filling volume (safety tray available as an option).

### Connections

Connect the machine to the mains (220V / 50Hz). We presuppose an on site fuse protection of the electric circuit.

### Test run

To check for leaks and function, first run the machine with **water** only. Fill in the etching chamber from above by opening the cover. Do not exceed the minimum and maximum level, otherwise the heater or pump may get damaged. The level mark **min - max** is located on the transparent front side of the machine.

Note: The level and temperature must always be monitored by the operator.

Turn on the main power switch and press the green button. The white indicator light should light up.

At first we will run the machine without the Rotation Wheel.

### Setting the Etching time

At the front panel on the left is the timer for the etching time. Machine must be powered on.

After approx. 2 seconds, the expiry time (setpoint) is displayed.

This can be adjusted with the UP or DOWN button.

The START / STOP button starts the etching process.





The set time then starts to countdown and at the same time the pump will start to spray and the rotation motor will start to turn. You can set the speed of the rotation motor with the potentiometer. We recommend to set the speed in a way that you ensure at least a full turn of the wheel during etching time.

When the time has elapsed, the motor and pump will automatically switch off, the display will flash and an acoustic signal will sound for 5 seconds. To stop the acoustic signal, press the STOP key.

The set etching time (setpoint) remains stored. By pressing the Start-Stop button, the set etching time reappears and can be restarted.

The etching process can only be switched on when the lid is closed (safety switch).

### Heater

the machine is equipped with a 1250 W Titanium heater. This heater is thermostatically controlled and protected by thermal fuse.

Turn on the heater with the middle right turning switch. Above the switch is the thermostat controller.

**Warning: The heater may be switched on only with filled tanks.** If no front panel key is pressed, the display shows the actual value of the thermostats. With increasing heating time, the display value must increase.

If you press the SET-button the target value is displayed in the screen. If you additionally press the "UP" or "DOWN" button, the set point is increased or decreased. By default, the heater is set to the target value 45 °C.

The heater is controlled by a digital thermostat. As an additional safety device the machine is equipped with a thermal fuse.

### Initial filling

Before initial filling, make sure all ball valves are closed again !! Fill the etching zone as in the test run, but this time with the desired chemical. If necessary, use a drum pump or similar. Observe the safety instructions and Material Safety Data Sheet of the chemical. Set up chemicals outside of the machine!





## Operation

### Feeding the etching chamber

Pull the safety pin off the bracket. To get to the wheel, you must first lift the left cover on the left side. This triggers the cover sensor and the machine switches off the pump and the rotary motor if it is still switched on.

Insert the left cover into the side guide. Then slide the right cover to the left until you can take it out and put it in the right holder.

There are two rods attached to the wheel with screws. By loosening the screws, you can move the bars up and down to adjust the board size. We generally recommend centering the board in the rotating wheel to ensure good etching quality. Insert a blind plate and fix the position. Then take the handle and lift the rotary wheel into the machine body. Make sure that the wheel is securely guided by the side rails and well positioned on the bottom of the drive wheel. Do a few test runs and remove and reinsert the board each time.

You can also remove the plate holder from the rotary wheel by loosening two knurled screws and moving a clamping bar (pictures on the left).

Using the removal tool, hook the rotary wheel in and lift it until a hole corresponds to the opening of the safety pin. If necessary, turn the wheel into position to get the right hole.

Push the safety pin back through the cover and wheel. The safety pin and the guidings of the lids secure the wheel in this position. Now you can insert boards into the rotary wheel.

The machine can either take one board of 350 x 350 mm or e.g. 3 boards of 100 x 160 mm.

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

Both poles have three brackets. These enable the mounting of the boards on the holder without having to push the entire rods back and forth.

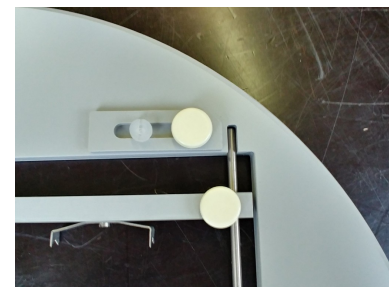
In order to mount a board with a maximum board size of 350 x 350 mm<sup>2</sup>, the normal fastening screws touch the rotating wheel. To avoid this, we deliver another set of screws with a smaller head.



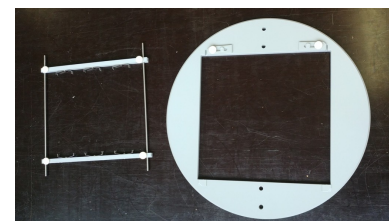
*First lift left lid on left side*



*Clamping bar closed*



*Clamping bar open*



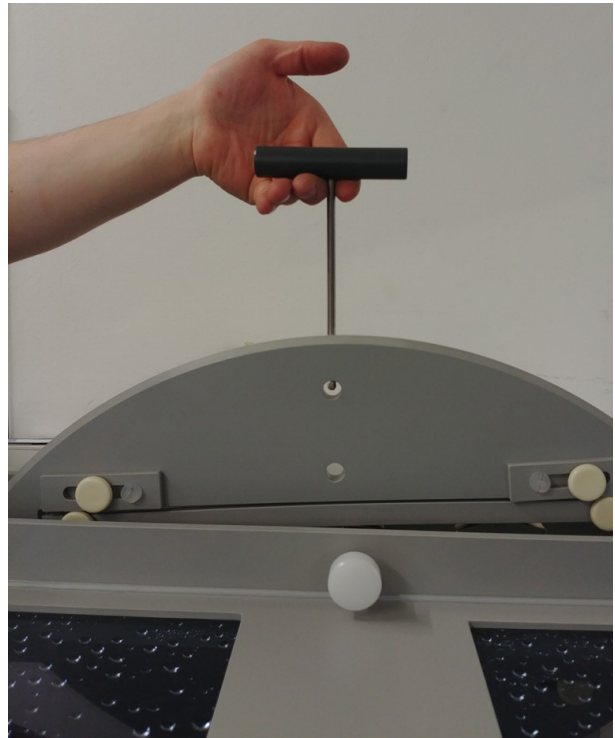
*Board holder taken from wheel*



*seitliche Drehradführung*



*Drehrad mit Sicherungspin arretiert*



*Entnehmen des Drehrads*

## 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.

Ferric-III-chloride etches warm and cold. The optimum temperature is approx. 45°C.

With our etching machines 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).

Brown spots on clothing and items caused by Ferric-III Chloride are easily removed by our stain remover RX3.

**Etchant Overview:**

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 Fe <sub>3</sub> Cl, 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

### Maintenance/Cleaning

**Changing of the etching agent**

The etching agent is discharged over a ball valve, which is below the machine body. The spout is pointing to the front.

To clean the inside of the machine, you can also remove the top cover. First remove the two covers and the rotating wheel. Remove the cover to access the etching chamber. Reach into the lid opening, lift the cover on the right and pull to the top right. Be careful not to damage the sensor holder. First lift the lid on the left (stand in front of the machine and pull the lid to the left).

Removing the lid makes it easier to remove sediment manually or to clean the filter, heating pipe and maintenance of the drive system or the nozzles.

To access the drive motor, remove the plastic cover on the back.

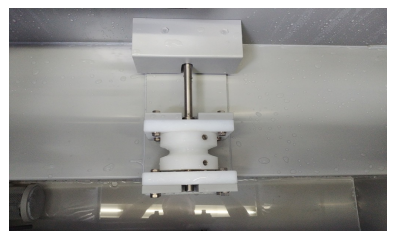
This makes it easy to remove any sediments manually or to clean filter, heating tube and maintain the drive system or the nozzles.

To reach the drive motor remove the plastic cover at the back.

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.



*View on heater, pump filter, thermo-sensor and thermal fuse*



*Rotation drive wheel*

### Cleaning of the machine in use of FeCl<sub>3</sub>:

**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.: 28 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 sludge 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 rinses 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 bucket. 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. Fill the machine with water and perform for a test run and then exchange the water with fresh FeCl<sub>3</sub>.

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 FeCl<sub>3</sub> ! 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 FeCl<sub>3</sub> 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 FeCl<sub>3</sub> 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.



Nozzle arrangement




Gear motor housing

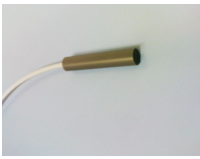




lid switch sensor

### Spare part list

699300	Kugelhahn DN15 f. Titan 3500	cog valve DN15 f. Titan 3500	
TI-001	Heizung komplett f. Titan 3500	Complete heater f. Titan 3500	
TI-002	Thermostat f. Ätzmaschine	Thermostat f. Titan 3500	
TI-003	Temperatursicherung Ätzmaschine	f. Thermal fuse f. Titan 3500	
TI-004	Timer f. Titan 3500	Timer f. Titan 3500	



TI-005	Sensor für Temperatur f. Titan 3500	Sensor for temperature f. Titan 3500	
TI-006	Frontplatte f. Titan 3500	Front panel f. Titan 3500	
TI-007	Vollkegeldüse f. Titan 3500	spray nozzle f. Titan 3500	
TI-008	Ätzmittelpumpe f. Titan 3500	Etching pump f. Titan 3500	
TI-009	Plattenhalter f. Titan 3500	Board holder f. Titan 3500	
TI-010	Plattenhalter-Balken f. Titan 3500	Board holder bars f. Titan 3500	
TI-011	Auffangwanne f. Titan 3500	anti pollution tray f. Titan 3500	
TI-012	Deckelschalter f. Titan 3500	Lid safety switch f. Titan 3500	

## 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 Titan 3500 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.

## Copyright

© 2020 Bungard Elektronik GmbH & Co. KG